Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

ANNEX 6A

ENVIRONMENTAL AND SOCIAL SAFEGUARDS (ESS)

Annex to the GCF Funding Proposal

Thai Rice: Strengthening Climate-Smart Rice Farming

Annex 6a

Environmental and Social Impact Assessment
Environmental and Social Management Plan
Environmental and Social Management Framework

GCF Funding Proposal

Thai Rice:

Strengthening Climate-Smart Rice Farming

August 2023

Version 4

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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Abbreviations and Acronyms

ATV	All-Terrain Vehicle
AWD	Alternate wetting and Drying
BAAC	Bank for Agriculture and Agricultural Cooperatives
BOI	Board of Investment
BUR	Biennial Update Report
CEDAW	Committee on the Elimination of Discrimination Against Women
CF	Continuous Flooding
CGIAR	Consultative Group on International Agricultural Research
CPMC	Community Pest Management Centre
CSO	Civil Society Organisation
DoA	Department of Agriculture
DoAE	Department of Agricultural Extension
E&S	Environmental and Social
EE	Executing Entity
EFD	Environmental Fund Division
ESIA	Environmental and Social Impact Assessment
ESM team	Environmental and Social Safeguards Management team
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Safeguards
FAO	Food and Agriculture Organisation of the United Nations
GCF	Green Climate Fund
GCM	General Circulation Model
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GRM	Grievance Redress Mechanism
GSEI	Good Governance for Social Development and the Environment Institute
GWP	Greenhouse Warming Potential
HSA	Hazardous Substances Act
IFC	International Finance Cooperation
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IRR	Internal Rate of Return
IRRI	International Rice Research Institute
LDD	Land Development Department
LLL	Laser Land Levelling
LT-LEDS	Long-Term Low Emission Development Strategy
MoAC	Ministry of Agriculture and Cooperatives
MoNRE	Ministry of Natural Resources and Environment
MSDHS	Ministry of Social Development and Human Security
MSME	Micro, Small and Medium-sized Enterprise
NAP	National Adaptation Plan
NDA	National Designated Authority
NDC	Nationally Determined Contribution

NEB	National Environment Board
NEQA	National Environmental Quality Act
NESDP	National Economic and Social Development Plan
NGO	Non-Governmental Organisation
OAE	Office of Agricultural Economics
ONEP	Office of Natural Resources and Environmental Policy and Planning
PCD	Pollution Control Department
PPE	Personal Protective Equipment
PS	Performance Standard
PSC	Project Steering Committee
RCP	Representative Concentration Pathway
RD	Rice Department
RID	Royal Irrigation Department
RIO	Regional Irrigation Office
RRC	Rice Research Centre
SDF	Sustainable Development Foundation
SDG	Sustainable Development Goal
SE	Social Enterprise
SEAH	Sexual Exploitation, Abuse and Harassment
SEP	Stakeholder Engagement Plan
SRP	Sustainable Rice Platform
SSM	Straw and Stubble Management
SSNM	Site-Specific Nutrient Management
TAS	Thai Agricultural Standard for Sustainable Rice
tCO_2eq	Tonnes of Carbon Dioxide-Equivalent
TEEB	The Economics of Ecosystems and Biodiversity
TMD	Thai Meteorological Department
TRSI	Thailand Rice Science Institute
T-VER	Thailand Voluntary Emission Reduction
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WB	World Bank
WOCAN	Women Organizing for Change in Agriculture and Natural Resource Management
WWF	World Wildlife Fund
PMU	Project Management Unit

Executive Summary

Baseline Conditions

Climate: Thailand enjoys a tropical climate which is influenced by seasonal monsoons. The local climate of Thailand is divided into 3 seasons: rainy season from mid-May to mid-October, winter from mid-October to mid-February, and summer from mid-February to mid-May. Mean temperature is 26.3°C in the North and 27.5°C in the Southern and coastal areas. Mean annual rainfall is 1,200-4,500 mm.

Economy: Thailand has 51 million ha of land, of which one-third is used to grow annual crops and about 7% is used to grow permanent crops. Thailand is ranked the second-largest economy in South-East Asia. It has experienced low, single-digit gross domestic product (GDP) growth over the past decade, with the industrial (34.8%) and service (56.7%) sectors serving as the main drivers of recent growth. As an agriculture-based country, in 2021 agriculture comprised 8.6% of Thailand's GDP. The Thai economy depends on exports, with more than half of total exports consisting of rice exports.

Rice cultivation: Rice farming is an economically and culturally important sector in Thailand. It occupies approximately 50% of total arable land, contributes 8% of the country's greenhouse gas (GHG) emissions and 51% of the country's agricultural GHG emissions. Because the majority of rice (ca. 70%) is cultivated under rain-fed conditions, it is highly vulnerable to climate change, especially to temporal and spatial changes in the amount and patterns of rainfall and increasing temperature. Rice is grown in all provinces of the country. Approximately three-quarters of Thai rice is rain-fed and one-quarter is irrigated. More than half of the total rice area is located in the North-East and Central Plains regions – the so-called 'rice bowl' of Thailand. The majority of farmers in the Central Plains have access to irrigation facilities, which allow two rice crops – in-season and off-season – to be grown during the year. Almost three-quarters of the dry-season rice grown under irrigated conditions is located in the Central Plains region, with the principal crop being long-grain rice. Situated at 90-200m above sea level, with undulating topography where irrigation is difficult, the North-East, in contrast, relies primarily upon rain-fed or mixed rain-fed / irrigated rice farming. The average size of farms is smaller than in the Central Plains and soil erosion presents challenges. The majority of North-Eastern rice is Hom Mali (the brand name for Thai jasmine rice), which is exported to Europe and North America, as well as glutinous rice.

Rice farmers: Rice farming in Thailand is characterised as high risk but low return. The sector is very fragmented. Most rice is grown on farms smaller than 2 hectares by smallholder farmers with limited access to credit or training. Most smallholder farmers are poor and, following changes to the national rice subsidy scheme in 2014, many (~20%) are in debt. Approximately 40% of rice farmers do not own the land they farm, only 11% own a tractor and fewer than 1% own a harvesting machine. Almost 80% of the country's poor live in rural areas, with the Central Plains and North having the highest levels of poverty. Since 2011, real farm incomes have declined by 7% and net farm profits by 14%.

Agricultural service providers: Agricultural service providers offer services such as land preparation, harvesting, water pumping and specialist machinery to farmers. They are typically micro, small and medium enterprises (MSMEs). Often, the service providers are themselves farmers who own sufficient machinery to offer services to other farmers. Mega-farms (farmer cooperatives) can also invest in such machinery, essentially becoming service providers themselves. Overall, the market for service providers is underdeveloped in Thailand. Many

service providers face significant challenges, including over-indebtedness and a lack of access to additional credit. As provision of farming services in other sectors (notably sugar cane) is usually more profitable for service providers than for smallholder rice farmers, there is an opportunity cost for service providers entering the rice sector.

Climate Change

Thailand is already experiencing the effects of climate change. According to the Intergovernmental Panel on Climate Change (IPCC), the mean land-surface air temperature in South-East Asia has increased by approximately 1°C over the past 100 years. In Thailand, the average surface temperature is increasing more rapidly, having increased at an average rate of 0.02°C/year between 1970-2017. Changes in temperature extremes have also been documented, with a statistically significant trend of increasing annual numbers of warm days and warm nights and a corresponding reduction in the number of cool days and cool nights. Mean annual precipitation varies across the country and shows considerable short-term variation, correlated with the El Niño Southern Oscillation and the Pacific Decadal Oscillation. Nonetheless, a general decreasing trend is evident between 1951-2016 for the whole of Thailand, with the largest reductions in the east and south, accompanied by accentuated seasonality: wetter wet seasons and drier dry seasons.

The following future changes in the climate are projected:

- **Increase in maximum and minimum temperature**. *Average* temperatures are predicted to increase by up to 1.7°C under Representative Concentration Pathway (RCP) 4.5 or up to 2°C (RCP 8.5) by 2059 compared to the baseline climate of General Circulation Models (GCMs) (1975-2004), with accompanying increases in the *maximum* temperature and the *minimum* temperature. There will be an increased occurrence of heat spikes – defined as days with temperature exceeding 40°C.
- The **frequency and severity of floods** are expected to **increase**. Projections of future annual precipitation suggest that rainfall during March to August will increase but will substantially decrease between September-February. While overall rainfall is expected to slightly increase by 2059 under both RCP 4.5 and RCP 8.5, seasonal precipitation patterns will change, resulting in wetter wet and drier dry seasons.
- Conversely, the **frequency and severity of droughts** are also expected to **increase.** Consecutive years of below-normal rainfall have the potential to cripple the agricultural sector and markedly slow Thailand's economy. The lack of precipitation during such drought events is compounded by the high temperatures and abundant insolation (and hence higher evapo-transpiration).

Farmers consume 70% of the country's water supply and rice is especially water-intensive, consuming more water than any other crop or economic sector. A typical Thai paddy field requires approximately 10,000 m^3 of water per season and each kilogramme of paddy rice produced requires 2-3 m^3 of irrigation water. However, the amount of irrigation water actually available is, even in a normal year, barely sufficient to fulfil the demands imposed by rice production. Even a moderate drought can reduce rice biomass by 25%. As a result of spikelet sterility and reduced accumulation of assimilates, rice grain yield declines when the average daily temperature exceeds 29°C, and grain quality continues to decline linearly as temperatures rise. The crop yield modelling commissioned for the preparation of the Thai Rice Project finds that a temperature increase of up to 2°C by 2059 under RCP 4.5 in the assessed area will reduce rice yields by 17-20%. In addition to sustained, incremental increases in temperature over the course of decades, rice yields are sensitive to transitory heatwaves. Heat exposure above ~34°C for as little as 1 hour

can reduce grain numbers and hence yield: the effect is irreversible, occurs even when water root uptake and transpiration are unaffected, and also applies to irrigated rice.

The livelihoods of smallholder farmers are threatened by the impacts of climate change. Changes in temperature, rainfall and the frequency or intensity of extreme weather events directly affect farmers' yields, as well as their households' food security, income and well-being. Rice farmers' awareness of climate change is high: almost 80% of farmers think that rainfall patterns are changing and that rice yields are suffering as a result. But smallholder farmers have limited capacity to adapt, given their lower income levels, limited land areas and lower education levels; their inferior access to technical assistance, markets and credit; and their often-chronic dependence on external support. Furthermore, women smallholder farmers face disproportionate challenges in adapting to climate change, as their needs and roles in agriculture (for example, with regard to technology access) are generally not recognised or addressed.

Greenhouse Gas Emissions

Rice farming in Thailand, and associated agricultural livelihoods in rice-growing regions, is highly vulnerable and exposed to the impacts of climate change. At the same time, rice farming is a significant contributor to GHG emissions, mainly through methane (CH_4) generated in flooded paddy fields but also carbon dioxide (CO_2) from agricultural burning practices and nitrous oxide (N_2O) from nitrogenous fertilizers.

Agriculture accounts for approximately 15% of Thailand's total GHG emissions and is the second-largest emitting sector after the energy sector. According to the most recent Biennial Update Report (BUR) (2022), rice cultivation produced 27 $MtCO_2eq$ of methane emissions, which accounts for 51% of total GHG emissions in the agriculture sector, or about 8% of Thailand's total GHG emissions. Thailand is the world's fourth-largest rice sector emitter – after China, India and Indonesia – and accounts for 7% of global rice sector methane emissions.

Thai Rice Project

The Thai Rice Project will enable climate-smart rice farmers – including, crucially, women farmers – to adapt to a changing climate (Outcome 1) while simultaneously reducing GHG emissions (Outcome 2). The project design follows a bottom-up logic: behavioural changes will be triggered at the level of the farmer, including women farmers. Farmers will invest in and adapt their practices (Output 1.1) and climate-smart technologies will be made available by service providers – including women farmers and women's farmer groups – (Output 2.1) as a result of the project's technical and financial support. The climate-smart rice that is produced will be verified and sold at higher market prices while rice straw residues will be monetised. The Thai Agricultural Standard for Sustainable Rice (TAS) will serve as a nationally-recognised sustainability standard, augmented in an international context by equivalent international standards and systems. Building on the existing Thailand Voluntary Emission Reduction (T-VER) domestic carbon market, an innovative scheme for the rice sector will be designed and implemented to unlock additional revenue flows to support Thailand's transition to climate-smart rice. Policy-makers will be supported with technical assistance, monitoring tools and a new institutional framework – the Thai Rice Facility – that coordinates investments from the public and private sectors (Output 3.1) to achieve a strengthened, more 'joined up' and gender-mainstreamed institutional and policy environment (Outcome 3).

The combination of these interventions will lead to a paradigm shift in how rice farming is conducted: male and female farmers across Thailand will apply climate-smart rice farming

supported by capable, well-equipped service providers. As a result, yields and livelihoods will improve, vulnerability to climate change will be reduced and GHG emissions will decrease significantly. In addition, governments across the region will benefit from the project's experiences through peer-to-peer learning formats, including through women's national and regional networks. By participating in the project and with its parent organisation – the Office of Natural Resources and Environmental Policy and Planning (ONEP) – serving as an Executing Entity, the Environmental Fund Division (EFD) will become a strong advocate for gender equality and will acquire significant insights into, and experience of, implementing a GCF project, thereby supporting its efforts to become a GCF Direct Access Entity.

The Thai Rice Project will target approximately 253,400 smallholder rice farmers, including a minimum of 100,000 female farmers. The focus of the project will be primarily at the level of individual farms, not broader landscapes. The project area will include a total of 21 provinces, consisting of 12 provinces in the Central Plains, 7 provinces in the North-East region and 2 provinces in the North of Thailand (Figure 1). The farmland targeted by the project extends over a physical area of ~718,000 hectares, of which ~306,000 ha is irrigated and ~412,000 ha is rain-fed. As rice can be planted more than once each year in the same field, the 'effective farmland' – the wet season planting area plus the dry season planting area – amounts to ~1.07 million ha.

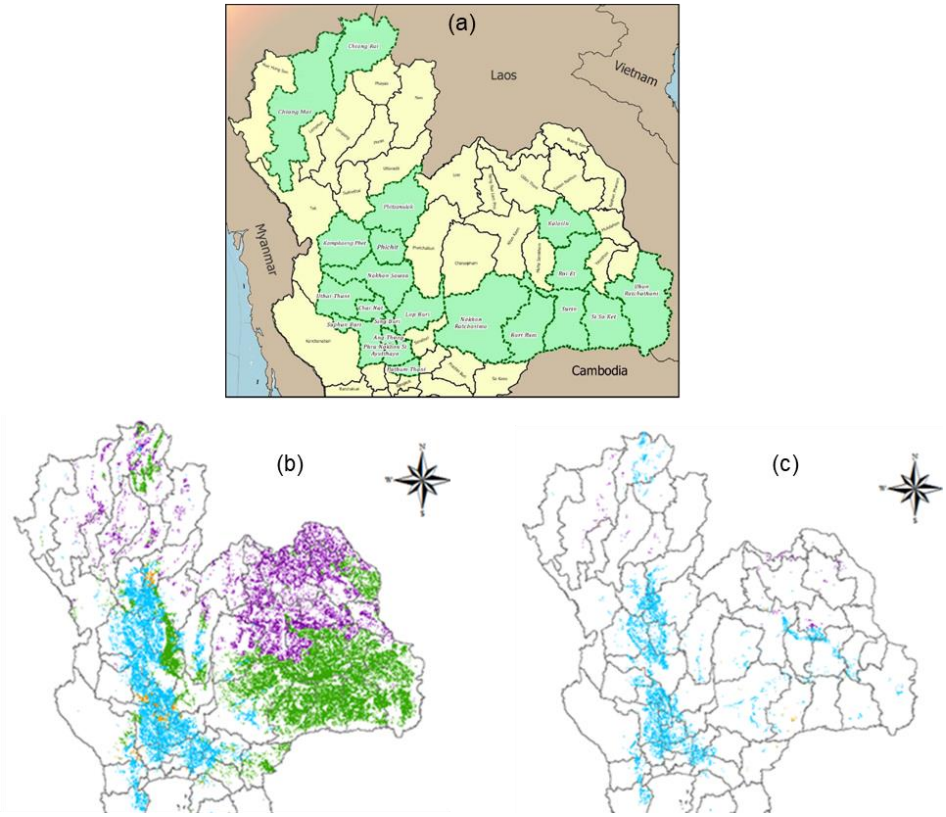


Figure 1: Project area covering 21 provinces (green-highlighted area) (a), rice planting area during wet season (b), and rice planting area during dry season (c) (coloured according to different groups of rice varieties grown in 2016, Hom mali in green).

Stakeholder Engagement

The Thai Rice Project idea was first discussed with the NDA on 24 September 2020 and with the Rice Department on 12 October 2020. Following these positive discussions, the Rice Department established a Project Working Group and further (multiple) rounds of stakeholder consultation took place in 2021, 2022 and 2023. For brevity, stakeholders consulted are summarized in Table 1. Full details, including a summary of meetings / workshops held, a list of participants and photographs, are provided in Annex 7.

The Project Steering Committee (PSC) will be responsible for providing strategic direction to the Thai Rice Project. The PSC will consist of representatives of Thai national ministries and departments – including the Office of Natural Resources and Environmental Policy and Planning (ONEP), which serves as the Thai NDA – and close project partners. The Chamber of Commerce (CoC) will represent private sector interests. During implementation of the Thai Rice Project, the PSC will periodically invite relevant stakeholders – such as private sector firms, academia, NGOs and development partners – in order to ensure full engagement and coordination. Many project actions, notably the training provided under Sub-Activities 1.1.1.1 and 1.1.1.2 and the outreach to supply chain actors under Sub-Activity 3.1.1.2, intrinsically involve engagement with stakeholders.

The Stakeholder Engagement Plan (SEP) for project implementation is provided in Annex 7a. In summary, the SEP is based on extensive consultations that have taken place with project stakeholders to understand their views, interests, needs and concerns, particularly those of local communities, ethnic and vulnerable groups that may be involved in and/or directly affected by the project. The views of the National Designated Authority (NDA), relevant government institutions, the private sector and civil society organisations (CSOs) were also sought. The stakeholder consultation process has been thoroughly documented to ensure that interested or concerned third-party groups are able to review the findings. The SEP will be re-validated by stakeholders during the project inception phase prior to continuous implementation thereafter.

Table 1: Stakeholders Consulted During Project Preparation

Public Sector	**Private Sector**
Bank for Agriculture and Agricultural Cooperatives (BAAC)	Agricultural service providers (e.g. land preparation, straw balers, ESS)
Department of Agricultural Extension (DoAE)	Atthajariya Company Limited
Department of Disaster Prevention and Mitigation (DDPM) (Ministry of Interior)	Axa
Ministry of Social Development and Human Security	CropLife
Environmental Fund Division (EFD)	Herba-Ebro Foods
Fiscal Policy Office (FPO)	Infuse
Geo-Informatics and Space Technology Development Agency (GISTDA)	Kubota
Health Promoting Hospital	MARS
Highland Research and Development Institute	Munich Re
Land Development Department (LDD)	Olam
	PepsiCo
	Sustainable Rice Platform (SRP) e.V.
	Swiss Re
	Syngenta
	Thai General Insurance Association (TGIA)

Ministry of Agriculture and Cooperatives (MoAC) National Bureau of Agricultural Commodity and Food Standards (ACFS) Office of Agricultural Economics (OAE) Office of Insurance Commission (OIC) Office of Natural Resources and Environmental Policy and Planning (ONEP – also the NDA) Rice Department (RD) Royal Irrigation Department (RID) Thai Meteorological Department (TMD) Thailand Greenhouse Gas Management Organisation (TGO)	**Civil Society** Asian Institute of Technology (AIT) Chiang Mai University Fiscal Policy Research Institute (FPRI) Good Governance for Social Development and the Environment Institute (GSEI) Homenet Thailand Kasetsart University King Mongkut University of Technology Provincial farmer groups, megafarms and farmers Provincial womens' groups (Suphan Buri, Chiang Rai, Roi Et) Puey Ungphakorn Institute for Economic Research (PIER) Sustainable Development Foundation Thai Organic Foundation Thailand Development Research Institute (TDRI) Thailand Environment Institute (TEI) The Creagy Weekend Farmer Network
International CIAT FAO GGGI IFC IRRI Mekong Institute Sparkassen Foundation (DSIK) UN Women UNDP UNEP WWF WOCAN	

Notable Environmental and Social Baseline Characteristics

Limited alternatives to rice: Switching crop species has the potential to increase farming incomes and reduce water demands in the Thai agricultural sector. In recent National Economic Plans, the Thai government has recommended that rice farmers cultivate other cash crops (in combination with rice farming) to increase crop diversity and protect their incomes. Approximately 9% of Thai paddy fields are located on land that is better suited to other crops, primarily sugarcane. Thailand has 57 sugar factories and has enough capacity to support an increase in sugarcane production. However, some crops are even more sensitive to climate change than rice, including sugarcane (and cassava) in upland Thai settings. Thai farmers tend to prefer more immediate measures – such as water management – that are consistent with established rice farming practices, rather than more fundamental (and potentially riskier) changes to their underlying agricultural systems. Sugarcane production also involves extensive residue burning during harvesting; thus, the promotion of sugarcane production would require the implementation of appropriate regulatory policies. There are also considerable obstacles to crop switching – including insufficient capital and lack of knowledge about production and markets – that would need to be overcome. Moreover, rice farming is central to Thai national identity: rice is more than just a subsistence or cash crop and is, instead, viewed as fundamental to Thais' way of life and traditions. Given the projected 30% increase in global rice demand by 2050 and the limited scope available for other rice-producing countries to generate a rice surplus, Thailand is well positioned, if climate change challenges are addressed, to continue to play a critical role in ensuring global rice supply. This is critically important in the current context of rising global food prices and wheat shortages.

Organic rice farming: Organic rice farming could address some of the challenges – excessive fertilizer use (and hence, in part, additional CH_4 and N_2O emissions), excessive pesticide use and access to premium rice markets – that the Thai Rice Project seeks to address. The number of organic farmers In Thailand has increased steadily over time – from approximately 2,500 in 2003 to 44,400 in 2019. This is still a very small share (0.003%) of total farmers, but the government has set ambitious goals to further expand the area under organic farming. However, shifting to organic rice farming is not straightforward. Even if farmers can be persuaded to switch, individual farmers cannot make the shift unless they are provided with the necessary assistance and techniques, such as managing soil fertility and tackling weeds and pests without herbicides and insecticides. Meanwhile, climate change may introduce additional stresses from pests that farmers find challenging to address without using chemical methods. Instead, the Thai Rice Project promotes the TAS and other sustainability standards for rice cultivation. These seek to reduce – and better manage – the use of fertilizers and pesticides, but they do so in a framework that is more straightforwardly adopted by farmers, entails fewer risks and has strong institutional foundations in Thailand.

Farmer demographics: The Thai agricultural labour force is declining annually at a rate of 0.25-0.4%, having fallen from 40% in the 1960s to 30-35% today. This is primarily driven by youth not becoming farmers (and, instead, opting for urban – better-paid – jobs) rather than a large-scale exodus of existing farmers. The result is that more than 40% of farms in Thailand are operated by old farmers, defined as individuals older than 60 years. This ageing phenomenon applies to all agricultural sub-sectors, not just rice farming. Thailand is not alone in experiencing such an ageing profile: the average age of farmers is, in fact, higher in Indonesia, the Philippines and Malaysia. Moreover, the lessons from other countries are strongly suggestive that wide-ranging and quite fundamental reforms relating to, inter alia, employment, welfare systems, fiscal policy, land ownership, education, rural development and many other policy areas are required to reverse, or even simply arrest, the ageing process. Even with determined government action, revitalising the demographics of the agricultural sector can be a challenging, protracted and uncertain process. The Thai government is implementing 2 programmes – the New Farmer programme and the Young Smart Farmers programme – to support young farmers, but they operate on a limited scale: to date, 7,000 young farmers have benefitted, compared with over 1.5 million young farmers (aged under 45) who have ceased farming. Addressing farmer demographics is largely out of scope for the Thai Rice Project. However, the project will support a number of interventions that directly or indirectly enhance the attractiveness of the rice sector to prospective younger farmers and that complement measures supported by the government's New Farmer and Young Smart Farmers programmes.

Gender: Thailand ranks 79 out of 191 countries in the Gender Inequality Index. In comparison, Malaysia is ranked 57 and Vietnam 71. Key challenges in realising gender equality and the empowerment of women in Thailand include: (i) a general lack of sex-disaggregated data and (ii) traditional attitudes and stereotypes – which underpin discrimination against, and vulnerabilities of, rural women and the low participation of women in decision-making positions. There is a clear gender division of labour in agriculture. Men do the so-called physically strenuous work, which includes operating machinery (tractor, harvesters, etc.) as well as spraying chemicals. Agricultural labour is often paid by work done, and the types of work that men do are often paid more per hour of work. Women's work, such as supplementary transplanting and packaging, is paid by day, so per-hour payments tend to be lower. This gender division of labour is partly based on the perception that women are better at 'tedious' tasks. Female employment in agriculture in Thailand as a share of total female employment declined from 61% in 1991 to 28% in 2019. The majority of women (53% of female workers in the agriculture sector) are essentially unpaid family workers:

just 27% own agricultural land while they make up 41% of the agricultural workforce. They tend to benefit less than men in periods of agricultural expansion and they tend to be hit harder in periods of agricultural contraction: they are, therefore, relatively more vulnerable than men. Despite the continued presence of gendered roles and prominent gender stereotypes, both women and men in rural areas share a general sense of gender equality in their contributions to agriculture. This stems from the fact that women tend to be in charge of households' financial management. Women and men have the same rights over land, and equal rights to inheritance are guaranteed by the Civil and Commercial Code, although those who take care of parents (who tend to be daughters) tend to receive more. Women and men have the same rights to open bank accounts, obtain credit and access formal financial services. Relations between wives and husbands tend to be relatively egalitarian.

Water management practices: For *irrigated rice* in the Central Plains, a high adoption of water-saving practices, including multiple drainage (alternate wetting and drying, AWD) and single drainage during the middle of the rice season, is generally observed. Comprehensive baseline data is captured by a farm survey conducted by GIZ and the Rice Department (RD) in 2022. The provinces in the North – Chiang Mai and Chiang Rai – have not yet adopted new water management activities at meaningful scale. Farmers in these provinces follow traditional practices and retain as much water in the field as possible: essentially, 100% continuous flooding in irrigated rice. For provinces in the North-East, continuous flooding is widely (~75%) applied. For *rain-fed rice*, the 2022 farm survey data shows very low adoption of AWD (8%) and mid-season drainage (7%) practices in the Central Plains during the wet season, and no adoption in the dry season. For provinces in the North and North-East regions, continuous flooding is essentially fully practised (100%) in both dry and wet seasons.

Rice straw and stubble burning is a widespread practice among Thai farmers to remove waste residue from their fields in preparation for planting the next crop and as a pest and disease management measure. The practice is not illegal, largely because of its prevalence, its negligible cost (an important consideration for low-income farmers) and the absence of alternatives, but the government has implemented a number of initiatives to try to reduce it. Approximately half of rice residue (about 20 million tonnes per year) is burned in the field, leading to the release of 15-22 $MtCO_2e$/year, as well as aerosol particles that contribute to the brown haze experienced in Thailand and other countries in South East Asia. The smoke from this biomass burning has been shown to be potentially toxic, with probable links to the prevalence of asthma and the frequency of asthma attacks.

Pesticide use: Thailand ranks fourth in the world in its annual use of pesticides, after China, the USA and Argentina. Of the five most commonly used pesticides in Thailand, four have been banned in the European Union. Pesticide intoxication is a major public health problem. The Department of Agricultural Extension (DoAE) is currently supporting farming communities to establish Community Pest Management Centres (CPMCs), of which there are currently approximately 2,000 across the country (~2 per district), with each one supporting approximately 30 farmers to implement integrated pest management (IPM) techniques. Such techniques have a proven track-record in Thailand (and, indeed, in other major rice-producing countries, such as Indonesia, Malaysia and Viet Nam): for instance, in 2010 Thailand implemented one of the world's most successful biological control programmes, the control of the cassava mealy bug. However, due to a range of knowledge, behavioural and economic barriers, IPM is not being systematically applied. An ongoing TEEB agri-food assessment in the Central Plains and North-East regions of Thailand is analysing the positive impact on rice yields of biological pest control, notably the role of damselflies, dragonflies and spiders on rice pests such as plant-hoppers and leafhoppers;

empirical findings suggest that rice yields in insecticide-treated fields are often lower than those in untreated fields.

Fertilizer use: Excessive use of chemical fertilizers in the Thai rice sector has polluted surface water and groundwater through seepage. Thai farmers have grown accustomed to applying high amounts of fertilizer (more than 20-50 kg per rai[1]). Over-use of fertilizers and pesticides results in leakage in some areas.

ESIA / ESMP / ESMF

This ESIA / ESMP / ESMF has been developed as part of the Funding Proposal submitted to the GCF to address the risks according to the GCF's Environmental and Social Policy. The GCF uses an interim Environmental and Social Policy based on the Performance Standards (PS) of the International Finance Cooperation (IFC), which are compatible with GIZ's safeguards as upheld by its Safeguards and Gender Management System (S+G). The older ESS (2nd updated, March 2022) follows PS1 through PS8, and adds two more ESSs (ESS9 and ESS10). This ESIA/ESMP/ESMF is accordingly based on the most recent version of the GCF ESS, as shown in Table 2 below.

The information and data used to formulate the *Environmental and Social Impact Assessment* (ESIA) were obtained from reviewing the draft project documents, background studies and data, and consulting the GIZ project development team. Consultations with relevant stakeholders, extensive literature reviews and compilation of information from official documents were also undertaken. The outputs from these processes include the identification and assessment of potential unintended negative impacts of the project.

Findings from the Environmental and Social Impact Assessment (ESIA) were used for the formulation of the *Environmental and Social Management Plan* (ESMP). The ESMP includes mitigation hierarchies to manage and mitigate potential risks, and detailed mitigation and/or compensation measures to make the project compliant with the GCF's and GIZ's E&S Policies.

The *Environmental and Social Management Framework* (ESMF) has been prepared to set out the principles, rules, guidelines and procedures for screening, assessing and managing the potential social and environmental impacts of the activities that involve financial support to individuals or institutions. The identities of the beneficiaries of this financial support will only be known during project implementation, when financing decisions are made by the relevant institutions. The ESMF contains measures to avoid and, where avoidance is not possible, to reduce, mitigate and/or offset, adverse risks and impacts in the context of (i) incentive payments to farmers and service providers by the Bank for Agriculture and Agricultural Cooperatives (BAAC) and (ii) Office of Natural Resources and Environmental Policy and Planning (ONEP) grant support to selected Thai Climate Initiative (ThaiCI) sustainable rice projects.

Environmental and Social Impact Assessment (ESIA)

The Thai Rice Project is categorized as Category B ('medium') E&S risk. This rating is based on the consideration that the project will implement activities that have "potential limited adverse environmental and/or social risks and impacts that, individually or cumulatively", are:

[1] A rai is a unit of area equal to 1,600 square metres (0.16 hectares).

- Few in number: Of the 10 ESS categories, 7 are rated Low Risk (ESS 2, ESS 3, ESS 5, ESS 6, ESS 7, ESS 8, ESS 9) and 3 are rated Medium (ESS 1, ESS 4, ESS 10). Moreover, SEAH risk is rated Low, emergency preparedness and response risk is rated Low and Human rights risk is rated Low.
- Generally site-specific: ESS risks are confined to smallholder rice fields and their environs.
- Largely reversible: It is noteworthy in this regard that key project interventions - e.g. AWD (water), SSNM (fertilizer) and IPM (pesticides) – relate to *reduction* or *avoidance* of the use of a particular resource, so reversibility of harms is not generally a concern.
- Readily addressed through mitigation measures, which are described in detail, fully costed, linked to detailed implementation arrangements and build on best national and international practice.

The Thai Rice Project has the potential to cause moderate negative environmental and social impacts. These potentially include impacts on water quality through contamination by chemicals and fertilizers, degraded soil quality, competition among farmers for water and the implementation of climate-smart agricultural technologies in the context of limited farmer knowledge about these technologies. The project does not require or involve land acquisition and/or resettlement. None of the interventions will require the displacement of people, involve economic displacement or will be conducted in protected areas or sensitive locations.

The project offers substantial positive environmental and social impacts for the beneficiaries in North, North-East and Central Thailand, notably in the form of improved adaptation to climate change (droughts, heat waves and others). The project offers positive global environmental impacts, notably in the form of reduced GHG emissions from the Thai rice farming sector. Co-benefits include reduced water and air pollution.

Table 2: Summary of Environmental and Social Impact Assessment

Environmental & Social Safeguards	Risk Level	Explanation / Basis for Risk Level Determination
ESS 1: Assessment and management of environmental and social risks and impacts	Medium	• The environmental and social management systems for rice cultivation are overseen and operated by a range of government institutions, including the Office of Natural Resources and Environmental Policy and Planning (ONEP), the Pollution Control Department (PCD) of the Ministry of Natural Resources and Environment (MoNRE), and the Department of Agricultural Extension (DoAE), the Rice Department (RD), the Land Development Department (LDD) and the Royal Irrigation Department (RID), all under the Ministry of Agriculture and Cooperatives (MoAC). Assessment, monitoring and reporting are undertaken by regional and local government agencies in close collaboration with provincial Rice Research Centres and agricultural extension offices. Financial assistance to rice farmers is provided by the Bank for Agriculture and Agricultural Cooperatives (BAAC), which operates an extensive branch network. • Water management is the most important environmental issue in rice cultivation, as rice requires substantial but varying amounts of water throughout the entire growing period. The water distribution system is most developed in the Central Region, where it is managed by water distribution committees that have established legal mandates and community representation.

Environmental & Social Safeguards	Risk Level	Explanation / Basis for Risk Level Determination
		• Soil management is an important aspect of rice agriculture. Soil organic matter (SOM) varies throughout the project area, from approximately 2-3% in the North to more than 4% in the Central Plains. LDD provides technical advisory support to rice farmers to manage soil quality (including soil acidity). LDD also operates a 'soil doctor' service to, among other things, advise on crop rotational techniques for soil management (e.g. in some areas, jute is promoted between the first and second rice growing seasons). • Air pollution from the burning of rice fields (as a land clearance technique) is a significant environmental harm associated with rice production. The Pollution Control Department and the Department of Agricultural Extension are actively working to prevent burning. • Social risks: Using new techniques such as laser land levelling (LLL) can replace conventional machines like tractors or hand ploughing machines and thus reduce workload during land preparation. LLL operation is usually undertaken by local service providers on demand. High demand for LLL services may induce lower demand for local labour and service providers. As detailed in the economic and financial analysis (Annex 3a), rice farming in all three project regions (Central Plains, North-East, North) currently produces only subsistence income (if at all) for farmers and their families. Rice farmers are among the poorest segments of Thai society. The adoption of climate-smart farming technologies and practices will produce a positive financial internal rate of return (IRR) – 14.2% in the Central Plains, 11.2% in the North-East and 13.6% in the North – thereby increasing farmers' incomes. Moreover, because of the adaptation benefits conferred by these technologies and practices, farmers' incomes will also be less volatile in the context of climate variations. Some (limited) erosion of cultural traditions, such as ceremonies marking events in the traditional farming calendar, may be experienced as farmers adopt new technologies and practices (see ESS 8). But these traditions are in long-term decline due to other technological and market developments that are unrelated to the project and would be put under even greater stress if rice farming were to become unviable due to climate change. The project poses some limited SEAH risks (see below) in the context of training and extension support and agricultural service provider activities. • Implementation of the Thai Rice Project will strengthen environmental and social management systems and will improve important facets of environmental and social governance (water usage, water quality, air pollution, GHG emissions, working conditions, etc.). Stakeholder capacities – farmers, extension services, government departments, etc. – will be strengthened. The project's ESS systems include policy, identification of risks and impacts, management plans, organisational capacity and competency, stakeholder engagement, grievance mechanisms and monitoring and review. • Several impacts show positive benefits, such as reduced greenhouse gas emissions, reduced fertilizer leachate into the environment, reduced water consumption and improved air quality (less straw burning). Negative impacts may stem from indirect impacts, such as water quality and availbility. The project may also

Environmental & Social Safeguards	Risk Level	Explanation / Basis for Risk Level Determination
		have cumulative impacts on biodiversity and agricultural standards improvement/adoption, which are likely to be beneficial.
ESS 2: Labour and working conditions	Low	• In the North and North-East regions, labour needs in rice farming are concentrated in the wet season (as most farms are rain-fed). This can generate labour shortages and competition for farm workers, and can lead to foreign workers (most of them from Myanmar and Cambodia) being employed. • Workloads and work allocations among male and female farmers are typically mutually decided: although there is a strong gender-driven division of labour, this is generally not perceived as unfair or unfairly imposed. Men tend to work on labour-intensive jobs while women work on management-related jobs and supplementary livelihoods. Farm mechanisation is weakening this traditional division of labour. • If an agricultural worker has employee status, he/she is covered by the terms of the Labour Protection Act (LPA, 1998). Agricultural workers who are employed year-round but are not covered by the LPA are, instead, covered by the 2004 regulation 'Labour Protection in the Agricultural Sector', which, inter alia, specifies mandatory holiday, sick leave and maternity rights. Self-employed agricultural workers or those whose employment is for fewer than 180 continuous days are covered by the 2013 Department of Labour Protection Notification on Occupational Safety, Health and Environment for Informal Workers. • Under Thai law, migrant workers must receive the same protections and fair labour practices as Thai workers. But many are unregistered and carry out low-wage and hard-labour jobs that many Thai workers are unwilling to do. Survey data reveals that migrant workers' incomes and working conditions vary significantly, depending on nationality, gender, the type of job, the agricultural crop and the province of employment. Approximately 58% of migrant workers who work full-time are paid less than the statutory minimum wage; this figure rises to 66% for migrant women. • Thailand has ratified the 3 instruments related to forced labour: the Forced Labour Convention (1930), the Abolition of Forced Labour Convention (1957) and the 2014 Protocol to the Forced Labour Convention (1930). Isolated examples of forced labour in the Thai agricultural sector have been recorded – particularly involving migrant workers – but it is not a widespread problem. • Thailand has ratified the 2 ILO fundamental Conventions on child labour and has adjusted its legal framework in line with these Conventions. Accordingly, the minimum age for employment in the agricultural sector is set to 15 years of age, while children aged below 18 are not allowed to engage in tasks that are considered hazardous. Child labour does exist, with approximately 3% of children affected according to National Statistical Office data. However, cultural factors and strong government enforcement of the legal regime (itself systematically strengthened over the past decade) mean that child labour is declining. It is believed to be largely concentrated in the shrimp, fishing and garment industries. Agricultural child labour is rare and typically involves migrant children (as approximately one-third of migrant agricultural workers bring their children with them).

Environmental & Social Safeguards	Risk Level	Explanation / Basis for Risk Level Determination
		• The proportion of ageing farmers is growing (as observed, for example, in mega-farm project member lists), largely as a result of youth choosing other employment sectors (or moving away from rural areas entirely). This is not an ESS risk as such, but it does suggest that manual farm work may present an ever-greater physical challenge to farmers. Promotion of mechanised technologies may mitigate some of the physical challenges associated with farmer ageing.
ESS 3: Resource efficiency and pollution prevention	Low	• Contamination of water bodies – including in neighbouring farms and the local vicinity – by fertilizers and pesticides is possible. Although the amounts applied will be reduced by the project, chemical and fertilizer use will still be necessary. It is important that farmers understand what practices, procedures and products are appropriate and safe to use. The aim is that environmental contamination and health impacts can be avoided or minimised. • Burning of rice residues (straw and stubble) is widespread, but the negative health impacts to farmers and communities are not widely known. Monitoring, reporting and effective communication is necessary. Proper straw and stubble management will reduce air pollution problems. Project activities that promote straw baling will be very helpful in reducing pollutant emission from straw burning, as well as generating additional incomes to local farmer communities. • Significant reduction of CH_4 emissions will be achieved through the application of LLL and AWD. • Emission reductions of N_2O will be achieved through the reduced amount of fertilizer used. The current baseline is that the fertilization rate practised by farmers is, on average, about double the optimum fertilization rate implied by soil analysis. Project activities will also lower farmers' costs of fertilizer and other associated items (such as labour costs) and reduce negative environmental impacts. • IPM will help reduce the contamination of chemicals in air, soil and water bodies. • Other measures, such as farm-level water management, rice variety diversification and dry direct seeding, will have positive impacts on resource use efficiency. Some of these measures will also lead to reduced greenhouse gas emissions.
ESS 4: Community health, safety and security	Medium	• Most farmers do not manage the entirety of the rice cultivation process themselves. Instead, they employ service providers (who are often farmers themselves who are augmenting their incomes) to carry out selected stages of rice production, such as ploughing, planting, fertilizing, spraying chemicals and harvesting. Farmers and service providers generally lack training in (and even awareness of) basic health and safety measures. • Management and use of chemicals (fertilizers, pesticides, fungicides, etc.) is often casual. Farmers are either unaware of safety protocols or choose to ignore them – e.g. protective clothes, goggles and gloves are often not worn because they are inconvenient when working in paddy fields. • Personal health problems are common – such as pain after lifting heavy loads (fertilizer, rice, agricultural equipment) and back pain after sustained periods of bending down.

Environmental & Social Safeguards	Risk Level	Explanation / Basis for Risk Level Determination
		• Accidents arising from the use of machinery (typically cuts and scratches, but also arising from loud noise and vibration) account for two-thirds of the 'major health problems' reported by Thai farmers. • Farmers are exposed to inclement (and occasionally hazardous) weather conditions.
ESS 5: Land acquisition and involuntary resettlement	Low	• The Thai Rice Project will be implemented on plots of land where rice cultivation is already practised – either by individual farmers or as officially-designated 'mega-farms'. The project will not involve new land acquisition or resettlement.
ESS 6: Biodiversity conservation and sustainable management of living natural resources	Low	• Ecosystem benefits of AWD reported in the academic literature include (non-exhaustive): improved soil structure, pest management, weed management, root and tiller development, phytotoxin removal and enhanced soil microbial activity. • Surveys conducted in the Central Region by the NAMA Support Project (NSP) indicate that implementation of climate-smart agricultural technologies and practices, such as AWD and SSNM, did not significantly change the biodiversity of rice fields. However, information on the effects of other technologies planned by the Thai Rice Project (e.g. alternative rice varieties or direct-seeding) is not available in the Thai context. (However, the general academic literature does not raise any major concerns). • Most rice residues are burned. However, some farmers leave them to decompose in situ, providing a form of soil enhancer and fertilizer. If such residues are diverted to market uses (bio-energy, pulp and paper production, etc.), this may represent a localised ecosystem loss of nutrients.
ESS 7: Indigenous peoples	Low	• The indigenous peoples of Thailand are commonly referred to as 'hill tribes' or 'ethnic groups'. They are located primarily in the upland areas of the North and West of the country: the Akha, Hmong, H'tin, Karen, Khmu, Lahu, Lisu, Lua, Mien and Mlabri. There are also smaller groups in the North, the so-called local Tai groups (Tai Lue, Tai Khuen and Tai Yong), the Kachin and the Shan. In total, ethnic groups account for approximately 5% of the population. • The Government of Thailand does not use the term 'indigenous peoples' and affirms that these groups are Thai citizens, that they enjoy the same fundamental rights as all citizens and that they are protected by the laws of the Kingdom. However, the highland minorities remain among the poorest communities in Thailand and many of them do not have proper documentation regarding their status. As a result, they generally do not vote, seek civil service jobs or travel to other parts of the country. • The project will be implemented only in lowland rice-farming areas or in the inter-mountain 'lowland' valleys of the uplands.
ESS 8: Cultural heritage	Low	• All cultural heritage sites in Thailand are controlled by the Fine Arts Department of the Ministry of Culture. No farming is allowed, by law, on cultural heritage sites. • Many cultural ceremonies and traditions are practised in association with rice cultivation, especially in rural areas. Many of these traditions and ceremonies are conducted to request ample rainfall, good harvests and the good health of farmers. Rice farming forms an integral part of the culture and way of life of rural communities. It has been observed that such cultural ceremonies and traditions are

Environmental & Social Safeguards	Risk Level	Explanation / Basis for Risk Level Determination
		gradually fading away, partly due to the penetration of new technologies that provide stability in the required production outputs. There are concerns that many of these cultures and traditions will eventually disappear completely with the uptake of new technology and with a new generation of farmers. • Many ceremonies and traditions play valuable roles, such as communication of local wisdoms, and strengthening social relationships between villagers and between old and young generations. • The project will not infringe on protected cultural heritage sites, nor develop natural resources on land subject to traditional ownership or tenure, which, inter alia, includes natural areas with cultural and/or spiritual value, such as sacred groves, sacred bodies of water and waterways, sacred mountains, sacred trees, sacred rocks, burial grounds and sites. As non-physical expressions of culture, such as customs, traditions, language, identity constructions, ceremonies, festivities and religious / spiritual modes of expression, are subject to general and ongoing societal change / modernisation processes in Thailand, the potential impact of the Thai Rice Project on cultural heritage is considered low.
ESS 9: Stakeholder engagement and information disclosure	Low	• Promoted by MoAC, many rice farmers in Thailand are grouped into mega-farms and community enterprises. Information dissemination channels are well developed in such groupings, with information flowing from group leaders. Information distribution to smallholder farmers (i.e. non-group farmers) is typically achieved through village heads (Phu Yai Bann). Furthermore, government institutions, such as the Rice Department, rice research centres, the Department of Agricultural Extension (DoAE) and BAAC, work closely with farmers and have established information, training and financial disbursement mechanisms. • Elderly smallholders have limited access to the internet and social media, and generally rely on 'old media' (radio and TV) for up-to-date information. • Farmers tend to be risk-averse and conservative. They tend to be influenced far more by 'real' outcomes (e.g. demonstration sites and proven results) and word-of-mouth from peers rather than abstract ideas and messages.
ESS 10: Climate change resilience and adaptation	Medium	• The following future changes to the climate are projected: an increase in maximum and minimum temperatures, an increase in the frequency and severity of droughts and floods, an increase in heatwaves, and greater seasonality. All present challenges to current models of rice farming. • The poverty, indebtedness and low levels of education that prevail in the Thai rice farming sector mean that farmers are vulnerable to climate change-driven impacts on rice outputs. • Supporting the continuation of rice farming in the context of increasing climate pressures opens the possibility of maladaptation. • Rice is a staple source of calories and micro-nutrients (magnesium, phosphorus, manganese, selenium, iron, folic acid, thiamin, niacin, etc.) for more than half of the world's population: climate-driven threats to rice output therefore represent a health and nutrition risk.

Environmental & Social Safeguards	Risk Level	Explanation / Basis for Risk Level Determination
Sexual exploitation, abuse and harassment (SEAH)	Low	• For the Thai Rice Project, risks of sexual abuse, exploitation and harassment (SEAH) exist in the context of project-supported training and extension support, agricultural service provider activities (regarding both potentially exploitative relationships with farmers and contacts between service provider staff and members of the public), and access to financial support. • The Thai Rice Project does not exacerbate such risks, but it is necessary to include mechanisms to avoid SEAH, to monitor occurrence, and to implement a zero-tolerance policy.
Emergency preparedness and response	Low	• During Thai Rice Project implementation, health and safety standards should apply to premises receiving members of the public – for instance, farmers – during training, capacity building and extension support. • Project-supported agro-met apps and services should be capable of providing farmers with emergency alerts (e.g. for storms, strong winds, floods, etc.) in addition to their standard climate-smart farming functionality.
Human rights	Low	• GCF's E&S policy, as well as GIZ's safeguards management system, puts a significant emphasis on avoiding infringement of the human rights of others and addressing adverse human rights impacts that project activities may cause or contribute to. • Each of the ESSs has elements related to human rights dimensions that a project may face in the course of its operations. For the Thai Rice Project, human rights risks and impacts are essentially related to agricultural labour and livelihoods and are assessed under ESS 2 and ESS 4.

Environmental and Social Management Plan (ESMP)

The ESMP provides a suite of practical measures (see Table 3) to manage the potential unintended negative environmental and social impacts associated with the project's activities, as well as to allow for meaningful and inclusive multi-stakeholder consultations and engagement throughout the life-cycle of the project. Further, the ESMP ensures that adequate processes are in place to appropriately monitor activities against GCF and GIZ ESS policies and standards.

Table 3: Thai Rice Project ESS Mitigation Measures

Environmental & Social Safeguards	Project Mitigation Measures
ESS 1: Assessment and management of environmental and social risks and impacts	• The project ESS management system will be established and operationalised. • The ESMP and ESMF will be staffed, resourced and implemented throughout project implementation. • Capacity building and enhanced institutional coordination between key government institutions with ESS mandates / reach (notably, MoAC and its constituent departments, MoNRE, ONEP including EFD, TMD, TCG, BAAC, TGO, etc.) (notably, Sub-Activities 1.1.1.2, 2.1.2.2, 3.1.2.2, 3.1.2.3 and 3.1.3.2). • Development and promotion of the TAS to mainstream sustainable, climate-smart rice (Sub-Activity 3.1.1.1).

	• TRIS enhancements to more effectively and efficiently transfer farmers' climate risks to insurance markets (Sub-Activity 2.1.1.3). • Design and operationalisation of the Thai Rice Facility as a coordinating and peer-exchange mechanism for climate-smart agriculture (Sub-Activity 3.1.3.1). • Development of the T-VER Rice Scheme as an environmentally robust carbon finance mechanism for incentivising low-carbon farming practices (Sub-Activity 3.1.2.3). • Support to identified NDC needs and sectoral MRV to improve the quality of climate data and its use to inform environmental policy-making (Sub-Activity 3.1.2.2).
ESS 2: Labour and working conditions	• Gender-based inequalities and divisions of labour will be addressed by the project's Gender Action Plan (see Section G.2.2). • The GAP also includes measures to address the employment vulnerabilities of migrants and to facilitate their inclusion in the transition to climate-smart rice (Sub-Activity 1.1.1.1). • Measures will be included to address the ageing profile of rice farmers, including – as part of its farmer training – devoting particular effort to reaching women and youth, as well as coordinating with the ISRL-T baseline project that is implementing activities to reduce rural exodus (Sub-Activity 1.1.1.1). • The project's support to technological innovation and the use of digital tools will reduce physical labour requirements of farming (notably, Sub-Activity 1.1.1.3). • Training and capacity building of farmers will build skills and open up new income-generating activities (premium rice, biomass residues, etc.) (Sub-Activities 1.1.1.1, 1.1.2.1, 3.1.1.1 and 3.1.1.2). • Farmers who feel that project activities worsen their working conditions or present unnecessary risks will be able to communicate their concerns using the project's Grievance Redress Mechanism (see Section D.5.3). • Training materials for farmers and service providers will emphasise that child labour and forced labour are illegal and will not be tolerated by the project. Farmers risk ejection from the project – with consequent loss of technical and financial support – if they employ such practices (Sub-Activities 1.1.1.1 and 2.1.1.1). • Site visits to farms undertaken by project staff for the purposes of MRV and stakeholder consultations will also be used to check for the use of forced labour or child labour. Farmers who are found to employ forced labour or child labour in contravention of national legislation will be reported to the relevant authorities.
ESS 3: Resource efficiency and pollution prevention	• LLL, AWD, DSR, rice variety diversification and crop diversification will reduce water consumption (Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.2, 2.1.2.1, 3.1.1.1 and 3.1.2.1). • AWD will be coordinated with local Water Usage Organisations to reduce the scope for competition over scarce water (Sub-Activities 1.1.1.1 and 1.1.1.2). • SSNM will reduce fertilizer consumption (and hence water pollution) (Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.2, 2.2.2.1 and 3.1.2.1). • IPM will reduce insecticide, pesticide and fungicide consumption (and hence water pollution) (Sub-Activities 1.1.1.1, 1.1.1.2, 2.2.2.1 and 3.1.2.1). • SSM will reduce air pollution (Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.2, 2.2.2.1 and 3.1.2.1).

	• Agro-met advisory services will improve input efficiencies and applications timings, reduce environmental leakages and generally improve farmers' environmental protection (Sub-Activity 2.1.1.2).
ESS 4: Community health, safety and security	• IPM and SSM will reduce farmers' exposure to hazardous chemicals and farmers' and communities' exposure to smoke (Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.2, 2.2.2.1 and 3.1.2.1). • LLL and AWD will markedly reduce water requirements for farming, which will, in turn, reduce farmers' exposure to malaria, hookworm and other intestinal parasites. • Agro-met advisory services will reduce farmers' exposure to extreme weather hazards (floods, storms, etc.) (Sub-Activity 2.1.1.2). • Promotion of the TAS standard will provide a financial incentive for farmers to adopt less harmful chemicals management practices (Sub-Activities 1.1.1.1, 1.1.1.2 and 3.1.1.1). • Occupational health and safety training will be provided for farmers and extension services. This will include guidance on the safe operation and maintenance of equipment associated with climate-smart farming (e.g. tractors, LLL trailers, etc.) (Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.2 and 2.1.1.2). • BAAC CSL loans will only be issued to farmers who have undertaken the project occupational health and safety training (Sub-Activity 2.1.2.1). • The project will create a reporting mechanism for occupational injuries to be administered by the project ESS Manager.
ESS 5: Land acquisition and involuntary resettlement	• The locations of all farm plots served by the project (i.e. where climate-smart technologies and practices are adopted) will be known and logged. Only land that is officially categorised as rice farming land by the government (i.e. only land that is associated with farmers registered with DoAE) will be eligible to participate in the project. • Local institutions, such as WUOs and provincial extension services, will be kept informed of (and, in many cases, involved in providing support to) participant farms. • Contact details for the project's grievance redress mechanism (GRM) will be communicated to participating farmers *and* to local communities (e.g. on public notice-boards, local government institutions, community and CSO websites, etc.), so that individuals who feel they have been wrongly excluded from the project or who claim their land is being used without their permission will be able to submit official complaints.
ESS 6: Biodiversity conservation and sustainable management of living natural resources	• A biodiversity module will be included in farmer and extension officer training on climate-smart agricultural practices. Although biodiversity is not typically an issue of great interest to rice farmers, the beneficial impacts on rice yields of some types of insects and birds, and the benefits of reduced pesticide application to personal well-being, will be emphasised (Sub-Activities 1.1.1.1 and 1.1.1.2). • Each year, a representative sample of farmers practising SSM will be analysed to ensure that their diversion of biomass residues for other purposes has not inadvertently led to a compensating increase in their use of chemical fertilizers. If this is found to be a problem, farmer training and adaptive measures will be put in place (Sub-Activities 1.1.1.1 and 1.1.1.2). • A multi-taxon biodiversity study (covering plants, invertebrates, frogs, fish and birds) will be undertaken as part of the project's mid-term review. 10 paired sites of conventional and climate-smart rice farming will be surveyed: where noteworthy positive or negative impacts are detected, these will be reported (e.g. in the mid-term review as well as relevant project reports and literature) and project activities will be

	amended to reinforce / reduce these impacts in the second half of project implementation.
ESS 7: Indigenous peoples	• For the North project region, the ethnic status of rice farmers participating in the project will be considered in the extension approach (at the same time as free, prior and informed consent is sought). A sample of those farmers who self-report as being part of an ethnic groups (or all such farmers, if the number is manageable) will be surveyed on an annual basis to ensure that (i) their access to project support is fair and equitable (i.e. there is no discrimination against them) and (ii) any challenges they encounter as a result of their ethnicity (cultural, language, etc.) will be addressed (e.g. in subsequent training materials, workshops, etc.). • Poverty, population growth and limited land in which to expand farming are placing considerable pressures on upland tribe communities. There is considerable potential for young, capable ethnic group members to move to the lowlands where they can rejuvenate ageing rice farming communities. Accordingly, the project will aim to direct some of its climate-smart training at ethnic groups who are not located in the project's target areas but who could, in the medium-term, provide a pool of talent and labour for climate-smart rice farming (Sub-Activity 1.1.1.1). This is foreseen to be operationalised in cooperation with stakeholders that have experience in engaging ethnic groups in the North, especially the Mah Fah Luang (MFL) Foundation.
ESS 8: Cultural heritage	• The project will only implement activities on land that is classified as existing rice farming land (see ESS 5). Cultural heritage sites will, therefore, be excluded. • The project will, at all times, be respectful of local traditions and customs. For instance, many farmers still rely on traditional cues (e.g. bird behaviour, tree flowering behaviour) to guide their planting practices. The project will provide scientifically-grounded agro-met data and advisories, but will frame this as augmenting existing information rather than being dismissive of it (Sub-Activities 1.1.1.1 and 2.1.1.2). • Training provided to farmers, will include references to traditions and customs and the positive roles they play in sustaining rice communities (Sub-Activity 1.1.1.1). • The project's media and publicity activities (e.g. brochures, videos, etc.) will reference, where relevant, cultural events and practices – to convey the message that climate-smart rice farming can be as integrated into the cultural fabric of rural life just as much as traditional rice farming. • The project's Stakeholder Engagement Plan (see Section D.5.3) includes project participation in local festivals and events as a means of maintaining good community relationships as well as supporting the conservation of local cultures and heritage.
ESS 9: Stakeholder engagement and information disclosure	• Building on extensive stakeholder consultations undertaken during project preparation, the Thai Rice Project will implement a robust and inclusive Stakeholder Engagement Plan (SEP). • Training materials, workshops and other project activities will be provided to stakeholders (farmers, extension service officers, etc.) in appropriate forms (language, tone, technical level, etc.) (Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.1, 2.1.1.2, 2.1.1.3 and 3.1.1.2). • Particular efforts will be made to engage with and support vulnerable stakeholders, including female-headed households, female-headed skipped generation households, ethnic groups and migrant workers (Sub-Activity 1.1.1.1). • The project will develop or enhance digital tools (mobile apps, atingi online learning platform, agro-met advisory services, etc.) that will

	enhance information flows to farmers (Sub-Activities 1.1.1.1, 1.1.1.3 and 2.1.1.2). • The project will operate training plots that serve to provide farmers with 'real world' assurance that the climate-smart technologies and practices being advocated by the project are effective (Sub-Activity 1.1.1.1, 1.1.1.2, 2.1.1.2, 2.1.1.3 and 3.1.2.2).
ESS 10: Climate change resilience and adaptation	• The climate-smart technologies and practices supported by the project are intended to enhance the resilience of Thai rice farmers (as well as reduce their GHG emissions). • Where farmers' climate risks cannot be fully eliminated, the project will also support enhancements to the national rice insurance scheme that serve to displace these risks to the insurance market (Sub-Activity 2.1.1.3).
Sexual Exploitation, Abuse and Harassment (SEAH)	• All beneficiaries of the project's training programmes (e.g. farmers, extension service officers, financial institutions, government agencies, Executing Entities, etc.) will receive awareness-raising and training on SEAH (Sub-Activities 1.1.1.1, 1.1.1.2, 2.1.1.1, 2.1.2.2, 3.1.2.1 and 3.1.3.2). • All project stakeholders (recipients of training and/or financial support) will have access to the SEAH grievance mechanism (which operates separately from the project's general Grievance Redress Mechanism). • All reports of SEAH violations will be collated centrally by the project ESS Manager. • SEAH will be addressed immediately on a case-by-case basis.
Emergency preparedness and response	• All premises used by the project must be in compliance with legal obligations. For instance, a venue must have a Building Certificate if required by the 1979 Building Control Act; seismic design provisions must be met (as stipulated under the 2021 revision to the Seismic Regulation); a Safety Officer must be designated according to the terms of the Occupational Health & Safety Act (as updated in 2022); and private sector premises used for public meetings must have third-party liability insurance to cover death and injury (in line with the requirements of the 2021 Ministerial Regulation of the 1979 Building Control Act). • Project-supported agro-met advisory services will be capable of providing farmers with emergency alerts (e.g. for storms, strong winds, floods, etc.) in addition to their standard climate-smart farming functionality (Sub-Activity 2.1.1.2).
Human rights	• The impact screening and assessment process of the Thai Rice Project will enable potential human rights issues to be addressed under the different ESS categories. • As part of its outreach and training activities, the project will explicitly support certain groups – such as female-headed households, ethnic groups and migrant workers – whose human rights may be more vulnerable than those of the 'normal' population (notably, Sub-Activity 1.1.1.1).

1. Introduction

1.1 Overview of climate and rice cultivation in Thailand

Thailand is a peninsular country in South-East Asia. It shares borders with Myanmar in the West, Laos and Cambodia in the North-East, and Malaysia in the South. On the East coast is the South China Sea, and on the West coast are the Indian Ocean and the Andaman Sea. Thailand has 5 different regions, and each one has its own geography. The North is hilly and mountainous, the North-East is a natural high plain, the Central region is a large, low plain, the East is also a plain but has valleys with small hills, and the West is hilly and mountainous. The South is a peninsula with the South China Sea and Gulf of Thailand to the West and the Andaman Sea to the East (ONEP, 2018). Thailand enjoys a tropical climate which is influenced by seasonal monsoons. The local climate of Thailand is divided into 3 seasons: rainy season from mid-May to mid-October, winter from mid-October to mid-February, and summer from mid-February to mid-May (ONEP, 2018). Mean temperature is 26.3°C in the North and 27.5°C in the Southern and coastal areas. Mean annual temperature has increased by 0.8°C per century since the 1950s. Mean annual rainfall is 1,200-4,500 mm. Monthly climatology of min-temperature, mean-temperature, max-temperature, and rainfall during 1991-2020 is shown in Figure 2.

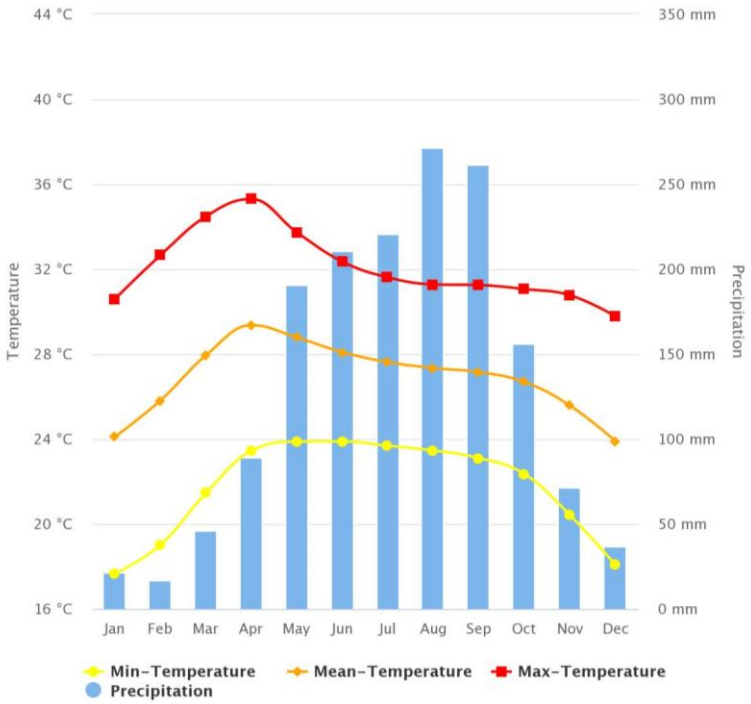


Figure 2: Monthly climatology of min-temperature, mean-temperature, max-temperature, and rainfall during 1991-2020. Source: World Bank Group, 2022.

Thailand has 51 million ha of land, of which one-third is used to grow annual crops and about 7% is used to grow permanent crops (GRiSP, 2013). Thailand is ranked the second-largest economy in South-East Asia. It has experienced low, single-digit gross domestic product (GDP) growth over the past decade, with the industrial (34.8%) and service (56.7%) sectors serving as the main drivers of recent growth. As an agriculture-based country, in 2021 agriculture comprised 8.6% of Thailand's GDP (World Bank, 2022). In rural Thailand, agriculture still represents a considerable part of the economy. The Thai economy depends on exports, with more than half of total exports originating from rice exports (GRiSP, 2013).

Rice cultivation in Thailand can be classified into four ecosystems. Rain-fed lowland (75%) is the main rice ecosystem, followed by irrigated (19%), deep water (5%) and upland (1%) rice (Varinruk, 2017). In addition, there is also a regional preference in the cultivation of rice varieties. Over 60% of the major rice cultivation areas are in the North-East (Figure 3).

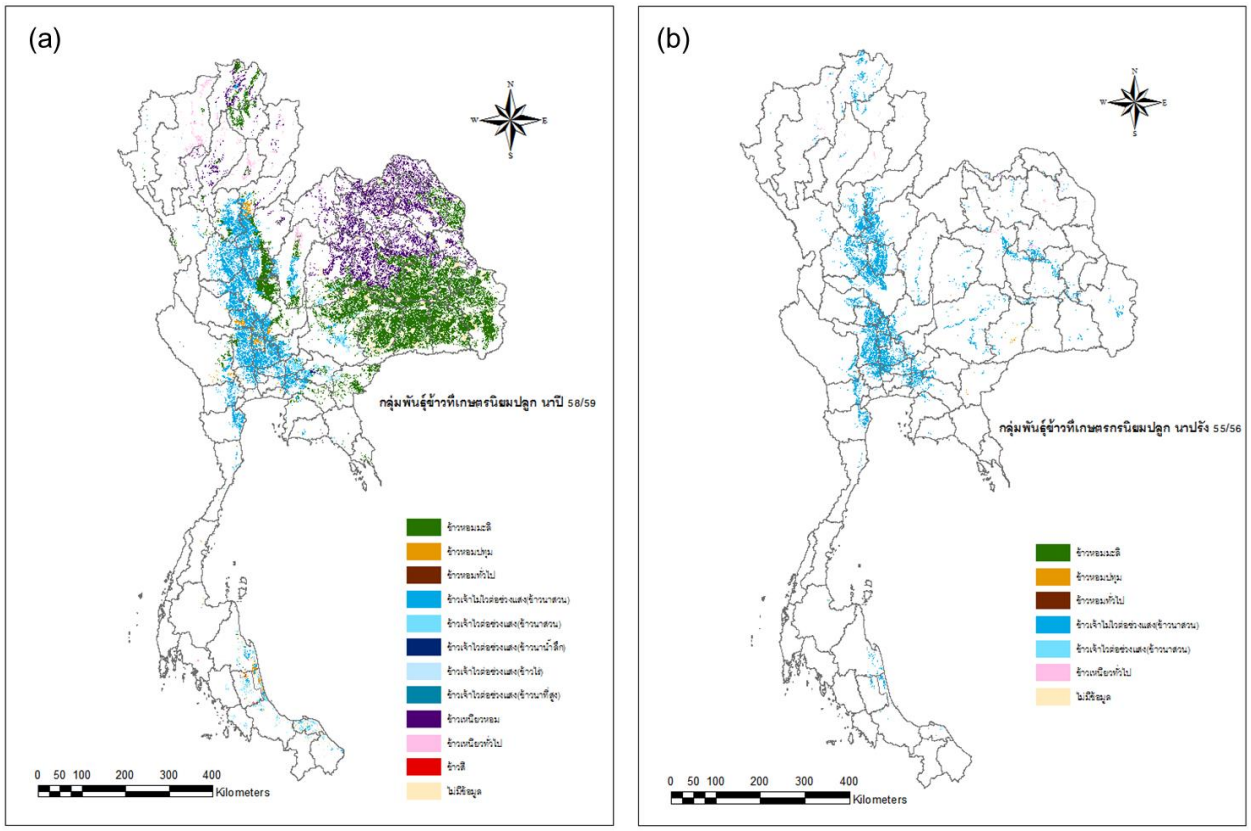


Figure 3: Major (wet season, (a)) and secondary (dry season, (b)) rice-growing areas in Thailand; colours indicate different rice variety grown

Source: (Rice Knowledge Bank, 2016*).*

Most of the glutinous rice variety RD6 is grown in the upper North-East (64%), while most of the fragrant rice variety KDML 105 or RD15 is grown in the lower North-East (95%). Although Hom Mali rice is of high quality, the average yield in the lower North-East (2.1 t ha^{-1}) is low compared with other varieties and regions (2.5-4.3 t ha^{-1}) (GRiSP, 2013; Varinruk, 2017). Also, the productivity of rice in these cultivation areas is affected by a variety of additional factors. For

instance, the potential for irrigation in the North-East is only 5% of what it could be. In addition, the variability of weather and climate conditions, poor soil, salinity, droughts and floods have become increasingly common and have a significant impact on the production of rice. On the other hand, rice is cultivated intensively on more fertile alluvial soils in the Central, Western and Eastern regions of the country. Due to the availability of water from irrigation networks, the areas typically produce two harvests of rice in a single year, making them ideal for growing rice. These areas are known for their production of white rice in a wide-range of varieties. Patum Thani 1, Suphan Buri 1, and Chainat 1 are the most frequently grown varieties. The average yield of these varieties is between 4 and 6 tonnes ha^{-1} (GRiSP, 2013).

2. Project description

2.1 Project objective and components

The project “Thai rice: strengthening climate-smart rice farming” builds on a number of baseline projects, most notably the Thai Rice NAMA Support Project (NSP), funded by the NAMA Facility, and is in line with the country’s Updated NDC and NAP. The project will target rice farmers in 21 provinces of Thailand (Figure 4 and Table 4) to overcome barriers related to technical capacity, financing, market linkages and policy, to promote the adoption of low-emission, climate-resilient rice farming technologies and practices.

Figure 4: Project area covering 21 provinces (green-highlighted area).

Through the employment of climate-smart agriculture (CSA) technologies and practices such as LLL, AWD, SSNM, SSM, IPM climate-smart rice varieties, dry direct seeded rice, crop diversification (including perennial plants and trees), inter-cropping, agro-met advisory support (described under Section 2.2), a match-making app to link farmers and service providers, financial instruments (incentive payments, climate-smart loan programme), and policy tools (such as the Thai Agricultural Standard for Sustainable Rice, TAS), the following immediate project impacts are expected:

- Reduction of at least 2.4 $MtCO_2eq$ over the 5-year Thai Rice Project implementation period and 12.4 $MtCO_2eq$ over the 15-year lifespan of the project,
- Reduction of the climate vulnerability of approximately 253,400 direct beneficiaries,
- High sustainability and replicability potential, leading to a paradigm shift in the way rice is grown and marketed in Thailand.

Table 4: Basic information of 21 provinces included in the project implementation area

Region/ Province	Total area (rai)	Rice planting area		Wet season rice				Dry season rice			
		Rice planting area (rai)	% of total province land area	Planting area	Harvested area (rai)	Production (tonnes)	Yield (kg per rai)	Planting area	Harvested area (rai)	Production (tonnes)	Yield (kg per rai)
North											
Chiangmai	32,548,125	679,531	2.09	563,670	559,011	335,013	599	115,861	115,813	80,221	693
Chiangrai	7,298,750	1,645,392	22.54	1,336,080	1,326,410	740,494	558	309,312	307,840	199,001	646
North-East											
Nakhon Ratchasrima	15,933,750	3,845,263	24.13	3,602,930	3,169,918	1,100,061	347	242,333	241,602	157,082	650
Burirum	6,451,875	3,020,421	46.81	2,986,700	2,781,215	978,424	352	33,721	33,590	17,414	518
Surin	5,077,500	3,130,675	61.66	3,099,960	2,975,807	1,122,075	377	30,715	29,301	13,601	464
Srisaket	14,309,375	3,083,909	21.55	3,008,570	2,910,421	1,011,718	348	75,339	74,988	39,534	527
Ubon Ratchathani	9,858,750	4,237,815	42.99	4,060,680	3,995,498	1,395,550	349	177,135	176,536	85,116	482
Roi-et	5,186,875	3,326,189	64.13	3,087,460	2,811,317	993,670	353	238,729	234,351	135,780	579
Kalasin	4,341,875	1,765,421	40.66	1,499,130	1,477,638	555,336	376	266,291	265,283	171,382	646
Central											
Phitsanulok	6,760,000	2,024,291	29.95	1,499,000	1,445,004	826,450	572	525,291	524,171	311,253	594
Phitchit	7,334,375	2,229,761	30.40	1,733,730	1,697	1,018,145	600	496,031	495,427	316,003	638
Kamphangphet	5,379,375	1,537,889	28.59	1,200,030	1,169,281	683,338	584	337,859	337,556	203,311	602
Nakhon Sawan	5,998,750	2,767,672	46.14	2,412,540	2,058,440	1,176,408	572	355,132	351,734	233,886	665
Uthai Thani	10,894,375	635,610	5.83	526,770	427,640	266,967	624	108,840	107,833	67,614	627
Chainat	1,543,750	1,051,247	68.10	848,480	780,601	484,371	621	202,767	202,442	129,796	641
Lopburi	10,035,625	868,942	8.66	782,860	681,487	338,204	496	86,082	85,854	51,103	595
Singburi	514,062.50	86,858	75.26	300,120	298,851	213,379	714	86,738	86,595	57,838	668
Suphanburi	3,348,750	1,923,078	57.43	1,198,818	1,178,471	823,581	699	724,260	723,071	529,854	733
Angthong	605,250	374,100	61.81	300,100	297,699	203,642	684	74,000	73,823	47,337	641
Phra Nakhon Si Ayuthaya	1,563,125	1,322,454	84.60	788,710	786,390	521,840	664	533,744	532,981	377,129	708
Pathumthani	953,750	515,950	54.10	312,402	312,072	223,421	716	203,548	203,239	140,778	693

2.2 Climate-smart technologies and practices to be implemented by the project

The following technologies and measures will be implemented by the project:

2.2.1. Laser land levelling (LLL)

Laser land levelling is a precision agriculture system for field levelling that is commonly used in Australia, Japan and the USA, and increasingly in China, India and Viet Nam (IRRI, 2019). LLL is a quick and effective means of ensuring that an agricultural field has a table-top flat surface (with a slope between 0-0.2%), which means that irrigation water reaches every part of the field with minimal waste from run-off or waterlogging. Application of LLL can increase water use efficiency by 12-40% and fertilizer use efficiency by 10-13% (Jat et al, 2015; Pame et al, 2023); moreover, because the crop stand is more uniform, post-harvest crop losses can be reduced by 2-5% (Hieu-Hien et al, 2014). Laser land levelling considerably lowers irrigation time for rice by 47-69 hours per hectare per season and can be deployed in conjunction with alternate wetting and drying (AWD) to maximise water savings (Van-Hung et al, 2022). The laser levelling system requires the use of a tractor with an external hydraulic system, a drag bucket and a set of laser system components that include a laser transmitter, a receiver, a control box and a hydraulic valve. A 60 horse-power (HP) four-wheel drive tractor (4WT) can pull a 2m wide x 1m depth drag bucket and carry an average of 1.5 m^3 of soil, levelling approximately 1.5 hectares per day. The initial levelness of the field is determined by conducting a topographic survey. In order to increase the effectiveness of LLL, land preparation measures can be undertaken beforehand.

2.2.2. Alternate wetting and drying (AWD)

AWD is a water-saving technology that farmers can apply to reduce their irrigation water consumption in rice fields – and their methane emissions – without decreasing their yields (Chidthaisong et al, 2018). Empirical testing of AWD in the Central Plains of Thailand indicates that AWD reduces total water input by approximately 19% in the wet season and 39% during the dry season compared with continuous flooding (Maneepitak et al, 2019). The high potential for water saving is underlined by other studies, which estimate that between 25-70% of irrigation water can be saved by applying AWD (Ishfaq et al, 2020). A recent meta-analysis confirms that even mild AWD can reduce water use by 23% while fully maintaining rice yields (Carrijo et al, 2017).

According to the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in comparison to continuously flooded irrigated rice during the cropping season, applying a single drainage period as a result of AWD implementation can reduce methane emissions by 29% (i.e. a scaling factor of 0.71).[2] The reduction can be increased to 45% (scaling factor of 0.55) if AWD implementation results in multiple drainage periods during the cropping season of irrigated rice (IPCC, 2019). Empirical studies conducted in the Central Plains of Thailand estimate mean methane emissions (averaged over 3 seasons) under a low-emission management regime centred on AWD are 0.43 kg CH_4/ha/day, compared with baseline methane

[2] The scaling factor for water regime, or *SFw*, characterises the percentage methane emission reduction based on the number of times a rice field is dried as a result of AWD implementation. In the case of intensive AWD, a rice field will be dried multiple times (in practice, 2-3 times), and this will reduce methane emissions by 45%. For example, if a continuously flooded rice field produces 100 tonnes of methane, the same rice field with AWD (multiple drainage) will produce 100*0.55 = 55 tonnes of methane: a 45% reduction and a 0.55 scaling factor.

emissions from traditional rice farming in the same region of 1.15 kg CH_4/ha/day: i.e. methane emissions can be reduced by 63% – with no impact on rice yields – through application of climate-smart water management practices. Furthermore, the relationship between seasonal water level and methane emissions has been found to be continuous and approximately linear: even relatively small reductions in water level have a tangible inhibitory impact on methane emissions (Jäkel et al, 2023).

In AWD, irrigation water is applied a few days after the disappearance of the ponded water. Hence, the field is alternately flooded and non-flooded. The number of days of non-flooded soil between irrigations can vary from 1 to more than 10 days, depending on a number of factors such as soil-type, weather and crop growth stage. A practical way to implement AWD is by using a 'field water tube' to monitor the water depth in the field. After irrigation, the water depth will gradually decrease. When the water level has dropped to about 15cm below the surface of the soil, irrigation should be applied to re-flood the field to a depth of about 5cm. From one week before to a week after flowering, the field should be kept flooded, topping up to a depth of 5cm as needed. After flowering, during grain filling and ripening, the water level can be allowed to drop again to 15cm below the soil surface before re-irrigation.

2.2.3. Site-specific nutrient management (SSNM)

SSNM helps maintain and/or enhance crop yields while saving fertilizer through more efficient use. It represents an effective adaptation strategy to declining water availability and rising temperatures (Boonwichai et al, 2019), potentially deployed in conjunction with drones which can: (i) identify localised areas for targeted fertilizer application through differences in leaf colour (Zhou et al, 2022), and (ii) apply small, geographically-precise amounts of fertilizer while also reducing farm worker exposure to agro-chemicals (Devi et al, 2020). SSNM is most relevant for rice farming systems where nitrogen fertilizers are currently (over) used (Islam, 2018). Excessive use of chemical fertilizers in the Thai rice sector has polluted surface water and groundwater through seepage (Thambhitaks and Kitchaicharoen, 2021). SSNM reduces the quantity of N applied, thus reducing total reactive N (NH_3, HN_4^+, NO_3, NO_2^-, NO, N_2O) losses to the environment through surface and underground leaching, volatilisation and N_2O emissions. Under SSNM, fertilizer is applied in accordance with recommendations from local extension services based on regular soil analysis using Soil Test Kits (STKs) which allow the user to analyse nitrogen (N), phosphorous (P), potassium (K) and pH levels. It can also include the promotion of organic fertilizers which, in Thai rice farming areas, essentially entails the application of animal manure or green manure (derived from sun hemp or mung bean, for example).

2.2.4. Straw and stubble management (SSM)

If they have access to irrigation systems, Thai rice farmers seek to grow 2 crop cycles per year. This leaves only a short time-period in which to prepare the land for planting the next crop. Furthermore, service providers for tillage and land preparation may refuse to provide services to farmers if straw and stubble have not been removed from the field beforehand. Post-harvest straw / stubble open burning is, therefore, widely utilised as a rapid means of clearing the surface biomass to facilitate land preparation, as well as a pest and disease management tool (Sereenonchai and Arunrat, 2022). This practice of burning rice residues leads to large-scale GHG emissions, as well as the release of other atmospheric pollutants (Junpen et al, 2018). According to IPCC good practice guidance, CO_2 emissions caused by biomass burning are generally not considered to be net emissions, as they effectively represent the conclusion of the carbon cycle that started with primary production. However, CH_4 and N_2O emissions from biomass

burning are considered. Moreover, after burning, farmers flood their fields (including the remaining stubble), leading to anaerobic decomposition of the stubble and further methane production.

To minimise GHG emissions, removal of the straw by baling or using it as substitute for fertilizer are more sustainable alternatives. Rice straw balers are machines that collect loose straw scattered in the field with a pick-up reel mechanism and a compacting unit to make a dense mass of square or round baled straw. This baled straw can then be used as cattle feedstock, material for furniture, substrate for mushroom production, feedstock for bioenergy, pulp / paper production through cellulose extraction, biochar or as a base for bio-fertilizer (if mixed with manure), providing farmers with additional income (Hung et al, 2020).

2.2.5. Integrated pest management (IPM)

Thailand ranks fourth in the world in its annual use of pesticides, after China, the USA and Argentina (Pariona, 2017). Of the five most commonly used pesticides in Thailand, four have been banned in the European Union (Formoso, 2021). Pesticide intoxication is a major public health problem (Tawatsin, 2015). Building on TAS recommended practices, the foundation projects support a combination of IPM techniques, including conservation of natural enemies through habitat modification and minimisation / avoidance of pesticide application, and modification of cultural practices (Dara, 2019). DoAE is currently supporting farming communities to establish Community Pest Management Centres (CPMCs), of which there are currently approximately 2,000 across the country (~2 per district), with each one supporting approximately 30 farmers to implement IPM techniques. Such techniques have a proven track-record in Thailand (and, indeed, in other major rice-producing countries, such as Indonesia, Malaysia and Viet Nam): for instance, in 2010 Thailand implemented one of the world's most successful biological control programmes, the control of the cassava mealy bug (Wyckhuys et al, 2019). However, due to a range of knowledge, behavioural and economic barriers, IPM is not being systematically applied (Deguine, 2021). An ongoing TEEB agri-food assessment in the Central Plains and North-East regions of Thailand is analysing the positive impact on rice yields of biological pest control, notably the role of damselflies, dragonflies and spiders on rice pests such as plant-hoppers and leafhoppers; empirical findings suggest that rice yields in insecticide-treated fields are often lower than those in untreated fields (TEEB, 2023).

IPM offers considerable adaptation benefits: by avoiding or reducing climate-induced outbreaks of pests, IPM reduces crop losses – pre-harvest and post-harvest – and enhances food security (Ali et al, 2019). Thai farmers already confront a number of pests, notably defoliators such as *Cnaphalocrocis medinalis* and *Nymphula depunctalis* and stem borers such as *Chilo polychrysus,* and *Scirpoplulga nivella* (Babendreier et al, 2020), and there is growing evidence that climate change – particularly drought, which results in water stress and hence nutrient stress – will drive an increase in rice pest activity (Bridhikitti, 2019). IPM also offers two indirect climate mitigation benefits: (i) by reducing avoidable yield losses, IPM reduces the GHG emission intensity per unit of food produced (Heeb et al, 2019); and (ii) IPM enables farmers to move away from straw and stubble burning practices while minimising the risk of corresponding pest or disease outbreaks (Mungkung et al, 2022).

2.2.6. Rice variety diversification, crop diversification and crop rotation

Preserving local genetic rice varieties, diversifying the use of rice varieties and switching to more climate-resilient rice varieties in certain geographies (e.g. drought-resistant and heat-resistant rice) offer potential climate adaptation benefits in Thailand (Amnuaylojaroen et al, 2021). There are 4 broad categories of market-differentiated types of rice in Thailand: white rice (typically consisting of modern, high-yielding varieties and generally sold at the lowest prices), parboiled

rice (typically modern, non-glutinous varieties for the export market and generally ~5% more expensive than white rice), Hom Mali rice (aromatic Thai jasmine rice with premium quality and price, often double the price of white rice),) and glutinous rice ('sticky rice', a daily staple in the North and North-East) (Rerkasem, 2017).

Within these categories, there are at least 89 local rice varieties found in Thailand, each with unique characteristics relating to, inter alia, disease resistance, adaptability to environmental conditions and production costs (Promsomboon and Promsomboon, 2016). The Thai rice strains San-pah-tawng 1 (SPT1), Neaw Phrae 1 (NP1), R258 and Skon Nakhon 1 (SKN1) are, for example, relatively heat-sensitive, whereas RD10, Chai Nat 1 (CNT1) and Suphan Buri 1 (SPR1) are relatively heat-tolerant (Sanwong et al, 2023). The range of varieties planted has, however, reduced significantly in recent decades as rice farmers have – with government support – moved away from traditional farming methods to modern, commercially-oriented rice agriculture: government support programmes currently cover 29 approved rice varieties (Napasintuwong, 2018). In addition to offering climate adaptation benefits, switching to other rice varieties offers mitigation benefits. 'Short-duration' rice varieties – those with shorter cropping periods (approximately 90 days for RD15 and RD31, for example, rather than 110-130 days for RD6 and KDML105) – generate less methane (Janz et al, 2019) and have reduced fertilizer requirements (Swarbreck et al, 2019).

For irrigated rice areas where rice is typically cultivated two or three times a year, crop diversification can serve as an option for switching from off-season (dry season) rice farming to cultivating other crops – such as potato, maize, vegetables or beans – that use less water during a drought situation or that offer higher incomes for farmers (He et al, 2021). For example:

- Irrigated areas in the North offer the potential to grow rice in the wet season, followed by a potato crop in the dry season and potentially even sweetcorn afterwards. The income from potatoes is 2-3 times higher than that from rice.
- Green gram, soybean, pigeon pea or groundnut are suitable crops that can be grown under moisture-stress conditions and which help conserve moisture and enrich soil through nitrogen fixation (Sritongtae et al, 2021). This can help sustain farmer livelihoods, reduce water consumption and CH_4 emissions, as well as improve soil health (Sinnarong et al, 2019).
- A perennials-based system oriented around perennial plants, trees and ponds does not require intensive care once fully grown. Moreover, the products can be obtained all year round if a range of different perennial plants are cultivated.
- Crop rotation also improves the ability of rice farmers to suppress pest and disease outbreaks and reduce the rate of pathogen spread (Lim et al, 2023). Such outbreaks can be disastrous for farmers: for example, an outbreak of rice blast, a fungal disease caused by *Magnaporthe oryzae*, can cause yield losses of up to 80% within 15-20 days (Simkhada and Thapa, 2022). Crop rotation enhances agro-ecosystem resilience and also facilitates faster recovery from biotic stresses once the stress has been removed (Liu et al, 2022).

However, farmers lack crop rotation experience and expertise, and also timely market price information for better decision-making. The choice of rice alternatives should also be closely linked to the farmer context: if subsistence farming and/or food security is a consideration, then the promotion of crops such as beans or potatoes may be appropriate, whereas nitrogen-fixing crops (for example) could be promoted for commercial farmers.

2.2.7. Dry direct-seeded rice (DSR)

Dry direct seeding is a crop establishment method wherein rice seeds are sown directly into an unsaturated, non-puddled field instead of the traditional method of growing seedlings in a nursery and then transplanting them into flooded fields. Globally, DSR is practised on approximately 33 mega-hectares, or approximately one-fifth of the area under paddy cultivation. The limitations of DSR can include higher seeding rates, lodging and risk of weed and nematode infestation (Shekhawat, 2023). DSR also works most effectively when undertaken in conjunction with early-maturing, short-duration DSR-adapted rice varieties and appropriate water-nutrient-weed management practices (Ohno et al, 2018). But DSR also offers significant benefits: plants are not subjected to stresses, such as being pulled from the soil and having to re-establish rootlets, and DSR saves significant irrigation water (11-18% water savings have been recorded in the Philippines and up to 40% in Malaysia (Sandhu et al, 2021), with 15-35% savings typical in Thailand (Minh et al, 2019)), labour (29% labour savings on average in Thailand (Minh et al, 2019) and time. DSR also reduces GHG emissions in a number of ways: (i) reduced methane emissions because of the less saturated / more aerobic conditions associated with direct seeding; (ii) reduced fossil fuel emissions from tractors and trucks, due to the avoided need for transplantation; and (iii) reduced emissions from the shorter-duration rice varieties often used in conjunction with DSR (Bishta, 2018). Overall, GHG emissions reductions in the range of 30-76% are typical, depending upon the baseline and the precise hydrological and nutrient regime used with direct seeding (Ishfaq et al, 2020).

2.2.8. Farm-level water management (FWM)

The amount of water available for rice farming at the beginning of the dry season depends on the total inflow during the preceding wet season (from May to October) and its subsequent storage. Construction / enlargement of hydraulic infrastructure, such as dams and 'monkey cheeks' (flood-retarding ponds), is being addressed by the government's recent (June 2019) 20-year Master Plan on Water Resource Management, which envisages the construction of over 541,000 small dams (Tempest, 2019) to address increasing drought frequency / severity (Yodsurang et al, 2022). A smaller-scale solution – and one that can be implemented by individual farmers without the high capital costs and planning / coordination challenges of dams and ponds (Trakuldit and Faysse, 2019) and the potential problems associated with groundwater abstraction (Koontanakulvong and Suthidhummajit, 2015) – is the installation of on-farm water tanks for rainwater collection. Such tanks are small – typically 2-4 metres tall and several metres wide – and can be pre-fabricated (e.g. plastic) or can be built on-site using simple earthen walls. They can supply water to rice fields via dedicated pipes or via a pre-existing system of irrigation channels. Because of their relatively small capacity, such tanks are most effectively employed in conjunction with water-efficient farming methods such as AWD.

2.2.9. Agro-meteorological advisory services

Providing farmers with up-to-date, accurate weather forecasts, accompanied by advisories or warnings, via SMS and mobile apps can help them to prepare and calibrate appropriate responses (e.g. planting date, water use, harvesting date). The government is already supporting a number of initiatives in this area. MoAC's Digital Agriculture Strategic Plan, for example, seeks to digitise agriculture by, inter alia, providing agricultural information systems and mobile phone alerts, and by raising the digital literacy of farmers. The RID provides weather advisories to farmers and has established a Smart Water Operation Centre (SWOC) to link data with relevant agencies for systematic water resource management during drought and flood crises. This Centre

brings together information from the Thai Meteorological Department (TMD), the Hydro and Agro Informatics Institute, the Geo-Informatics and Space Technology Development Agency, the Department of Water Resources, and the Hydrographic Department of the Royal Thai Navy, where it is compiled for forecasts. Working in 3 Northern provinces, a GCF project that is currently commencing implementation (FP170[3]) is supporting MoAC to develop more granular weather / water forecasts that are more localised and available in shorter time-frames than the current annual basis.

In the meantime, most farmers continue to rely upon regional media (TV and radio) for forecasts, which is typically not sufficiently localised to be particularly useful.[4] Current services also tend to focus on the provision of basic meteorological information rather than *interpretations* of this information – e.g. practical, agriculturally-relevant advisories for farmers to implement recommended actions. This is an increasing problem in the context of predicting the onset of the rainy season: this is a vital determinant of farmers' rice seeding, but onset timing is becoming more erratic due to climate change and farmers are unable to interpret the technical information they are provided with. As a result, they often resort to traditional methods of predicting rainfall, such as the flowering of mango trees, the stem shapes of Bermuda grass or the behaviour of ant colonies (Arunrat et al, 2017). Advisories also become more important when farmers adopt new technologies or practices (such as IPM or new rice strains, for example) with which they lack experience and for which traditional cues do not apply.

2.3 Implementation arrangements for ESS

2.3.1. Involved institutions and roles

The institutions involved in the Environmental and Social Safeguards arrangements for the Thai Rice project are listed in Table 5.

Table 5: Entities related to ESS implementation and role descriptions

Type	Institution	Roles in ESS
Executing Entity	Rice Department (RD)	RD has major roles in promoting megafarm activity, coordinating among entities to foster the adoption of CSA technologies by farmers, and promoting Thai Agricultural Standard (TAS) adoption as a complement to mitigation technology implementation. RD will also have the important role of coordinating with other supporting organisations on implementation of ESS measures directly related to its mandate. The staff of RD will be trained on ESS.

[3] UNDP-GCF: 'Enhancing Climate Resilience in Thailand through Effective Water Management and Sustainable Agriculture (EWMSA)'.
[4] This is a widespread sentiment amongst farmers, as described in the Market Study commissioned for the Thai Rice Project (Annex 2b).

Type	Institution	Roles in ESS
	Bank for Agriculture and Agricultural Cooperatives (BAAC)	The financial support schemes implemented by BAAC will consider E&S aspects. Incentive payments will foster the uptake of the described CSA technologies and practices that have been screened on E&S risks. BAAC staff will receive ESS training.
	Office of Natural Resources and Environmental Policy and Planning (ONEP) of the Ministry of Natural Resources and Environment (MoNRE) [NDA]	ONEP is responsible for the Environmental Fund Division (EFD) and serves as the focal point for international environmental conventions, including the UNFCCC. ONEP is also the GCF NDA. ONEP will ensure grant support to climate-smart rice projects that need to undergo a thorough ESS screening. As with RD and BAAC, implementation of ESS mitigation measures will be in line with the country's policies.
	International Rice Research Institute (IRRI)	IRRI will have a major ESS role on implementation of climate-smart agriculture technologies complying with ESS through farmer training.
Supporting organisation	**DoAE**	DoAE will work closely with Rice Department staff in the provinces to provide extension services to farmers, and to avoid negative environmental and social impacts of rice cultivation. Extension officers of DoAE will be trained on ESS before they provide training and extension services to farmers and related stakeholders.
	RID	RID will be responsible for water management related to agricultural activities, making sure that supply of water for rice cultivation is effective and fair.
	LDD	LDD will provide advisory support for project technologies relating to fertilizer and soil management, aiming at avoiding over-use of chemical fertilizers.
	TMD	TMD provides digital solutions, such as agro-met advisory services, and will provide training on their applications, as well as provide technical support to farmers on how to use the TMD products.
	PCD	PCD monitors and reports environmental quality, including air, water and soil quality.

Type	Institution	Roles in ESS
	DOA	DOA controls the use of chemicals in agriculture. With regard to ESS, DOA plays an important role in providing rules, regulations and protocols for safe and appropriate use of chemicals during rice cultivation.
	Ministry of Labour	Several Departments under the Ministry of Labour are responsible for providing labour administration and protection. This includes foreign and migrant workers in agriculture.

2.3.2. Project counterparts / stakeholder identification

Three categories of stakeholders are relevant with regard to ESS in the Thai Rice Project: farmers, service providers and institutions pertaining to the enabling environment. In addition, the Thai Rice project team from GIZ were also included as an additional stakeholder for the purposes of ESS-related consultations and information-gathering.

Farmers are defined and classified into three groups according to their sizes: mega-farm farmers, community enterprise farmers and smallholder farmers.

Service providers are farmers or entrepreneurs who provide agricultural machines and relevant technologies such as tractors, transplanting machines, combine harvesters, laser land levelling equipment, straw baler machines, millers, and chemical spraying equipment (e.g. drones[5]).

Further stakeholders who play a key role in driving/supporting the two above stakeholders for project achievement are enabling environment institutions/organisations. In this report, they are defined as individuals (such as local leaders) and institutions/organisations that are involved in the implementation of climate-smart agriculture technologies in the target area. This includes those who are involved in field practices all the way up to national policy-makers. Central and local governments are therefore the main actors in this respect. In addition, non-governmental organizations, including social enterprises, academic institutions and civil society organisations, were also interviewed. They provide valuable insights on, inter alia, social concerns, gender aspects, the needs and interests of vulnerable groups, ethnic groups, cultural heritage etc.

2.4 Stakeholder engagement and plan

Stakeholders were engaged through a comprehensive consultation process, via on-site interviews and interviews undertaken through an online platform (such as Zoom). The average duration of each interview was approximately 1 hour. Prior to the interviews, lists of questions were shared but, depending on circumstances and specific to each stakeholder group, not all questions were necessarily asked. However, during the interviews, detailed discussions and follow-up questions to obtain more information were pursued as necessary. A summary of stakeholders consulted during project preparation is provided in Table 6. For details, please refer to the Stakeholder Engagement Plan (SEP).

[5] Spraying with drones is prohibited in Thailand, but a practice nonetheless nonetheless used in Thailand.

Table 6: Stakeholders consulted during project preparation

Public Sector	**Private Sector**
Bank for Agriculture and Agricultural Cooperatives (BAAC) Department of Agricultural Extension (DoAE) Department of Disaster Prevention and Mitigation (DDPM) (Ministry of Interior) Ministry of Social Development and Human Security Environmental Fund Division (EFD) Fiscal Policy Office (FPO) Geo-Informatics and Space Technology Development Agency (GISTDA) Health Promoting Hospital Highland Research and Development Institute Land Development Department (LDD) Ministry of Agriculture and Cooperatives (MoAC) National Bureau of Agricultural Commodity and Food Standards (ACFS) Office of Agricultural Economics (OAE) Office of Insurance Commission (OIC) Office of Natural Resources and Environmental Policy and Planning (ONEP – also the NDA) Rice Department (RD) Royal Irrigation Department (RID) Thai Meteorological Department (TMD) Thailand Greenhouse Gas Management Organisation (TGO)	Agricultural service providers (e.g. land preparation, straw balers, ESS) Atthajariya Company Limited Axa CropLife Herba-Ebro Foods Infuse Kubota MARS Munich Re Olam PepsiCo Sustainable Rice Platform (SRP) e.V. Swiss Re Syngenta Thai General Insurance Association (TGIA)
International	**Civil Society**
CIAT FAO GGGI IFC IRRI Mekong Institute Sparkassen Foundation (DSIK) UN Women UNDP UNEP WWF WOCAN	Asian Institute of Technology (AIT) Chiang Mai University Fiscal Policy Research Institute (FPRI) Good Governance for Social Development and the Environment Institute (GSEI) Homenet Thailand Kasetsart University King Mongkut University of Technology Provincial farmer groups, megafarms and farmers Provincial womens' groups (Suphan Buri, Chiang Rai, Roi Et) Puey Ungphakorn Institute for Economic Research (PIER) Sustainable Development Foundation Thai Organic Foundation Thailand Development Research Institute (TDRI) Thailand Environment Institute (TEI) The Creagy Weekend Farmer Network

3. Legal and institutional framework

3.1 International treaties, conventions, and agreements

Thailand is a member of, and signatory to, many organisations, treaties and conventions that have the objective of protecting natural resources and the environment. Those that are related to the project include UNFCCC, the Kyoto Protocol, the Paris Agreement, the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal, the Vienna Convention for the Protection of the Ozone Layer, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Biological Diversity. Thailand has accessioned the Convention on Wetlands (definitive signature) and the United Nations Convention to Combat Desertification (UNCCD-accession) (Sanooj et al., 2022). Thailand has ratified the 3 instruments related to forced labour: the Forced Labour Convention (1930), the Abolition of Forced Labour Convention (1957) and the 2014 Protocol to the Forced Labour Convention (1930). Thailand has also ratified the 2 ILO fundamental Conventions on child labour and has adjusted its legal framework in line with these Conventions.

Thailand's 2nd Updated NDC (2022) sets an ambitious mitigation target of 30% emission reductions against business as usual (BAU) by 2030. The 2nd Updated NDC notes that this target could be increased to 40% with adequate access to international technology development and transfer, financial resources and capacity building support. The 2nd Updated NDC also places greater emphasis on agriculture and natural resources, including: (i) increasing the ability to respond to and manage climate risks in the agricultural sector, and (ii) improving water resource management to increase water security and reduce loss and damage from water-related disasters. Climate-smart agriculture – including low-methane rice production and site-specific nutrient management – is identified as one of 8 mitigation priorities. For details of Thailand's Long-Term Low-Emission Development Strategy (LT-LEDS), National Communication (NC) and National Adaptation Plan (NAP), please refer to the Thai Rice Funding Proposal.

3.2 National policies and legal framework

The legal framework in Thailand is based on a hierarchy starting with the Constitution (2017), which is the supreme law. It is then followed by laws, legislation such as Codes and Acts, decrees and ministerial regulations. Laws passed by the government generally come into force after announcement in the Royal Thai Government Gazette. The current Constitution provides that the State shall conserve, protect, maintain, restore, manage and use or arrange for the utilisation of natural resources, environment and biodiversity in a balanced and sustainable manner, provided that the relevant local people and local communities shall be allowed to participate in, and obtain the benefit from, such an undertaking as provided by law.

3.2.1. Constitution of The Kingdom of Thailand B.E 2560 (2017)

The Constitution is the supreme law for governing the country. It determines the infrastructure and political institutions for the organization of the state, including the protection and preservation of the rights and liberties of the people, and is the foundation of other laws. It serves as the basis of the government and guides the formulation of organic and other laws, the relationship between

the legislature, the executive branches, judicial institutions and other independent bodies. It protects and exercises the rights and liberties of the Thai people.

3.2.2. Enhancement and Conservation of National Environmental Quality Act (NEQA, No. 2) B.E. 2561 (2018)

The key environmental law is the Enhancement and Conservation of National Environmental Quality Act (NEQA, No. 2) B.E. 2561 (2018). This law requires that any project undertaken or permitted by the State that may severely affect the natural resources, environmental quality, health, sanitation, quality of life or any other essential interests of the people or community or the environment, must be assessed for its impact on environmental quality and health of the people or communities. These provisions basically set out requirements of environmental impact assessment (EIA) and environmental health impact assessment (EHIA) reports. EIAs and EHIAs are used to recognise the effects of projects as well as to establish the appropriate mitigation measures so that Thailand's natural resources will be used efficiently to the economic benefit and continued development of Thailand.

The types of projects or activities required to perform EIAs/EHIAs are clearly defined in NEQA. According to the latest Notification of MoNRE (2019), the Thai Rice Project does not require an EIA/EHIA.

3.2.3. Hazardous Substances Act B.E. 2535 (HSA)

The primary legal instrument used to regulate all hazardous chemicals, including pesticides, is the HSA. The purpose of this Act is to regulate the importation, production, marketing and possession of all hazardous chemicals used in Thailand. It also aims to prevent hazardous exposure to humans, plants, animals and the environment. Under this Act, the Hazardous Substance Committee (HSC) was set up as the governing body which assigns various aspects of governance to three Thai ministries; the Ministry of Industry (MoI), the Ministry of Public Health (MoPH) and the Ministry of Agriculture and Cooperatives (MoAC), based upon chemical usage.

3.2.4. Act on Ancient Monuments, Antiques, Objects of Art and National Museums, B.E. 2504 (1961)

The Fine Arts Department is operated under the legal framework of the Act on Ancient Monuments, Antiques, Objects of Art and National Museums, B.E. 2504 (1961). This Department is responsible for the protection, maintenance, improvement, promotion, creation, dissemination of information, organisation of study, research, development, and passing on art and cultural heritage of the country and to preserve national values and identity leading to sustainable development of Thai society and national security. It is also responsible for the study and management of archaeological sites and objects, as well as the operation of the country's national museums. It also covers intangible cultural heritage, literature and historical archives. Among its constituent bureaus are the National Archives and the National Library.

3.2.5. The Thirteenth National Economic and Social Development Plan (2023-2027)

The 13th National Economic and Social Development Plan (2023-2027) is a second-level plan that acts as a key mechanism to translate the National Strategy into implementation and serves as a framework for the formulation of third-level plans to enable relevant development partners to function in support of achieving the targets of the National Strategy within the expected timeframe.

The National Economic and Social Development Council Act B.E. 2561 (2018) stipulated that the 12th National Economic and Social Development Plan shall be in effect until 30 September 2022, meaning that the five-year time-frame of the 13th National Economic and Social Development Plan comes into effect on 1 October 2022 and falls within the national budgetary fund for the 2023-2027 period — the second five-year implementation period of the National Strategy. The 13th National Economic and Social Development Plan was formulated to focus on tangible development implementation and targets as well as to indicate a clear direction Thailand should take during the following five-year period.

3.2.6. Personal Data Protection Act B.E. 2562 (2019)

On 25 May 2018, the General Data Protection Regulation (GDPR; Regulation (EU) 2016/679) went into effect. The Personal Data Protection Act, B.E. 2562 (2019) (PDPA), which is Thailand's first consolidated data protection law, was published in the Thai Government Gazette on 27 May 2019 and took effect on 27 May 2020. Both laws aim to guarantee protection for individuals and their personal data, and impose similar obligations on businesses when collecting, using and disclosing personal data. The data protection authority under the Act is the Personal Data Protection Committee (PDPC). The PDPA is largely based on the GDPR. Both the PDPA and GDPR have similar provisions regarding the legal basis of processing, as both list consent, performance of a contract, legal obligations, legitimate interests or vital interests as a legal basis. In addition, the PDPA mirrors the GDPR's extraterritorial applicability and applies to data controllers and data processors outside of Thailand, if they process personal data of data subjects in Thailand and offer goods and services to, or monitor behaviour of, the data subjects. Moreover, both regulations empower data subjects with a number of rights, including the right to erasure, the right to be informed, the right to object, the right to data portability, and the right to access. Nevertheless, there are some key differences between the PDPA and the GDPR. In particular, unlike the GDPR, the PDPA does not apply to certain public authorities, and the definition of 'personal data' in the GDPR is much more detailed, as it specifically includes IP addresses and cookie identifiers, whilst there is no mention of these in the PDPA. Furthermore, although the PDPA states that a data subject has the right to anonymise their personal data, unlike the GDPR, the PDPA does not define anonymised or pseudonymised data.

3.2.7. National Human Rights Commission Act B.E. 2542 (1999)

The National Human Rights Commission is an independent organization under the Constitution of the Kingdom of Thailand B.E. 2540. It is an independent mechanism to promote and protect the rights and liberties of the Thai people, according to the guarantee of the right to freedom in the Constitution. The process of drafting the legislation to establish the National Human Rights Commission is a good example of active participation of the public in legislation: the Cabinet scheduled public hearings across the country, while the public sector also organized the exchange of lessons-learned with the human rights commissions of other countries.

3.2.8. Gender Equality Act, B.E. 2558 (2015)

Thailand's Gender Equality Act B.E. 2558 (2015) is the first national legislation of its kind in Southeast Asia that specifically focuses on protecting individuals against discrimination due to gender expression. Under the Equality Act, gender discrimination is defined as any act or omission of an act that causes division, discrimination or limitation of any right and benefit either directly or indirectly, without justification based on gender.

The Law's enactment saw the creation of key entities, one of which is the Gender Equality Promotion Committee (SorTorPor Committee), which is chaired by the Prime Minister. It comprises various representatives of the government, as well as expert members who represent women's organisations and those from the fields of gender diversity, gender equality, law, human rights and social sciences. One of the Committee's main duties is to create policies and measures to promote gender equality in the public and private spheres in the central, regional, and local areas of Thailand.

Likewise, the Committee on Consideration of Unfair Gender Discrimination (WorLorPor) and the Department of Women's Affairs and Family Development was established. The Law is enforced by the WorLorPor Committee, the duties and powers of which mainly include deciding on gender discrimination complaint cases filed by complainants. It also establishes temporary measures for the protection or mitigation of complainants, issues orders based on a case's decision, and submits complaints to the Ombudsman, among other functions. Meanwhile, the Department is tasked with managing all administration and academic functions of both the SorTorPor and WorLorPor Committees, as well as supporting and promoting research to prevent unfair gender discrimination, and working with public and private organisations to prevent such.

In addition, the Equality Law also saw the creation of the Gender Equality Promotion Fund under the Department, which includes government subsidies, financial support from agencies, donations, fines from penalties against the Law's violators, and other sources of funds. According to the Act, the Fund must be spent on activities and initiatives promoting gender equality, preventing gender discrimination, assisting and compensating persons subject to gender discrimination, providing advice, and promoting research and dissemination of knowledge about gender discrimination, among others.

3.2.9. Labour Protection Act B.E. 2541 (1998)

The Law contains general provisions, which include the obligation of an employer to treat male and female workers equally. The Law also prohibits sexual harassment and covers termination of employment. It concerns the general use of labour, providing for hours of work, holidays, overtime and rest periods. It prohibits female labour in underground mines, on scaffolds over 10 metres, or with explosives; it also prohibits certain activities for pregnant women, including night work. Pregnant women are entitled to receive 90 days maternity leave and may not be dismissed due to their pregnancy. With regard to child labour, the Law defines a child as a person under 15 years of age. Child employees under the age of 18 must be registered and cannot perform night work and other specified tasks (e.g. work with radiation, poisons, heavy machinery or in mines). The Law established a Wages Committee to fix minimum wages. The Law also created a Work Safety, Occupational Hygiene and Environmental Conditions Committee, and provides for labour inspection. It covers work discipline and requires employers with ten or more employees to promulgate work rules.

3.2.10. Employment and Job Seekers' Protection Act, B.E. 2528 (1985)

The Employment and Job Seekers' Protection Act imposes a licence requirement to entities offering domestic employment services and recruiting workers to work abroad. The Act prohibits foreign employers from recruiting Thai workers directly. The Act sets out the conditions for obtaining a licence for exercising domestic and foreign employment services. The recruitment of workers to work abroad can only be exercised by companies where the manager is a Thai

national. Employment contracts for work abroad are subject to approval by the Director General of the Labour Department. Employment seekers may be subjected to prescribed physical examinations as well as selection and proficiency tests. Recruited workers are entitled to training in the legal and cultural traditions of the country of destination. The sending and repatriation expenses of the recruited workers are (implicitly) the responsibility of the employer. The employment agency is responsible for the repatriation expenses in certain situations – inter alia, when a recruited worker is not given the job or the wage prescribed in the employment contract. On certain conditions, these expenses are recoverable from the Fund to Assist Workers Abroad established by the Employment and Job Seekers' Protection Act, which regulates its financing, management and use. The responsibility of the employment agency to arrange for the repatriation ceases if the recruited worker does not return to Thailand within 30 days of the expiry of the employment contract. The Act provides for measures to control its functioning and criminally sanctions violations against it.

3.2.11. Organic Act on Anti-Corruption B.E. 2561 (2018)

This Law provides measures and effective mechanisms in order to prevent and eliminate corruption, as well as added mechanisms to encourage people to whistle-blow and assist investigations. The Public Sector Anti-Corruption Commission and the Office of Public Sector Anti-Corruption Commission (PACC) are the principal institutions operating under the Law, with law enforcement agencies involved in witness protection as required.

3.2.12. Anti-Money Laundering Act, B.E. 2542 (1999)

This Law aims to eliminate the funding of illegal activities in Thailand, such as the drug trade, corruption and fraud. Recently, changes have been drafted to align the Act with international Anti-Money Laundering legislation standards.

3.2.13. Legal framework and institutional arrangements for air quality

Air emissions are regulated by MoNRE, the Ministry of Industry (MoI) and the Ministry of Public Health (MoPH). MoNRE, through the Pollution Control Department (PCD), has issued a notification that prescribes ambient air standards and test methodologies for carbon monoxide, nitrogen dioxide, sulphur dioxide, suspended particulate matter, ozone and lead. Air quality standards are specified under various regulations, including announcements of the Pollution Control Committee, announcements of the PCD, and notifications of MoNRE. Currently, there is no specific legislation that gathers together all air quality standards. The standards and average amount for each type of substance in the air are set out in separate laws and regulations (Sanooj et al., 2022).

The PCD is also responsible for identifying structures, operations and conveyances deemed to be sources of air pollution that must control the release of air pollutants. Once a place of origin has been identified, it is the duty of the owner or lessor to install an air pollution treatment system and any other equipment or tools to limit or eliminate pollution that may affect air quality, with approval from PCD officials.

MoPH is the agency that regulates business detrimental to health. Under Thai law, any business that pollutes by releasing a large number or volume of noxious gases is categorised as a business detrimental to health, and the owner must obtain a licence to operate it. Businesses detrimental to health regarding air quality are those that collect and burn coal, carry out mining, and undertake metal smelting and forging.

3.2.14. Legal framework and institutional arrangements for water quality

Various laws have been enacted and implemented regarding water quality and water effluent issues. The Navigation in Thai Territorial Waters Act, B.E. 2456 (1913), as amended in B.E. 2540 (1997), contains provisions that prohibit a person from discharging anything into a watercourse that could cause pollution, harm aquatic plants and animals, or obstruct navigation unless permitted otherwise. A similar prohibition is stipulated in the Fisheries Act, B.E. 2558 (2015), and the Royal Irrigation Act, B.E. 2485 (1942), but the latter applies only to 'irrigation canals'. Point source pollution that could affect watercourses is also subject to control by law. The Factory Act, B.E. 2535 (1992) empowers MoI to regulate effluent standards for wastewater discharged from factories. Under the Public Health Act, B.E. 2535 (1992), in conjunction with the Building Control Act, B.E. 2522 (1979), the Ministry of the Interior may issue a ministerial directive to regulate the discharge of wastewater into watercourses (Sanooj et al., 2022).

The National Environment Board (NEB) has the authority under the NEQA to issue notifications prescribing environmental quality standards regarding the following matters:

- Water quality standards for rivers and canals, marshes, swamps, lakes, reservoirs and other inland public water sources, categorised by use and water catchment area;
  Quality standards for underground water; and
- Quality standards for seawater and the seaboard, including coastal and estuarine waters.

The NEB is authorised to issue standards for controlling pollution from drainage of wastewater or effluent discharged into the environment, in order to meet the environmental quality standards prescribed by the NEB. Penalties are imposed under both the Navigation in Thai Territorial Waters Act and the Fisheries Act for the release of pollutants into water sources.

3.2.15. Legal framework and institutional arrangements for chemicals

The principal legislation regulating chemicals hazardous to health is the Hazardous Substances Act (HAS) (Sanooj et al., 2022). Only certain substances are controlled under the HSA. The HSA prescribes a list of hazardous substances and mixtures under four classifications, each of which has different requirements and prohibitions:

- If the hazardous substance is classified as Type 4, it is prohibited to possess, import, export or manufacture it.
- An importer, exporter or possessor of a Type 3 hazardous substance must register it and apply for an import, export or possession licence.
- An importer, exporter or possessor of a Type 2 hazardous substance must register it and notify the relevant authority.
- If the hazardous substance is classified as Type 1, there is no requirement for the importer, exporter or possessor to register it or notify officials. The importer must submit a declaration to the authority before import.

The HAS regulates hazardous substances as well as products that contain them. The governing agency for this work is the Department of Industrial Works (DIW). However, the Pollution Control

Department (PCD) works with DIW to investigate factories where pollution has been complained about, and if the PCD finds that pollution is related to hazardous waste, it will contact DIW to investigate and take the case. There are also other laws that deal with chemicals for specific purposes, such as those relating to employee health and safety that requires, among other considerations, that employers provide employees with sufficient information about each chemical and instructions for use. A recent update on chemical regulation in Thailand included the prohibition on the use, trade, manufacture and possession of paraquat and chlorpyrifos by the National Hazardous Substances Committee (NHSC) on 30 April 2020. As a result, on 15 May 2020, MoI endorsed a notification to re-categorise the two substances from Type 3 (permission needed) to Type 4 (prohibited for production, importation, exportation and possession) (Sanooj et al., 2022).

The regulatory process for registration, production, distribution and sale of pesticides used in crop production is currently controlled by DoA under MoAC. DoA has released two main regulations:

- Notification of MoAC on Registration, Licence Issuance and Renewal of Hazardous Substances under the Responsibility of the Department of Agriculture B.E. 2552 (2009).
- Notification of MoAC on Production, Importation, Exportation and Being in Possession of Hazardous Substances under the Responsibility of the Department of Agriculture B.E. 2547 (2004).

3.2.16. Legal framework and institutional arrangements for solid and hazardous waste

There is no specific law that governs solid and hazardous waste. However, most types of waste are classified as hazardous substances under the HSA. Thus, the procedures and requirements under the HSA apply to them. For a factory operator specifically, they are obliged by the Notification of the Ministry of Industry and the Announcement of DIW issued pursuant to the Factory Act to manage industrial waste according to the prescribed measures and standards, report waste storage, disposal and management annually and to obtain DIW's approval before transporting the waste outside of their factory, among others (Sanooj et al., 2022).

On 15 September 2020, the Ministry of Commerce announced a ban on the import of 428 items of electronic waste into Thailand, which was a move to fulfil the country’s Basel Convention obligations. The full list of items can be found on the Department of Foreign Trade's website. Violations are punishable by a term of imprisonment for up to 10 years or a fine of five times the value of the electronic waste imported illegally, or both.

3.2.17. Legal framework and institutional arrangements for contaminated land

The Notification of the National Environment Quality Committee No. 25 (B.E. 2547) re: Standards of Soil Quality, issued under the NEQA, sets out acceptable levels of soil contamination (Sanooj et al., 2022). The Notification divides soil into two main categories: (1) soil used for the purposes of living and agriculture, and (2) soil used for other purposes.

The amount of certain compounds in soil is used to evaluate the acceptable level of contamination for each category of soil. The Notification also establishes specific methods for testing soil for contamination by each type of compound.

Although the NEQA is the preliminary source law for regulations that govern contaminated land, it imposes no punishment on anyone who degrades soil to a level that does not meet the quality standards. However, strict civil liability may apply if the degradation causes harm to an individual's

life, health or property. Currently, there is no definition given for 'contaminated land'. The Notification defines 'standard of soil quality' but does not define sub-standard soil as 'contaminated land', and the quality standards under the NEQA merely indicate a benchmark for desirable environmental conditions.

Thailand's Land Development Act, B.E. 2551 (2008) (the LDA), empowers MoAC to regulate the use of land that uses, or is contaminated by, chemicals or other materials that could degrade the land's suitability for agricultural use. The LDA also prescribes appropriate measures to remedy land contamination. Generally, the owner or possessor of the source of pollution is liable to pay compensation for damage, regardless of whether the leak or contamination is the result of a wilful or negligent act. Compensation includes reimbursement for all expenses incurred by the government to clean up any pollution that arises from the leak or contamination. Under the LDA, a polluter must also restore contaminated land back to its original condition or compensate the State or persons suffering damage from contamination.

Under the NEQA, a landowner or person who possesses land (tenant) is liable to pay compensation and clean-up costs. For example, the owner of a factory is responsible for compensation and clean-up costs regarding the emission of wastewater that causes damage to the public. However, if an owner leases a factory to a tenant and, during the time the tenant occupies the premises, the factory emits harmful wastewater, the tenant will be responsible for the costs. Under the LDA, the polluter is also responsible for restoration of the contaminated land to its original condition.

3.2.18. Legal and institutional framework related to agriculture and water resources management

In Thailand, agriculture is governed at national level and controlled by MoAC. Policies are set at national level and then implemented in local areas through regional offices or research extensions of MoAC. The Ministry does not have a direct policy on 'the environment' per se. However, it does have policies that address specific environmental issues, such as organic farming, new theory agriculture and management of natural resources. Thailand has other ministries (such as the Ministry of Natural Resources and Environment) overseeing environmental issues in different sectors.

Use of surface water is primarily monitored by the Department of Water Resources and the Royal Irrigation Department, as set out in the People's Irrigation Act B.E. 2482 (revising the Control of Weirs and Dikes Act B.E. 2477) as amended (No. 2, B.E.2523; No. 3, B.E. 2526), the State Irrigation Act 2485 as amended (No. 2, B.E. 2497; No. 3, B.E. 2507; No. 4, B.E. 2518; No.5, B.E. 2530) and subsequent ministerial regulations.

Under the People's Irrigation Act B.E. 2482, the use of major amounts of surface water for private irrigation affecting an area larger than 200 rai (32 hectares) requires permission from the local authorities and from the District Office. In granting permission, the following factors are taken into account:

- If the work is constructed for the benefit of an area up to 500 rai located in the same district, the District Commission will report it to MoAC.
- If work is constructed for the benefit of an area up to 1,000 rai located in the same province, the Provincial Commission will consider the granting of permission and report the matter to MoAC.

State irrigation, including works by the State to supply water from a waterway or reservoir designated as a waterway for irrigation purposes, is regulated by the State Irrigation Act B.E. 2485.

The Government of Thailand has also passed a 20-year Master Plan on Water Resource Management (2018-2037), following a proposal by the Office of the National Water Resources. The Master Plan provides a framework that all government ministries need to include in their work plans and action plans. The Office of the National Water Resources monitors and assesses the effectiveness of the Master Plan.

3.3 Legal and institutional framework related to climate change

A bill on climate change has been prepared by ONEP, due to be considered by the Cabinet in 2023. Once approved by the Council of Ministers, the bill will be introduced to the National Assembly for consideration. If it is enacted, it will establish a committee called the National Climate Change Policy Committee, which will have the authority to suggest policies, measures and regulations, necessary operations and model schemes, to the Cabinet and State agencies, regarding the management of climate change. The bill also specifies rights of citizens to be informed by the State about climate change information, to prepare for changes and consequences, to provide information and express opinions for solutions to climate change, and to be sponsored for operations to deal with climate change. The State has obligations under this bill to evaluate and assess the effect of climate change, and to provide information and warnings to the public, to sponsor research and development of technology and innovation that will help with adaptation to cope with climate change, and to adopt policies that take climate change into account.

The bill also states that the National Climate Change Policy Committee must provide a plan to reduce greenhouse gases (Nationally Determined Contributions: NDC), which will be compulsory for State agencies to follow, and to ask the private sector to cooperate, including National Master Plan on Climate Change, Thailand National Adaptation Plan, and Thailand’s NDC Roadmap on Mitigation 2021-2030. Under the bill, the Thai Meteorological Department will work with ONEP to deliver a central database for the country's weather that provides information regarding changes in weather, temperature and water levels, and the impact of those changes on water management, agriculture, food supply, public health, travel, natural resource management and habitation. Public and private sectors can also request financial support from a fund that will be established under this bill to operate or conduct projects, research or activities, regarding GHG emissions and storage, GHG reduction and climate change operational efficiency. The bill also has a section about penalties for anyone failing to comply with its requirements. Penalties under this bill will only be administrative fines, but if a convicted person does not pay the fine, their property may be seized instead.

3.4 Other key national strategic and development plans

3.4.1. The National Strategy (2018-2037)

This is the core development strategy of Thailand. It states that “impacts of climate change have been anticipated to intensify with regard to variability, frequency and coverage. Such impacts will inevitably threaten lives, damage property and critical infrastructure, and affect agricultural production and water security.” The Thai Rice Project addresses 3 of the 6 constituent strategies under the National Strategy: the National Strategy on Competitiveness Enhancement, the National Strategy on Developing and Strengthening Human Capital and the National Strategy on Eco-Friendly Development and Growth.

The 13th National Economic and Social Development Plan (NESDP, 2023-2028) is built around 5 strategic pillars, one of which is ‘environmental conservation to deal with climate change’. The NESDP reaffirms the government’s commitment to the NDC and identifies climate change risks – notably, drought and floods – as threats to national efforts to achieve poverty reduction and the SDGs. The NESDP is based on the Sufficiency Economy Principle, UN Sustainable Development Goals (SDGs) and Bio-Circular Green Economy (BCG). The draft plan sets out 13 targets, including:

- Transforming Thailand into a circular economy and low-carbon emitter;
- Promoting reuse and waste recycling;
- Reducing GHG emissions in industrial sectors; and
- Reducing risks and impacts from natural disasters and climate change by reforestation.

3.4.2. The Bio-, Circular and Green (BCG) economy

The BCG is being promoted by the Thai government as a new model to propel economic recovery, with a focus on 4 strategic sectors: (1) agriculture and food; (2) medical services and wellness; (3) bioenergy, biomaterials and biochemicals; and (4) tourism and the creative economy. To support the implementation of the BCG model, the Thailand Board of Investment (BoI) has approved a series of incentive measures to encourage investments that will reduce impacts on the environment, support sustainable development and lead the post-Covid 19 recovery. This includes a grassroots economy support scheme, which supports local organisations involved in the development of sustainable agricultural activities.

3.4.3. Large-scale farming model or ‘megafarm’

In 2015, the Ministry of Agriculture and Cooperatives launched the first phase of a new initiative programme called the “large-scale farming model”. This aimed to improve production efficiency and competitiveness by reducing production costs, increasing yields, and aligning production with market demand. The programme, however, has experienced several problems that may undermine its future, including a lack of experienced managers, land fragmentation, poor water management, weak governance, farm debts, enticing benefits in the short run and equity issues (Duangbootsri, 2018). Large scale farming has more than 6,000 groups with 405,205 households, and the North-East has 3016 groups with 233,155 households or more than 50% of large scale farming the country.

3.4.4. UN Sustainable Development Goals (SDGs)

Thailand attaches great importance to the achievement of the 2030 Agenda for Sustainable Development, particularly within the context of the Decade of Action for the SDGs. Since the last official submission in 2017, Thailand has made significant strides across all 17 SDGs. However, as with other countries, the COVID-19 pandemic adversely impacted Thailand's economy and society, and hampered efforts to achieve the SDGs. The Sufficiency Economy Philosophy is a homegrown approach that focuses on human empowerment, resilience, and environmental conservation, along with the application of technology and local wisdom in addressing development challenges and promoting recovery efforts; it represents a complement to the SDGs.

The SDG landscape in Thailand is well-established. The SDGs have been integrated into the 20-Year National Strategy, which is the country's main development framework. The National Committee for Sustainable Development (CSD), chaired by the Prime Minister, represents the central mechanism to advance all 17 Goals. The CSD has designated government focal points for each of the 169 targets, while its four sub-committees provide operational oversight of SDG implementation, application of the Sufficiency Economy Philosophy for the SDGs, monitoring and evaluation, and environmental assessments. Thailand's SDGs Roadmap provides the blueprint to move forward in six key areas, namely, policy integration and coherence, enabling mechanisms, partnerships, pilot projects, monitoring and evaluation, and awareness-raising.

Thailand has achieved considerable success in eradicating extreme poverty as part of SDG1,and is committed to developing a national multi-dimensional poverty index. Projects aimed at improving nutrition for school children and food security boost progress on SDG2. With regards to SDG3, the country's Universal Health Coverage and Village Health Volunteers played an integral role in the effective management of the COVID-19 crisis. On SDG4, efforts have been expanded to provide financial support for poor students through the use of digital tools and the Education Equality Fund (EEF). Gender equality initiatives, including efforts to address domestic violence, are the cornerstone of Thailand's implementation of SDG5.

Increased access to clean water sources and sanitation is supporting SDG6. The development of a Smart Grid is underway to increase energy efficiency in accordance with SDG7. Workforce capacities are continuing to be strengthened to correspond to the needs of the global economy as part of SDG8. The promotion of a Bio-Circular-Green (BCG) Economy Model through the development of sustainable infrastructure will advance SDG9. To support the achievement of SDG10, the government has applied the Thai People Map and Analytics Platform to help identify vulnerable groups who require support, while projects such as Baan Mankong (Stable Home) support impoverished communities to achieve secure and sustainable housing as part of SDG11. On SDGs 12, 13, 14, and 15, Thailand has advanced actions on climate change and sustainable consumption and production, strengthened efforts to protect marine and coastal ecosystems, and increased stakeholder engagement on forest area management. Thailand's implementation of SDG16 centres on promoting fair and equal access to justice for all, and multi-stakeholder cooperation on human rights promotion, as well as anti-trafficking and anti-corruption efforts. Lastly, Thailand has forged effective partnerships among all sectors in line with SDG17, including civil society, private sector networks, and academia. Beyond its borders, Thailand has expanded its role as a development partner to exchange knowledge, experiences, and best practices with neighbouring countries and countries in other regions. Thailand aims to build on the momentum of this VNR in ensuring a whole-of-society approach as it moves forward, using the Sufficiency Economy Philosophy as its pathway.

3.5 Gap analysis of GCF policy and Thailand legal frameworks

3.5.1. Overall policy

Thailand's policy framework is consistent with the GCF's policy framework but differs in the clarity of its implementation. As Thailand is a developing country, some policy frameworks cannot be effectively enforced, which is only encouraged. Looking at the GCF's policy framework, it is found that there are no gaps in any issue, but there are gaps in policy details that are not clear enough. This causes the project to add details that should be self-explanatory in order to create clarity in management. The basic principle is to adapt the policy framework of the funding source to suit the context of the project and the area of activity.

Table 7: Gap analysis of GCF's and Thailand's overall policy frameworks

GCF policy framework	Corresponding Thailand policy with respect to GCF policy framework	Gap
Accreditation policies Accreditation policies govern the GCF's accreditation process, and they consist of the Initial guiding framework for the Accreditation Process, policies on re-accreditation, policies on fees for Accredited Entities (AEs) and policies defining the legal and operational relationship between GCF and AEs.	The accreditation process will be handled by project fund holders under different departments of the organization.	This part of the policy differs according to the nature of the activity, which does not yet have a clear central standard.
Administrative policies GCF's administrative policies cover GCF's key administrative processes including information disclosure, human resources, travel, procurement, accounting, communications, and management of conflict of interests. They also set out draft provisions for privileges and immunities.	- Administrative policies (information disclosure, human resources, travel, procurement, accounting, communications, and management of conflict of interests) are implemented for all activities in Thailand through administrative and management framework of relevant ministries. - Personal Data Protection Act B.E. 2562 (2019)	
Business model policies Business model policies and decisions establish the basic operating parameters of GCF's business model and the key principles that guide the Fund's operations in line with the Governing Instrument. Allocation frameworks define parameters for guiding GCF's investments across replenishment cycles.	Domestic business operations must be consistent with national policies and relevant laws of Ministry of Commerce and Ministry of Industry.	The balance between business interests and sustainable development may not be clear in the current situation.
Complementarity and coherence Establishes a framework for strengthening complementarity and enhance coherence with the operations and processes of other climate finance institutions.	- Domestic activities seek to align with the main national policies to achieve national goals. - The National Strategy (2018-2037)	Consistency processing may not be instantaneous due to the lack of a centralized and efficient data linkage, sometimes resulting in disconnected activities.

Country ownership policies Country ownership policies set out the principles and processes through which GCF will seek to operationalize a country-driven approach. They elaborate guidance on the establishment of Nationally Designated Authorities (NDA) and focal points, the establishment of a no-objection procedure, the development of country programmes, and the conduct of country coordination, in addition to setting out overall guidelines for country ownership intended to guide the GCF, developing countries and partners.	Thailand has a direction for national development according to the National Strategy (2018-2037).	
Financial instruments The policies on financial instruments set out the full range of financial instruments deployed by the Fund and their terms and conditions.	Thailand has a policy of financial management that is transparent and verifiable. - Constitution of The Kingdom of Thailand B.E 2560 (2017) - Organic Act on Anti-Corruption B.E. 2561 (2018)	
Integrity policies GCF's integrity policies set out GCF's approach to maintaining the highest integrity standards across its activities and operations. They establish the principles and minimum standards of internal Anti-Money Laundering / Countering Financial Terrorism (AML/CFT) controls and define specific conduct and activities which are prohibited by the GCF, including the institutional response in case of allegations.	- Constitution of The Kingdom of Thailand B.E 2560 (2017) - Organic Act on Anti-Corruption B.E. 2561 (2018) - Anti-Money Laundering Act, B.E. 2542 (1999)	
Investment framework The GCF's Investment Framework sets out the parameters which guide GCF's investment decision-making and its assessment and consideration of Funding Proposals.	Every investment activity has rules and regulations for making decisions before investing.	
Observers The Governing Instrument sets out that the Board will make arrangements, including developing and operating accreditation processes, to allow for effective participation by accredited observers in its meetings.	- Observers are protected by national law depending on the activities they undertake. - Constitution of The Kingdom of Thailand B.E 2560 (2017)	
Operations of the Board Policies set out the procedures for the conduct of Board operations, including procedures for decision-making and participation of Advisers during Board Meetings.	Thailand activities or projects are carried out with procedures determined by the relevant authorities, requiring consultants and auditors according to the	

	characteristic and scale of the activities.	
Project approval process The consideration and approval of funding proposals by the GCF is undertaken through a designated Project Approval Process. Policies under this category establish the key steps, requirements, responsibilities, and tasks in GCF's project and programme cycle, from submission through to approval and implementation.	The consideration and approval of public and private sector funding proposals is characterized by key steps, requirements, responsibilities, and responsibilities. and tasks in the project for efficient operation.	
Resource mobilization The Governing Instrument sets out that the Fund will receive financial inputs from developed country Parties to the Convention, and may also receive financial inputs from a variety of other sources.	Thailand has financial constraints to develop its potential, so needs funding from developed country Parties to the Convention and from a variety of other sources such as GCF.	Financial and technological constraints are the main obstacles for Thailand to achieve its national development goals.
Results, monitoring and evaluation The Governing Instrument sets out that the programmes and projects, as well as other activities, funded by the Fund will be regularly monitored for impact, efficiency and effectiveness in line with rules and procedures established by the Board.	Thailand has policies and tools to regularly track, monitor and inspect projects in order to achieve the desired efficiency and effectiveness.	
Risk management framework GCF's risk management framework defines GCF's approach to managing risk at both the institutional and funding proposal investment level, covering funding, non-financial, investment and compliance risks. It also contains GCF's risk appetite, approach to assessing risk throughout the project review as well as approaches to reporting on risk matters. This policy category also includes the GCF's internal control framework.	Thailand has a risk management policy in project implementation which depends on the source of funding but does not have a clear central measure.	Standardized guidelines for risk management or risk tolerance should be established.
Sustainability policies The Governing Instrument sets out that the GCF will adopt best practice environmental and social safeguards to be applied to all programmes and projects financed using the resources of the Fund and that it will encourage the involvement of relevant stakeholders, including vulnerable groups and addressing gender aspects across its operational modalities. GCF's sustainability policies articulate how GCF	Thailand adopts best practices in environmental, economic, and social protection, applies to all projects to maximize resource utilization, and promotes integrated projects so that solutions are accepted by all stakeholders. Project implementation must not violate human rights principles, not reduce people's quality of life, and promote equality in accordance	

incorporates gender, environmental, social and indigenous peoples' considerations into its decision making and operations to effectively manage related risks and enhance the impact of its investments.	with sustainable development guidelines. • The National Strategy (2018-2037) • The Thirteenth National Economic and Social Development Plan (2023-2027) • Constitution of The Kingdom of Thailand B.E 2560 (2017) • Enhancement and Conservation of National Environmental Quality Act (NEQA, No. 2) B.E. 2561 (2018)	

3.5.2. Environment and social policy

Most of Thai laws are consistent with the environmental and social policy of GCF with respect to identification, analysis, avoidance, minimization and mitigation of potential adverse environmental and social impacts of activities, to maximization of environmental and social benefits, and improvement of environmental and social performance. All policies reflect Thailand's commitment to achieve environmental and social benefits in all of the activities it undertakes; the Thai policy framework also emphasises the importance of clearly conveying environmental and social objectives to stakeholders and communities to effectively manage environmental and social risks and impacts and improve outcomes under (typically limited) budgets.

Table 8: Gap analysis of GCF's and Thailand's environmental and social policy frameworks

GCF environmental and social policy	Corresponding Thailand legal framework with respect to GCF environmental and social policy	Gap
Integration of environmental and social sustainability The ESMS and the policy provide an opportunity for GCF to incorporate environmental and social considerations, including SEAH, in ways that not only include safeguard measures of "do no harm," but also improve environmental and social outcomes and generate accessible and inclusive co-benefits to the environment and the communities, including women and girls, and indigenous peoples, that depend on it. Within the parameters of the ESMS, this is translated into the operations of GCF, such as accreditation, investment criteria, ESS application, monitoring and accountability, information disclosure, gender mainstreaming, SEAH risk	• The National Strategy (2018-2037) • Act on Ancient Monuments, Antiques, Objects of Art and National Museums, (B.E. 2504 (1961)) • Bio-, Circular and Green (BCG) economy • UN Sustainable Development Goals (SDGs) • The Thirteenth National Economic and Social Development Plan (2023-2027)	Some gaps may exist regarding gender and considerations of indigenous peoples. In Thailand, the constitution says that men and women are all equal in all aspects. However, the translation of the constitution into practices is not quite fully comparable to that is considered under GCF policy. As mentioned in ESIA (Annex 6a), ONEP is on the process of setting the gender policy and this is planned to implement in a year to come. On the other hand, BAAC has its own gender guideline that is in part consistent with that of GCF gender policy. For the indigenous peoples, Thailand considers that there is virtually no discrimination

mitigation, incorporation of considerations related to indigenous peoples, women and girls, stakeholder engagement, and the redress mechanism		such that a specific group is called “indigenous people that need different treatments from other Thai citizen”. So the gaps in interpretation of the meaning of “indigenous people” be that of GCF and Thailand exists. For both gender and indigenous people issues, to comply with GCF policy, some capacity building of EE and related staffs on ESS are proposed as indicated in Sector 7.3.
Transboundary risk and impact approach The GCF shall ensure that in case of potential transboundary impacts of GCF-funded projects all necessary consultations and due diligence processes, including prior notification and accessible, inclusive, gender-sensitive consultations with the relevant stakeholders, including addressing their comments.	• Hazardous Substances Act (B.E. 2535 (1992))[6]	The legal framework in Thailand does not cover all issues of transboundary risk and impact. However, the Thai Rice Project does not involve transboundary risk or impact.
Scaled risk-based approach The ESS standards will be implemented in a risk-based manner and not in a blunt, one-size-fits-all approach. This approach will require that environmental and social requirements and processes are commensurate with the level of risk and meeting the relevant ESS standards.	• Enhancement and Conservation of National Environmental Quality Act (NEQA, No. 2) (B.E. 2561 (2018))	
Fit-for-purpose approach In the context of the GCF accreditation process, the approach recognizes the roles of a wide range of entities, which can differ according to the scope and nature of the activities of the entities, and their capacity to manage environmental and social risks and impacts. GCF enables entities to access various levels of support differentiated by their cap.	• Enhancement and Conservation of National Environmental Quality Act (NEQA, No. 2) (B.E. 2561 (2018))	

[6] B.E.: Buddhist Era.

Equality and non-discrimination All activities financed by GCF will require that, where they are unavoidable, adverse impacts do not fall disproportionately on women and girls, persons in vulnerable positions and situations and marginalised groups, and individuals that are affected or potentially affected by GCF-financed activities, and avoid prejudice and discrimination in providing access to development resources and benefits.	• Constitution of the Kingdom of Thailand B.E 2560 (2017)	
Gender-sensitive approach GCF will contribute to gender equality and inclusiveness by ensuring that the methods and tools to promote gender equality and reduce gender disparities in climate actions are established and implemented. In designing activities for GCF-funding, GCF will require accredited entities to adequately assess the gender risks and impacts (as part of social risks and impacts assessments), and link the corresponding gender risk management measures to the activity-level gender action plans.	• Gender Equality Act (B.E. 2558 (2015))	
Zero-tolerance of SEAH The Policy on the Prevention and Protection from Sexual Exploitation, Sexual Abuse, and Sexual Harassment (the Policy) establishes GCF's zero tolerance of SEAH. It sets clear obligations for GCF Covered Individuals to prevent and respond to SEAH and to refrain from condoning, encouraging, participating in, or engaging in SEAH. The scope for this policy is focused on Covered Individuals.	• Gender Equality Act (B.E. 2558 (2015)) • Constitution of the Kingdom of Thailand B.E 2560 (2017)	
Knowledge-sharing GCF will lead and promote the sharing of lessons and experiences in applying ESS and in implementing the ESMS among entities and stakeholders, and will integrate	• Related agreements under individual policies / measures, such as large-scale farming models ('megafarms')	Knowledge-sharing is the prerogative of individual projects / measures / policies and is not enforced by law. The Thai Rice Project has a well-developed knowledge

these lessons with capacity development, communications, and outreach activities of GCF and the entities.		management plan (Annex 23a).
Harmonized application of environmental and social requirements GCF will promote the harmonized application of environmental and social safeguards to reduce multiple and overlapping requirements for activities through the development of a common approach that considers the requirements of other co-financing institutions while providing the highest level of environmental and social protection required among the parties, with at least the level of protection by GCF being required.	• The National Strategy (2018-2037) • Bio-, Circular and Green (BCG) economy • Enhancement and Conservation of National Environmental Quality Act (NEQA, No. 2) (B.E. 2561 (2018)) • The Thirteenth National Economic and Social Development Plan (2023-2027)	
Compliance with applicable laws GCF will not support activities that do not comply with applicable laws, including national laws and/or obligations of the country directly applicable to the activities under relevant international treaties and agreements, whichever is the higher standard.	• Constitution of the Kingdom of Thailand B.E 2560 (2017)	
Consistency with the United Nations Framework Convention on Climate Change UNFCCC) REDD-plus safeguards The environmental and social requirements of GCF will be consistent with all relevant REDD-plus decisions under UNFCCC and existing highest standards for the operationalization of these decisions.	• Thailand NDC • National Master Plan on Climate Change 2015-2050 • Thailand National Adaptation Plan • Thailand's Nationally Determined Contribution Roadmap on Mitigation 2021-2030 • National REDD+ Strategy (under preparation)	
Labour and working conditions All activities financed by GCF will promote decent work, fair treatment, non-discrimination and equal opportunity for workers, free of SEAH and guided by the core labour	• Labour Protection Act (B.E. 2541 (1998)) • Employment Protection and Job Seekers Act (B.E. 2528 (1985)) • Constitution of Tthe Kingdom of Thailand B.E 2560 (2017)	

standards of the International Labour Organization.		
Indigenous peoples All GCF-financed activities will avoid adverse impacts on indigenous peoples, and when avoidance is not possible, will minimize, mitigate and/or compensate appropriately and equitably for such impacts, in a consistent way and improve outcomes over time; promote benefits and opportunities; and respect and preserve indigenous culture, including the indigenous peoples' rights to lands, territories, resources, knowledge systems, and traditional livelihoods and practices. All GCF-financed activities will support the full and effective participation of indigenous peoples, including women and girls and recognize their contribution to fulfilling the GCF mandate throughout the entire life cycle of the activities.	• Constitution of the Kingdom of Thailand B.E 2560 (2017)	
Human rights All activities supported by GCF will be designed and implemented in a manner that will promote, protect and fulfil universal respect for, and observance of, human rights for all recognized by the United Nations. GCF will require the application of robust environmental and social due diligence so that the supported activities do not cause, promote, contribute to, perpetuate, or exacerbate adverse human rights impacts.	• Constitution of the Kingdom of Thailand B.E 2560 (2017)	
Biodiversity All GCF-financed activities will be designed and implemented in a manner that will protect and conserve biodiversity and critical habitats, ensure environmental flows of water, maintain the benefits of ecosystem services, and promote the sustainable use and management of living natural resources.	• Enhancement and Conservation of National Environmental Quality Act (NEQA, No. 2) (B.E. 2561 (2018))	

4. Environmental and social baseline situation in the target regions

4.1 Northern region

The Northern region has a total area of 106.03 million rai (6.25 rai = 1 ha), accounting for 33% of the country's area. The topographies of the upper area are characterised by highlands, mountains, forests and watersheds. The lower area in the West and East are high mountains. The central part is the lowland area of the Ping River, Wang, Yom, Nan, Sakae Krang and Pasak, linking the Mekong sub-region, South Asian countries and the ASEAN Economic Community. The Eastern and Northern areas are bordered by the Lao People's Democratic Republic, with the Mekong River as a border line. The West borders with the Republic of the Union of Myanmar (OAE, 2019).

The Northern region has 17 provinces, namely Chiang Mai, Lamphun, Lampang, Mae Hong Son, Chiang Rai, Phayao, Phrae, Nan, Phitsanulok, Tak, Uttaradit, Sukhothai, Phetchabun, Nakhon Sawan, Kamphaeng Phet, Phichit and Uthai Thani.

The Northern region has 8 large river basins: Ping River Basin, Wang River Basin, Yom River Basin, Nan River Basin, Salween River Basin, Kok River Basin, Pa Sak River Basin and Sakae Krang River Basin. The main rivers of the region are the Ping River, Wang River, Yom River, and Nan River, which converge to form the Chao Phraya River in Nakhon Sawan Province. It also hosts several large natural water bodies, including Kwan Phayao (Phayao), Bueng Boraphet (Nakhon Sawan), and Bueng Si Fai (Phichit) (OAE, 2019).

The climate is humid with three seasons: summer with hot and dry conditions from February to May, a rainy season from May to October and winter from October to February. The average rainfall in 2015 was 1,053.10 millimetres.

In 2015, land use in the Northern region was classified as forest of 56.50 million rai or 53.3%, agricultural area of 32.5 million rai or 30.6%, and other areas of 17.03 million rai or 16.1% (OAE, 2019).

4.1.1. Socio-economic profile of Northern region

The total population of the Northern region increased from 11,802,566 in 2012 to 12,010,024 in 2021 (Table 9). In 2021, there were 5,871,707 men and 6,138,317 women (NSO, 2022a). Most of the population of both genders are of working age (15-59 years), as shown in Figure 5. More than 40% of the population is concentrated in the provinces of Chang Mai, Chiang Rai, Nakhon Sawan and Phetchabun (Table 10). However, as of 2021 only 26.9% (3,235,622 people) of the region's population lived in municipal areas (NSO, 2022b).

Table 9: Population of Northern region in 2012-2021

Province	Total population in each year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Northern	**11,802,566**	**11,825,955**	**11,846,651**	**12,072,421**	**12,079,106**	**12,098,164**	**12,115,915**	**12,119,572**	**12,027,271**	**12,010,024**
Chiang Mai	1,655,642	1,666,888	1,678,284	1,728,242	1,735,762	1,746,840	1,763,742	1,779,254	1,784,370	1,789,385
Lamphun	404,673	405,268	405,468	406,385	405,999	405,918	405,955	405,075	402,011	401,139
Lampang	756,811	754,862	753,013	752,356	748,850	746,547	742,883	738,316	728,964	724,678
Uttaradit	461,294	460,995	460,400	459,768	458,197	457,092	455,403	453,103	448,745	446,148
Phrae	457,607	456,074	454,083	452,346	449,810	447,564	445,090	441,726	437,350	434,580
Nan	477,673	477,912	478,264	479,518	479,916	479,838	478,989	478,227	476,727	475,875
Phayao	488,120	486,744	484,454	482,645	479,188	477,100	475,215	472,356	467,356	464,505
Chiang Rai	1,200,423	1,204,660	1,207,699	1,277,950	1,282,544	1,287,615	1,292,130	1,298,304	1,295,026	1,298,425
Mae Hong Son	244,356	246,549	248,178	273,764	275,884	279,088	282,566	284,138	284,549	285,916
Nakhon Sawan	1,073,347	1,073,142	1,072,756	1,071,942	1,066,455	1,065,334	1,063,964	1,059,887	1,040,308	1,035,028
Uthai Thani	328,950	329,536	330,179	330,906	330,299	329,942	329,433	328,618	325,868	325,116
Kamphaeng Phet	727,555	728,631	729,522	730,158	729,542	729,133	727,807	725,867	714,118	712,143
Tak	526,045	532,353	539,553	618,382	631,965	644,267	654,676	665,620	670,265	676,583
Sukhothai	602,601	602,713	602,460	601,712	600,231	599,319	597,257	595,072	587,883	585,352
Phitsanulok	854,372	856,376	858,988	863,404	865,759	865,368	866,891	865,247	849,481	847,384
Phichit	549,395	548,855	547,543	545,957	543,482	541,868	539,374	536,311	532,310	529,395
Phetchabun	993,702	994,397	995,807	996,986	995,223	995,331	994,540	992,451	981,940	978,372

Source: (NSO, 2022a).

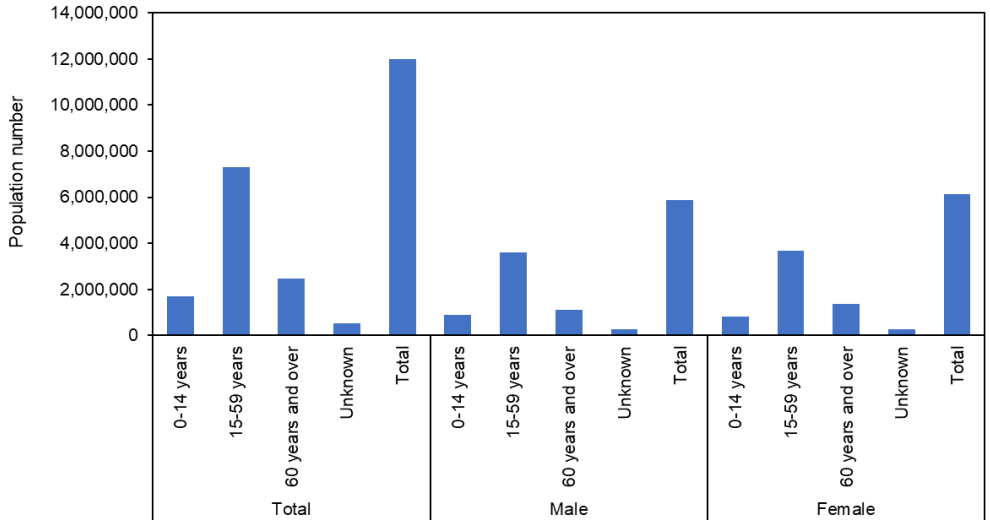


Figure 5: Northern region's population categorised by gender and age in 2021
Source: (NSO, 2022a).

Table 10: Northern region's population categorised by gender in 2021

Province	Population			Proportion
	Male	Female	Total	
Northern	**5,871,707**	**6,138,317**	**12,010,024**	**100%**
Chiang Mai	864,364	925,021	1,789,385	14.9%
Lamphun	192,712	208,427	401,139	3.34%
Lampang	352,894	371,784	724,678	6.03%
Uttaradit	217,413	228,735	446,148	3.71%
Phrae	209,403	225,177	434,580	3.62%
Nan	237,959	237,916	475,875	3.96%
Phayao	225,943	238,562	464,505	3.87%
Chiang Rai	630,868	667,557	1,298,425	10.8%
Mae Hong Son	144,811	141,105	285,916	2.38%
Nakhon Sawan	504,657	530,371	1,035,028	8.62%
Uthai Thani	158,926	166,190	325,116	2.71%
Kamphaeng Phet	351,539	360,604	712,143	5.93%

Province	Population			Proportion
	Male	Female	Total	
Tak	341,966	334,617	676,583	5.63%
Sukhothai	283,429	301,923	585,352	4.87%
Phitsanulok	414,577	432,807	847,384	7.06%
Phichit	258,012	271,383	529,395	4.41%
Phetchabun	482,234	496,138	978,372	8.15%

Source: (NSO, 2022a).

Although tourism plays an important role in driving the economy of the North, especially in Chiang Mai and Chiang Rai, agriculture is still the important sector in ensuring there is sufficient food for local consumption and tourism. Rice is a major crop in the Northern region. In 2020, planted area, harvested area and yield production in the Northern region were 14,397,570 rai, 13,881,704 rai, and 7,868,566 tonnes, respectively for major rice (Table 11) and 2,746,130 rai, 2,716,114 rai and 1,634,873 tonnes, respectively for second rice (Table 13). Nakhon Sawan and Phichit are the largest rice production areas for major rice and second rice, respectively. Hom Mali rice is the main variety of major rice (Table 12), while Pathum Thani 1 is popularly planted in the second rice season (Table 14).

Table 11: Planted and harvested areas and yield production of major rice during 2018-2020 in the Northern region

Province	Planted area (rai)			Harvested area (rai)			Yield production (ton)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Northern region	**13,814,978**	**14,135,973**	**14,397,570**	**13,597,349**	**13,366,164**	**13,881,704**	**7,847,727**	**7,519,998**	**7,868,566**
Chiang Rai	1,249,246	1,290,746	1,280,640	1,232,146	1,155,349	1,209,989	714,114	634,777	669,005
Phayao	620,411	629,275	635,810	614,313	611,878	623,059	322,992	293,101	306,018
Lampang	434,724	438,833	436,810	431,796	434,479	433,093	228,456	223,262	223,001
Lamphun	106,621	106,134	106,330	106,247	105,794	105,992	65,244	64,044	64,479
Chiang Mai	462,338	508,506	516,150	458,229	505,682	513,819	273,952	303,823	310,348
Mae Hong Son	182,475	198,648	200,980	180,597	197,144	200,027	75,776	82,429	84,055
Tak	320,947	359,085	353,930	317,655	354,536	349,275	135,859	148,058	145,134
Kamphaeng Phet	1,166,918	1,144,063	1,210,770	1,165,656	1,140,280	1,204,880	689,886	649,138	684,719
Sukhothai	1,052,055	1,100,464	1,112,860	993,644	1,051,782	1,069,330	543,793	572,091	582,561
Phrae	297,947	298,207	305,580	296,946	296,789	304,398	169,824	167,601	173,497
Nan	276,301	308,638	313,960	272,523	305,413	310,663	141,049	156,750	161,676
Uttaradit	582,374	582,849	613,200	534,692	529,032	565,308	320,584	313,034	335,673
Phitsanulok	1,375,939	1,391,726	1,440,860	1,333,796	1,341,936	1,403,101	773,435	774,482	821,399
Phichit	1,706,488	1,729,583	1,751,080	1,698,442	1,667,595	1,688,307	1,041,351	1,033,110	1,053,801
Nakhon Sawan	2,399,821	2,370,216	2,410,490	2,390,272	2,222,823	2,271,981	1,425,335	1,270,411	1,301,655
Uthai Thani	514,915	515,589	528,020	506,070	340,256	496,536	325,336	214,024	314,059
Phetchabun	1,065,458	1,163,411	1,180,100	1,064,325	1,105,396	1,131,946	600,741	619,863	637,486

Source: (OAE, 2021).

Table 12: Planted and harvested areas and yield production of major rice types during 2018-2020 in the Northern region

Province	Planted area (rai)			Harvested area (rai)			Yield production (ton)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Hom Mali rice	677,433	699,443	692,758	670,717	658,801	675,093	342,344	312,692	324,888
Other fragrant rice	1,982,797	2,178,678	2,195,299	1,964,464	2,047,987	2,095,330	961,774	985,879	1,012,723
Pathum Thani 1	374,979	548,321	480,935	356,900	500,277	456,185	238,527	328,362	300,813
Other white rice	8,093,051	7,955,073	8,241,664	7,951,105	7,521,061	7,940,572	4,837,110	4,476,443	4,760,774
Glutinous rice	2,686,718	2,754,458	2,786,914	2,654,163	2,638,038	2,714,524	1,467,972	1,416,622	1,469,368

Source: (OAE, 2021).

Table 13: Planted, harvested areas and yield production of second rice during 2018-2020 in the Northern region

Province	Planted area (rai)			Harvested area (rai)			Yield production (ton)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Northern region	**4,500,812**	**2,913,328**	**2,746,130**	**4,453,790**	**2,885,518**	**2,716,114**	**2,884,488**	**1,770,136**	**1,634,873**
Chiang Rai	454,187	340,505	300,220	432,325	327,222	297,042	296,970	207,433	180,966
Phayao	73,298	36,735	35,510	72,667	36,037	34,888	46,235	23,207	22,501
Lampang	37,445	17,471	15,850	37,341	17,324	15,691	21,230	9,090	8,259
Lamphun	14,845	7,626	7,160	14,810	7,626	7,160	10,302	4,456	4,202
Chiang Mai	131,640	99,799	100,400	131,319	99,286	99,794	89,886	65,214	65,249
Mae Hong Son	120	127	100	120	127	100	70	72	56
Tak	16,003	11,187	5,520	15,927	11,030	5,389	8,940	5,925	2,865
Kamphaeng Phet	609,042	307,644	405,230	608,925	306,625	401,999	387,486	184,428	239,039
Sukhothai	443,285	320,591	321,930	439,516	314,892	315,503	265,615	173,021	170,655
Phrae	36,586	35,715	31,800	36,435	34,987	31,672	22,457	19,413	17,069
Nan	7,232	12,365	10,060	7,219	12,325	10,040	4,202	6,986	5,705
Uttaradit	291,358	238,168	202,990	290,578	237,527	202,564	189,655	150,200	125,782
Phitsanulok	781,212	402,669	353,400	763,706	399,476	346,638	497,596	235,742	203,320
Phichit	708,269	481,146	495,480	707,051	480,640	491,524	444,055	302,344	304,773
Nakhon Sawan	782,967	535,584	370,060	782,660	534,454	366,350	525,622	343,728	231,803
Uthai Thani	90,922	40,847	65,190	90,790	40,847	64,731	60,604	24,045	37,944
Phetchabun	22,401	25,149	25,230	22,401	25,093	25,029	13,563	14,832	14,685

Source: (OAE, 2021).

Table 14: Planted and harvested areas and yield production of second rice types during 2018-2020 in the Northern region

Province	Planted area (rai)			Harvested area (rai)			Yield production (ton)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Pathum Thani 1	205,525	160,785	147,389	203,214	158,671	146,579	138,662	104,615	94,523
Other white rice	3,849,777	2,294,081	2,174,938	3,813,429	2,280,938	2,149,874	2,457,503	1,389,594	1,286,762
Glutinous rice	445,510	458,462	423,803	437,147	445,909	419,661	288,323	275,927	253,588

Source: (OAE, 2021).

Households in the Northern region earn, on average, 20,995 THB per month. The major source of earnings (58.2%) is from wages and salaries (30.7%), followed by the net profit from non-farm business (14.5%) and the net profit from farming (13.0%). Income from economically inactive households is mainly from assistance by other persons outside the household or from the government (19.8%), followed by income from assets and property rental, such as interest receipts (3.0%). Another source of earning (non-money income) is from assistance in terms of welfare/goods and services (19.0%) (NSO, 2022c).

In the Northern region, the average monthly expenditure per household is 16,441 THB. Approximately 87.6% (14,397 THB) is spent on household consumption: 38.2% of household consumption is spent on food, beverages and tobacco. Following this are expenses related to housing and household operation, furniture and equipment (20.9%), vehicle and transportation (14.4%), personal care/clothing/footwear (4.9%), communication (3.9%), education (1.6%) and recreation/entertainment, medical and health care and religious activities (1.4%). Finally, the remainder, approximately 12.4% (2,044 THB), is spent on non-consumption expenditure such as taxes, gifts, insurance, lottery and gambling, and interest payments (NSO, 2022c).

Over half of households in the Northern region (53.6%) are indebted, amounting to 201,724 THB per household. Most of the household debt (59.8%) is for household spending: of this amount, 31.8% is for the purpose of household consumption, followed by the purpose of purchase/hire purchase of house and land (26.3%), and for education purposes (1.7%). Regarding debt for investment and other purposes (40.2%), about 29.2% is for agricultural operations and 10.3% is for business operation in non-farm business, and others (0.7%) (NSO, 2022c).

Households of employed professionals/technicians/managers/workers earn the highest income (about 46,555 THB per month), followed by households of entrepreneurs for non-agricultural business and households of clerical/sales and service workers (25,822 baht and 24,531 THB, respectively). The lowest earning households, earning approximately 12,329 THB per month, are associated with fishing, forestry, hunting and agricultural services. Households with high incomes also tend to spend more and have high debts. Households associated with fishing, forestry, hunting, agricultural services and labourers in logistics, transportation and basic work have a ratio of expenditure to income of approximately 87.1 to 84.5%, resulting in the lowest proportion of their remaining money for saving and debt payment compared to other occupational groups (NSO, 2022c).

4.1.2. Environmental profile Northern region

Forest land makes up the highest fraction of land use in the Northern region, followed by agriculture (rice paddy fields, field crops, swidden agriculture, orchards, and perennial). These land uses make up more than 90% of total area in the North. The land-use for urban and miscellaneous are less than 7% (Figure 6). The soil suitability for rice cultivation is relatively low, with most of the fertile areas being found in the lower-Northern region.

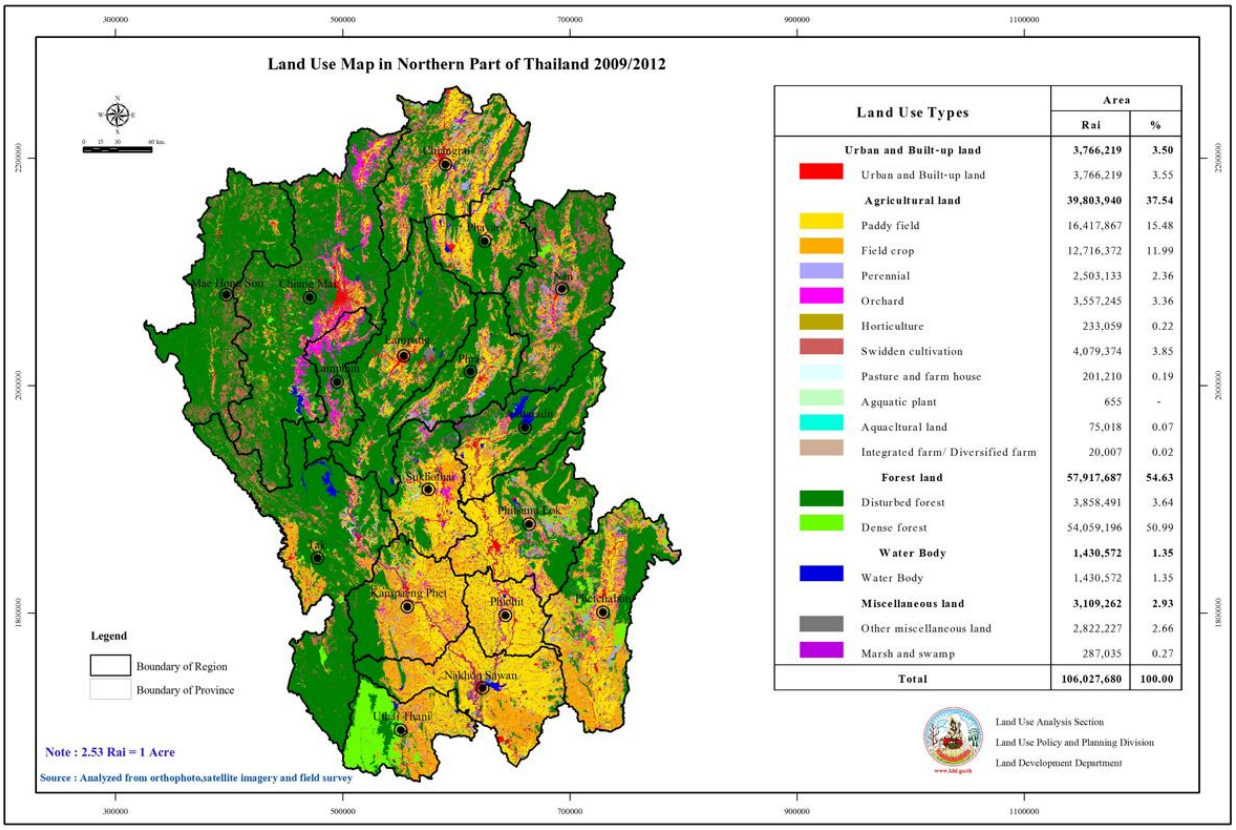


Figure 6: Land use in the Northern region of Thailand
Source: (LDD, 2013).

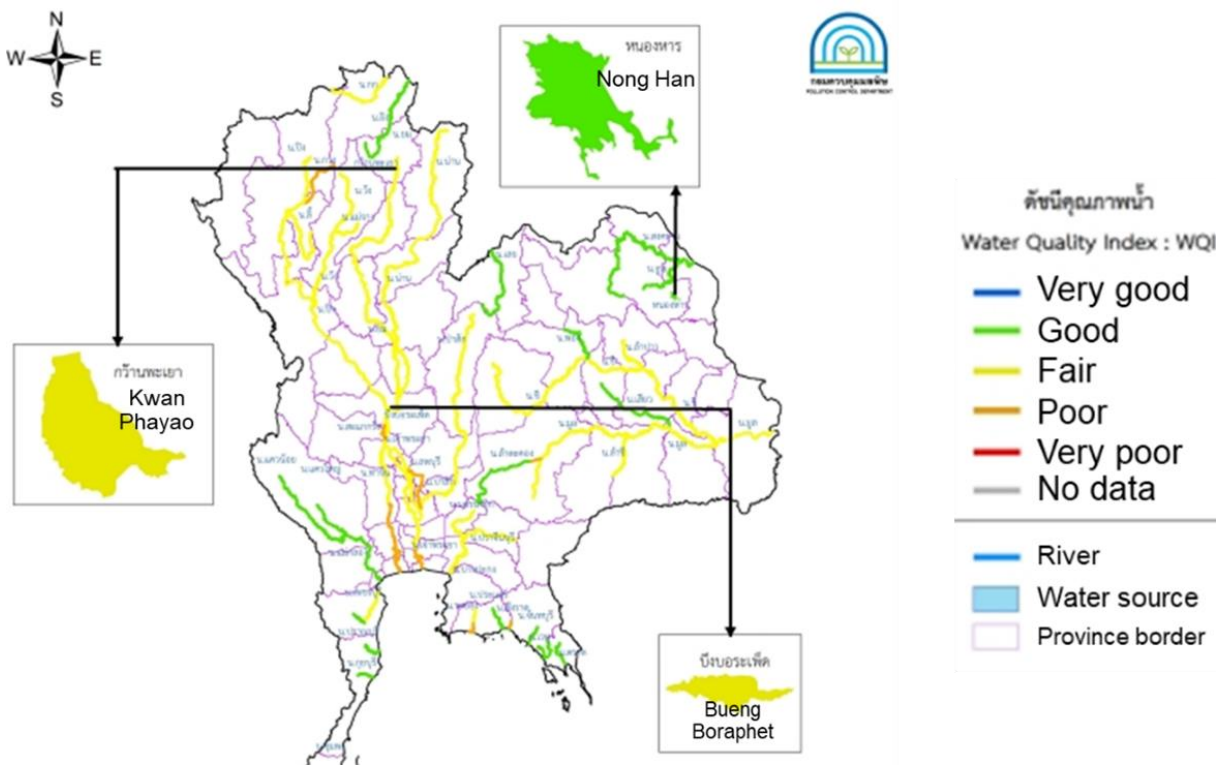


Figure 7: State of water quality of surface water sources in 2021
Source: (PCD, 2022).

Water quality in the Northern region is predominantly rated as fair (Figure 7). The parameters that do not meet the water quality standards in surface water sources tend to be organic impurities or biological oxygen demand (BOD) (BOD: 27% of all measured points), total coliform bacteria (TCB: 14% of all measurement points), Faecal Coliform Bacteria (FCB: 13% of all measurement points), Dissolved Oxygen (DO: 12% of all measurement points), Ammonia Nitrogen (NH_3-N: 13% of all measurement points), and Heavy Metals (HM: 0.3% of all measurement points) (Figure 8).

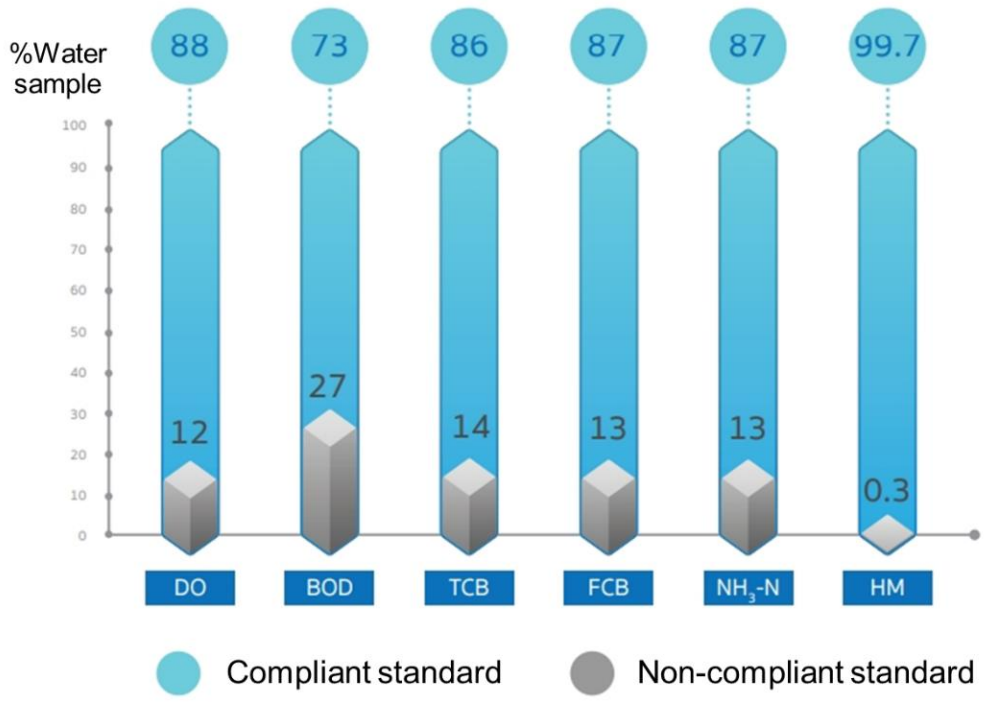


Figure 8: Water quality measurement in the North compared to the water quality standards in surface water sources (type 3) in 2021
Source: (PCD, 2022).

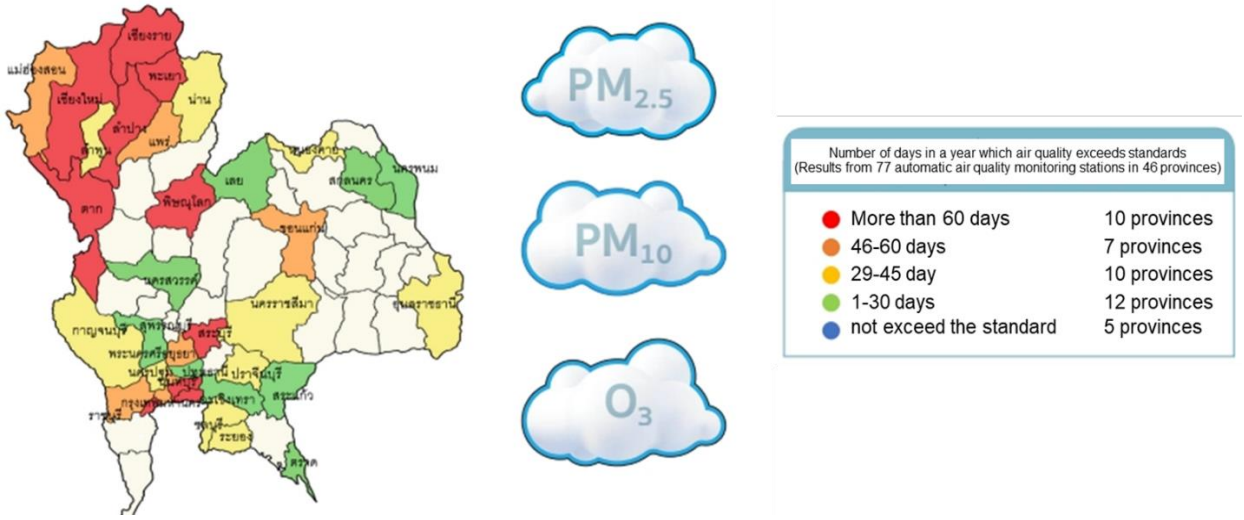


Figure 9: Number of days in a year in each region that faced with air pollutions problem in 2021
Source: (PCD, 2022).

Air pollution (especially $PM_{2.5}$) is the major environmental problem found in the Northern region. Statistics show that Chiang Mai, Chiang Rai, Phayao, Lampang, Tak and Phitsanulok are the provinces most affected by air pollution (more than 60 days a year where air quality exceeds the standard) (Figure 9). The annual average amount of $PM_{2.5}$ nationwide in 2021 was 22 µg/m^3 (4% decrease from 2020). The annual average amount of $PM_{2.5}$ in the Northern region in 2014-2021 ranged between 20 and 35 µg/m^3. The highest and lowest $PM_{2.5}$ concentrations were found in 2012 and 2018, respectively (Figure 10). The annual average of PM_{10} nationwide in 2021 was 40

µg/m^3 (7% decrease from 2020). The PM_{10} amount in the North during 2012-2021 was not different from other regions: its values ranged between 35-50 µg/m^3. It was observed that during 2017-2018, PM_{10} in this region was lower than other areas of Thailand (Figure 11).

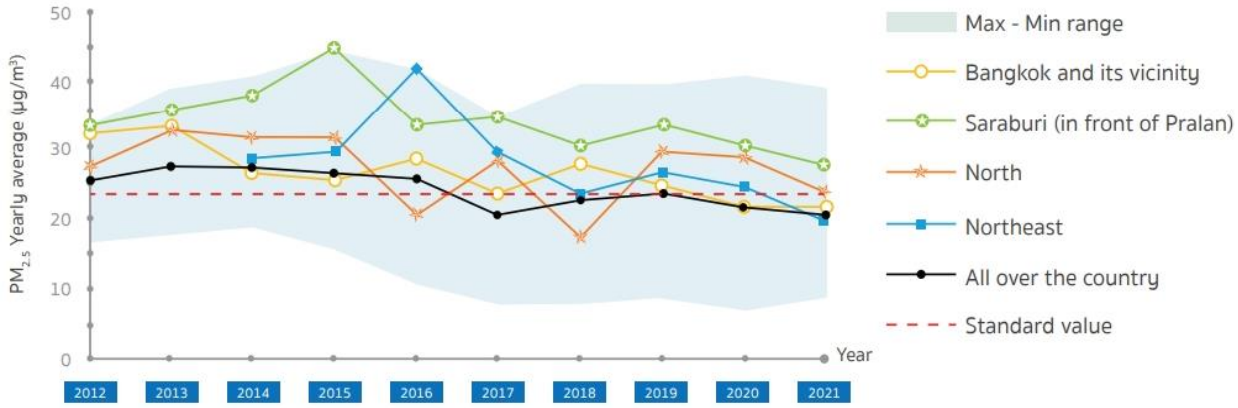


Figure 10: The annual average of $PM_{2.5}$ between 2012-2021
Source: (PCD, 2022).

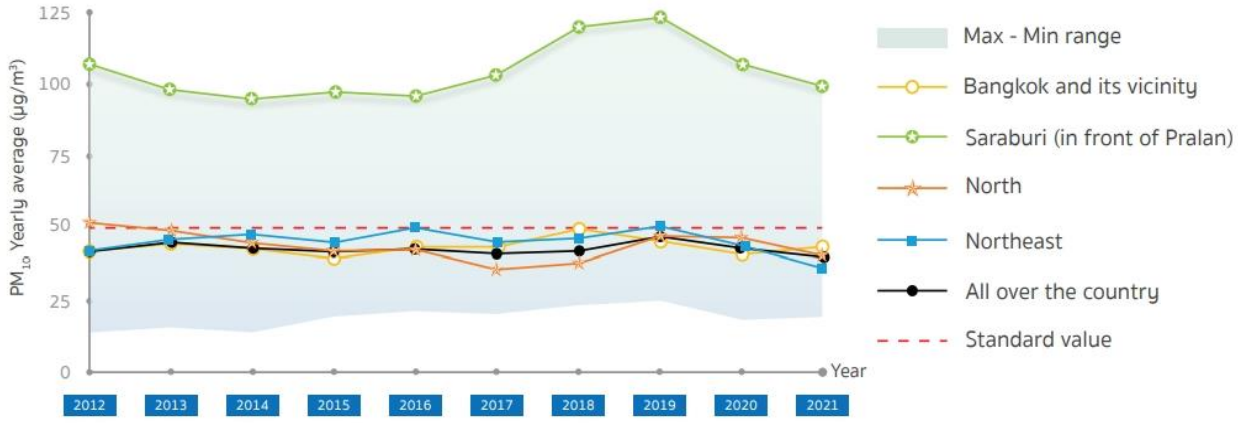


Figure 11: The annual average of PM_{10} between 2012-2021
Source: (PCD, 2022).

The air pollution problem in the North usually occurs annually from January to April. This significantly affects the quality of the environment, public health, tourist activity and other economic activity, and reduces visibility for both land and air traffic. In 2021, the average $PM_{2.5}$ concentration tended to decrease from the previous years, from 46 µg/m^3 to 40 µg/m^3. The number of days when concentrations exceeded the standard level and the number of hotspots also decreased (Figure 12).

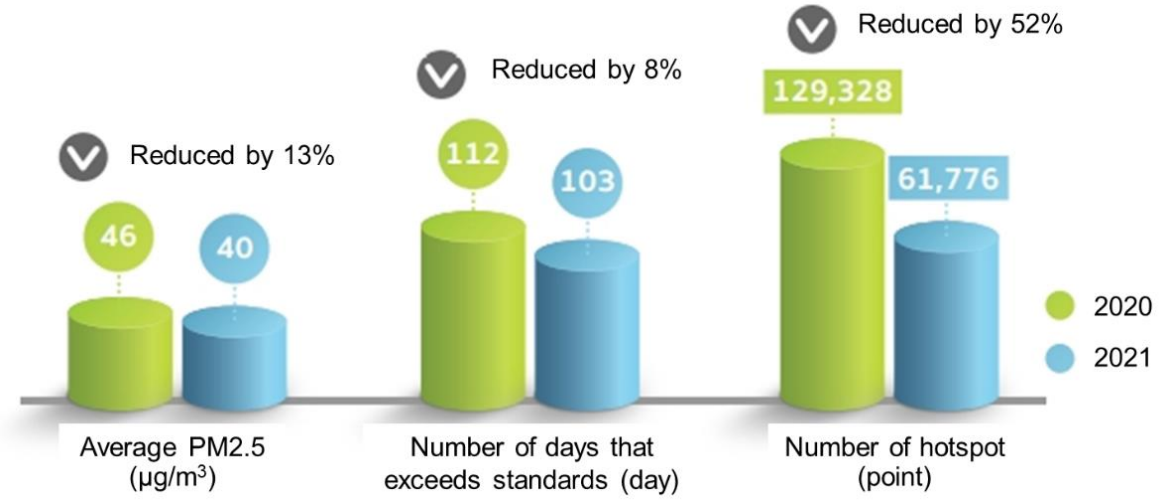


Figure 12: $PM_{2.5}$ and hotspot situation in 2020-2021
Source: (PCD, 2022).

The Northern region generates solid waste of approximately 4,904 tonnes per day, which is the second-lowest (higher than Western region) of the regions (Figure 13). The average solid waste generation rate for the entirety of Thailand is 1.03 kg per capita per day.

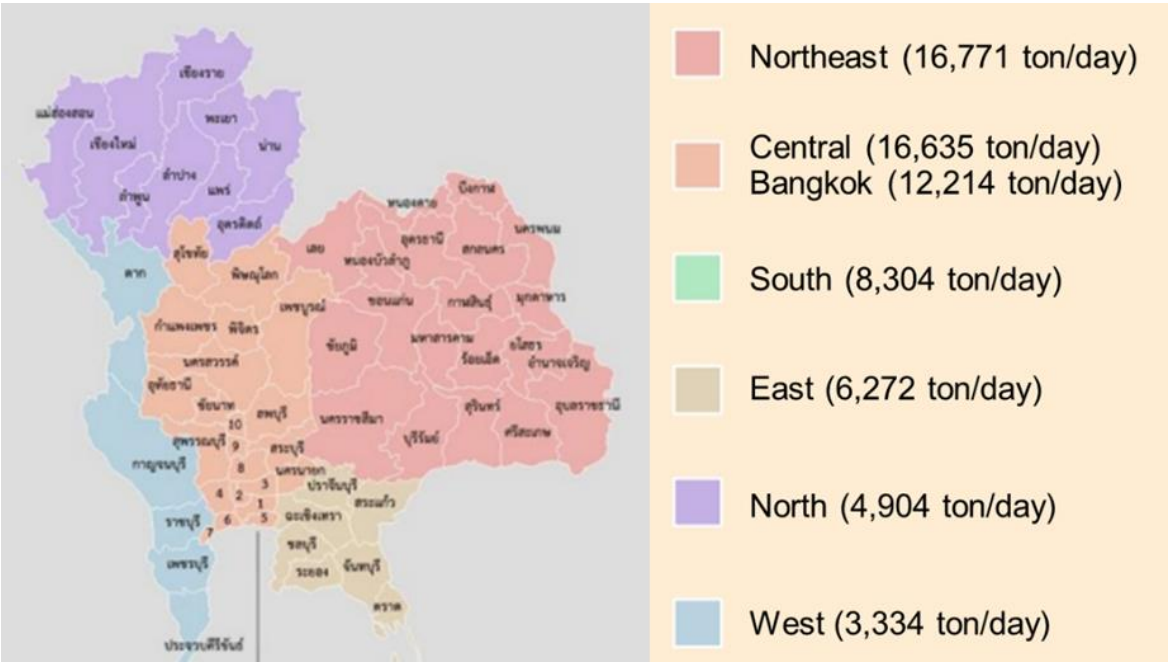


Figure 13: The amount of solid waste generated in each region of Thailand in 2021
Source: (PCD, 2022).

4.2 North-Eastern region

The North-Eastern region or Isan covers an area of 168,854 km^2 (105.53 million rai). It consists of 20 provinces, namely Amnat Charoen, Bueng Kan, Buriram, Chaiyaphum, Kalasin, Khon Kaen, Loei, Maha Sarakham, Mukdahan, Nakhon Phanom, Nakhon Ratchasima, Nong Bua Lamphu, Nong Khai, Roi Et, Sakon Nakhon, Si Sa Ket, Surin, Ubon Ratchathani, Udon Thani and Yasothon. It is the largest region in Thailand. It is located on the Khorat plateau that drains westwards from a high altitude into an eastward lowland. It is bordered by the Mekong River (along the border with Laos) to the North and East, by Cambodia to the South-East and the Sankamphaeng Range South of Nakhon Ratchasima to the South. To the West, it is separated from Northern and Central Thailand by the Phetchabun Range. It has the Phu Phan Range as an internal mountain range (Suwanlee and Som-ard, 2020).

The North-Eastern region has three large river basins, namely the Mekong River Basin, Chi River Basin and Mun River Basin. The main rivers of the region are the Chi River, which originates in the Phetchabun Mountain Range and flows into the Mun River in Ubon Ratchathani Province; and the Mun River, which originates at the San Kamphaeng Mountain Range and flows into the Mekong River at Ubon Ratchathani Province. There are also tributaries such as Lam Pao, Lam Nam Un, Lam Nam Songkhram, Lam Siew, Lam Nam Lo, Lam Nam Phong, and Nam Ta Khong. The region has large natural water sources that are distributed in areas such as Nong Han (Sakon Nakhon) and Bueng Lahan (Chaiyaphum). There are also groundwater sources, but the quality of groundwater varies from very salty, brackish and fresh because the areas in the Korat Basin and Sakon Nakhon Basin are supported by rock salt. If the groundwater is drilled too deep, saltwater may be found (OAE, 2019).

There are three seasons each year. The rainy season is from May to October, the cool season is from November to February, and the hot season is from February to May. The highest air temperature province is Udon Thani, while the highest and lowest precipitation provinces are Nakhon Phanom and Nakhon Ratchasima, respectively. The lowest air temperature province is Loei. The average temperature range is from 30.2°C to 19.6°C (OAE, 2019).

The North-Eastern region is used for forest (15.66 million rai, 14.8%), agriculture (63.86 million rai, 60.5%), and other land uses (26.01 million rai, 24.7%) (OAE, 2019).

4.2.1. Socio-economic profile of the North-Eastern region

The total population of the North-Eastern region during 2012-2021 varied from 21,697,488 to 22,015,239 (Table 15). In 2021, the total population was 21,826,920, divided into 10,814,540 men and 11,012,380 women (NSO, 2022a). Most of the population of both genders are of working age (15-59 years), as shown in Figure 14. About 43% of the population is concentrated in the provinces of Nakhon Ratchasima, Ubon Ratchathani, Udon Thani, Buriram and Khon Kaen, known as "big five of Isan" (Table 16). However, as of 2021 only 20.2% of the region's population lived in municipal areas. Thus, the population is still largely rural, but concentrated around the urban centres (NSO, 2022b).

Table 15: Population of the North-Eastern region during 2012-2021

Province	Total population in each year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Northeastern	**21,697,488**	**21,775,407**	**21,845,254**	**21,916,034**	**21,945,392**	**21,989,477**	**22,015,239**	**22,014,248**	**21,848,228**	**21,826,920**
Nakhon Ratchasima	2,601,167	2,610,164	2,620,517	2,628,818	2,631,435	2,639,226	2,646,401	2,648,927	2,633,207	2,634,154
Buriram	1,566,740	1,573,438	1,579,248	1,584,661	1,587,897	1,591,905	1,594,850	1,595,747	1,581,184	1,579,805
Surin	1,386,277	1,388,194	1,391,636	1,395,024	1,395,567	1,397,180	1,397,857	1,396,831	1,378,221	1,376,230
Si Sa Ket	1,458,370	1,462,028	1,465,213	1,468,798	1,470,341	1,472,031	1,473,011	1,472,859	1,458,580	1,457,556
Ubon Ratchathani	1,826,920	1,836,523	1,844,669	1,857,429	1,862,965	1,869,633	1,874,548	1,878,146	1,866,697	1,868,519
Yasothon	540,267	540,383	540,211	540,182	539,815	539,542	538,729	537,299	534,500	533,394
Chaiyaphum	1,133,034	1,135,723	1,137,049	1,138,252	1,138,199	1,139,356	1,138,777	1,137,357	1,124,924	1,122,265
Amnat Charoen	373,494	374,698	375,380	376,382	377,120	378,107	378,621	378,438	376,195	376,350
Bueng Kan	412,613	416,236	418,566	420,647	421,625	423,032	423,940	424,091	422,042	421,995
Nong Bua Lamphu	505,071	507,137	508,864	510,074	510,734	511,641	512,117	512,780	509,470	509,001
Khon Kaen	1,774,816	1,781,655	1,790,049	1,798,014	1,801,753	1,805,910	1,805,895	1,802,872	1,794,531	1,790,863
Udon Thani	1,557,298	1,563,964	1,570,300	1,575,152	1,578,783	1,583,092	1,586,666	1,586,646	1,567,983	1,566,510
Loei	629,787	632,205	634,513	638,819	639,801	641,666	642,773	642,950	638,736	638,732
Nong Khai	512,439	514,943	517,260	519,580	520,363	521,886	522,103	522,311	517,435	516,843
Maha Sarakham	945,149	955,644	960,588	964,596	963,484	963,072	963,047	962,665	953,660	948,310
Roi Et	1,308,570	1,308,958	1,308,318	1,308,166	1,307,982	1,307,911	1,307,208	1,305,211	1,298,640	1,296,013
Kalasin	985,084	984,030	984,907	985,203	985,232	986,005	985,346	983,418	977,175	975,570
Sakon Nakhon	1,129,174	1,134,322	1,138,609	1,142,737	1,145,949	1,149,472	1,152,282	1,153,390	1,146,936	1,146,286
Nakhon Phanom	708,350	710,860	713,341	715,399	716,873	718,028	718,786	719,136	717,201	717,040
Mukdahan	342,868	344,302	346,016	348,101	349,474	350,782	352,282	353,174	350,911	351,484

Source: (NSO, 2022a).

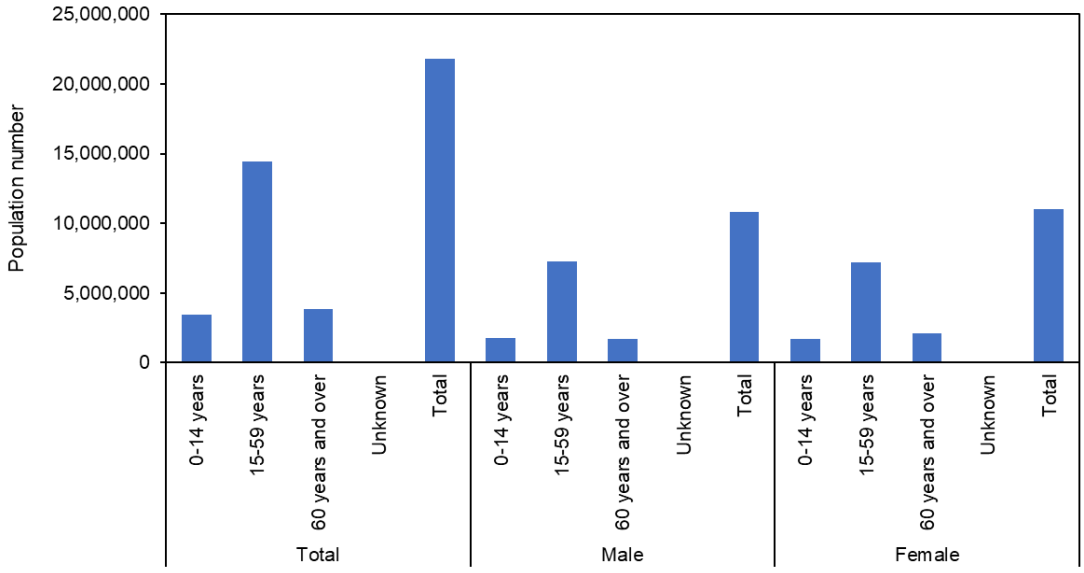


Figure 14: North-Eastern region's population categorised by gender and age in 2021
Source: (NSO, 2022a).

Table 16: North-Eastern region's population categorised by gender during 2021

Province	Population			Proportion
	Male	Female	Total	
North-Eastern	**10,814,540**	**11,012,380**	**21,826,920**	**100%**
Nakhon Ratchasima	1,293,783	1,340,371	2,634,154	12.1%
Buriram	783,531	796,274	1,579,805	7.24%
Surin	684,354	691,876	1,376,230	6.31%
Si Sa Ket	725,426	732,130	1,457,556	6.68%
Ubon Ratchathani	932,466	936,053	1,868,519	8.56%
Yasothon	265,945	267,449	533,394	2.44%
Chaiyaphum	554,299	567,966	1,122,265	5.14%
Amnat Charoen	187,122	189,228	376,350	1.72%
Bueng Kan	211,494	210,501	421,995	1.93%
Nong Bua Lamphu	253,757	255,244	509,001	2.33%
Khon Kaen	879,849	911,014	1,790,863	8.20%
Udon Thani	775,357	791,153	1,566,510	7.18%
Loei	319,949	318,783	638,732	2.93%
Nong Khai	256,268	260,575	516,843	2.37%
Maha Sarakham	464,976	483,334	948,310	4.34%
Roi Et	641,883	654,130	1,296,013	5.94%
Kalasin	481,988	493,582	975,570	4.47%
Sakon Nakhon	569,364	576,922	1,146,286	5.25%
Nakhon Phanom	357,096	359,944	717,040	3.29%
Mukdahan	175,633	175,851	351,484	1.61%

Source: (NSO, 2022a).

Agriculture is the largest economic sector in the North-East. This includes crops, livestock, agricultural services, fisheries and forest. They account for 79.9%, 13.6%, 4.4%, 1.8% and 0.3% of the gross agricultural regional product, respectively. Rice is the main agriculture crop. In 2020, planted area, harvested area and yield production in the North-Eastern region were 38,051,740 rai, 33,986,165 rai and 12,006,664 tonnes, respectively, for the major rice (Table 17) and 1,277,260 rai, 1,258,056 rai and 688,280 tonnes, respectively, for the second rice (Table 19). Ubon Ratchathani and Kalasin have the largest area of rice production in the major rice and second rice, respectively. Hom Mali rice is popular for the major rice (Table 18), while Pathum Thani 1 is popularly planted for the second rice (Table 20).

The regional problem with regard to rice cultivation is the low rate of irrigation: only 11.4% of the agricultural area has irrigation infrastructure. The majority of farming is dependent on rainwater. Many areas are subject to drought and are therefore unable to utilise their full potential. In recent years, farmers have increasingly diversified into cash crops such as sugarcane, cassava, maize, and rubber. Silk production is also an important industry.

According to the 12th National Economic and Social Development Plan (2017–2021), the North-Eastern region is considered to be the economic centre of the Greater Mekong sub-region (GMS). Emphasis is placed on the development of tourism and new production bases in the industrial sector, as well as infrastructure development to link Thailand with Laos and Vietnam. However, the North-Eastern region is the poorest region in Thailand, and features a higher income inequality than other regions. This leads to the migration of populations from rural areas to cities, which feature relatively higher economic and industrial growth (Pinyochatchinda and Walsh, 2015; Chattranond, 2020). This has led to increasing population density in the big cities (Suwanlee & Som-ard, 2020).

Average income is 21,587 THB per month. The major source of earnings (55.3%) is from wages and salaries (29.5%), followed by the net profit from non-farm business (14.9%) and the net profit from farming (10.9%). Income from the economically inactive sector mainly comes from assistance from other persons outside the household or from the government (22.4%), followed by income from asset and property rental, such as interest receipts (2.5%). The other sources of earning (non-money income) are from assistance in terms of welfare/goods and services (19.8%) (NSO, 2022d).

The average household in the North-Eastern region spends 16,869 THB per month, or approximately 78.1% of their income. Two-thirds of households in the North-Eastern region (63.9%) are indebted, with an average debt per household of 215,853 THB. Most of the household debt (65.8%) is for household spending: of this amount, 43.3% is for the purpose of household consumption, followed by the purpose of purchase/hire of house and land (21.0%), and for education purposes (1.5%). Regarding debt for investment and other purposes (34.2%), about 25.3% is for agricultural operations and 8.9% is for business operations in non-farm business and others (NSO, 2022d).

Table 17: Planted and harvested areas and yield production of major rice during 2018-2020 in the North-Eastern region

Province	Planted area (rai)			Harvested area (rai)			Yield production (tonnes)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
North-Eastern region	**36,878,181**	**37,799,154**	**38,051,740**	**32,869,030**	**32,022,751**	**33,986,165**	**11,706,257**	**11,282,079**	**12,006,664**
Loei	436,492	427,153	430,010	432,618	402,680	415,434	161,594	135,705	141,048
Nong Bua Lamphu	656,134	678,756	710,360	628,603	636,631	678,468	208,135	212,379	226,671
Udon Thani	1,759,560	1,932,381	1,974,920	1,721,157	1,869,622	1,916,361	627,752	667,337	688,051
Nong Khai	534,607	565,535	571,030	490,551	528,358	537,683	175,597	185,231	189,657
Bueng Kan	484,724	488,144	490,900	407,529	454,161	459,682	123,844	141,353	144,690
Sakon Nakhon	2,150,825	2,160,571	2,161,620	2,050,387	2,059,417	2,064,335	709,435	686,235	691,562
Nakhon Phanom	1,368,192	1,453,597	1,460,030	1,182,611	1,441,663	1,449,395	413,072	504,766	510,141
Mukdahan	488,421	475,555	476,320	467,269	463,618	466,347	184,418	185,931	187,418
Yasothon	1,332,068	1,338,008	1,350,830	1,261,915	1,071,448	1,206,669	459,002	385,878	437,798
Amnat Charoen	984,396	1,051,308	1,054,110	979,608	967,422	1,001,230	353,962	336,807	351,381
Ubon Ratchathani	3,924,596	3,940,858	3,965,960	3,812,967	3,621,494	3,771,406	1,382,578	1,302,467	1,359,944
Si Sa Ket	3,006,706	3,002,790	2,998,340	2,840,277	2,904,394	2,906,182	1,034,863	1,006,455	1,014,651
Surin	3,042,244	3,076,991	3,096,870	2,607,326	2,880,510	2,879,446	979,686	1,076,468	1,052,706
Buriram	2,769,234	2,884,034	2,905,310	1,992,820	2,293,871	2,482,934	674,885	795,719	866,421
Maha Sarakham	2,062,177	2,106,457	2,108,380	1,715,062	1,938,581	1,945,459	598,858	697,799	703,812
Roi Et	3,059,709	3,085,728	3,086,760	2,662,576	2,458,025	2,599,359	939,444	846,372	905,584
Kalasin	1,470,036	1,485,635	1,491,240	1,424,566	1,378,278	1,386,100	527,097	513,207	518,641
Khon Kaen	2,314,227	2,348,246	2,382,230	1,910,807	1,634,793	1,855,518	618,727	517,871	589,357
Chaiyaphum	1,572,444	1,738,598	1,750,490	1,434,930	960,665	1,405,278	524,697	335,915	494,289
Nakhon Ratchasima	3,461,389	3,558,809	3,586,030	2,845,451	2,057,120	2,558,879	1,008,611	748,184	932,842

Source: (OAE, 2021).

Table 18: Planted and harvested areas and yield production of major rice types during 2018-2020 in the North-Eastern region

Province	Planted area (rai)			Harvested area (rai)			Yield production (tonnes)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Hom Mali rice	22,833,188	23,592,482	23,654,971	20,034,500	19,611,212	20,830,608	7,120,426	6,931,808	7,372,218
Pathum Thani 1	23,620	26,310	27,377	19,839	19,662	21,777	9,515	9,370	10,397
Other white rice	981,709	843,691	867,578	924,848	710,596	776,241	378,372	285,853	313,922
Glutinous rice	13,039,664	13,336,671	13,501,814	11,889,843	11,681,281	12,357,539	4,197,944	4,055,048	4,310,127

Source: (OAE, 2021).

Table 19: Planted and harvested areas and yield production of second rice during 2018-2020 in the North-Eastern region

Province	Planted area (rai)			Harvested area (rai)			Yield production (tonnes)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
North-Eastern region	**1,406,047**	**1,299,669**	**1,277,260**	**1,395,548**	**1,286,352**	**1,258,056**	**782,108**	**713,904**	**688,280**
Loei	387	310	300	387	310	300	167	125	120
Nong Bua Lamphu	14,876	9,495	9,010	14,653	9,323	8,918	7,817	4,101	3,925
Udon Thani	44,037	44,035	37,830	43,688	43,986	37,561	20,970	22,390	19,321
Nong Khai	82,743	93,113	94,010	82,382	91,293	93,054	43,630	47,901	48,107
Bueng Kan	11,209	16,312	14,080	11,141	16,140	13,991	5,712	8,123	7,052
Sakon Nakhon	92,348	74,955	49,990	91,608	74,109	49,020	46,517	35,853	23,282
Nakhon Phanom	66,471	73,250	53,210	65,479	72,726	52,574	34,805	38,666	27,389
Mukdahan	423	1,903	1,100	423	1,903	1,100	202	957	554
Yasothon	70,121	79,721	36,430	69,978	79,553	36,358	40,156	44,716	20,459
Amnat Charoen	3,068	5,030	4,540	3,068	5,030	4,540	1,529	2,436	2,208
Ubon Ratchathani	154,427	170,337	150,500	153,918	169,682	150,050	73,604	81,523	72,545
Si Sa Ket	77,795	73,927	65,710	77,474	73,610	65,366	39,633	37,399	33,403
Surin	50,325	33,683	40,210	49,866	32,085	38,602	22,995	13,863	16,331
Buriram	19,738	12,730	18,870	19,548	12,247	18,697	9,577	5,741	8,782
Maha Sarakham	24,319	36,442	123,220	23,959	36,176	121,767	13,928	21,027	71,332
Roi Et	173,766	221,787	160,150	172,936	220,663	158,555	101,636	128,555	90,169
Kalasin	289,865	292,638	170,350	288,518	289,322	165,244	180,422	186,614	102,302
Khon Kaen	25,360	17,281	108,950	24,910	17,139	108,092	13,687	9,348	59,997
Chaiyaphum	73,315	13,123	33,570	71,196	11,764	30,086	43,747	6,941	17,763
Nakhon Ratchasima	131,454	29,597	105,230	130,416	29,291	104,181	81,374	17,625	63,239

Source: (OAE, 2021).

Table 20: Planted and harvested areas and yield production of second rice types during 2018-2020 in the North-Eastern region

Province	Planted area (rai)			Harvested area (rai)			Yield production (tonnes)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Pathum Thani 1	22,006	18,337	22,365	21,612	17,952	21,938	11,808	9,223	11,356
Other white rice	884,693	773,856	785,667	879,388	766,375	774,273	505,243	437,869	435,618
Glutinous rice	499,348	507,476	469,228	494,548	502,025	461,845	265,057	266,812	241,306

Source: (OAE, 2021).

Households with individuals being employed as professionals/technicians/managers/workers earn the highest income on average (approximately 48,032 THB per month), followed by households of entrepreneurs for non-agricultural business and households of clerical/sales/service workers (40,753 THB and 31,985 THB, respectively). The lowest, earning approximately 14,829 THB per month, are the households associated with fishing, forestry, hunting and agricultural services. Similar to the Northern region, most of the households with high income also spend more and have higher debt. Households associated with fishing, forestry, hunting, agricultural services and labourers in logistics, transportation and basic work have a ratio of expenditure to income of approximately 85.7 to 104.6%, resulting in the lowest proportion of their remaining money for saving and debt payment compared to other occupational groups (NSO, 2022d).

4.2.2. Environmental profile of Northeastern region

The land use classification of the North-Eastern region is shown in Table 21. A total area of 105.53 million rai is mostly used for agriculture (67.6%), followed by forest (18.6%). Most of the agricultural area is planted with rice (accounting for 43.5% of the total regional area and 64.3% of the total agricultural area in the region), followed by other field crops such as cassava, sugarcane and maize (accounting for 15.4% of the total regional area and 22.8% of the total agricultural area in the region). Most of the forests in this region are disturbed or degraded (Figure 15).

Table 21: Land-use types in the North-Eastern region in 2012

Land-use type	Area (rai)	Proportion
Urban and built-up land	5,426,919	5.14%
Agricultural land	71,344,578	67.6%
Paddy field	45,880,371	
Field crop	16,263,387	
Perennial	7,277,946	
Orchard	1,176,207	
Horticulture	147,322	
Swidden cultivation	-	
Pasture and farmhouse	446,836	
Aquatic plant	278	
Aquacultural land	129,612	
Integrated farm/ Diversified farm	22,619	
Forest land	19,677,789	18.6%
Disturbed forest	14,203,041	
Dense forest	4,637,370	
Water body	3,516,293	3.33%
Miscellaneous land	5,568,384	5.28%
Other miscellaneous land	4,704,574	
Marsh and swamp	863,810	
Total	105,533,963	100%

Source: (FAO, 2017).

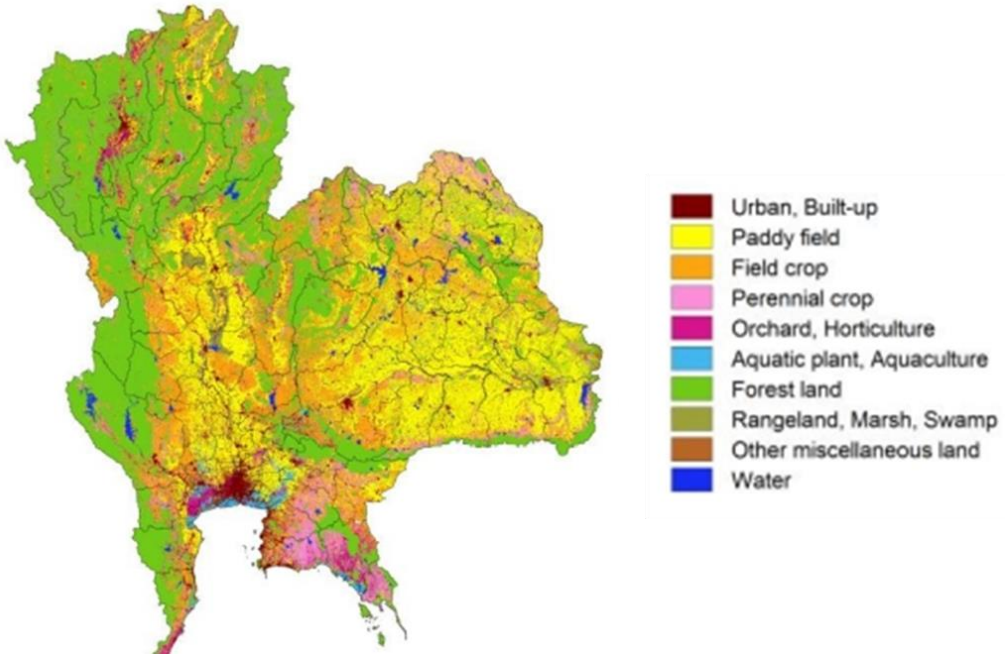


Figure 15: Major land-use types in Thailand during 2009-2012
Source: (FAO, 2017).

The soil in the North-Eastern region contains many soil groups and textures. The majority of soil has a sandy loam texture with low fertility. This is one of the key limitations for agricultural activities, particularly in crop production. Cropping in the North-East is therefore characterised by low productivity.

The average annual precipitation during 1981-2010 in the North-Eastern region was around 1,000-1300 mm. The provinces adjacent to the Central region had lower rainfall than provinces further away. The provinces in the northern part of this region (Nong Khai and Bueng Kan) have higher rainfall than the central and southern parts.

The water quality of water sources in the North-Eastern region are generally good (Figure 16). The most non-conforming parameter for surface water quality standards in Category 3 surface water sources, from 10% or more of all measurement points, is ammonia nitrogen (NH_3-N) (21% of all measurement points), biological oxygen demand (BOD: 23% of all measurement points) and heavy metals (HM: 0.8% of all measurement points) (Figure 16).

The North-East experiences less air pollution than the Central and Northern regions. Khon Kaen is the province that has the highest air pollution (46-60 days a year that air quality exceeds the standard), followed by Nakhon Ratchasima, Nong Khai and Ubon Ratchathani, which experience air pollution for 29-45 days a year when air quality exceeds the standard. The air quality of Loei, Nakhon Phanom and Sakon Nakhonwere exceed the standard for 1-30 days per year (Figure 9). The annual average $PM_{2.5}$ in the North-Eastern region in 2014-2021 was 20-40 µg/m^3; the highest and lowest concentrations were found in 2016 and 2021, respectively (Figure 10). The PM_{10} level in the North-East during 2012-2021 was not significantly different from other regions, with values ranging from 35 to 50 µg/m^3 (Figure 11).

The North-Eastern region generates approximately 16,771 tonnes per day of solid waste – the highest rate of all the regions (Figure 13).

Figure 16: Water quality measurement in the Northeast compared to the water quality standards in surface water sources (type 3) in 2021
Source: (PCD, 2022).

4.3 Central region

The Central region has a total area of 42.12 million rai or 13.1% of the country (including the Bangkok area). The landscape is divided into 3 parts: namely, the western side is a high area in the Thanon Thongchai and Tanaosri mountain ranges that stretches to the south along the border with Myanmar. The middle part is a river basin formed by the deposition of sediment that the Chao Phraya River and its tributaries carry, and the soil conditions are highly fertile. The lower part consists of the plains and coastal plains. The northern side is adjacent to Uthai Thani, Nakhon Sawan, Phetchabun, and the southern side is adjacent to Chumphon. The eastern side is adjacent to Nakhon Ratchasima, Nakhon Nayok, Chachoengsao and the Gulf of Thailand.

The Central region consists of 26 provinces: Ang Thong, Bangkok Metropolis, Chai Nat, Kanchanaburi, Lop Buri, Nakhon Pathom, Nonthaburi, Pathum Thani, Phetchaburi, Phra Nakhon Si Ayutthaya, Prachuap Khiri Khan, Ratchaburi, Samut Prakan, Samut Sakhon, Samut Songkhram, Saraburi, Sing Buri, Chonburi, Rayong, Chanthaburi, Trat, Chachoengsao, Prachinburi, Nakhon Nayok, Sa Kaeo and Suphan Buri (OAE, 2019).

The Central region has a tropical grassland climate with moderate rainfall. There is a southwest monsoon transporting moisture from the Andaman Sea to the Central region. As the Thanon Thongchai and Tanaosri mountain ranges, which stretch in the north-south direction in the western part of the region, block monsoon winds, the area behind these mountain ranges has relatively low rainfall, with an average amount of 1,500 millimetres per year (OAE, 2019).

The Central region has 7 major watersheds, namely the Chao Phraya River Basin, Sakae Krang River Basin, Pasak River Basin, Tha Chin River Basin, Mae Klong River Basin, Phetchaburi Basin and the West Coast Basin. The important rivers in the Central region are: (1) the Chao Phraya River that is divided into 3 rivers, namely the Tha Chin River, Noi River, and Lop Buri River, (2) Pasak River (3) Mae Klong River and (4) Phetchaburi River. As the region where Bangkok, the nation's capital, is situated, the Central region is the focal point for many facets of the nation's prosperity, contributing to agriculture, the economy and trade (OAE, 2019).

There are three seasons each year in the Central region. The rainy season is from May to October, the cool season from November to January, and the hot season from February to April (OAE, 2019).

Land uses in the Central region are classified into 13.92 million rai of forest areas or 33.04%, agricultural area of 18.25 million rai or 43.33%, and other utilisation area of 9.95 million rai or 23.63% of the region's total area (OAE, 2019).

4.3.1. Socio-economic profile of the Central region

The total population of the Central region during 2012-2021 ranged from 16,222,892 to 17,314,234 (excluding Bangkok) (Table 22). In 2021, the total population was 17,314,234 (excluding Bangkok) and 22,842,228 (including Bangkok), which is divided into 8,392,697 men and 8,921,537 women (excluding Bangkok) (NSO, 2022a). Most of the population of both genders are of working age (15-59 years), as shown in Figure 17. The 4 provinces (excluding Bangkok) that have the largest populations are Chonburi, Samut Prakan, Nonthaburi and Pathum Thani (Table 23).

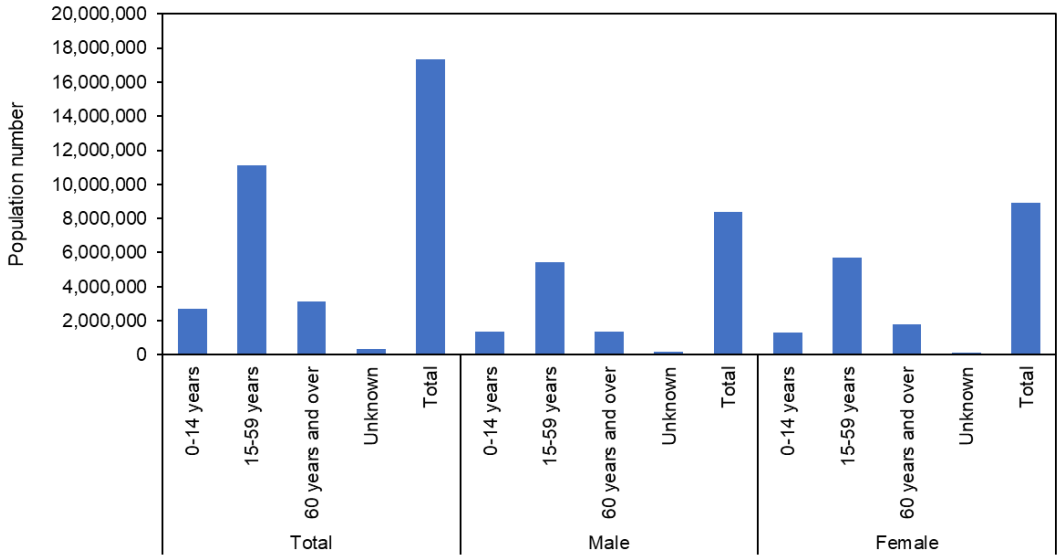


Figure 17: Central (excluding Bangkok) region's population categorised by gender and age in 2021
Source: (NSO, 2022a).

Table 22: Population of Central region during 2012-2021

Province	Total population in each year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Bangkok	**5,673,560**	**5,686,252**	**5,692,284**	**5,696,409**	**5,686,646**	**5,682,415**	**5,676,648**	**5,666,264**	**5,588,222**	**5,527,994**
Central	**16,222,892**	**16,366,870**	**16,532,023**	**16,753,526**	**16,879,244**	**17,018,869**	**17,151,984**	**17,265,094**	**17,255,105**	**17,314,234**
Samut Prakan	1,223,302	1,241,610	1,261,530	1,279,310	1,293,553	1,310,766	1,326,608	1,344,875	1,351,479	1,356,449
Nonthaburi	1,141,673	1,156,271	1,173,870	1,193,711	1,211,924	1,229,735	1,246,295	1,265,387	1,276,745	1,288,637
Pathum Thani	1,033,837	1,053,158	1,074,058	1,094,249	1,111,376	1,129,115	1,146,092	1,163,604	1,176,412	1,190,060
Phra Nakhon Si Ayutthaya	793,509	797,970	803,599	808,360	810,320	813,852	817,441	820,188	819,088	820,512
Ang Thong	283,882	283,732	283,568	283,173	282,404	281,187	280,840	279,654	276,584	274,763
Lop Buri	758,059	757,970	758,406	758,655	757,321	757,273	758,733	755,556	742,928	739,473
Sing Buri	213,216	212,690	212,158	211,426	210,588	210,088	209,377	208,446	205,898	204,526
Chai Nat	333,172	332,769	332,283	331,655	330,431	329,722	328,263	326,611	322,477	320,432
Saraburi	625,689	629,216	633,460	637,673	640,065	642,040	645,024	645,911	643,828	643,963
Chonburi	1,364,002	1,390,354	1,421,425	1,455,039	1,483,049	1,509,125	1,535,445	1,558,301	1,566,885	1,583,672
Rayong	649,275	661,220	674,393	688,999	700,223	711,236	723,316	734,753	741,524	751,343
Chanthaburi	521,812	524,260	527,350	531,037	532,466	534,459	536,496	537,698	535,559	536,557
Trat	222,855	224,010	224,730	229,435	229,437	229,649	229,914	229,958	228,536	228,376
Chachoengsao	685,721	690,226	695,478	700,902	704,399	709,889	715,009	720,113	720,718	724,178
Prachinburi	473,770	476,167	479,314	482,195	484,829	487,544	491,640	494,680	493,670	495,325
Nakhon Nayok	255,174	256,085	257,300	258,577	258,358	259,342	260,093	260,751	260,081	260,433
Sa Kaeo	548,342	550,937	552,187	556,922	559,017	561,938	564,092	566,303	560,925	561,992
Ratchaburi	846,631	850,162	853,217	867,883	869,823	871,714	873,518	873,101	869,313	868,281
Kanchanaburi	838,269	842,882	848,198	882,146	885,112	887,979	893,151	895,525	891,976	894,054
Suphan Buri	847,308	848,066	849,053	849,699	848,567	852,003	848,720	846,334	838,628	835,360
Nakhon Pathom	874,616	882,184	891,071	899,342	905,008	911,492	917,053	920,030	920,729	922,171
Samut Sakhon	508,812	519,457	531,887	545,454	556,719	568,465	577,964	584,703	586,199	586,789
Samut Songkhram	194,042	194,116	194,189	194,376	194,069	193,902	193,791	193,305	192,052	190,842
Phetchaburi	468,874	471,087	474,192	478,589	480,652	482,375	484,294	485,191	482,193	482,875
Prachuap Khiri Khan	517,050	520,271	525,107	534,719	539,534	543,979	548,815	554,116	550,678	553,171

Source:(NSO, 2022a).

Table 23: Central region's population categorised by gender during 2021

Province	Population			Proportion
	Male	Female	Total	
Bangkok	**2,592,292**	**2,935,702**	**5,527,994**	
Central	**8,392,697**	**8,921,537**	**17,314,234**	**100%**
Samut Prakan	645,884	710,565	1,356,449	7.83%
Nonthaburi	599,167	689,470	1,288,637	7.44%
Pathum Thani	563,851	626,209	1,190,060	6.87%
Phra Nakhon Si Ayutthaya	394,024	426,488	820,512	4.74%
Ang Thong	131,399	143,364	274,763	1.59%
Lop Buri	368,733	370,740	739,473	4.27%
Sing Buri	97,144	107,382	204,526	1.18%
Chai Nat	153,962	166,470	320,432	1.85%
Saraburi	316,201	327,762	643,963	3.72%
Chonburi	772,463	811,209	1,583,672	9.15%
Rayong	368,992	382,351	751,343	4.34%
Chanthaburi	262,257	274,300	536,557	3.10%
Trat	112,941	115,435	228,376	1.32%
Chachoengsao	354,834	369,344	724,178	4.18%
Prachinburi	244,642	250,683	495,325	2.86%
Nakhon Nayok	128,854	131,579	260,433	1.50%
Sa Kaeo	280,673	281,319	561,992	3.25%
Ratchaburi	421,921	446,360	868,281	5.01%
Kanchanaburi	448,312	445,742	894,054	5.16%
Suphan Buri	402,883	432,477	835,360	4.82%
Nakhon Pathom	442,800	479,371	922,171	5.33%
Samut Sakhon	282,683	304,106	586,789	3.39%
Samut Songkhram	91,101	99,741	190,842	1.10%
Phetchaburi	232,927	249,948	482,875	2.79%
Prachuap Khiri Khan	274,049	279,122	553,171	3.19%

Source: (NSO, 2022a).

The Central region is the main economic centre of the country after Bangkok. The Central region's GDP is 3,522,515 million THB, accounting for 22.8% of the country's total gross domestic product. Compared to other regions, the Central region is highly developed. The Central region has relatively well-developed water resources and irrigation systems compared to other regions. This region has a border area adjacent to Myanmar, thus having potential and opportunities for development in agriculture, industry, trade, tourism and services (NESDC, 2019).

The Central region has potential for agricultural development from upstream, midstream and downstream, with fertile soil and water, good irrigation systems and favourable topography making it a source of various agricultural commodities including vegetables, fruits, livestock and fishing. In addition, the Central region is also a source of agricultural processing industries that link agricultural production sources in both the Central region and other regions. The Central region has the National Institute of Rice Science located in Suphan Buri province and provincial rice research centres located in several areas, including Chainat, Suphan Buri, Lop Buri,

Ratchaburi, Pathum Thani and Ayutthaya. There are also wholesale and retail markets of important agricultural products in the area, such as Tai Market in Pathum Thani Province, Sri Muang Market in Ratchaburi Province. and Mahachai Market in Samut Sakhon Province.

The Central region generates approximately 207,379 million THB of agricultural products, a decrease from 226,621 million THB in 2013. Agricultural and forestry products account for 5.1% of the value of the Central region's products. The agricultural sector of the Central region accounts for 16.1 percent of the country's agricultural product value. The average growth rate over the past five years (2013-2017) of the agricultural sector decreased by 0.6%, due to excessive use of chemicals, the problem of soil deterioration and many areas often suffer from floods and droughts.

The Central region is an important source of agricultural production in the country and tends to have better production quality than other regions. The main agricultural locations (agriculture and fisheries) in the Central region are Ratchaburi Province (accounting for 12.3% of production), followed by Suphan Buri Province (12.2%), Kanchanaburi (10.1%) and Nakhon Pathom (9.5%). The Central region is an area with fertile river plains suitable for farming. Although economic growth has dramatically reduced the Central region's agricultural land in favour of industrial and residential areas, the Central region is still regarded as one of the country's major agricultural producers in the fields of cultivation, livestock and fisheries.

In 2020, planted area, harvested area, and yield production in Central region (excluding Bangkok) were 8,449,490 rai, 8,176,671 rai and 5,062,365 tonnes, respectively, for major rice (Table 24) and 3,037,830 rai, 2,956,908 rai and 1,871,254 tonnes, respectively, for second rice (Table 26). Suphan Buri and Phra Nakhon Si Ayutthaya provinces are the largest areas of rice production in the major rice and second rice, respectively. Pathum Thani 1 is a variety that is popular for both the major rice (Table 25) and the second rice (Table 26).

Households in the Central region earn, on average, 28,166 THB per month (NSO, 2022e). The major source of earnings (72.5%) (20,404 THB) is from economically active activities such as wages and salaries (47.9%), followed by net profit from non-farm business (16.1%) and net profit from farming (8.5%). Income from economically inactive activities includes assistance from other persons outside the household or from the government (11.3%), followed by income from asset and property rental, such as interest receipts (1.6%). The other source of earning (non-money income) is from assistance in term of welfare/goods and services (14.6%).

Table 24: Planted and harvested areas and yield production of major rice during 2018-2020 of the Central region

Province	Planted area (rai)			Harvested area (rai)			Yield production (tonnes)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Bangkok	**81,142**	**82,713**	**81,560**	**80,896**	**82,713**	**81,407**	**54,205**	**57,053**	**56,587**
Central region	**8,507,059**	**8,490,019**	**8,449,490**	**8,382,239**	**7,989,688**	**8,176,671**	**5,250,274**	**4,935,498**	**5,062,365**
Saraburi	326,159	325,984	323,250	324,410	321,297	322,074	208,506	194,122	195,029
Lop Buri	749,397	756,567	751,500	741,304	734,981	739,854	404,244	377,778	381,287
Sing Buri	333,369	303,955	302,780	332,281	302,768	301,824	241,713	216,756	216,784
Chai Nat	848,728	848,024	846,480	842,555	780,920	795,065	557,946	513,826	524,563
Suphan Buri	1,198,652	1,209,062	1,196,180	1,189,423	1,078,777	1,129,518	883,259	790,737	833,264
Ang Thong	361,089	337,782	330,730	359,575	328,677	323,316	241,622	224,163	220,865
Phra Nakhon Si Ayutthaya	788,275	810,747	800,880	786,033	806,785	797,740	518,775	536,781	533,077
Nonthaburi	85,539	85,693	86,350	85,461	85,483	86,213	57,667	59,010	59,598
Pathum Thani	299,794	309,678	307,650	299,279	308,717	306,938	213,238	221,059	220,571
Nakhon Nayok	371,935	363,455	366,710	368,139	359,825	363,970	207,797	201,355	204,663
Prachinburi	381,015	390,794	391,660	371,856	384,307	385,943	154,154	157,268	156,678
Chachoengsao	632,269	609,496	612,570	627,400	601,258	607,923	406,957	376,965	382,975
Sa Kaeo	716,502	738,743	739,670	658,212	582,446	670,856	227,227	182,004	224,087
Chanthaburi	14,138	13,448	13,260	13,697	12,830	12,629	5,048	4,714	4,586
Trat	14,515	14,552	14,640	14,233	14,287	14,368	6,445	6,333	6,313
Rayong	10,893	9,890	9,980	10,722	9,816	9,906	5,190	4,819	4,891
Chonburi	67,353	67,179	66,060	61,158	65,453	64,364	29,084	30,164	29,788
Samut Prakan	18,501	18,312	18,450	18,471	18,266	18,404	13,248	13,382	13,510
Samut Sakhon	4,641	5,031	4,930	4,629	5,003	4,903	3,253	3,470	3,417
Nakhon Pathom	277,199	270,197	268,530	275,128	268,718	267,108	206,155	201,997	201,858
Kanchanaburi	377,255	375,067	371,800	372,373	296,811	331,730	227,875	190,740	213,818
Ratchaburi	236,251	237,911	236,480	234,119	235,724	234,824	160,749	159,834	160,782
Samut Songkhram	2,210	2,308	2,250	2,200	2,290	2,250	1,544	1,596	1,572
Phetchaburi	291,749	282,877	284,300	290,526	281,189	282,913	204,119	198,022	200,057
Prachuap Khiri Khan	18,489	20,554	20,840	18,159	20,347	20,631	10,254	11,550	11,745

Source: (OAE, 2021).

Table 25: Planted and harvested areas and yield production of major rice types during 2018-2020 of the Central region

Province	Planted area (rai)			Harvested area (rai)			Yield production (tonnes)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Other fragrant rice	1,298,787	1,410,482	1,409,301	1,228,315	1,201,152	1,312,118	452,211	421,617	474,256
Pathum Thani 1	1,012,093	1,362,649	1,354,277	1,004,082	1,300,063	1,311,493	718,440	925,306	940,471
Other white rice	6,173,371	5,698,021	5,666,825	6,128,476	5,471,961	5,534,438	4,071,474	3,582,562	3,640,730
Glutinous rice	22,808	18,867	19,087	21,366	16,512	18,622	8,149	6,013	6,908

Source: (OAE, 2021).

Table 26: Planted and harvested areas and yield production of second rice during 2018-2020 of the Central region

Province	Planted area (rai)			Harvested area (rai)			Yield production (tonnes)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Bangkok	**93,832**	**72,099**	**70,500**	**93,602**	**71,926**	**70,077**	**60,111**	**46,054**	**42,365**
Central region	**4,969,770**	**3,062,604**	**3,037,830**	**4,958,965**	**2,982,302**	**2,956,908**	**3,441,193**	**2,036,737**	**1,871,254**
Saraburi	196,498	37,886	38,500	195,715	30,475	37,730	128,755	17,608	17,734
Lop Buri	301,213	57,445	52,900	300,668	56,467	52,107	194,880	31,471	28,730
Sing Buri	253,552	46,000	52,560	253,359	45,633	51,615	166,838	30,099	33,896
Chai Nat	521,647	102,554	200,810	521,118	99,971	198,802	346,450	60,798	118,611
Suphan Buri	832,353	592,802	469,990	830,766	590,378	468,604	599,010	427,210	306,580
Ang Thong	251,058	73,264	80,420	250,756	72,729	79,213	167,741	46,852	44,797
Phra Nakhon Si Ayutthaya	717,402	485,835	510,210	716,664	484,912	508,679	504,311	331,885	320,844
Nonthaburi	93,683	71,035	68,870	93,626	71,012	68,802	67,341	50,151	43,918
Pathum Thani	268,726	184,093	191,960	268,545	183,718	191,384	194,498	122,048	126,247
Nakhon Nayok	160,554	151,467	160,160	159,693	150,286	158,871	104,670	94,458	99,238
Prachinburi	136,102	127,000	141,590	135,295	122,651	138,758	87,302	76,154	84,154
Chachoengsao	293,386	253,391	403,620	291,429	199,707	343,078	202,937	123,125	195,505
Sa Kaeo	8,116	10,357	15,620	8,030	10,210	15,411	4,656	6,069	9,181
Chanthaburi	-	-	-	-	-	-	-	-	-
Trat	2,563	2,593	4,950	2,553	2,533	4,836	1,406	1,380	2,643
Rayong	3,707	3,065	3,600	3,691	2,968	3,492	2,000	1,456	1,721
Chonburi	39,363	32,174	41,320	39,090	31,410	40,739	26,462	18,321	23,468
Samut Prakan	17,783	16,732	21,370	17,714	14,211	21,209	12,674	8,999	11,450
Samut Sakhon	2,866	2,931	2,480	2,831	2,907	2,432	1,930	1,958	1,536
Nakhon Pathom	254,618	254,627	255,010	254,471	254,224	253,735	192,190	191,485	183,302

Kanchanaburi	181,155	184,736	80,990	180,982	183,996	77,751	133,263	135,063	56,161
Ratchaburi	174,177	174,540	34,740	174,001	174,359	34,534	125,523	125,311	24,722
Samut Songkhram	1,569	1,943	1,450	1,569	1,943	1,450	1,079	1,378	1,015
Phetchaburi	153,093	108,857	116,880	152,315	108,708	116,529	108,634	78,298	83,002
Prachuap Khiri Khan	10,754	15,178	17,330	10,482	14,968	17,070	6,532	9,106	10,434

Source: (OAE, 2021).

Table 27: Planted and harvested areas and yield production of second rice types during 2018-2020 of the Central region

Province	Planted area (rai)			Harvested area (rai)			Yield production (tonnes)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Pathum Thani 1	775,666	373,166	327,531	774,324	365,988	319,749	538,173	249,232	201,164
Other white rice	4,190,391	2,686,443	2,706,519	4,180,928	2,613,330	2,633,423	2,900,592	1,785,556	1,667,756
Glutinous rice	3,713	2,995	3,780	3,713	2,984	3,736	2,428	1,949	2,334

Source: (OAE, 2021).

Households in the Central region spend, on average, 22,332 THB per month (NSO, 2022e). Nearly half of households in the Central region (48.4%) are indebted; the average debt is 189,455 THB per household. The main purpose of borrowing is for household spending (80.3%) and household consumption (43.7%), which consists of buying house/land (35.6%) and loans for education (only 1.0%). Regarding loans for investment and others (19.7%), the bulk is mainly on farm business (12.2%), followed by non-farm business and others (7.4%, 0.1%, respectively).

Households of employed professional, technical and executive workers earn the highest income (about 49,740 THB per month), followed by households of entrepreneurs for non-agricultural business and households mainly owning land (33,497 and 33,041 THB, respectively) (NSO, 2022e). The lowest-earning households, with approximately 17,248 THB per month, are those of labourers in agriculture, forestry and fisheries. Households of clerical, sales and services workers and labourers in logistics have a ratio of expenditure to income of approximately 88.3 to 89.2%, resulting in the lowest proportion of their remaining money for saving and repaying debt.

4.3.2. Environmental profile of the Central region

The land in the Central region is used for agricultural activities (49.3%; rice has largest area), followed by forest land (34.3%), and urban and built-up land (8.88%) (Table 28).

Table 28: Land-use types of the Central region in 2012

Land-use type	Area (rai)	Proportion
Urban and built-up land	3,857,249	8.88%
Agricultural land	21,410,545	49.3%
Paddy field	8,900,821	20.5%
Field crop	6,738,193	15.5%
Perennial	1,650,437	3.80%
Orchard	2,234,026	5.14%
Horticulture	453,480	1.04%
Swidden cultivation	-	-
Pasture and farmhouse	182,159	0.42%
Aquatic plant	12,757	0.03%
Aquacultural land	1,238,672	2.85%
Integrated farm/ Diversified farm	-	-
Forest land	14,909,264	34.3%
Disturbed forest	2,524,837	5.81%
Dense forest	12,384,427	28.5%
Water body	1,452,955	3.34%
Miscellaneous land	1,820,427	4.19%
Other miscellaneous land	1,588,024	3.65%
Marsh and swamp	232,403	0.53%
Total	43,450,440	100%

Source: (FAO, 2017).

The irrigated area of farmland in the Central region is 58.8%, higher than the national average of 22.0%. The irrigated area of the Central region covers an area of approximately 10.6 million rai, accounting for 32.3% of the country's irrigated area. Soil in the Central region contains several

groups and textures. Soil suitability for rice cultivation in Figure 3 shows that most of soils in this region have high level of suitability for rice cultivation (good to high).

The average annual precipitation during 1981-2010 in the Central region was more than 900 mm. Most of the water quality in water sources of the Central region ranged between fair and good. The parameters that do not meet the water quality standard in surface water sources (type 3), from 10 percent or more of all measurement points are organic impurities or BOD: 36% of all measurement points), Dissolved Oxygen (DO: 27% of all measurement points), Phecol Coliform Bacteria (FCB: 18% of all measurement points), Total Coliform Bacteria (TCB: 17% of all measurement points), Ammonia in Nitrogen (NH_3-N: 12% of all measurement points), and Heavy Metals (HM: 0.4% of all measurement points) (Figure 18).

Figure 18: Water quality measurement in the Central region compared to the water quality standards in surface water sources (type 3) in 2021
Source: (PCD, 2022).

The area that experiences the highest air pollution in the Central region is Na Phra Lan Sub-District in the Chaloem Phrakiat District of Saraburi Province (Figure 10, Figure 11, and Figure 12). The number of days that the level of PM_{10} exceed the standard is 101 days (10% increase from 2020). The average annual level of PM_{10} is 98.6 µg/m^3 (8% decrease from 2020). These high levels are caused by the dispersion of dust from the stone crushing plants, cement plants, lime plants and quarry plants in the area and nearby areas, as well as traffic, local transportation and damaged public roads. Actions have been taken to address management of PM_{10} problems. This includes policies and measures on preventing and solving dust problems in Na Phra Lan Sub-District, strict implementation and enforcement, monitoring pollution and other air pollutants from the automatic air quality monitoring station located in the area of Na Phra Lan Provincial Police Station, coordinating with local agencies, inspecting and monitoring pollution problems with spot checks, and detecting dust exhaustion in the form of black soot from vehicles in Na Phra Lan areas (PCD, 2022).

In 2021, the overall situation of $PM_{2.5}$ in the Central region improved (except Saraburi). The number of days that $PM_{2.5}$ exceeded the standard was 64 days, a decrease of 9% from the previous year (in 2020, the number of days exceeding the standard was 70 days) (Figure 19). This was partly due to the implementation of the National Agenda Action Plan on "Solving the Pollution Problems of Particulate Matter" and stricter measures, such as proactive inspections, increasing of the frequency of notifications, communication to increase awareness among the public, integration and promotion of participation from all sectors, the use of academic information to prevent and solve air pollution problems, and improved inter-agency coordination.

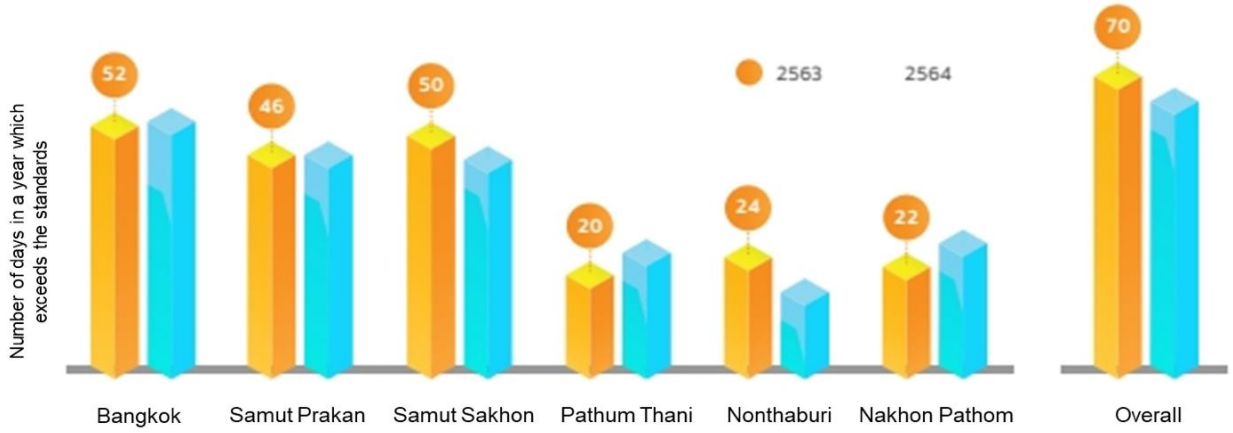


Figure 19: Number of days in a year that experienced $PM_{2.5}$ during 2020-2021
Source: (PCD, 2022).

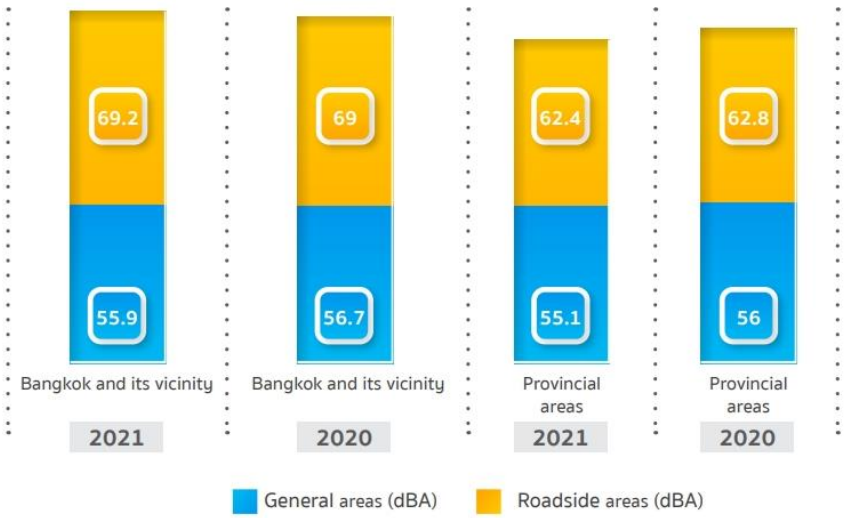


Figure 20: State of noise level in Bangkok and its vicinity and provincial areas during 2020-2021
Source: (PCD, 2022).

In addition, the annual average noise level in the general area of Bangkok and its vicinity in 2021 was 55.9 decibels (in 2020, it was 56.7 decibels). For the roadside areas, the annual average noise level is 69.2 decibels (in 2020, it was 69.0 decibels) (Figure 20).

5. Environmental and social impact assessment

The present chapter assesses the potential negative environmental and social impacts of the proposed project activities. The impacts are assessed against the policies and standards of the project's ESS reference framework. For each impact, risk mitigation measures for the mitigation of negative impacts are identified and their assumed effectiveness stated. The objective of the assessment is to achieve compliance with the ESS reference framework. The results of the assessment are integrated and operationalised in the ESMP and the ESMF.

5.1 Anticipated positive impacts

The Thai Rice Project aims at facilitating the transformation of Thai rice smallholder cultivation towards a low-emission and climate-resilient development trajectory through the promotion of sustainable and environment-friendly climate smart agriculture in the Central, Northern and North-Eastern provinces of Thailand. For this purpose, climate smart agriculture (CSA) technologies and practices will be applied by farmers and the respective services provided to them. Further, loans and incentive payments will be provided and an enabling environment promoted.

The promoted CSA technologies and practices – including LLL, AWD, SSNM etc. (described in Section 2.2) – are proven to reduce greenhouse gas emissions in the rice field environment. For example, AWD technology can reduce methane and nitrous oxide emissions by 25-45% from the base case (conventional practice). The application of SSNM provides lower but sufficient amounts of fertilizer applied to the field and leads to the reduction of N_2O emissions (as well as reduced production costs). It is anticipated that full implementation of the project can reduce greenhouse gas by approximately 2.4 $MtCO_2eq$.

Rice cultivation in Thailand is moving towards the Thai Agricultural Standard for Sustainable Rice (TAS). Many farmers are also interested in implementing the Sustainable Rice Platform (SRP). The technologies implemented in this project are in line with TAS and SRP, and thus the standard of rice cultivation practices will be raised in Thailand. The project will also help reduce $PM_{2.5}$ from straw burning by introducing straw management and utilisation. Some of major positive impacts are listed below.

The positive impacts listed in Table 29 will be sustained as long as climate-smart technologies and practices continue to be operated. There is no risk of carbon benefits reversibility (as the project *avoids* GHG emissions, it does not sequester them) or reversal of resource-efficiency benefits (as, again, the project *reduces* and *avoids* water and agro-chemical use). There are strong reasons for expecting farmers to continue using climate-smart technologies and practices in the medium- and long-term, after the project has ended, because such interventions generate a positive financial return (positive IRR), they reduce farmers' vulnerability to climate shocks, and the project will create capacities and mechanisms (a climate-smart agricultural extension service, a BAAC Climate Smart Loan scheme, the Thai Rice Facility, etc.) that will endure long after the project ends.

Table 29: Positive Impacts from Project Implementation

Positive Impact	Description
Climate Change Abatement	It is anticipated that the project will reduce at least 2.4 $MtCO_2eq$ and reduce the climate vulnerability of 253,400 direct beneficiaries during project implementation. In addition, the project will mitigate 12.5 $MtCO_2eq$ over the 15-year lifespan of the project.
Agricultural Standards	The technologies applied to farmers are in line with the TAS and SRP, consequently raising the standard of rice cultivation in Thailand in a market-recognised manner.
Biodiversity	Research in Thailand confirms the positive impacts on biodiversity in rice fields when AWD and SSNM is applied.
Sustainable Development Goals	30-40% water use reduction is expected in cases of complete AWD. In this regard, the Thai Rice Project tackles the challenges of water resources (SDG 6). The project supports a strong multi-actor partnership (SDG 17) that offers a proven approach to enhance incomes (SDG 1) and food security (SDG 2) of rural rice farming populations, while also combatting climate change (SDG 13). The project promotes the empowerment of women (SDG 5) and requires adherence to international norms on labour rights (SDG 8). Promoting responsible consumption (SDG 12) creates the demand to accelerate and scale-up action to transform the rice sector.
Bio-circular and Green Economy	The promotion of straw utilisation, such as through energy production, mushroom cultivation and the support of local value chain products, is in line with Thailand's policy of Bio-circular and Green economy.
Pollution	As a consequence of straw utilisation, it is anticipated that straw burning will decline. Thus $PM_{2.5}$ and other related pollutants will decrease.
Farmer well-being	The project promotes LLL and SSNM with promising yield improvement, income increases, while at the same time having low investment needs. The project also promotes farmer health and safety (e.g. through appropriate use of agro-chemicals).
Digitisation / IoT	The project will improve the digital skills of the rural population, particularly providing older stakeholders with the opportunity to access and use digital tools and communication channels.

5.2 Assessment of possible negative impacts (ESS triggered)

Possible negative impacts that trigger ESS are listed below. The impacts are relatively small in magnitude, spatially localized and predominantly temporary; all can be addressed using well-established mitigation approaches.

Table 30: Possible negative impacts of the project

ESS	Possible negative impact	Description	Project mitigation/activity
ESS 3	Pollution	Chemical overflow to water ways and their continuance in the soil can occur under the overuse of chemicals and fertilizer.	Implementation of SSNM and capacity building of farmers and service providers for proper fertilizer application (Activity 1.1.1, 2.1.1).
ESS 3	Water supply shortage and competition for water	Timely and sufficient water allocations may not be met due to extreme climate and variability and high demand .	Strengthening knowledge of farmers and coordinating project interventions with water users and management authorities (Activity 1.1.1).
ESS 2	Replacement of labour by machinery	Machines may replace human labour requirements. This may indirectly impact the migration of local farmers / farm labourers to work in urban areas.	The project will introduce CSA to farmers and increase the capacities of service providers as well as promote climate-smart loans and the Thai Rice Facility (activities 1.1.1, 1.1.2, 2.1.1, 2.1.2, and 3.1.3). It is anticipated that employment and local labour demand will be increased because rice farming will be placed on a more sustainable,

ESS	Possible negative impact	Description	Project mitigation/activity
			higher value-add footing. The accessibility to finance will facilitate activities of farmers moving towards CSA technologies and practices.
ESS 10	'False' application of AWD	The AWD system needs field water level monitoring. Excessive precipitation can result in flooded conditions in rice fields, while under-application of water can lead to soil cracking and N_2O emissions. It is therefore necessary to control the water level effectively during AWD implementation.	The project will provide capacity building, including application of AWD, to farmers and demonstrate regional exchange and peer to peer learning to ensure the effectiveness of CSA implementation (Activity 1.1.1). AWD has been successfully applied in other countries and the NAMA Support Project (NSP) has demonstrated its potential in Thailand.
ESS 9	Technology accessibility and unwillingness to join the project	Lack of communication with stakeholders, in particularly elderly farmers with limited internet access, knowledge on modern media and mobile applications may lead to unwillingness to join project activities.	The project has a well-developed stakeholder engagement plan to enhance understanding of all stakeholders.

5.2.1. Summary of Assessment

According to the GIZ and GCF safeguard systems, projects are rated according to unintended negative impacts (or environmental and social (E&S) risks).

- A: highest risk: “Activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented”
- B: for medium risk: “Activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures”
- C: for minimum to no risk: “Activities with minimal or no adverse environmental or social risks and/or impacts.”

The Thai Rice Project is given an overall category based on the single highest E&S risk of any safeguard category and not by averaging risks. The definition of “E&S risk” employed by GIZ is as follows: “Possible unintended negative impacts of a GIZ programme/project on humans and objects of protection.” In addition to the unintended negative impacts, external risks that arise from the project’s context or environment (informed by climate risk and vulnerability assessments) are taken into account.

The project is categorised as **‘Category ‘B’** or ‘medium’ in line with the GCF risk categorisation, in terms of the environmental and social risks in adherence with GIZ’s guidelines for its S+G Management System, which applies the highest risk classification of triggered safeguards / standards to automatically inform the programme’s overall E&S risk category.-

The project has the potential to cause moderate negative environmental and social impacts. These potentially include impacts on water quality through contamination by chemicals and fertilizers, degraded soil quality, competition among farmers for water and the implementation of climate-smart agricultural technologies in the context of limited farmer knowledge about these technologies. The project does not require or involve land acquisition and/or resettlement. None of the interventions will require the displacement of people, involve economic displacement or will be conducted in protected areas or sensitive locations.

5.3 Environmental and social impact assessment

This section the assesses the environmental and social impacts against the relevant standards. These standards include the GCF’s interim ESS Standards that are based on the International Finance Corporation (IFC) Performance Standards (PS), as adopted by the GCF board in 2014, the GCF’s Indigenous People Policy (decision GCF.B.19/11), the GCF’s gender policy (B.24/12), and the GIZ´s safeguards and gender standards. Further information on these standards is described in Annex I.

5.3.1. ESS 1: Assessment and management of environmental and social risks and impact

5.3.1.1 Impact assessment

5.3.1.1.1. Environmental and social assessment

The project, “Thai Rice: Strengthening climate-smart rice farming”, targets rice farmers in 21 provinces of Thailand to overcome barriers related to technical capacity, financing, market linkages and policy, to promote the adoption of low- emission, climate- resilient rice farming technologies and practices. The project involves capacity development measures for the promotion of climate-smart technologies and practices (LLL, AWD, SSNM, SSM, IPM), climate-

smart rice varieties, dry direct seeded rice, crop diversification (including perennial plants and trees), inter-cropping, agro-met advisory support, match-making and related interventions. It also includes financial support (incentive payments, climate-smart loans, ThaiCI grants), crop insurance for farmers and institutional support (policy advice, standard promotion through TAS and SRP, the Thai Rice facility set-up and regional learning).

The scope of assessment encompasses all project activities, both technical and financial. The assessment is performed throughout the project life-cycle, starting from project development (using the current environmental and social baseline as stated in Chapter 4), during project implementation through implementation (inter alia by the ESS team) and after the project end by using monitoring tools identified in the ESMP and ESMF. The project will implement a Stakeholder Engagement Plan (SEP) to ensure effective two-way communication and a Grievance Redress Mechanism (GRM) to address concerns raised by relevant stakeholders (see Annex 7.a). Both serve as tools to ensure adverse effects – if they occur – will be minimised.

A range of CSA technologies and practices will be promoted by this project with different, mainly positive, E&S impacts to the environment. For example, ADW reduces the amount of water needed, and SSNM relates to fertilizer application, which may impact water quality. Proper straw management (SSM) can reduce straw burning which causes air pollution (in particular $PM_{2.5}$).

i) Direct Impact

Water consumption: Promotion of AWD in irrigated areas such as in the Central Plain of Thailand involves water distribution from irrigated canals. This can lead to the risk of deficient amounts of water received due to high demand of water and mismanagement of water distribution. In the Central region the water distribution system is managed by the -under the Royal Irrigation Department (RID). Usually, the amount of annual water distribution is considered at the beginning of each year, based on the requested amount from users. A plan for water distribution is decided by this committee. The plan can be revised in case urgent situations arise. The start of the rice growing season depends on the water supply, particularly from the irrigation system. Usually, water distribution is prioritised for community consumption. There is a risk of inadequate water supply from irrigated canals for AWD farmers due to annual plan adjustment for water distribution within a season. It is noted that in some areas not all farmers are directly connected to the main irrigated canal but there are some farmers using water from a secondary canal diverted from the main canal. In case of limited water flows through the main canal, farmers at the end of the canal may receive inadequate amounts of water to grow rice as they had planned.

RD and DoAE have the capacity to voice interests and concerns in the water distribution committee, alongside representatives from water user groups. Information on the numbers of farmers participating in the Thai Rice Project can be communicated to this committee to ensure adequate amounts of water supplied to them. In addition, as the role of RD is to support CSA practices, it can promote individual or community ponds as a contingency plan to avoid the risk of water deficiency. This is useful in case the received amount of water from the public irrigation system is not sufficient. This situation of water distribution may affect AWD application, as farmers have to be sure about water availability before letting water dry up naturally. In addition, erroneous application of AWD or incomplete AWD may not lead to the expected amount of GHG reductions and yield increases.

The project will have a positive impact and co-benefit on water consumption. This is because the required amount of water consumption will be lowered through AWD. Other stakeholders, such

as surrounding communities and industry, will benefit from the distribution of saved water from the irrigation system.

Greenhouse gas emissions: The project will implement mitigation technologies such as AWD that help reduce methane emissions by 30-40% while SSNM can reduce N_2O emissions. It is anticipated that the project will have a positive impact in reducing at least 2.4 $MtCO_2eq$ and reduce the climate vulnerability of 253,400 direct beneficiaries.

Air quality: It is likely that straw burning activity will reduce during project implementation due to implementation of government policies, although the results from scientific reports show that the $PM_{2.5}$ in Chiangmai nonetheless increased between 2018-2021.[7] The project will actively promote SSM to prevent agricultural residue burning, which is considered the key source of $PM_{2.5}$. The project will implement straw management and promote utilisation of rice straw, including, for example, using straw as source of mushroom cultivation, bio-fertilizer and crafting goods inter alia by women associations in the community. This activity is expected to reduce straw burning after harvesting and hence reduce air pollution. Utilisation of rice straw for energy purposes is promoted by the Ministry of Energy under the Alternative Energy Development Plan (AEDP). Farmers will also have additional income from rice straw management. The promotion of straw utilisation through energy production, mushroom cultivation and local value chain products is in line with Thailand's policy of Bio-circular and Green economy.

Investment: The project implementation will include SSNM and IPM, which allows farmers to use appropriate amounts of fertilizer and pesticides applied to the field. Controlling the amounts of fertilizer and pesticide application can mitigate chemical contamination of waterways and soils. In addition, the use of smaller amounts of chemical fertilizer leads to lower farmer investments, which is beneficial to farmers as the price of chemical fertilizer is high and uncertain.

Social: Using new techniques such as laser land levelling (LLL) can replace conventional machines like tractors or hand ploughing machines and thus reduce workload during land preparation. LLL operation is usually done by local service providers on demand. High demand for LLL services may induce lower demand for local labour and service providers. However, introducing LLL into rice farming will create new jobs and reduce workloads during land preparation. Nevertheless, LLL operations can reduce the use of water and enhance the efficiency of AWD with reduced incidence of water-borne diseases and reduced pesticide used. It is anticipated that project interventions will increase the demand for LLL services. As detailed in the economic and financial analysis (Annex 3a), rice farming in all three project regions (Central Plains, North-East, North) currently produces only subsistence income (if at all) for farmers and their families. Rice farmers are among the poorest segments of Thai society. The adoption of climate-smart farming technologies and practices will produce a positive financial internal rate of return (IRR) – as described in Annex 3 – thereby increasing farmers' incomes. Moreover, because of the adaptation benefits conferred by these technologies and practices, farmers' incomes will also be less volatile in the context of climate variations. Some (limited) erosion of cultural traditions, such as ceremonies marking events in the traditional farming calendar, may be experienced as farmers adopt new technologies and practices (see ESS 8). But these traditions are in long-term decline due to other technological and market developments that are unrelated to the project and would be put under even greater stress if rice farming were to become unviable due to climate change. The project poses some limited SEAH risks (see Section 5.4.1) in the context of training and extension support and agricultural service provider activities.

[7] https://www.iqair.com/th-en/newsroom/thailand-2021-burning-season

ii) Indirect impact

Water quality: Thai farmers have grown accustomed to applying high amounts of fertilizer (more than 20-50 kg per rai). Most rice cultivation ecosystems in the Central region consist of irrigated rice with usually two cultivation cycles per year (in some areas five crops consecutively in two years are found). Over-use of fertilizers and pesticides results in leakage in some areas. Chemical overflow to waterways and their continuance in the soil can occur if overuse of chemicals and fertilizer is maintained in the long term. The project will implement SSNM, allowing farmers to control/lower the amount of fertilizer used. It is anticipated that the use of smaller amounts of chemical fertilizer will lead to reduced contamination of waterways. The Thai Rice Project aims at reduced water pollution and monitors developments through the Co-Benefit 2 indicator (see Funding Proposal).

Soil conservation: The impact of the project on the soil environment is negligible. An improvement system for rice soil is ongoing in the three targeted regions, led by the Land Development Department (LDD) and RD. Soil organic matter in the lower part of the Northern region is considered as medium to high with 2.01-3% organic matter content. On the other hand, organic matter in the Central plain is more than 4% which is a high to very high level. Soil organic carbon in the Central plain and the lower Northern region are in between 15-45 tonnes/ha. High Soil Organic Carbon (SOC) stocks can be found in the Central plain. It is likely that soil in the Central plain is more fertile than in the Northern region. Being supported by LDD, farmers and farmer groups occasionally meet with LDD to discuss soil improvement, particularly in areas with acidic soils. LDD is also supporting 'soil doctors', assisting farmers on a voluntary basis to solve soil problems during cultivation. In some areas a rotated crop such as jute is promoted in between the first and second rice growing seasons, aiming to improve soil fertility. RD usually communicates with soil doctors in the case of fertilizer application and soil improvement. This channel can be used to promote SSNM and IPM with local soil doctors. LLL (used to level soil during pre-cultivation stage) is a physical technology and will not influence soil composition directly.

Conflict: Distribution of water via the public irrigation system during the dry season or long intervals with little or no precipitation may cause lack of water for farmers located at the end of canals and farmers connected to secondary canals. This situation of water shortage may lead to competition between farmers and lack of trust in water management authorities, particularly in the Central Plain of Thailand as most farmers rely on the public irrigation system. The project will strengthen knowledge and built capacity of farmers, coordinate water management related interventions with local Water Usage Organisations, and support policy and planning in order to adapt to this situation. Further, conflicts between farmers and service providers may arise in the case of high demand of LLL services and the consequent non-availability or delay of services.

Social: A range of machines, spanning land preparation to harvesting, will be introduced and may replace human labour. This may, in turn, impact migration of local farmers and farm labourers to work in urban areas. The project will introduce CSA to farmers and increase the capacity of service providers, as well as promote loans and the Thai Rice Facility. It is anticipated that employment and local labour demand will actually be increased through the promotion of rice farming that is more sustainable, more robust in the face of climate change and which is able to access premium rice markets offering higher prices. The accessibility of loans and the Thai Rice Facility can facilitate farmers moving towards CSA technologies and practices. Thai farmers have a close relationship to the Bank of Agriculture and Agricultural Cooperatives (BAAC). During consultations with stakeholders during project preparation, farmers informed us that most of them

already have an account with BAAC as a channel to receive financial assistance from the government. BAAC also offers loans to farmers and service providers under certain conditions. The positive IRR associated with adoption of CSA technologies and practices will have indirect income benefits for the other members of farmers' households: on average, there are 3 such indirect beneficiaries – a spouse and two children.

iii) Cumulative impact

Rice standard: There are several rice standards used in Thailand, including the Sustainable Rice Platform (SRP), Good Agricultural Practices (GAP) and the Thai Agricultural Standard for Sustainable Rice (TAS). The CSA technologies and practices introduced by the project are in line with those standards and will gradually induce Thai farmers to transition to meeting these standards. This will raise the quality of Thai rice production as well as build competitiveness for rice exports. It is also anticipated that the income situation of farmers will stabilise or increase.

Biodiversity: Biodiversity in Thai rice fields is quite rich. The project will support the implementation of CSA (AWD, SSNM, IPM, etc.) for which preliminary surveys and literature identify no significant impact on biodiversity of rice fields. To evaluate the project's real impact on biodiversity may take time and thus needs to be monitored in due course. It is anticipated that the project's net impact on biodiversity is likely to be positive, but this expectation cannot be corroborated at this point in time.

Social: Income benefits for farmers and members of farming households will continue over time, enabling gradual accumulation of savings that can serve as a buffer against adverse economic shocks. The labour-saving nature of mechanised farming, such as the avoided need to carry heavy loads, will result in cumulative health benefits that manifest themselves in old age (e.g. reduced incidence of chronic back pain). Traditional societal bonds linked to traditional agricultural practices will continue to evolve.

iv) Unprecedented impact

Drone implementation: During stakeholder interviews, it was found that some farmers spray fertilizer and pesticides using Unmanned Aerial Vehicles (UAVs) such as drones (a practice prohibited in Thailand). However, UAVs occasionally deviate from anticipated routes, leading to off-target spreading of fertilizer and pesticides. If applied unintentionally on neighbouring fields, this may cause unintended and unexpected damage to cultivation on those fields.

False application of AWD: During the dry season (little precipitation, high temperatures), the soil of rice fields occasionally cracks after water drainage. Soil cracking leads to higher water use than common AWD when water is drained into the field. A lower amount of methane reduction can occur. Soil cracking can also lead to N_2O emissions occurring, trading off with the emission reductions of CH_4. It is therefore necessary to control the water level effectively during AWD implementation. The project will provide capacity development measures to farmers and extension services for the correct application of AWD and foster regional exchange and peer-to-peer learning to ensure effectiveness of CSA implementation.

Unwillingness to join the project: Farmers might be hesitant to participate in the project due to limitations of access to technologies and practices and to the financial measures of the project.

This might be due to communication difficulties with stakeholders, in particular elderly farmers with limited internet access, knowledge on modern media and mobile applications. The project's Stakeholder Engagement Plan is intended to enhance understanding of all stakeholders and to minimise this potential impact.

5.3.1.1.2. Assessment of organisational capacity and competency (ESMS)

The following section analyses the institutional capacities of the Executing Entities to implement the E&S mitigation measures.

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH: The institution is one of the largest international providers of capacity development and technical assistance on climate change worldwide. GIZ has been operating in Thailand since 1956. The GIZ country office currently employs 180 staff, the majority of whom work on climate change and/or agricultural issues. All GIZ projects are undertaken in close coordination with, and the approval of, the Government of Thailand, based on the Thai-German Framework Agreement on Development Cooperation.

With regard to E&S safeguarding, GIZ has ample experience, based on its long-term project implementation track-record. GIZ will ensure that project interventions are aligned with GCF and GIZ standards, as well as with rules and regulations of Thailand and lead the implementation of mitigation measures as laid down in ESMP and ESMF. With its ESMS (including the G+S Desk at headquarters level), GIZ will be able to coordinate, assist, advise and provide ESS related support to the Thai Rice Project.

Rice Department (RD) has the mandate to develop strategies, policies and plans related to rice production at both the national and international levels. This mandate includes rice technologies, varieties, production methods and standards. RD employs approximately 1,800 professional staff, including provincial officers. More than 50 regional RD centres operate in 28 provinces to support local research on rice and seed distribution. RD has experience in the development of the Thai Agricultural Standard for Sustainable Rice (TAS). The standard encompasses economic, social and environmental dimensions comprehensively, consistent with the E&S safeguards outlined in the present document. RD as a government organisation is bound by the Gender Equality Act, B.E. 2558 (2015). ESS and gender aspects are also included within the National Economic and Social Development Plan and Gender Equality Promotion Plan (Annex 2.64), which are updated every five years. Both documents are applicable to the whole of government. Consequently, RD has the institutional mandate to implement ESS by itself and by cooperation with other supporting organisations.

However, capacity building through training on specific issues such as climate scenarios, GHG mitigation measures, gender mainstreaming and ESS procedures and instruments, including technical support to further upgrading the ESS, are still needed.

Generally, RD's understanding of environmental issues and GHG mitigation measures and technologies is limited, as very few researchers work on these topics. In addition, English language barriers sometimes prevent staff from accessing the full scope of available information (especially staff at provincial Rice Research Centres). Further, staff turnover of researchers and officials and holding of temporary positions present challenges in terms of continuity of operations.

With regard to technical capacity, RD researchers at the Rice Research Centres are equipped with basic infrastructure, knowledge and skills. They have the capacity to take samples, analyse data, and monitor environmental and social impacts, as well as greenhouse gas emissions, related to rice farming due to projects related to rice and farmer development in Thailand. In addition, RD has gas chromatography (GC) instruments installed at four Rice Research Centres, namely Chainat, Prachinburi, Suphan Buri and Ubon Ratchathani. Each Centre's laboratory staff have reasonable levels of skill for analysing samples.

In order to implement E&S measures, RD should invest in additional capacity in this area, inter alia on the following key topics:

- Future climate scenarios as a basis for communication with farmers and other stakeholders on the impact of climate change on rice cultivation;
- GHG emissions and mitigation measures in the rice value chain, in line with sustainable development and standards as well as carbon credit schemes (notably, T-VER);
- Synergy areas with RID and DoAE in order to provide coherent guidance to farmers and further stakeholders (e.g. on farm-level water management and IPM);
- Environment and social impacts (including gender) and safeguards in rice production with the objective of environmental protection and gearing rice cultivation towards sustainability.

It is recommended to create a series of trainings for RD on the GCF ESS and the project's environmental and social documentation, including the ESMP, ESMF and Stakeholder Engagement Plan (SEP).

The Bank for Agriculture and Agricultural Cooperatives (BAAC) is a government-owned bank (99.8% Ministry of Finance and 0.2% agricultural cooperatives). BAAC is authorised to lend to farmers for agricultural-related activities and, more recently, for rural non-agricultural activities. It dominates lending to the agricultural sector in Thailand, accounting for 83% of total agricultural loans. BAAC not only provides soft loans, it is also involved in knowledge dissemination to farmers through numerous training programmes for different target groups, such as supporting community tree banks, training on the use of clean energy through BAAC community learning centres, adaptation to climate change, enhancing farming practices for dairy farmers, etc. The approach is to provide training to rice farmers related to environmental issues, e.g. on air pollution from burning of rice stubble/straw in rice field that cause air pollution (especially $PM_{2.5}$). BAAC launched a campaign and training to stop burning and provide recommendations for rice straw utilisation for additional income. However, there are no financial incentives or preferential loan conditions to support these practices.

BAAC has its own policy on "Social and Environment Responsivity" (Announcement 612/2065), and Corporate Governance & Social Responsibility that incorporate the topics of gender, safety, human rights, environmental conservation and protection, and quality of life. Further, it has an all-encompassing Corporate Governance document in the form of "BAAC's Code of Conduct" which is in line with Thailand's Constitution B.E. 2550 Article 279. The Code of Conduct incorporates environmental and social (E&S) topics, rule of law and human rights as well as gender policies to ensure their safeguarding within the institution. The document is built around the Sufficiency Economy concept as developed by the recently-departed HRM King Rama 9 and is aligned with the ISO 26000 CSR standard. BAAC's corporate policies explicitly promote appropriate and safe working conditions for employees as well as the promotion of gender and diversity issues (Principle 3 in BAAC's Corporate Social Responsibility Policy) as well as a clear stance against discrimination on the grounds of race and/or religion (as evidenced e.g. in BAAC's Sustainable

Development Report of 2020). In addition, Principle 4 of the aforementioned policy and BAAC's loan policy mandate that loan products may not negatively impact the natural environment, with an added emphasis to promote the restoration of ecosystems.

The capacity of BAAC in relation to ESS is addressed in BAAC's Sustainability Report 2021. In general, the bank has organised trainings and provided loan products aimed at achieving SDG 1 (poverty), 10 (inequality) and 13 (climate action) and aligns with the BCG model. It supports the tree bank project, green credit to support the production of safe food, the use of on-farm renewable energy, agri-tourism and eco-tourism. For example, corporate policies explicitly mention the recent construction of new BAAC headquarters using energy-efficient buildings and restoration of local ecosystems (e.g. providing sufficient green space in local landscape planning).

Nonetheless, E&S standards can be strengthened in BAAC. In general, the bank's focus of debt restructuring programmes is on farmers' increase of non-farm income and productivity improvements. There is no specific recommendation of the use of CSA technologies and practices in rice farming. In addition, the consideration of the loan approval is based on the value of collateral and availability of guarantors, not (CSA) practices applied by farmers. Although the programme of community tree banks and the green credit programme are well developed, BAAC does not plan to move towards carbon credits from rice cultivation. In addition, staff knowledge of GHG emissions and mitigation technologies can be improved. Further, E&S aspects are not yet taken into consideration for loan approval and loan restructuring.

The Office of Natural Resources and Environmental Policy and Planning (ONEP) has the mandate to formulate policies and implement measures to enhance and preserve environmental quality and natural resources in Thailand. ONEP has developed several training measures, some of which target increased capacity of government officers on the understanding of climate change and on environmental impact assessments (EIAs) of various types of projects. It has capacities with regards to conducting EIAs through established processes. It also has a policy on gender equality and an action plan on gender equality of the Environmental Fund, covering the period 2023-2027. In recent years ONEP has also cooperated with GIZ to build up its ESS competencies and capacities and other international standards.

ONEP has several Divisions involved in Environment and Social Safeguard issues. The Climate Change Management and Coordination Division (CCMC) acts as the UNFCCC designated National Focal Point and the National Designated Authority (NDA) of the Green Climate Fund (GCF) for Thailand. Its main role is to coordinate, support and work closely with key ministries and agencies to access and utilise both domestic and international measures, instruments and mechanisms to implement GHG mitigation and adaptation. ONEP is responsible for NDC development and the Long-Term Low-Emission Development Strategy (LT-LEDS). CCMC developed Thailand's GHG emission inventory system (TGEIS) and the handbook on measurement, reporting and verification (MRV) of the Thai GHG inventory. The Environmental Impact Assessment Division is responsible for justification and approval of government and private sector projects that require EIA reports in conformity with EIA regulations. The Division of Biodiversity Management focuses on biodiversity conservation policies and establishes guidelines, measures, criteria and mechanisms for implementation at national and international levels. This includes biodiversity management, biosecurity, access and sharing of benefits from genetic resources and wetlands. ONEP has issued a document of good practices and indicators for biodiversity in agriculture, including good practice for rice farming on biodiversity. The Environmental Fund Division (EFD) provides the financial mechanism to create incentives for the government sector, local governments, state enterprises, private sector and non-governmental organisations working on environmental issues to participate in environmental protection and

conservation and natural resources quality. ONEP also incentivises environmental measures for BOI investment and green loans with BAAC.

ONEP employs 437 employees in total (as of 30 September 2021), with 75% female employees. The organisation has an institutional ethics policy. ONEP policies, regulations and plans related to ESS are the Master Plan in Integrated Management of Biodiversity 2015-2021, the Master Plan on Climate Change 2015-2050, the Biodiversity Act (under development), the Climate Change Act (under development) and the Environmental Fund regulation, including the Environmental Fund Environmental and Social Safeguards Policy.

With the mandate to drive environmental policies and implementation at both national and local levels, ONEP has developed several capacity building measures, including: (1) Training on increasing capacities of government officers on the understanding of climate change; (2) Training of selected provinces to integrate climate change issues into their annual provincial plans and budgets; (3) Training on environmental impact assessments for various type of projects; (3) Training on health and safety in EIA reports. Thus, ONEP is well placed for the implementation of E&S safeguards implementation in the context of the Thai Rice Project.

ONEP has the institutional mandate to implement ESS, by itself and in cooperation with other supporting organisations. The Thai Rice Project will strengthen EFD's implementation capacities to complement ongoing GCF readiness support (EFD is currently seeking accreditation with the GCF), as well as providing technical and financial support to enable EFD to expand the scope of ThaiCI grant support to climate-smart rice agriculture.

The International Rice Research Institute (IRRI) is an independent, non-profit, international research and educational institute dedicated to reducing poverty and hunger through rice science, improving the health and welfare of rice farmers and consumers, and protecting the rice-growing environment for future generations. It is headquartered in the Philippines, has an office in Thailand and is a founding member of the Consultative Group on International Agricultural Research (CGIAR). IRRI has well established gender and ESS policies and implements these in its international projects. IRRI will therefore play an important role in transferring its relevant experiences on gender and ESS through the training of other Executing Entities and other relevant project stakeholders.

As IRRI has worked in the arena of rice research for a long time, it has accumulated knowledge on GHG emissions and mitigation technologies of rice cultivation, in particular in Southeast Asia where regional branches exist inter alia in Vietnam and Thailand. IRRI's role in the Thai Rice NAMA project encompassed capacity building for Thai farmers and government officials from rice research centres and DoAE local extension offices on mitigation technologies, GHG measurement and monitoring as well as sustainable cultivation practices.

IRRI has a robust set of policies and systems for addressing environmental and social risks, including: a Code of Conduct, a whistleblowing policy and procedure, a grievance resolution policy and procedure, an occupational safety and health policy, a risk management policy and an HR policy. IRRI, in alignment with CGIAR, is also fully committed to prioritising gender, diversity and inclusion at work to drive innovation and fulfil its mission. IRRI is aligned with CGIAR principles on this and is currently in the process of operationalizing these principles through the GDI (Gender, Diversity and Inclusion) Task Force. In addition, IRRI benefits from the CGIAR GDI knowledge hub as well as the CGIAR gender platform, which is designed to emphasize gender equality at the forefront of global agricultural research for development. IRRI has a zero-tolerance policy towards SEAH in the workplace and this is explicitly defined in IRRI disciplinary guidelines.

A number of relevant policy documents are in place and have been reviewed, including the “IRRI Code of Conduct” with specific provisions to SEAH, IRRI’s “Whistleblowing Policy and Procedure” and IRRI’s guidelines on “Harassment and Discrimination”. These policies will be implemented accordingly in the context of the GCF Thai Rice Project.

Most Thai rice farmers use local languages, with limited English language capacity. Therefore, IRRI researchers rely on local researchers as translator or assistants. This is needed to include local wisdom, traditions and customs of rice farmers in project implementation practices.

Impact rating: Medium

Several impacts show positive benefits, such as reduced greenhouse gas emissions, reduced fertilizer leachate into the environment, reduced water consumption, and improved air quality (less straw burning). Negative impacts may stem from indirect impacts, such as water quality and lack of water availability due to climate extremes. The project may also have cumulative impacts on biodiversity, agricultural standards improvement/adoption and farmers’ climate resilience, which are likely to be beneficial and permanent impacts. Cumulative impacts relate primarily to the improvement of the national sustainable rice standard (TAS), as well as farmer well-being: because climate-smart rice farmers will generate higher incomes, they will be able to accumulate wealth over time, thereby providing them with insulation against future socio-economic and climate shocks. The magnitude, scale and complexity of potential negative impacts is generally low (and no higher than medium) and can be addressed with the proposed mitigation actions.

The roles and responsibilities of EEs are well designed, with regulation of environmental and social safeguards in place. An ESM team will be established to support ESS implementation in project activities and sub-activities. The project will also create an EAC to oversee and give guidance to the ESM team to ensure project implementation is in accordance with the ESS standards of the GCF and GIZ.

The project has an environmental and social management system in place, with coverage of the required components of the GCF Environmental and Social Safeguards including policy, risk and impact, ESMP/ESMF, organisation capacity, emergency preparedness and response, stakeholder engagement, communication and grievance mechanism, reporting to community and monitoring and review.

The ESMP and ESMF are the key policy documents governing the project’s environment and social safeguards. The documents include ESS assessment, action plans, mitigation measures, monitoring and reporting, and budgets for actions.

The project has developed a Stakeholder Engagement Plan (Annex 7a) to ensure two-way communication of stakeholders is enabled and practised, and that information can be disseminated and considered in the project. A grievance redress mechanism will also be established to communicate and minimise unavoidable impacts if cases occur.

5.3.1.2. Grievance Redress Mechanism

According to the GCF’s E&S policy, the purpose of the Grievance Redress Mechanism (GRM) is to receive and facilitate the resolution of concerns and grievances about the environmental and social performance of GCF-financed activities. Full details of the project’s GRM are provided in

Annex 7a (SEP). In the context of the Thai Rice Project, the specific objectives of the GRM are to:

- Provide a communication channel to receive feedback and grievances from stakeholders (including, but not limited to, farmers, service providers, local authorities, NGOs and others), ultimately with the goal of resolving grievances amicably where possible and minimising the use of the legal system.
- Establish a grievance procedure with clear responsibilities and reporting lines in order to process stakeholder grievances in a timely and transparent manner.
- Establish a system for recording grievances and the measures (if any) put in place to respond to the grievances.
- Provide a separate GRM for SEAH-related grievances that reflects the particular gender, cultural and privacy sensitivities that can be associated with SEAH complaints.

The project's GRM is predicated upon the following basic principles:

- Transparency: the receipt and processing of grievances will be conducted transparently, in a culturally-appropriate and gender-sensitive manner, and in the appropriate language.
- Consistency: open channels of communication will be maintained between the claimant and the GRM for the duration of the grievance process.
- Accessibility: all stakeholders will be able to freely access the GRM.
- Disclosure: all grievances will be recorded and archived, regardless of whether the grievances are justified or not (the subsequent investigation will determine if the grievances are justified).
- Discussion: all justified grievances will be followed up by one or more discussions with the claimant – accompanied, if useful or relevant, by a site visit by a project representative.
- Privacy: the GRM will be consistent with Thai data protection law and will respect complainant confidentiality and privacy.

Two categories of grievance can be identified:

A grievance that is not related to project implementation. This occurs when a claimant raises a grievance that may geographically or temporally overlap with the project, but which nonetheless lies outside of the conceptual project boundary. This type of grievance is beyond the scope of the GRM. As per standard GRM practice (see below), a preliminary screening and investigation will be undertaken if a grievance is reported to the GRM.

A grievance that is related to project implementation. Such a grievance stems from implementation of project Outputs, Activities and Sub-Activities that lead to adverse impacts on stakeholders. This type of grievance can be direct or indirect:

- **Direct**: a project-delivered intervention fails to satisfy the recipient in some way.
- **Indirect**: a set of conditions established by the project may impose harm or inconvenience on a stakeholder. The grievance is not about a project-supplied service and the complainant may not necessarily be a targeted project beneficiary (for example, it might be a farmer outside the project boundary), but the grievance could probably not have arisen in the absence of the project.

A detailed description of the GRM is provided in Annex 7a (SEP). In brief, the project's GRM enables grievances to be reported through a number of channels, ensures all grievances are acknowledged and responded to within defined time-periods, and are systematically recorded. The GRM is predicated upon an escalatory model. Grievances are processed locally to the extent possible. Where the local-level Grievance Consideration Unit (GCU) is unable to address a grievance to the satisfaction of the complainant, the grievance is escalated to a GCU in the next level of the GRM hierarchy.

Processing Grievances

A grievance is initiated by a complainant. The complainant submits a grievance to the project, via the project website, phone number, a local project representative, a local event,a grievance boy located at an appropriate location or a local Damrongdhama Centre. This grievance is recorded, screened for scope eligibility by the ESS Manager and, if found to be eligible, is then processed and delegated to the appropriate GCU. In either case – eligible or non-eligible – the grievance submission is acknowledged to the complainant within a defined time period (5 days). The project's ESS Manager, a member of the Project Management Unit (PMU), is responsible for day-to-day management of the GRM and for maintaining systematic records of grievances received and how they are addressed.

The GRM is based upon an escalatory model. Grievances are processed locally to the extent possible. Where the local-level GCU is unable to address a grievance to the satisfaction of the complainant, the grievance is escalated to a GCU in the next level of the GRM hierarchy. GCUs are temporary structures that are convened to consider specific grievances and are then dissolved after successful resolution of the grievance or when the grievance is escalated up to the next level. This ensures that GCUs can be constituted with the appropriate technical, cultural or geographical expertise to address context-specific grievances.

There are 3 hierarchical levels in the GRM and complementarity with a fourth (GCF) level: local, national, GIZ, and GCF. At each hierarchical level, a grievance will be considered, and remedial actions proposed within 30 days of the grievance being first received (local level) or the grievance being escalated to the next level (national or GIZ).

Table 31: Steps to Resolve Grievances

Step to Resolve Grievance	Responsible Entity
Step 1: Submission of grievance to the project	Stakeholders
Step 2: Registration of grievance	GIZ officer records the claim
Step 3: Screening for scope eligibility	ESS Manager
Step 4: Investigate grievance by hierarchical levels	Consider and propose remedial actions by local-level GCU or national-level GCU or GIZ Thailand country office or GCF
Step 5: Closure of grievance	ESS Manager records, documents and formally closes grievance case

Table 32: Grievance Analysis According to Degree of Severity

Level of Grievance	Description	Actions
Not justifiable	Grievance or concern is not related to the project.	Communicate and explain real situation to claimant. Register as not justified.
Negligible	Grievance is related to project with no damage. Resolution can be done immediately.	Communicate and explain real situation to claimant. Solution will be considered based on the grievance treatment system.
Minimum	Grievance is related to project and causes small damage and/or over small area. Negotiation is required.	Communicate, explain real situation, disclose data and information if needed, discussion with claimant for solution. Solution will be considered based on the grievance treatment system.
Moderate	Grievance is related to project and causes moderate damage with expansion of area. Negotiation and consultation are required.	Communicate, explain real situation, disclose data and information if needed, discussion with claimant and any other stakeholder involved for solution. Solution will be considered based on the grievance treatment system.
Serious	Grievance is related to project and causes large damage and/or over vast area with difficulty to control.	Communicate, explain real situation, disclose data and information if needed, discussion with claimant and any other stakeholder involved for solution. If necessary, local-level GCU nominated to resolve the issue. Usually, nominated GCU contains a respected person in a village. Solution will be considered based on the grievance treatment system.
Catastrophic	The grievance is related to project and damage cannot be controlled; typically requires complicated resolution.	Consult national-level GCU for solution if grievance cannot be addressed by local-level GCU.

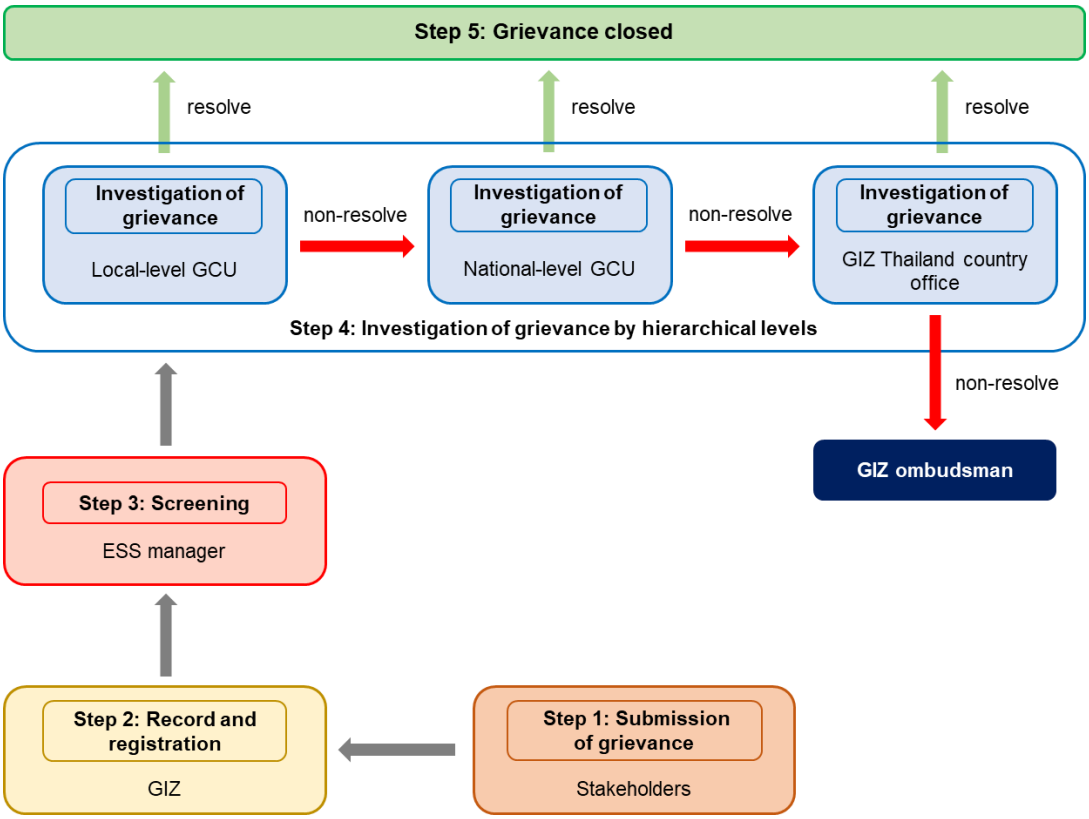


Figure 21: GRM Procedure Flowchart

SEAH-Related Grievances

SEAH-related grievances follow a different process, as they have the potential to be qualitatively different – and potentially more serious – than non-SEAH grievances:

- Potential conflicts of interest: the complaint may relate to the behaviour of a project stakeholder who might be involved in the consideration of grievances.
- Privacy: a complainant making serious allegations of sexual harassment or abuse may not wish his/her identity to be widely known.
- Gender and cultural sensitivity: a complainant, particularly if traumatized, may wish to discuss a grievance only with someone of their own gender or in a culturally acceptable context.

Accordingly, the Thai Rice Project incorporates a survivor-centered and gender-responsive GRM for SEAH-related grievances.

Individuals who wish to submit a SEAH-related grievance will be encouraged to use a dedicated project phone number (different from the general GRM phone number) or a dedicated project e-mail address (different from the general GRM e-mail address) which will be directly received by the ESS Manager. A full description of the SEAH GRM process will be provided on the project website as well as in project literature (leaflets, workshop notes, etc.).

Given the range of possible grievances, and the range of possible levels of seriousness of allegations, a one-size-fits-all model is not considered desirable. Nor also may the standard

escalatory model – start locally and then, if necessary, escalate to the national level and then the GIZ level – be appropriate: for example, if the allegations relate to local project representatives or if there is a danger of the identity of the complainant becoming known to the local community (against the wishes of the complainant).

SEAH-related grievances will always be considered with compassion and sensitivity. Where the ESS Manager is not best placed to lead the investigatory response (e.g., for gender or linguistic reasons), he/she will nominate a Grievance Focal Point who is better positioned to do so. The Grievance Focal Point may be a member of the PMU, a member of the broader project implementation team (e.g., an EE staff member) or an outside expert. In all cases, the Grievance Focal Point will be bound by tight confidentiality requirements.

As a starting point, the Grievance Focal Point will follow up with the complainant – by phone, e-mail or in-person (as appropriate) – to elucidate the details of the complaint and to understand the 'ground rules' that the complainant wishes to operate under (e.g., whether his/her identity is to be kept confidential, whether he/she is happy for other relevant stakeholders to be interviewed, what sort of resolution the complainant is seeking, etc.). This will then define the options available to the project to investigate the grievance and, if found to be legitimate, to put in place appropriate response measures. The Grievance Focal Point and the ESS Manager (if they are not the same individual) will, together, formulate a bespoke response approach based on the nature and seriousness of the allegations and the wishes of the complainant.

If a complainant is unhappy with the response approach that is developed or the actions that are proposed to address the grievance, the complainant can escalate the grievance to the GIZ Country Office.

5.3.1.3. Mitigation and management measures

- Strengthen communication to stakeholders, particularly farmers and groups of farmers to perceive and understand their needs and constraints in order to avoid competition over water consumption and competition for farming machines.
- Provide necessary knowledge and skills required for EE to increase understanding of ESS of GEF and GIZ and implementation of ESMP procedures throughout the project lifecycle.
- Build capacity of service providers to minimise the impacts of using drones and 'false AWD'.
- Enhance information and knowledge accessibility, including information of the Climate-Smart Loan scheme, to all level of stakeholders.
- Improve monitoring and reporting systems in relation to pollution caused by malfunctions of CSA technologies and improper usage.
- Implement the Grievance Redress Mechanism (as outlined in Annex 7a).

5.3.2. ESS 2: Labour and working conditions

5.3.2.1. Impact assessment

During the past decades, one important change in the agricultural sector, especially rice farming in Thailand, concerns labour shortages. Employment in the Thai agriculture sector has been diminishing in the decade between 2010 to 2019, which accounted for 20.44% of the total labour force. Decreasing employment in this sector partly results from labour moving to other economic sectors, especially the service sector which increased from 41.11% in 2010 to 46.09% in 2019. This is especially obvious for the mobility of young people. Consequences of this are that averaged age of rural farmers has increased and there are more houses with elders living without their children. For example, studies indicate that in 1987, 35% of those aged 15–24 years were agricultural workers, while in 2007 the percentage had decreased to 12%. However, for those aged 40–59 years the percentage of persons in agricultural work increased from 26% in 1987 to 46% in 2011, while among those over age 60, the percentage in agricultural work more than tripled from 4% in 1987 to 13% in 2011 (Tonsri, 2014). This demographic shift has occurred as Thailand has become more industrialized and young people discover that the hard work and high cost of farming produces an uncertain income, partly due to the dependence on weather patterns and fluctuating crop prices.

Although mechanisation has replaced some human labour and improved farmer efficiency greatly, rice farming involves intensive field work and care. It is commonly reported that rice farmers in Thailand usually face hazardous working conditions. For rice cultivation, these include high background noise levels from employment of machines and modern technology, moving heavy materials of more than 20 kg by lifting, pushing, pulling, twisting the body or stooping while sitting or standing most of the time, using fingers, hands and arms in a continuous abnormal posture (including twisting of the wrist), using hands or fingers to work with a machine or tool (e.g. using machines for ploughing), sitting or standing on vibrating machines (such as a tractors or harvesters), squatting or kneeling to work most of the time, and working on slippery surfaces.

A study surveying agricultural working conditions in different types of agricultural work (rice, flower, and vegetable farmers) in Thailand revealed that a large percentage (31%) of farmers reported having a spill of chemicals or pesticides onto their body or into their eyes. Other accidents that were reported frequently were cuts from sharp objects; falls on slippery surfaces; and being hurt by toxic animals, such as snakes and insects (Kongtip et al., 2018). There were significant differences in the reports of chemical/pesticide spills to the body or in the eyes by farm type, with rice farmers having the highest frequency of reporting (50%) and flower farmers the lowest (14%). Likewise, rice farmers reported the highest frequency of injuries from sharp objects (33%), while flower farmers reported the lowest frequency (13%).

The farmer surveys also indicate that when spraying insecticides during the rainy season (the season of most agricultural production and insect infestation), most Thai agricultural workers reported wearing long pants (56%), long sleeve shirts (75%), boots (68%), a cloth wrapped around their face (74%), and rubber gloves (55%). Less than half reported wearing cotton gloves (34%), a balaclava (39%), a disposable paper mask (35%), or goggles (17%). The behaviour of agricultural workers while spraying pesticides was classified into positive and negative pesticide exposure prevention behaviours. Most of the farmers in the study reported always using a range of good pesticide exposure prevention practices; 60% reported reading the label before using; 57% reported taking a bath after being soaked by pesticides; 65% reported always washing their hands before eating or drinking; 63% reported changing their contaminated clothing after

spraying; 63% reported taking a bath after spraying and 63% reported separating contaminated clothing from normal clothing when washing. When comparing the farming types, the flower/vegetable farming group reported the highest frequency of these good exposure prevention practices in all areas except “Before using a new pesticide bottle, you read the label,” a practice where the rice/vegetable farmer group reported the highest frequency (71%).

The Ministry of Labour has a regulation to protect agricultural workers; however, it only covers agricultural workers who are employees and who are employed all year round in cultivation. The focus of the regulation is on wages and benefits, not health and safety (Tajgman, 2006). Thai farm owners generally do not hire workers for 180 continuous days, so many of these provisions are irrelevant. Self-employed agricultural workers and those who work in the informal agricultural sector are covered by a guidance document from the Department of Labour Protection and Welfare. This guidance encourages all informal workers, including self-employed persons, to take care of their workplaces in order to promote safety and health at work and to meet applicable standards. However, currently there is no administrative structure for the effective administration of this notification or any provision of occupational safety and health services or consultation to informal sector agricultural workers to aid them in improving their working conditions (ESS4, Kongtip et al., 2018). For further details please see section on ESS4.

During consultation with stakeholders, it was identified that labour shortages are one of the important realities related to labour in rice farming in Thailand. This issue was raised by farmers in all three regions covered by the project. This is one of the reasons that makes farmers turn to machinery to minimise the labour use and time required for each step of rice cultivation. The issues extracted from consultations with stakeholders include:

- In Northern and North-Eastern regions, labour needs in rice farms are concentrated in the wet season as most rice farming is under a rainfed system. This can generate labour shortages and competition for farm workers. Occasionally foreign agricultural workers (most of them from Myanmar and Cambodia) are employed.
- Workload distribution among male and female farmers are mutually decided. There is generally no perceived pressure/ unfair work allocation. Men are prone to work on physically demanding tasks while female workers on management-related jobs. No child is forced to work in rice farming according to interviewed stakeholders.
- Generally, labour and working conditions are in compliance with law and regulations.
- So far, no complaints about illegal labour, sexual exploitation, abuse or harassment and discrimination in rice farming were reported.
- The project will have positive impacts by creating more jobs, especially those that relate to service providers who will bring new technologies into the project region. It is likely that the involvement of younger generations using modern technology, digital communication tools and social media will increase.
- There are concerns that the proportion of aged farmers is increasing (e.g. as observed from megafarm project member lists). Physically demanding work on the field for extended periods of time may not be appropriate as it is for the younger workforce.

Impact rating: Low

The project will be implemented through the employment of various technologies and mechanisms. The impacts of applying these technologies on labour and working conditions are evaluated as follows:

- LLL: this is a new technology. Introducing it will significantly reduce labour work during land preparation and field puddling, as currently without LLL land is levelled by using

machines, such as tractors. The current quality of land levelling according to information from farmers and LLL service providers is much lower than using LLL. Further, LLL will significantly reduce the use of water, and this will make AWD more effective. It will also lead to less incidence of water-borne diseases and less pesticides will be used. Introducing LLL is anticipated to create new jobs and reduce work load during land preparation. Therefore, it is envisaged that LLL will bring positive impacts to labour and working conditions in the project area.

- AWD: additional work may be needed to monitor the water level in the field with the application of AWD. It may also induce more weed growing in the rice field and thus extra care may be needed. However, this is not a laborious and time-demanding work. It is therefore assessed that application of AWD will bring positive water management impacts. However, negative impacts cannot be ruled out completely, but their potential level is anticipated to be “low” in the worst case. Monitoring during implementation will lead to further insights in this regard.
- Other technologies and practices (including SSNM, SSM, IPM) are unlikely to change the baseline of labour and working conditions. They are likely to increase attention of farmers and related stakeholders in with regards to work execution (e.g. measuring, monitoring and reporting variables associated with implementation of technologies and practices, such as the amount, type and timing of fertilizer and chemicals used and of straw collection). In order to achieve the anticipated positive adaptation and mitigation impacts, training and effective communication measures will be crucial.

Overall, it is therefore assessed that the implementation of the project will bring several positive impacts. Negative impacts, if any, will likely be very benign and will not result in worsening the baseline. The risk category of the impacts is therefore rated as “low”.

5.3.2.2. Outline of the mitigation and enhancement measures

Although the risk of the impacts for ESS2 is low, there might be some general mitigation and enhancement measures to ensure that negative project impacts, even if low, will be avoided and the positive impacts can be enhanced. Prioritized mitigation measures include:

- To avoid or minimise the chance of accidents during work, good understanding of technologies and practices will be implemented by the project. These should be explicitly and clearly explained to farmers and relevant stakeholders.
- Channels and methods need to be in place to allow farmers to timely communicate concerns and urgent matters to be settled, such as conflicts between employee and employer, consistent with the minimal requirement of labour law. Stakeholder engagement and the Grievance Redress Mechanism serve this purpose (see Annex 7a).
- The ESS team will serve as a service and advice point to consider labour and working condition issues related to project implementation.

5.3.3. ESS 3: Resource efficiency and pollution prevention

5.3.3.1. Project climate change mitigation impact

Assessment of GHG emissions from rice cultivation

Rice cultivation accounts for up to 50% (mainly methane) of total emissions from agriculture in Thailand. Any activity leading to a significant reduction of methane can therefore contribute significantly to overall greenhouse gas mitigation in the Thai agriculture sector.

There have been various measures proposed for mitigating CH_4 emissions in paddy fields through water management. Water drainage at appropriate timing during rice growth could significantly reduce CH_4 emissions (Minamikawa and Yagi, 2009). In central Thailand, for example, CH_4 emission was reduced by 35% by mid-season drainage (Towprayoon et al., 2005). Field drainage helps reduce CH_4 emission mainly by introducing oxygen into the soil and thereby inhibiting methanogenesis and promoting methanotrophic activity (Conrad and Rothfuss, 1991; Bender and Conrad, 1992; Conrad, 1996).

A precise water controlling technique, alternate wetting and drying (AWD), was introduced by IRRI in 2013 (IRRI, 2013). This technique controls water not to fall below a soil depth of 15 cm. Water consumption and CH_4 emissions were reported to be effectively reduced. Several studies indicate successful CH_4 mitigation by using AWD, while there are mixed results in the literature on the effects on N_2O and rice yields. LaHue et al. (2016) report a reduction of 60-87% in CH_4 emissions while maintaining a low N_2O emission level in a California paddy field through AWD. Grain yield was not affected by AWD or higher in AWD treatment compared to the control. On the other hand, Lagomarsimo et al. (2016) report that in a 2-year measurement in an Italian paddy field, a reduction of 70% water consumption and 97% CH_4 emissions was achieved by AWD. However, N_2O emissions were increased more than 5-fold under AWD as compared to permanent flooded fields. In the second year, with a 40% water saving, the reductions of rice yields and CH_4 emissions (13% and 11%, respectively) were not significant, but N_2O fluxes more than doubled. Carrijo et al. (2017) conducted a meta-analysis on the effects of AWD on rice yield and found that when water level is controlled not to drop below a soil depth of 15cm, the AWD effects on rice yield is not significant.

Chidthaisong et al. (2018) studied the impacts of AWD during five crops (3 dry and 2 wet seasons), and three treatments of water management were compared: Continuous Flooding (CF), flooding whenever surface water level declined to 15 cm below the soil surface (AWD) and site-specific AWD (AWDS) that weakened the criteria of soil drying (AWDS). Methane and nitrous oxide emissions were measured by a closed chamber method. Rice grain yield did not significantly differ among the three treatments. The amount of total water use (irrigation + rainfall) was significantly reduced by AWD (by 42%) and AWDS (by 34%) compared to CF. There was a significant effect of treatment on the seasonal total methane CH_4 emissions; the mean methane CH_4 emissions in AWD were 49% smaller than that in CF. The seasonal total nitrous oxide N_2O emissions did not differ among treatments. The contribution of nitrous oxide to the GWP ranged from 39-62% among the three treatments in the dry season but from 3-13% in the wet season. The results indicate that AWD is feasible in terms of GHG mitigation, rice productivity and water saving in this site, especially in the dry season.

Recent studies in the Central region indicate that AWD reduces GHG emissions in all studied sites, with a reduction potential of 10-45% compared to continuous flooded rice fields (Figure 22).

Assessment of rice straw burning

Rice straw burning has been practised in rice cultivation for a long time. However, recent regulations to reduce air pollution have been introduced in Thailand. The problem is especially severe during the off-season in the Central and Northern regions of Thailand (Tipayarom and Oanh, 2007). Farmers aim to increase crop outputs through planting several cycles of rice. Many choose to burn the straw as it helps saving costs and eases land preparation. According to a recent study, burning is also common for other cash crops including sugarcane and maize (Attavanich and Pengthamkeerati, 2018). Burning mostly occurs in off-season rice farms, which accounts for 57%, then followed by sugarcane farms 47%, maize farms 35%, and wet season rice farms 29% of the total burned areas.

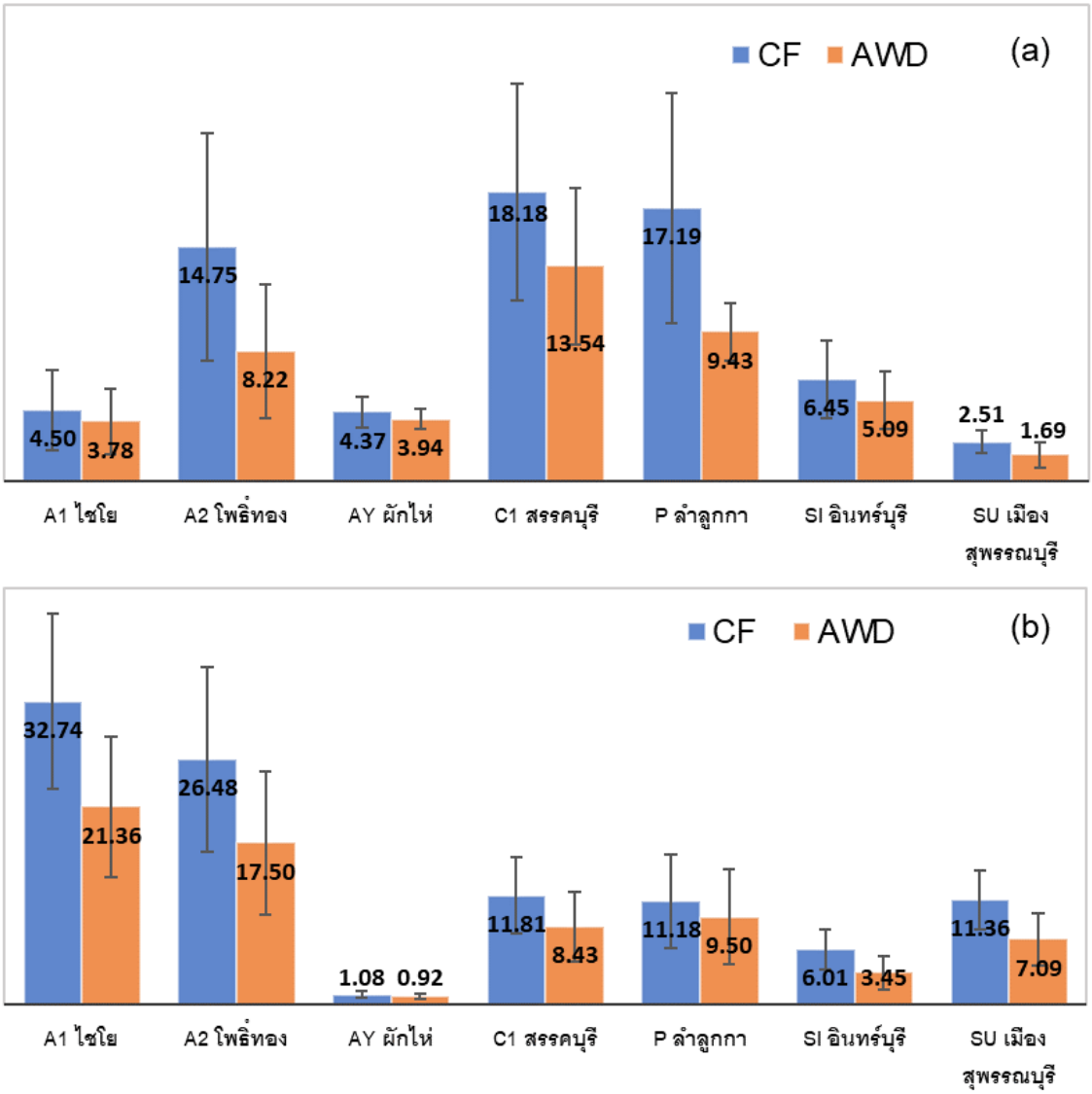


Figure 22: Total emission (t CO2eq ha-1 season-1) from wet season rice (a) and dry season rice (b) during the growing season 2019/20 (A1 and A2 were in Angthogg, AY was in Ayuttaya, C1 in Chainat, P in Pathumthanis, SI in Singburi and SU in Suphunburi, respectively

Beside the effects on air pollution, straw burning also causes negative impacts on farmland (Figure 23). According to the LDD, such negative impacts include the following: 1) burning can modify soil structure such that soil tends to be more compact and harder. This can prevent the penetration of roots, thus reducing their capacity to absorb nutrients and make them more susceptible to pests and diseases; 2) loss of organic matter and soil nutrients: carbon is converted to CO_2 and CH_4 (incomplete burning), and soil nutrients may be converted into forms unsuitable for plant uptake; 3) burning can kill beneficial insects and microbes, especially those associated with atmospheric N_2 fixing bacteria, phosphorus transformation; and 4) loss of soil water.

Figure 23: Burning of rice straw in Thailand is a common practice.

Junpen et al. (2018) estimate that every year 61.87 Mt of rice residue are generated, comprising 21.35 Mt generated from irrigated fields and 40.53 Mt generated from rain-fed fields. About 23.0% of the total rice residues generated are subject to open burning – of which nearly 32% are actually burned in the fields (Figure 24). The emissions from such rice residue burning consist of 5.34 Mt CO_2, 44 kt of CH_4, 422 kt of CO, 2 kt of NO_X, 2 of SO_2, 38 kt of $PM_{2.5}$, 43 kt of PM_{10}, 2 kt of Black Carbon (BC), and 14 kt of Organic Carbon (OC). According to air quality trends, the results show the higher level of PM_{10} concentration is due to the agricultural burning activities, as reflected in the higher monthly averages of the months in which agricultural burning occurs, by around 1.9 - 2.1 times (Figure 25).

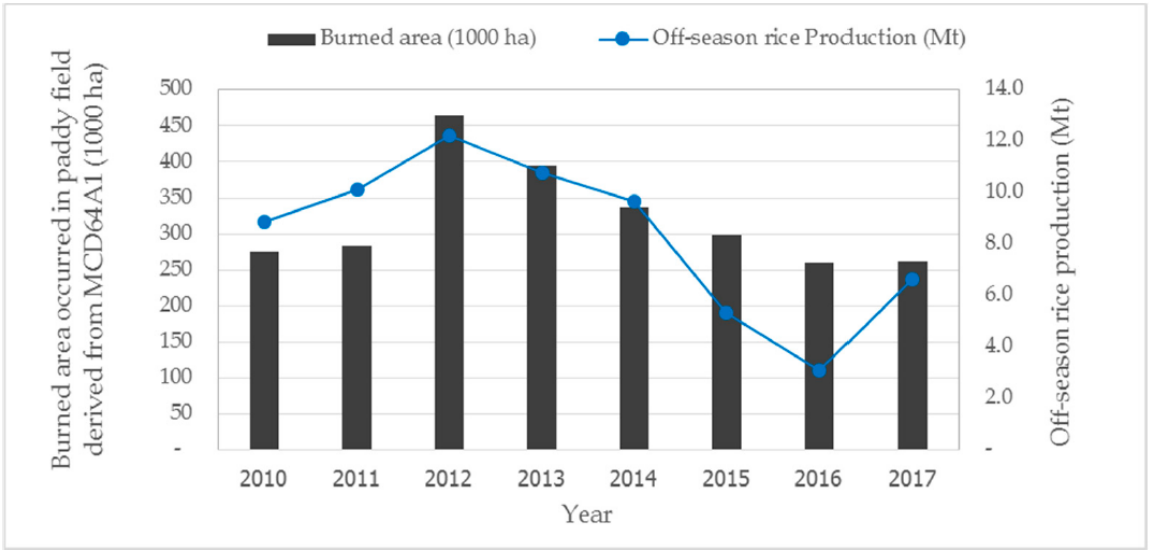


Figure 24: Annual temporal distribution of burned areas occurring in paddy fields, derived from satellite images and planted area of off-season rice in Thailand during 2010–2017
Source: (Junpen et al., 2018).

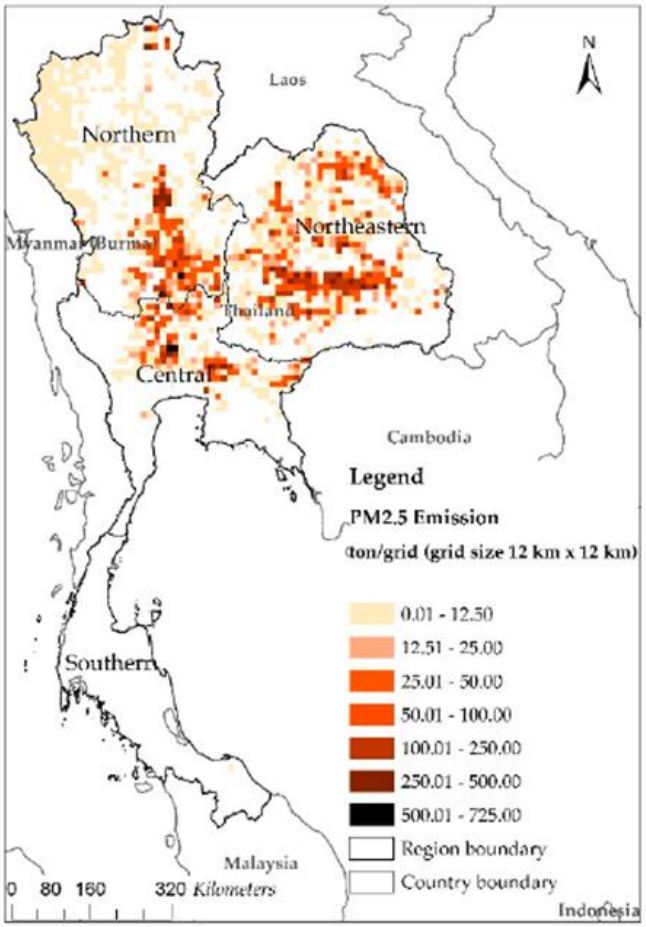


Figure 25: Spatial distribution of annual $PM_{2.5}$ emissions from rice residue open burning of rice straw
Source: (Junpen et al., 2018).

A study by Deuja et al. (2022) indicates that compared to a Business as Usual (BAU – 100% rice straw burning) scenario, the damage to human health related to $PM_{2.5}$ emissions from open burning of rice straw increases health impacts by 81.1%. The study also points out that, in 2019, the Global Burden of Disease (GBD) study ranked $PM_{2.5}$ exposure as the 6th-highest global mortality risk factor and the 7th leading risk factor in Thailand. An assessment of the impact of alternative scenarios demonstrates that adopting rice straw management techniques, animal feed and electricity production individually can reduce health damage efficiently compared to open burning. A vast economic benefit of 242 billion THB could be generated. Both the health impact and economic benefit assessments were able to corroborate the efficiency of alternative rice straw utilisation techniques in comparison to open burning, both when integrated or carried out individually.

Assessment of pesticide use

Agricultural production in Thailand relies heavily on pesticide use as a powerful tool to reduce loss and damage from diseases, pests and insects. In most cases, it is almost impossible to grow crops and achieve productivity as expected without the use of pesticides. Although recent statistics indicate that the import of chemicals used in agriculture are declining (implying the decreasing use), more than 136,100 tonnes are still used annually (Figure 26). The most common type of pesticides imported are herbicides, followed by insecticides and fungicides (OAE, MoAC 2021). Most farmers report the use of some type of pesticide once a month. This aligns with a study by Sapbamrer and Nata (2014) that reported 78% of rice farmers in Northern Thailand used pesticides one time a month or less. However, others have reported even more frequent pesticide use, with farmers reporting applications an average of 3 to 4 times a month (Panuwet et al., 2008; Kachaiyaphum et al., 2010).

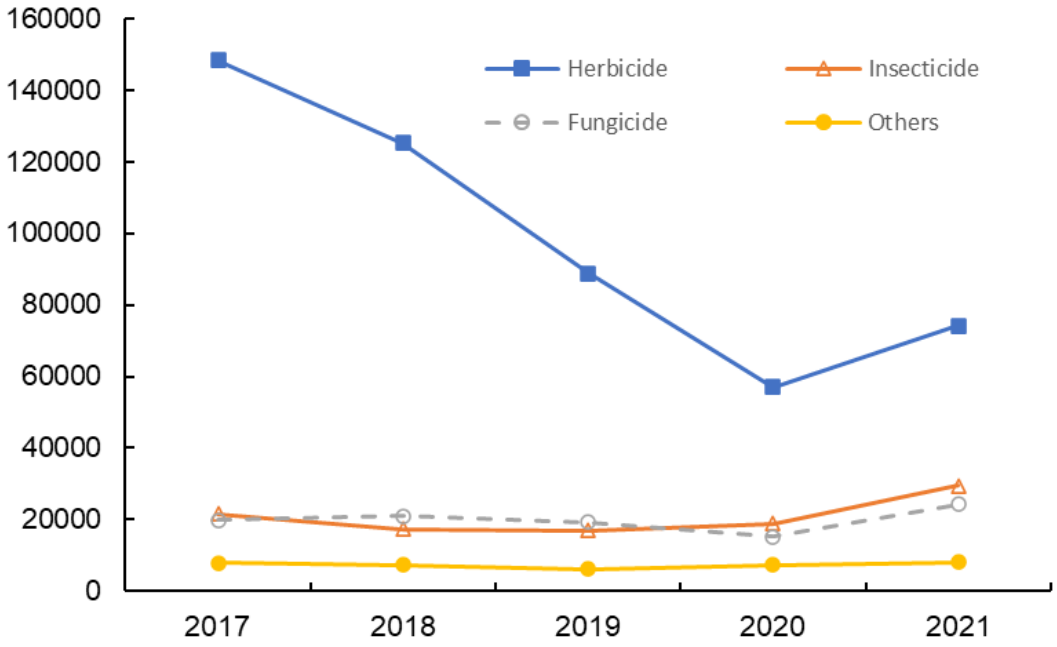


Figure 26: The number of imported pesticides during 2017-2021
Source: (OAE, 2022).

Pesticides are regulated under the Thai Hazardous Substance Act of 1992 (last amended in 2008). Under this Act, the Department of Agriculture controls the registration, production, distribution, and sale of pesticides. However, once registered, there is little or no control on the end use, sale or disposal of registered pesticides, nor are there training requirements for users. There are reported to be more than 26,000 retailers licensed to sell more than 20,000 pesticide formulations available in Thailand, and there are no restrictions on the advertising or sale of these products (Panuwet et al., 2012). Recommendations to improve the regulation of pesticide sales and to require mandatory training for agricultural users of pesticides have not been implemented to date (Kaewboonchoo et al., 2015).

At present, there are approximately 400 Active Ingredients (AI), that include formulations with differing percentages or combinations of AIs, registered for importation. Over 20,000 pesticide formulations (accounting for 80% of all pesticides used in Thailand) are licensed for production (Danutra, 2004). The certificate of pesticide registration lasts for six years and can be renewed upon expiration. The registration process of new pesticides includes efficacy testing and analysis of their chemical and toxicological properties. The responsibility for efficacy testing is put upon manufacturers and must be performed according to an experimental design approved by the Office of Plant Protection Research and Development (OPPRD) of the DOA. Recent regulations require that new pesticides must undergo evaluation of Pre-Harvest Intervals (PHIs) and Maximum Residue Limits (MRLs) under supervision of the Office of Agricultural Production Science Research and Development (OAPSRD) prior to registration being granted. Presently there are 1504 pesticide products that have established PHIs (Panuwet et al., 2012).

At present, there are over 26,000 retailers licensed to directly sell agricultural chemicals (with no restriction except correct product information), including pesticides to any buyers or farmers as long as the products are legal to sell. However, many more unlicensed pesticide retailers exist. Due to the large number of unlicensed retailers, the point of sale is ineffectively controlled, resulting in the purchase of unregistered pesticides, substandard pesticide solutions, and the sale of prohibited pesticides (Panuwet et al., 2012).

A study by Trung et al. (2022) indicates that rice farmers tend to apply pesticides more than needed as they do not want to take any risk of crop loss. The study suggests that policies providing crop insurance and enhancing farmers' awareness on proper input application are critical to mitigate the adverse impacts of overuse and reducing the inefficient use of these chemical inputs. With regards to the use of chemicals in rice farming the following features can be observed: (1) farmers lack of knowledge about optimal levels of input use; (2) significant influence of input suppliers; (3) weak management from authorities; and (4) risk aversion under uncertainties caused by fake products, asymmetric market information of inputs, soil quality, pests and diseases and climatic variability.

Sapbamrer and Nata (2014) report that the number of pesticides used by rice farmers in Thailand varied by type, with 26% of the pesticides reported classified as insecticides, 50% herbicides, and 23% fungicides. In previous work, rice farmers in Northern Thailand reported more use of insecticides (85% reported use) and herbicides (63% use) but less use of fungicides (7%). Thai rice farmers commonly grow rice in the rainy season when grasses and weeds grow very quickly, which may have contributed to the higher reporting of herbicide use. Insecticide use depends on the types of pests, so may vary by location and season. Rice farmers in this study did not use organophosphate (OP) insecticides; they used pyrethroids (31%) and carbamates (17%).

In general, rice farming does not significantly cause pollution to public water bodies, as the level of concentration is relatively low compared to other crops. For example, PCD (2001) reported that

the Biological Oxygen Demand (BOD) of rice farming water is around 2.4 and 3.2 mg L^{-1} for transplanted and broadcasting rice, respectively. Pollutants from rice farming can be approximated around 1.75 kg rai^{-1} $year^{-1}$. Rice farming practices that reduce the water drainage out from the field have become common practice, which significantly helps to reduce the pollutant loads to water bodies.

Assessment of water consumption

The development of a modern irrigation system in Thailand began when the Chao Phraya Project was constructed in 1951. The project was to benefit the lowland rice farmers in the Central Plain (Isvilanonda and Poapongsakorn, 1995). In Thailand, most large and medium-scale irrigation projects were implemented by the government under the National Economic and Social Development Plans (NESDP). From the 1st to the 5th NESDPs, the expansion of irrigated areas has taken place at a significant rate (average 7.53% annually) or increased from 1.56 to 3.91 million. High investment costs, long gestation periods and low rates of return on investment in a later period led to the shift in investment priorities to small scale projects during the 1990s and 2000s, resulting in a slower growth in irrigated area since the 6th plan. Currently, the irrigated areas cover about 23.9% of the total cultivated area. A potential for further expansion of irrigated area is limited because of rapid increase in the cost of irrigation development, and the growing concern for adverse environmental conditions of irrigation projects. During the 7^{th} and 8^{th} NESDPs (1992-96 and 1997-01), the Royal Irrigation Department concentrated on improving water distribution systems for both state owned and private irrigation projects.

The amount of water use varies according to the method of rice farming. Direct seed broadcasting requires on average 1066 m^3 rai^{-1} or 666 mm, transplanted rice requires a little bit higher amount of water around 1140 m3 rai-1 (PCD, 2021).

Field experiments were set up at 7 Amphors in 6 Provinces in the Central region of Thailand including 1) Amphor Chaiyo, Angthong province 2) Amphor Phothong, Angthong province 3) Amphor Pakhai, Phra Nakhon Si Ayutthaya Province 4) Amphor Sankaburi, Chainat province 5) Amphor Lamlukka, Pathumthani province 6) Amphor Inburi, Singburi provinve and 7) Amphor Muang, Supanburi province. With two seasonal cultivations, AWD reduces water consumption by 13-75% (Figure 27).

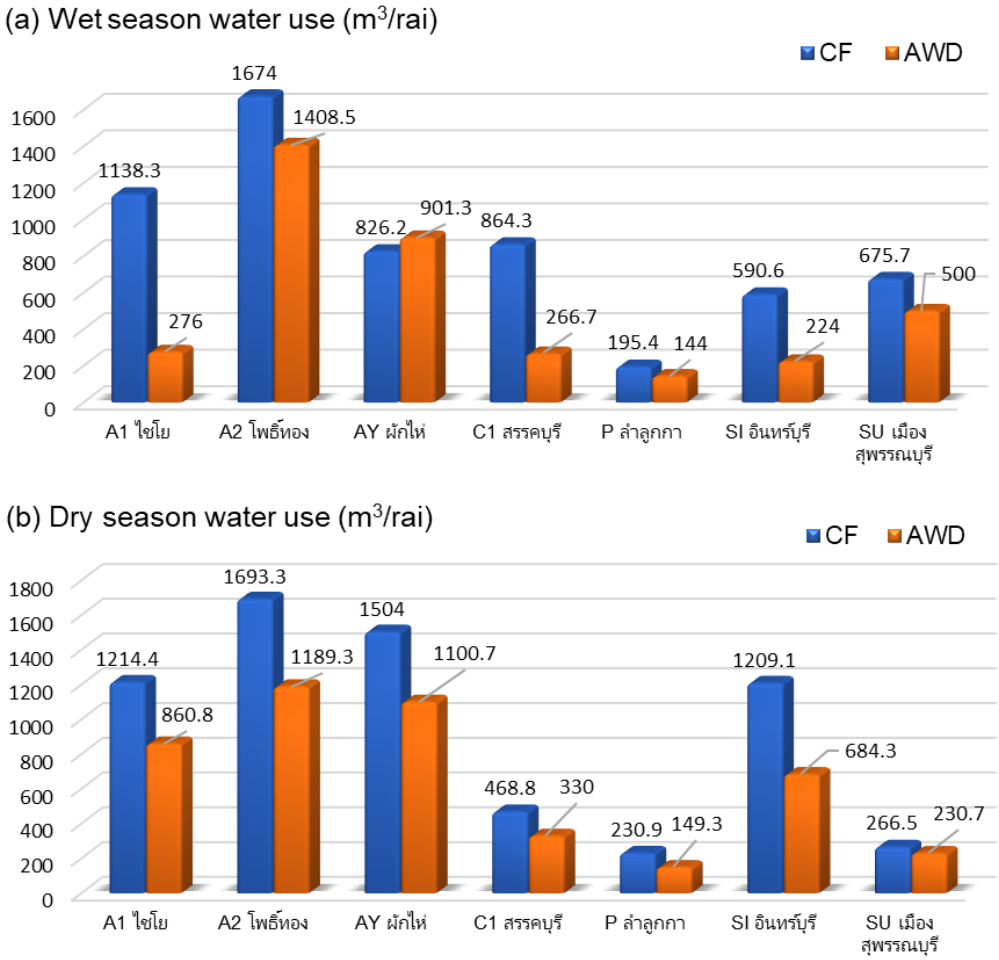


Figure 27: Water consumption and the impacts of applying AWD on water use (A1 and A2 were in Angthogg, AY was in Ayuttaya, C1 in Chainat, P in Pathumthanis, SI in Singburi and SU in Suphunburi, respectively).

Assessment of fertilizer use

Information on the use of fertilizer in rice farming is available in several statistical reports from official agencies, such as the Office of Agricultural Economics (OAE). The values for 2557/2558 growing season in the project implemented provinces are shown below. Against the rate of fertilizer use, the average rate for North, Northeast and Central are 34.59, 26.72, and 43.44 kg rai^{-1} for the growing season 2019/2020 (OAE, 2022).

Table 33: Fertilizer application rate for rice cultivation in the wet season in each province.

No.	Province	Fertilizer application rate (kg rai^{-1}) in 2019/2020 wet season
1	Chaingrai	28.75
2	Chiangmai	30.86
3	Nakorn sawan	42.51
4	Pitsanulok	35.72

No.	Province	Fertilizer application rate (kg rai^{-1}) in 2019/2020 wet season
5	Ubon Ratchathani	26.77
6	Srisaket	33.27
7	Burirum	33.48
8	Roiet	30.38
9	Surin	34.93
10	Nakornratchasrima	27.13
11	Kalsin	30.40
12	Lopburi	40.08
13	Singburi	50.79
14	Chainat	47.65
15	Suphunburi	46.76
16	Angthong	48.48
17	Pichit	38.20
18	Uthaithani	35.18
19	Kampheangphet	34.80
20	Ayuttaya	46.36
21	Pathumthani	47.08

Prior to the commencement of the project, studies were carried in some of the project areas. The results clearly indicate that farmers usually apply more fertilizer than it is needed, as determined from soil analysis on nutrient requirements. Many studies have suggested that application of fertilizer based on soil analysis or site-specific nutrient management (SSNM) lead to higher grain yield, income and net benefits than under BAU practices (Table 34).

Table 34: Comparison of fertilization rate between farmer practices and recommended rate.

Site name/Province	Type of chemical fertilizer (kg rai^{-1})	
	Farmer practice	Rate recommended from soil analysis
Chaiyo/Angthong	18-46-0, 0-0-60 (11, 8 kg)	46-0-0, 18-46-0, 0-0-60 (5, 0, 0 kg)
	16-8-8 (8 kg)	46-0-0 (4 kg)
	-	46-0-0 (4 kg)
Phoethong/Angthong	46-0-0, 16-20-0 (10,15 kg)	46-0-0, 18-46-0, 0-0-60 (5, 0, 0 kg)
	20-4-4 (25kg)	46-0-0 (4 kg)
	13-3-21 (25kg)	46-0-0 (4 kg)
Pakhai/Ayuttaya	46-0-0, 18-46-0, 0-0-60 (5,10,5 kg)	46-0-0, 18-46-0, 0-0-60 (5, 0, 0 kg)
	16-20-0 (25 kg)	46-0-0 (4 kg)
	-	46-0-0 (4 kg)
Sankaburi/Chianat	46-0-0, 0-0-60 (4.1, 8.3 kg)	46-0-0, 18-46-0, 0-0-60 (2, 7, 0 kg)
	46-0-0,18-46-0,0-0-60 (4.2,4.2,4.2 kg)	46-0-0 (4 kg)
	46-0-0 (10 kg)	46-0-0 (5 kg)
Muang/Suphanburi	18-46-0, 0-0-60 (11,8 kg)	46-0-0, 18-46-0, 0-0-60 (2, 7, 0 kg)

Site name/Province	Type of chemical fertilizer (kg rai^{-1})	
	Farmer practice	Rate recommended from soil analysis
	46-0-0 (8 kg)	46-0-0 (4 kg)

Stakeholder consultations additionally raised the concern that the issue of soil health and soil fertility must not be ignored. Repeated and intensive use of farmland, especially in the Central region where 2-3 crop cycles are common, may result in soil quality deterioration. Prevention measures and monitoring of soil health should be performed during project implementation. Additional points raised during consultations are:

- Contamination of water bodies from chemicals and fertilizers is an issue of concern (see also ESS1);
- The spraying of chemicals by drone practised by some farmers, but not currently being legal nor promoted by the project, may affects vicinity areas where other crops are cultivated;
- AWD needs relatively effective ways (timely and sufficiently) to manage water among farmers. Insufficient water quota/allocation can induce competition within farmer groups and lack of trust in public water management system. Careful and fair management, good and effective communications are needed to avoid conflicts;
- The degradation of soil quality and fertility has emerged as a concern as less attention is paid to conserve and protect the soil as a valuable resource by farmers. Viable measures should be enforced throughout project implementation. Meaningful engagement of "Soil Doctors" to support farmers is crucial.
- The level of understanding of farmers on weather conditions and forecasts, on availability of water and on environmental protection in general is still low. Capacity building and knowledge dissemination on the named issues are highly needed.
- The project has anticipated positive impacts on reduction of GHG emissions, the amount of water, air pollution from rice straw burning, fertilizer and chemical uses, promotion of the safe use of chemicals. It will promote circular economy mainly through straw utilisation and commercialisation.

Impact rating: Low

From the above information, the implementation of CSA technologies and practices by the project will have several positive impacts. They include:

- Significant reduction of CH_4 emissions through the application of LLL and AWD.
- The emission reductions of N_2O will be achieved through the reduced amount of fertilizer used. The current baseline is that fertilization rate practiced by farmers is on average about two times higher than the optimum fertilization rate implied by soil analysis. This could also lower the cost of fertilizers and other associated costs (such as labour costs) and reduce negative environmental impacts.
- Proper straw and stubble management will reduce air pollution problems.
- Project activities that promote straw baling will be very helpful in reducing pollutant emission from straw burning, as well as generating additional incomes to local farmer communities.
- IPM will help reduce the contamination of chemicals in air, soil and water bodies.
- Other measures, such as farm-level water management, rice variety diversification and dry direct seeding, will have positive impacts on resource use efficiency. Some of these measures will lead to reduced greenhouse gas emissions.

Nevertheless, some negative impacts could possibly occur, including:

- Effects of rice cultivation on soil, lowering its quality and productivity. Although reduced chemicals and fertilizer amounts will be used, their use is still necessary. The impacts on environment and society will thus still persist. It is important that farmers understand which practices, procedures and products are appropriate and safe to use. The aim is that environmental contamination and health impacts can be avoided or minimised.
- Burning of rice straw will still occur despite the project's interventions. Monitoring, reporting and effective communication is still necessary.

5.3.3.2. Project carbon footprint

The project management and technical assistance activities may release a certain quantity of greenhouse gases, for example from travel and meeting activities. During the project preparation phase, most of the meetings have been done via online mode or by project staff based in Thailand; thus, only a very small amount of greenhouse gas emissions has been emitted from travel activities. During the other phases of the project, it is also foreseen that greenhouse gas emissions will be relatively low. Emissions from international air travel will be offset as per common GIZ practice.

The project activities will not generate more than the IFC reporting requirement of 25,000 tonnes or more of CO_2 annually. Although the amount of CO_2 that the project will generate has not been calculated, one of the main objectives of the Project is to have a positive impact on GHG emissions since the implementation of CSA technologies and practices will significantly reduce GHG emissions. Therefore, rather than generate emissions, the project will contribute to a significant amount of GHG reduction. The project is not expected to generate unintended negative impacts that exacerbate the vulnerability of local people or ecosystems to climate change. Further, the project is expected to positively contribute to adaptation through increasing the resilience of local livelihoods and ecosystems.

5.3.3.3. Outline of the mitigation and enhancement measures

- Generally, Thai farmers are well aware of the dangers associated with the use of pesticides. However, there should be mechanisms to ensure the appropriate use of hazardous chemicals (safety measures) and the treatment of hazardous waste. This can be achieved through training and capacity building.
- A system for recording the amount and type of chemical and fertilizer used in rice cultivation should be established (see logical framework for the respective indicator).
- SSM and alternative use of rice residues in the local economy (e.g. in energy generation[8]) will reduce burning and thus air pollution and negative health impacts. Nonetheless, burning of rice straw will still occur despite project interventions. Thus monitoring, reporting and effective communication is still necessary.
- Crop rotation should include carefully selected plants such as leguminous plants that can help improve soil conditions.

[8] There are examples where straw is in demand for use for energy. Large farms in Thailand (such as SCG) have set up energy pellet factories, e.g. in Ayuttaya. This factory provided crucial support to the Zero Burn Scheme in Sena District. Farmers can transport straw bales to the factory, to be transformed into energy pellets, which will then be hauled to feed as fuel to The Siam Cement (Kaeng Khoi) Co., Ltd. and The Siam Cement (TaLuang) Co., Ltd. (https://www.scgsustainability.com).

- Establish soil evaluation and monitoring mechanisms to track the change of soil health and quality status, including contamination by chemical use. Soil doctors may play an important role in communicating the appropriate measures for soil conservation.

5.3.4. ESS 4: Community health, safety and security

5.3.4.1. Impact assessment

Agriculture, particularly rice cultivation, involves a wide range of different types of machinery, working in both indoor and outdoor environments under widely varying geographic and climatic conditions. Agriculture is in fact one of the most hazardous sectors and many agricultural workers suffer occupational accidents and ill health each year Farming is associated with an increased risk of health problems: there are musculoskeletal disorders, respiratory diseases, hearing loss, and hypertension. The contributory causes of such accidents and ill health are many, but often include (ILO, 2011):

- Working with machines, vehicles, and tools,
- Exposure to chemicals, organic substances, infectious agents and dust,
- Lifting heavy weights and other work inducing musculoskeletal disorders,
- Exposure to excessive noise and vibration, and
- Exposure to extreme temperatures, inclement weather, flood and drought conditions.

In Thailand, a study of the health problems of farmers uncovered illnesses caused by pesticide exposure, skeletal and muscular dysfunction, and respiratory disease. It was discovered that 88.77% of farmers in Thailand had waist pain and 66.30% had back pain. In addition, 83.20 % had been involved in an accident while farming, 65% had chemical exposure-related symptoms, and 76% had skeletal and musculoskeletal symptoms. Yaruang and Suhonthasarn (2016) reported that the majority of the farmers in Chiang Rai province (75.06%) has occupational safety behaviours at a moderate level. In terms of general health perception, it was found that 92.27% of participants at a moderate. The results of screening blood tests for cholinesterase were found to be 9.98%, 40.65% of farmers operating in levels of insecurity and risk.

A report of the Bureau of Occupational and Environmental Diseases, Department of Disease Control, Ministry of Public Health in 2017 found that pesticide poisoning was diagnosed in 10,312 people, a rate of 17.12 cases per 100,000 populations (BOED, 2018). The province with the highest morbidity rate was Satun (144.06), followed by Phrae (127.26) and Uttaradit (116.16), respectively (Figure 28).

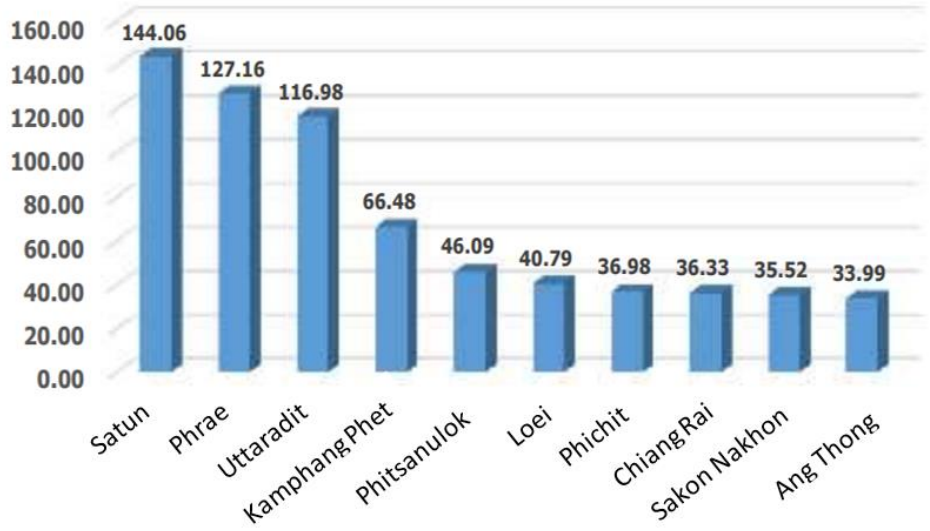


Figure 28: Pesticide poisoning caused the most morbidity in the first 10 provinces in 2017 (morbidity rate per 100,000 populations)
Source: (BOED, 2018).

The age group with the highest number of patients is 15-59 years, with 7,079 cases, representing 68. 65% , followed by 60 years and older, with 2,670 cases, and under 5 years of age, with 346 cases, representing 25.89% and 3.36%, respectively (Figure 29). The occupation group with the highest number of patients is upland crops and vegetable growers, with 5,344 cases, or 51.82%, followed by general labourers with 2,057 cases, or 19.50%, and unemployed individuals with 699 cases, or 6.88%.

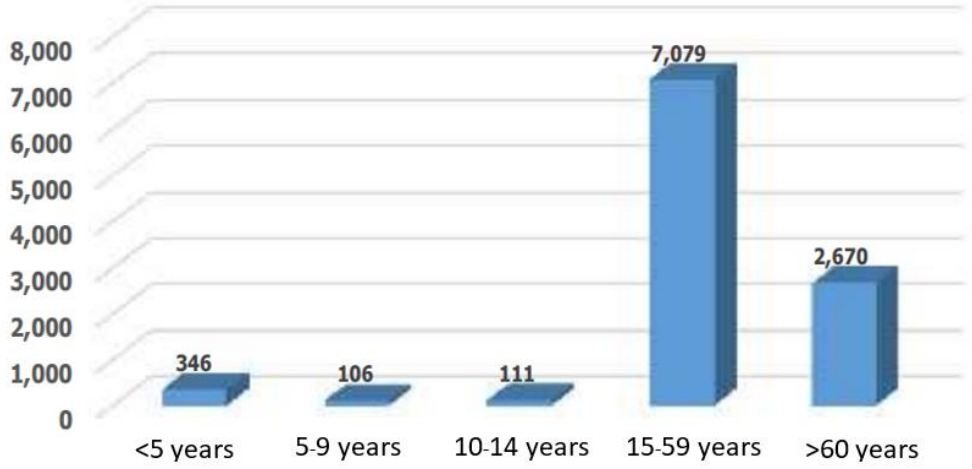


Figure 29: Number of pesticide poisoning cases in 2017 classified by age group
Source: (*BOED, 2018*).

As a result, working conditions on Thai farms vary greatly, putting the health of many agricultural workers at risk. Kongtip et al. (2018) conducted a cross-sectional study in three Thai provinces on the work activities and conditions of 424 farmers representing five farm types: rice, vegetable, flower, rice/vegetable, and flower/vegetable. More than 64% worked more than 5 days per week. Seventy-four percent of them had only primary school education. A number of the health and hazardous working conditions surveyed significantly different by farm type. Rice farmers were

found to have the highest prevalence of allergies, nasal congestion, wheezing, and acute symptoms after pesticide use, while flower farmers had the lowest prevalence of these health outcomes. Rice farmers reported the highest prevalence of hazardous working conditions including high noise levels, working on slippery surfaces, sitting or standing on vibrating machines, spills of chemicals/pesticides, and sharp injuries. The economic cost of work-related injuries and illnesses among informal sector agricultural workers in Thailand is unknown and in need of study. Gaps in the regulations covering pesticide sales allow farmers to purchase pesticides without adequate training in their safe use (see also section on ESS3). Training targeted to farm type regarding safe pesticide use and the prevention of accidents and musculoskeletal disorders is needed. Studies of chronic health effects among Thai farmers are needed, with special emphasis on respiratory, metabolic disease and cancer.

Impact rating: Medium

- Most farmers do not manage all of their rice fields themselves. Instead, they employ service providers and short-term workers to assist at almost every stage of rice production, such as ploughing, planting, fertilizing, and spraying chemicals, and harvesting. In addition, chemical spraying drones are widely available (although prohibited). However, there are occasions when farmers may need to spray chemicals by themselves. In doing so farmers often ignore the safety measures, such as wearing protective clothes, glasses, and gloves because their use is inconvenient when working in the field. Nevertheless, safety protocols must be implemented when applied.
- Risks and insecurity in the farming process are primarily personal issues, such as pain after lifting heavy loads (fertilizer, rice, agricultural equipment etc.). Further, bending down during field work for extended periods of time can lead to pain in back and other body parts. Farming activities can result in moderate injuries, e.g. in shoulders. Health of farmers can be weakened in the long term.

Table 35: Work activities of farmers that are at risk and which affect health and safety

Work activity	Risk description
Using tractors and all-terrain vehicles	    The majority of tractors are equipped with rubber tires, hydraulic systems, power take-off (PTO), and a combination of engine speeds and gear ratios. The most significant risks associated with tractor operation are rollovers, run-overs, and PTO entanglement. All-terrain vehicles (ATVs) are used as transport vehicles. Instability resulting in rollovers, run-overs, PTO stub, and other miscellaneous risks, including,

Work activity	Risk description
	but not limited to, slips and falls when climbing on or off tractors and ATVs, crushing injuries from unintentional rolling, and driving under low-hanging branches, can be categorized as risks associated with tractors and ATVs. The noise generated by farm tractors and ATVs can lead to hearing loss. Utilization of tractors and ATVs may result in musculoskeletal injuries due to vibration.
Spraying chemicals	  Pesticides and other hazardous chemicals may be utilized in a manner that poses a risk not only to farmers, but also to the surrounding community and the environment as a whole. In addition, the use of these chemicals should be governed by the applicable environmental protection measures mandated by national law or international standards.
Sowing chemical fertilizer	  When farmers breathe in gaseous forms of anhydrous ammonia from toxic fertilizers, it can irritate their skin and cause serious lung problems. When handling fertilizers, farmers should reduce exposure to a minimum.
Lifting heavy weights and other work	  Risks and insecurity in the farming process are primarily personal issues, such as pain after lifting heavy loads (fertilizer, rice, agricultural equipment etc.). Further, bending down during field work for extended periods of time can lead to pain in back and other body parts. Farming activities can result in moderate injuries, e.g. in shoulders. Health of farmers can be weakened in the long term.

Work activity	Risk description
Disease	  Thai rice farmers are exposed to a range of disease risks, including musculoskeletal disorders, skin irritation, heat-related illness (heat exhaustion, heat rash, cramps, etc.), infectious diseases and lower respiratory tract complaints (Chaiklieng et al, 2021). Most health-related risks stem from the use of agro-chemicals (pesticides, fertilizers, etc.) and the physical effort required in rice farming (see above). Infectious disease and infection risk stem primarily from the outdoor and aquatic environment associated with rice farming, which exacerbates risks associated with malaria, *Leptospira*, *Ricketsia conorii*, hookworm and other intestinal parasites (Shah et al, 2019).

5.3.4.2. Outline of the mitigation and enhancement measures

The risk of ESS4 impacts is medium and varies based on the specific agricultural activity at hand. National systems for Occupational Safety and Health (OSH) in agriculture should thus comprise mechanisms aimed at promoting OSH in agriculture (ILO, 2011), including:

- Authorities or bodies responsible for OSH and for ensuring compliance with national laws and regulations, including systems of inspection,
- Information about hazards and risks in agriculture and how these may be addressed, and related advisory services,
- Occupational Safety and Health training for employers and workers,
- Occupational health services, available in rural and urban areas,
- Mechanisms for the collection and analysis of data on occupational injuries and diseases such as occupational injury report system,
- Provisions for collaboration with relevant insurance or social security schemes covering occupational injuries and diseases,
- Support mechanisms for a progressive improvement of OSH in small agricultural enterprises, mega farms and community enterprises.

Prioritised mitigation measures in rice farming are detailed as follows.

Tractors and all-terrain vehicles: The elimination of risks associated with the maintenance and operation of agricultural tractors presents a significant challenge. Given the number and variety of tractors and ATVs, the variety of outdoor tasks, and the level of risk, total elimination may be challenging. Nonetheless, the employer should have as a primary objective the elimination of tractor and ATV hazards through the use of all available safety measures, such as engineering controls, safe work systems and procedures, and worker training, introduction and supervision. The employer must ensure that adequate competency-based training is provided to tractor and ATV operators, as well as competency-based certification where applicable. The employee is expected to cooperate fully and adhere to these training and certification requirements.

Chemicals

All pesticide handlers (applicators, mixers/loaders) have a legal obligation to follow all personal protective equipment (PPE) instructions that appear on the product label. A pesticide label indicates the minimum PPE a person must use in the performance of handling activities. The following are the fundamental rules of personal hygiene when using agrochemicals:

- Avoid exposure to agrochemicals by following good practices and using protective clothing and equipment when necessary.
- Thoroughly wash the exposed parts of the body after work, before eating, drinking or smoking, and after using the toilet or sanitary service.
- Regularly examine the body to make sure the skin is clean and in good health.
- Protect any part of the body that has cuts or inflammations.
- Avoid self-contamination at all times, particularly when decontaminating or removing protective clothing.
- Never use unsafe practices, such as blowing through sprayer nozzles to unlock them (always use a soft probe).
- Do not carry contaminated items such as dirty rags, tools or spare nozzles in the pockets of personal garments.
- Separately remove and wash personal contaminated clothing on a daily basis.
- Keep fingernails clean and cut.
- Avoid handling any product that produces an allergic reaction, such as a skin rash.

Figure 30: Work clothes used when handling agro-chemicals
Source: (Madriz, 2017).

Agricultural workers' clothes not normally considered as PPE (Figure 30), because they are woven garments, which absorb the spills from pesticides. The applicator shall use one-piece or two-piece suits, and the top part must fall over the pants and should never be put on from the bottom. These suits must be made of synthetic materials, waterproof, adjusted to the body and must not have any openings beyond what is required (hands, feet and head). Boots and aprons intended to resist contamination by concentrates should be equally resistant. Coveralls or aprons

should be impervious to liquids, if they are subject to high levels of contamination, when the user is, for example, under a tree and spraying the fruits above. If the exposure is reduced to occasional splashes of liquids, dry powders or granules, an overall made with some textile material such as treated cotton or polyester can suffice.

Disease

LLL and AWD will markedly reduce water requirements for farming, which will, in turn, reduce farmers' exposure to malaria, hookworm and other intestinal parasites (Subedi, 2021).

5.3.5. ESS 5: Land acquisition and involuntary resettlement

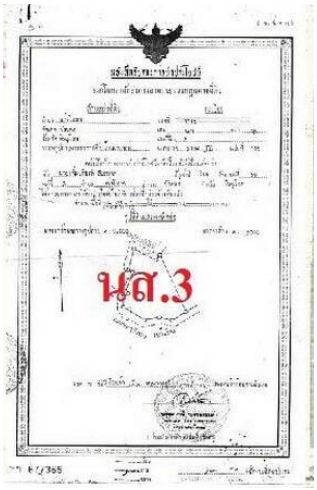
5.3.5.1.Impact assessment

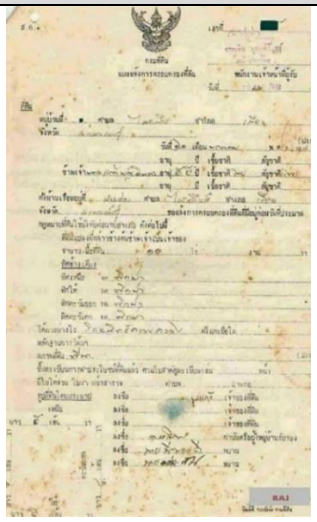
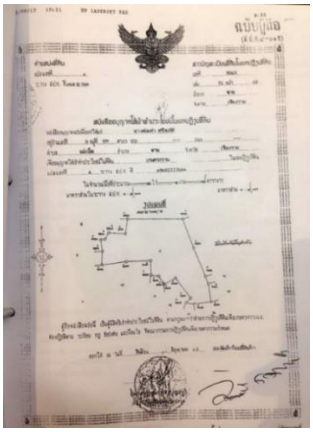
Land in Thailand can be owned by one person or by a group of Thais. Anyone who is a Thai citizen can buy land. Land issues are mostly controlled by the Land Code B.E. 2497 (A.D. 1954), the Land Reform for Agriculture Act B.E. 2518 (A.D. 1975), the Land Development Act B.E. 2543 (A.D. 2000), the City Planning Act B.E. 2518 (A.D. 1975), the Condominium Act B.E. 2522 (A.D. 1979) and its amendments, and the Rules Relating to Land Allocation B.E. 25 (A.D. 1992). The Ministry of the Interior is in charge of establishing land rules (Tilleke and Gibbins, 2011).

According to the Office of Agricultural Economics, in 2020, 47.98% of farmers owned their own land, totalling about 149.25 million rai (about 59 million acres/23.8 million hectares) and the other 52.02% did not. For agricultural land not owned by farmers, only 37.39% was leased and 62.61% was free arable land (Ratanakorn et al., 2022). Listed in Table 36 are some Land Documents Providing Evidence of Land Ownership or Possession Rights in Thailand.

Table 36: Land documents providing evidence of land ownership or possession rights in Thailand.

Land document types	Description
1. Land Title Deed (Nor Sor Si (4) Jor (Chanote)) 	The N.S.4.J or Chanote is a certificate of true ownership for land and the only true ownership land title deed. Land held under Chanotes are accurately surveyed and GPS plotted in relation to a national survey grid and marked by unique numbered marker posts set in the ground. Chanote titles are found in the more developed areas of Thailand. Legal acts (sale) do not have to be published. There are no general restrictions on the use and the land can be sub-divided. A Land Title Deed represents the purest type of land ownership. It facilitates easy transfer and is primarily issued in urban areas. One original set is kept at the District Land Office where the land transfer is registered, while the second original set is given to the landowner.
2. Confirmed Certificate of Use (Nor Sor Saam (3) Gor))	The N.S.3.G has the same legal basis as the Nor. Sor Saam however the boundaries of the land are defined and the land is accurately surveyed in relation to neighbouring land areas (the land area parcel points are set by using an aerial survey), the right of use has been confirmed and legal acts concerning the land, such as

Land document types	Description
	sale, do not need to be published and it is possible to register rights against the land and subdivide the land in smaller plots. This document certifies the right to use land and is frequently issued pending the issuance of a Land Title Deed, under which the owner may register possession rights or lease the land. The certificate is primarily transferred at the District Land Office or Branch District level, depending on the situation.
3. Certificate of Use (Nor Sor Saam) 	The N.S.3 is a title deed which shows a person's right to possess a certain plot of land, but the land borders must be confirmed with neighbouring plots. There are no so-called parcel points or numbered concrete posts which are hammered into the ground to mark the boundaries of the land. The name showing on the title is the person who has the right to the land and has the legal right to possess the land and use the benefit of the land as an owner (it is not actual full ownership). This right will be recognized by the law and can be used as evidence in any dispute with an ordinary person or the government. It is possible to register a sale or lease and apply and obtain approval to build on this land if building complies with relevant building regulations, zoning and or other laws (e.g. environmental protection). The owner may burden the land (mortgage, lease, etc.) and register this with the Land Department. The land may be sold subject to a 30-day public notice period. This is similar to the Confirmed Certificate of Use, but lacks completion of formalities such as provision of an aerial photo of the land. Transfer of this certificate requires posting of intent at each of the following places: - Provincial Land Office or Branch Land Office - District Land Office or Branch District Office - House of the village headman - Location of the land - Municipal Office, if the land is in a municipality.
4. Certificate of Possession (Sor Kor Neung (1))	The S.K.1 land document is a notification form of possession of land and has little real rights associated with it. It entitles the holder to occupy and use the land (generally for farming). The person who actually occupies the land may have a better right than the person who has just a notification form. This land may be sold and transferred by inheritance. Legally the

Land document types	Description
	transfer process is not more than handing over the notification form and possession or use of the land from one person to another. It is not possible to register rights (sale, lease, usufruct, mortgage, etc.) over this type of land. This certificate merely acknowledges possession and does not imply ownership rights associated with that possession. The certificate cannot be transferred. However, a person in physical possession can transfer possession. Common in rural areas, this certificate is required for the issuance of a Certificate of Use or Land Title Deed.
5. Letter of permission to use the land in the reform area (Sor Por Kor 4-01) 	Sor Por Gor. 4-01 (S.P.G. 4-01) is an allotment of land from the land reformative committee. Under no circumstance may this land be bought or sold. It confers the right to occupy only and be transferred only by inheritance. It seems that the land may be used for agriculture only.

Under the Agricultural Land Reform Act B.E. 2518 1975, the Agricultural Land Reform Office (ALRO) can take land from the public domain or purchase and expropriate it from landowners and reform it into agricultural areas. The ALRO was established on 6 March 1975, due to the importance of the agricultural sector in Thailand and issues relating to land ownership. ALRO was initially formed to help farmers not owning or leasing farmland with unreasonably high rent. All land categorized as agricultural reformed land is specifically marked as such. Lease, hire and purchase of agricultural reformed land to is allowed for Thai nationals. The ALRO can allocate land to Thai agricultural workers or agricultural institutions subject to conditions (section 30, Agricultural Land Reform Act).

Impact rating: Low

Rice cultivation has been practised in the project area for a long time already. The majority of the area has the status of “mega farmland” under the respective government initiative. The Thai Rice Project will not involve new land acquisition or resettlement. Nonetheless, land use rights will play a role, e.g. regarding farm-level water management that might involve micro interventions like installation of water tanks. These interventions will appropriately take into consideration land use rights and are not anticipated to induce any negative social or environmental impacts.

5.3.5.2. Outline of the mitigation and enhancement measures

Land ownership in Thailand is based on ownership and ownership rights. A culture of land ownership has developed among the Thai people as a direct result of holding the ownership and possessory rights of the land. When a person has the legal right to possess something, no one else has the authority to interfere. However, mitigation measures will be implemented in the context of the Thai Rice Project to ensure that for micro interventions like installation of water tanks, no negative impacts will be induced:

- FWM interventions can only take place once land ownership, possession and land use rights are clear. This can involve data verification (hand-made maps or GIS data) at the village, sub-district level and consultation with local authorities and relevant parties.
- Consultation and conflict mitigation in case of conflicts of interests between project stakeholders.

5.3.6. ESS 6: Biodiversity conservation and sustainable management of living natural resources

5.3.6.1. Impact assessment

Rice fields provide not only a staple food but are also bio-diverse and multi-functional ecosystems. Within a single crop rotation, the ecosystem of the rice field encompasses a diversity of habitat states that are ephemeral, providing a variety of niches for diverse flora and fauna species. Some ecosystem components are harvested and supplement local diets, including fish, frogs, crabs, mice and crickets. Other ecosystem components, notably spiders, damselflies and dragonflies, control rice pests such as plant- and leaf-hoppers. The food webs sustained by this biodiversity span many trophic levels in the rice field ecosystem. Near the bottom of many food chains, macro- and meso- invertebrates help to decompose organic matter, ultimately feeding the microorganisms in soil that contribute to other ecosystem services such as soil nutrient exchange, soil moisture retention, carbon emission and sequestration, and crop resilience, each of which has key relevance to sustainable rice production.

General overviews of rice field biodiversity are provided by Berg et al (2017), Karunarathna and Wilson (2017), and Maltchik et al (2017), while TEEB (2022) and Munkung et al (2019) provide useful analysis of biodiversity and ecosystem functioning in Thai rice farming specifically.

Halwart and Bartley (2015) report the existence of over 100 different useful aquatic species growing in rice fields. In Cruz-Garcia et al. (2016) study on biodiversity in paddy fields of Northeast Thailand, the spatial and seasonal distribution of wild food plants were scrutinised across different sub-systems occurring within paddy ecosystems in two adjacent rice farming villages in Kalasin, Northeast Thailand. Data was collected in 102 sampling sites corresponding to seven subsystems including tree rows, mounds, field margins, shelters, ponds, pond margins and levees. Frequency of occurrence and absolute abundance was quantified for each species in the two seasons of two years.

A total of 42 species from 28 botanical families were reported, and one third of these have been classified as weeds of rice by other authors. Results show that species abundance, frequency of occurrence and diversity varied seasonally and spatially within paddy rice ecosystems. Higher diversity indexes were observed in the monsoon in most sub-systems. The most diverse sub-systems in the monsoon were shelters, mounds and pond margins, and tree rows and mounds in

the dry season. Field margins, ponds and levees presented lower diversity, but are habitat of aquatic species important for the local diet, such as *Ipomoea aquatica* and *Marsilea crenata*. The herbs *Lobelia sp.* and *Glinus oppositifolius*, classified as rice weeds, were most abundant species in the dry season. *Leucaena leucocephala*, of which the roots, leaves and fruits are commonly consumed as vegetable, was the most abundant tree in most subsystems. More than half of the species were specific to one or two sub-systems due to particular niche requirements. This study highlights that the development of more productive lowland rice systems may jeopardise the diversity of wild food plant species in the rice landscape, which is important for the food security of the rural poor (Figure 31).

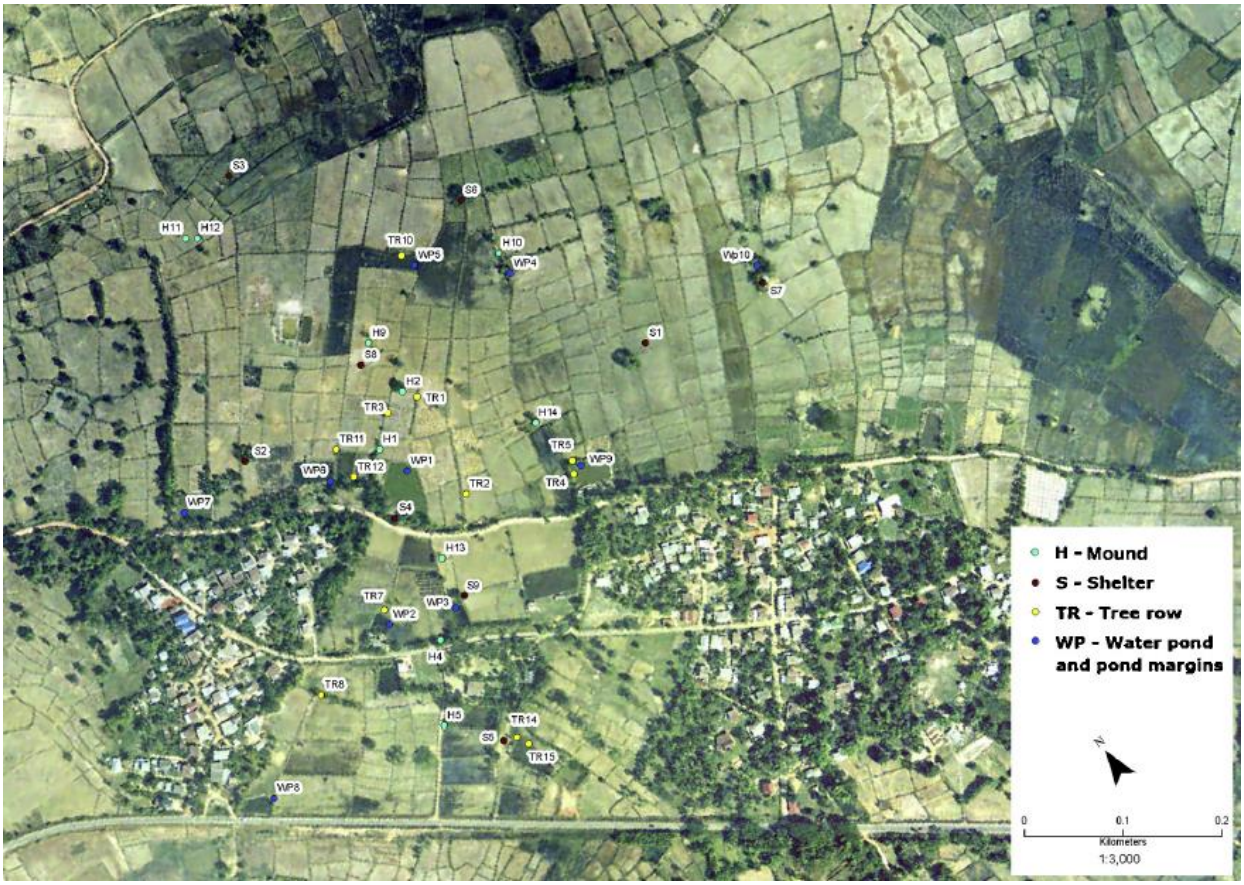


Figure 31: Satellite images showing a typical landscape of rice farming in North-East Thailand. Legends are related to biodiversity study locations
Source: (Cruz-Garcia et al., 2016).

A survey of biodiversity under AWD implementation in the Central region of Thailand was conducted by Towprayoon et al (2019). It was found that weeds were the major plants found. Rice weed was the dominant type found both in the AWD and continuously flooded fields (Figure 32). In many cases, AWD seems to promote the growth of weed. For rice insect pests, a survey found in total 39 types of insects, the most common ones being beetle, bee, earthworm, ladybird, and planthopper. Many of these insects are considered beneficial insects playing a role in the ecosystem and in controlling other insect pests. Earth worms and spiders were found mainly in fields under AWD.

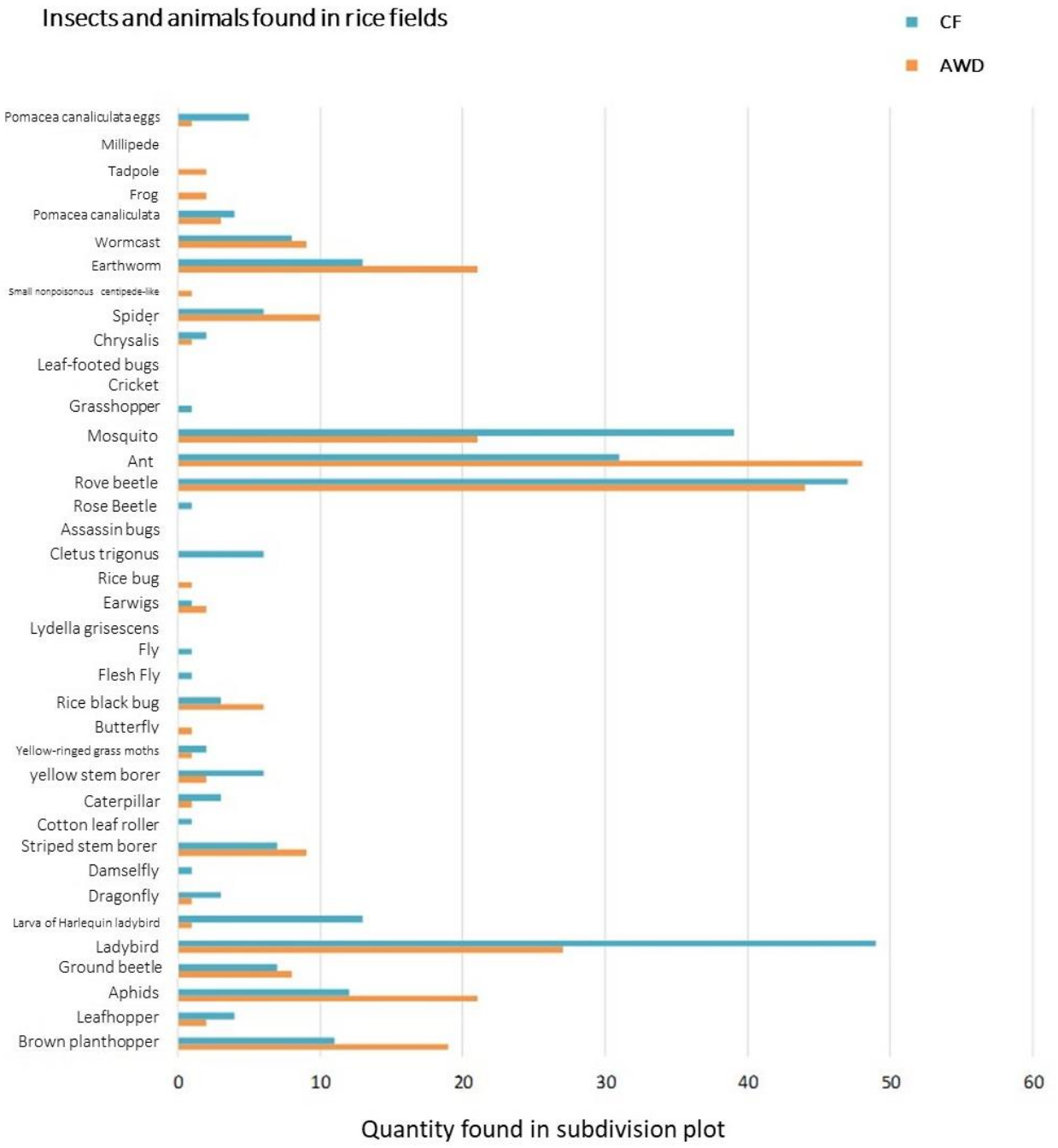


Figure 32: Animal and insects found in rice fields, compared between control (Continuously Flooded, CF) and AWD fields
Source: (Towprayoon et al., 2019).

Use of chemicals, including pesticides, has been shown to significantly reduce biodiversity in rice fields. Chaigarun et al. (2011) found that pesticides were highly toxic to natural enemies such as spiders and hymenopteran parasitoids, and thus disorganised predator-prey relationships. Moreover, the above-ground arthropod diversity in the rice field with untreated pesticides was of a significantly higher degree than in the rice field with treated pesticide (Figure 33 and Figure 34).

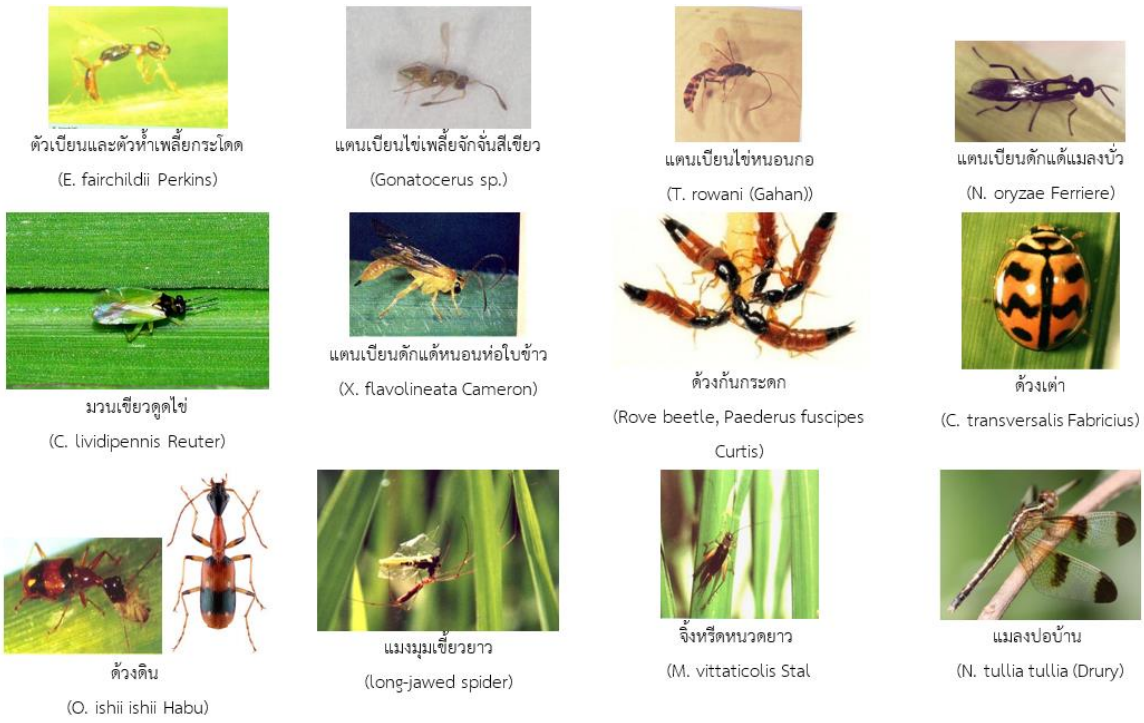


Figure 33: Beneficial insects found in rice farms in the Central region.

Figure 34: Pest and animals that cause damages to rice production in the Central region of Thailand.

Stakeholder consultations also indicated that data on biodiversity in Thai rice field are very difficult to obtain. The following topics were raised during the consultations.

- In the Central region, together with local birds, birds migrating to rice fields were often observed.

- Generally, biodiversity conservation is not a topic of concern for farmers.
- Some local communities were found to play a crucial role in maintaining the genetic diversity by applying alternative approaches (as opposed to consumerism and commercial farming). These communities were noticed for collecting native rice varieties, opting for traditional rice farming that helps preserve local cultural crop and farming systems and practices, promoting ecotourism and engaging in conservation of endemic rice varieties.
- In the Northeast region, it was sometimes observed that the population and variety of local frogs and tadpoles are declining. These small animals are usually the sources of local food and often serve to create income for farmers. The specific reasons for the decreasing population are not clear. Excessive catch, application of herbicides and pesticides, and climatic factors such as droughts are all potential factors affecting their populations.

Impact rating: Low

Based on the information compiled above, it is difficult to evaluate the potential level of impact of the Thai Rice Project on biodiversity and natural habitats. However, preliminary surveys and literature indicate that the impacts tend to be insignificant (and potentially net-positive). Ecosystem benefits of AWD reported in the academic literature include (non-exhaustive): improved soil structure, pest management, weed management, root and tiller development, phytotoxin removal and enhanced soil microbial activity (Allen and Sander, 2019). Preliminary surveys in the Central region indicate that implementation of CSA, such as AWD and SSNM, do not significantly change the biodiversity in rice fields. However, detailed information on the effects of the other CSA technologies planned to be promoted by the project is not available. In addition, changes in biodiversity at a detectable level may need a certain period of time to allow for monitoring.

Further, up to today, most rice residues are burned. However, some farmers leave them to decompose in situ, providing a form of soil enhancer and fertilizer. If such residues are diverted to market uses (bio-energy, pulp and paper production, etc.), this may represent a localised ecosystem loss of nutrients.

Positive impacts on the protection of biodiversity can be expected from the reduction of unnecessary agrochemical use (fertilizers and pesticides) and practising responsible use when needed.

5.3.6.2. Outline of the mitigation and enhancement measures

Possible mitigation measures are:

- Incorporate the topics of biodiversity into basic education at local level. Regular field trips / surveys to monitor of biodiversity (types and amounts of species) would help raise awareness of the importance of biodiversity conservation of the local populace. This would lead to enhanced knowledge and understanding of the importance of biodiversity conservation and sustainable management of living natural resources in the rice farming landscape.
- Establishment of mechanisms to ensure that biodiversity is being protected by local farmers and other relevant stakeholders.
- Application of bio-based methods in SSNM and IPM to minimize the use of hazardous chemicals.

- It is therefore recommended that relevant indicators (e.g. a local biodiversity indicator for rice fields) and a monitoring framework is created and implemented throughout the project cycle.

5.3.7. ESS 7: Indigenous peoples (ethnic groups)

5.3.7.1. Impact assessment

Scientific research and documentation related to indigenous peoples in Thailand is very scarce. One source of recent information on this topic dates back to 2015 (Dhir, 2015). Additional, more up-to-date information was derived from a series of stakeholder interviews conducted for the present assessment.

The Ethnic Groups Plan (EGP, Annex 6b) as well as this document use the term “ethnic group” to refer to communities commonly described as “hill tribes” (chao khao), “forest tribes/people” (chao ba), and other groups that self-identify as “Indigenous Peoples” in Thailand. Thailand has adopted the UN Declaration on the Rights of Indigenous Peoples but has yet to formally recognize the existence of Indigenous Peoples. The recent Constitution (2017) only refers to ethnic groups (Hien et al, 2022). Ethno-linguistic groups distinct from the Tai ethno-linguistic group include Malay and Mokan in southern areas; Khmer, Mon, Mountain Khmer and Mon (Kuy) in the north-east and east; and Akha, Hmong, Karen, Lahu, Lisu, Yao in the north and west.

The Sirindhorn Anthropology Center (Public Organization) maintains a database of ethnic groups, using the name that the group calls themselves and by which they want to be called. There are 62 ethnic groups listed; however, not all ethnic groups necessarily self-identify as indigenous people (Sirindhorn Anthropology Center, 2023).
There is not an authoritative list of ethnic groups that self-identify as indigenous peoples in Thailand and information differs by source. Difference in naming further complicate assessment.

The Council of Indigenous Peoples in Thailand (CIPT), established in 2014, comprises representatives of groups that self-identify as indigenous people. However, membership may not necessarily include all ethnic groups that self-identify as such. Member groups are located in Chiang Mai, Chiang Rai and Mae Hong Son in the north (Bisu, Dara-ang, Hmong, Karen, Khmu, Mlabri) and Pattalung, Satun, Songkla, and Trang in the south (Mani, Moken, Moklen, Uraklawoy), with some small groups in other localized areas (Chong, Kaleung, Kaw-Empi, Sotawueng, Tai-Sak, Yakru) (Thai IP Portal, 2023).

The Asia Indigenous People Pact (AIPP), a regional organization founded in 1992 by indigenous peoples’ movements and author for the “Thailand” chapter in the International Work Group for Indigenous Affairs (IWGIA)’s annual “The Indigenous World” report, notes that the ethnic groups that self-identify as indigenous peoples of Thailand live mainly in three regions of the country: fisher communities and small populations of hunter-gatherers in the south; small groups on the Korat plateau of the north-east and east; and many different highland peoples in the north and north-west of the country (Hien et al, 2022). Nine groups are explicitly recognized and all are in the north: Hmong, Karen, Lisu, Mien, Akha, Lahu, Lua, Thin and Khmu (Berger et al, 2023).

Ethnic groups in the highland remain among the poorest sectors within Thailand’s population. In 2021, the World Bank reported that 12.2% of Thais were living under the national poverty line estimated at 2,762 baht ($79) per person, per month. Also in 2021, Apidechkul et al (2021) reported that 71.2% of the ethnic people living in Chiang Rai province had an annual income of

less than 50,000 baht ($1,428), and 20.6% had 50,001-100,000 baht. In effect, around 80% of the ethnic groups living in this province are under the national poverty line of Thailand (Belghith, 2023). Further, many do not have proper documentation regarding their status. Consequently they cannot vote, seek civil service jobs or travel freely to other parts of the country. The lack of citizenship status for highland women has also been cited as a factor in their vulnerability to trafficking and exploitation for sexual and labour purposes.

Thai citizenship is granted to members of ethnic groups who were born in Thailand, provided that their parents were Thai nationals. Many indigenous people are denied Thai citizenship, though, as they do not possess birth registration or other proofs of identity. Generally, current laws and resolutions have paid more attention to ethnic groups to support their development and safeguard their rights through:

- Provision of housing and promotion of the notion of permanent residence,
- Promotion of occupation in the agricultural as well as non-agricultural economic sectors,
- Improved provision of health care and other services by the Government,
- Foster social development and welfare by involving communities, strengthening their capacity to benefit from and manage natural resources and the environment, to coordinate the provision of social welfare, and to promote and support the culture of tribal peoples,
- Provision of relief assistance to persons in difficult social situations,
- Implementation of projects for the development of the area, to create stability in highland communities along the border, to develop professional communities in the area, to attend to the needs of HIV/AIDS patients, to provide family assistance to poor children, and to enable the expression of grievances in an emergency.

The lack of properly disaggregated data makes it difficult to provide a detailed description of the employment situation of ethnic groups in Thailand. Among the hill tribes, agriculture is the predominant activity and slash and-burn farming practices are widespread. Another major issue faced by ethnic groups is the fear of land alienation, particularly in the context of environmental conservation. Many areas inhabited by indigenous peoples have been classified as lying within reserved forests, protected watersheds, national parks or wildlife sanctuaries through laws to establish State control over forests and natural resource.

The lack of disaggregated data on the socioeconomic situation of ethnic groups in the country results in limitations to assess both existing policies and efforts for new policies that are appropriate of remedying the vulnerability of these populations.

From the stakeholder interviews, the following information was derived:

- Ethnic groups do not contribute significantly to rice cultivation in lowland areas, where the project will be implemented.
- Ethnic groups that self-identify as indigenous peoples in the North are not dominated by rice farming activities, agriculture is dominated by other cash crops such as vegetables and fruit. They grow rice in a limited area for self-subsistence but not for commercial purposes.

Impact rating: Low

Since there are no ethnic groups involved in lowland rice cultivation in the project areas, the impact is considered “negligible or low”. Nonetheless, ethnic groups’ interests will have to be taken into consideration, e.g. in the context of their role as temporary labourers in lowland rice cultivation.

5.3.7.2. Outline of the mitigation and enhancement measures

- It is vital that efforts should be made to strike a balance between environmental conservation and the rights of ethnic groups, particularly through processes of participation and consultation.
- It is vital that issues relating to employment generation, skills development, vocational training and access to credit should be resolved so that members of ethnic groups of all ages have access to more opportunities.
- Alternative forms of employment and livelihoods become all the more relevant, given future pressure caused by the shortage of new agricultural land to absorb the growing population of the hill tribes.
- In order to gain better insight into living conditions, needs and concerns of ethnic groups and deduct measures to further ethnic groups' interests, an EGP (Annex 6b) has been developed in the context of the Thai Rice Project.

5.3.8. ESS 8: Cultural heritage

5.3.8.1. Impact assessment

Rice cultivation in Thailand's rural areas is an integral part of the local way of life. Many customs and traditions are associated with rice cultivation. From an administrative and governance perspective, all cultural heritage sites in Thailand are managed by the Fine Arts Department of the Ministry of Culture. To begin with, farming is prohibited in the first place. It is evident that, in line with this prohibition, no farming activities of the Thai Rice Project will take place within the areas of protected cultural heritage sites.

The importance of rice cultivation in Thailand leads to rich non-physical expressions in culture, as customs and traditions, language, identity constructions, ceremonies, festivities and religious / spiritual modes of expression show. Many customs, traditions ceremonies and festivities are conducted to plea for ample rainfall, good harvests and good health of farmers and their families. However, modernisation processes in Thai society as well as the application of modern technologies have led to a diminished role of these traditions. This results in the concern that these traditional and customary practices might entirely disappear in the future. Customs and traditions serve as a spiritual basis of rural communities, at the same time they contain local knowledge and wisdom, historic references and storytelling. They act as vehicles for the enhancement of mutual understanding and help keeping good relationships among local communities. For all these reasons, the vulnerable customs and traditions need to be valued, protected and preserved.

The following examples show the importance of customs and traditions associated with rice cultivation:

1) Rituals to respect ancestors (Figure 35): there is a traditional belief among Northeast locals that two factors are important for prosperity of villages. The first is water resources and the second is forest. Ancient village settlement therefore chose locations near water sources and forests. To protect these two important resources, locals usually build a small shrine at the location they considered sacred. Each year around the beginning of the rainy season, a ceremony is arranged at the shrines to pay respect to the ancestors and to ask for prosperity, protection and a good agricultural harvest. These ceremonies strengthen the social relationships of local communities. The ceremonies and rites are traditionally

conducted by a master, usually the spiritual leader in the village. Oftentimes, shrine are also built on farms, where individual ceremonies are celebrated, similar to the ones taking place for the whole village. The festivities help create spiritual confidence of local communities that they are protected and their crop harvest will be rich. With the modernization process of Thai society and the increasing use of modern agricultural technologies and machinery, these customs and traditions loose importance in rice cultivating communities in Thailand.

Figure 35: Ritual to respect ancestors in Thai rural village
Source: (https://www.m-culture.go.th, accessed October 2022).

2) Boon Koon Lan (Figure 36): rice farmers in the North-East of Thailand believe that each living creature is protected by the spirit “Kwan”. Thisalso applies to the rice plant. The Boon Koon Lan ceremony is made for blessing the harvested rice on the day farmer transport the harvested rice to the family storage building. In rural areas, rice is stored inside a special buildings to ensure that enough rice for consumption is available until the next harvest. Like other village ceremonies, the ceremony is conducted by a master (usually the spiritual village leader) who also prepares and uses the necessary ceremonial items. Further, the festivity strengthens the social relationships in family and village. Over centuries the storage house has proven to be useful. It is part of farmers’ local knowledge and wisdom that paddy rice stored in such manners is well preserved, usually without loss or damage from pest, fungi or rodents. The stored rice is a crucial asset for farmers as it can be sold when additional income is needed. Due to the recent commercialization of rice farming, nowadays farmers only store the share of rice necessary for consumption in the household, while the remainder is sold immediately after the harvest. As a consequence the Boon Koon Lan ceremony is celebrated less and less frequently.

Figure 36: Boon Koon Lan of North-East farmers, performed on the day to transport paddy from rice field to the family's storing house
Source: (https://www.m-culture.go.th, accessed October 2022).

3) Boon Bung Phai (Bun Bung Fai Rocket Festival) (Figure 37): the Rocket Festival is usually celebrated on the weekends in the middle of the month of May, just before the start of the rainy season. This ancient festival is a merit-making ceremony which involves firing home-made rockets towards the sky to captivate the rain gods Phaya Thaen and the Naga and hope for a good monsoon season before the crop plantations take place. The ritual combines fertility rites which are important to the agrarian society with the Buddhist concept of making merit (Srisupun and Apichartwallob, 2009).

Figure 37: Launching home-made rockets during Boon Bung Phai festival, the ritual in agrarian communities to ask for rainfall and happiness to agrarian community (travelbeginsat40.com).
Source: (www.holidify.com, accessed October 2022).

4) Ploughing Ceremony (Figure 38): the ploughing ceremony is observed across the whole country, especially the Northern and North-Eastern regions of Thailand. While the festivity is usually performed by individual farmers on their own farmland in agricultural regions, the ceremony is also conducted at a national level in the capital, known as the Royal Ploughing Ceremony. The Royal Ploughing Ceremony is an ancient royal tradition also observed in Cambodia and Myanmar to mark the traditional beginning of the rice-growing season. The name of the ceremony can be translated as “first plough” of the season. The tradition has Hindu and Buddhist origins. It is intended to honour farmers, bless the plants and solemnly start the new growing season. Before starting field work, farmers therefore ask for a good growing season, luck, a cultivating season without any barriers, etc. In the ceremony, oxen are covered in red and gold and circle the ceremonial ground nine times, as nine is considered a lucky and auspicious number in Thailand. The Royal Ploughing Ceremony is held at Bangkok’s Sanam Luang, an open field and public square in front of Wat Phra Kaew and the Grand Palace. The festivity is often attended by members of the royal family and broadcast on media, including national television. At individual farms, the ceremony serves the purpose of motivating farmers for the upcoming work in the fields. The ploughing ceremony is still widely practised by Thai farmers.

Figure 38: Ploughing Ceremony performed by local farmers
Source: (https://www.facebook. com/brpd.rd, http://www.culture.lpru.ac.th/)

From the stakeholder consultations, the following information on cultural heritage was extracted:

- Some farmers in the Central region conduct a ritual activity by offering food and ornaments before the start of harvesting at the end of the season. However, this ritual is observed less frequently than in the past, indicating the loss of importance and slow disappearance of this kind of customs and traditions among agrarian communities in Thailand.
- Rituals including offering of food, fruits and ornaments to spirits protecting the land and farm at the flowering stage of the rice plant shall traditionally foster their wellbeing and a good harvest. These ritual celebrations are taking place less frequently as compared to the past, too. A special script is read during the ceremony. As the text is known and understood by some community leaders only and the preservation of this type of non-physical cultural heritage is important, ways should be explored for its preservation.

Impact rating: Low

Rice farming is an integral part of life in agrarian communities in Thailand. Especially in rural areas, customs and traditions have been practised in association with rice cultivation for centuries. It has been observed that recently these cultural ceremonies are diminishing in importance and frequency, partly due to societal modernisation processes and the penetration of new

technologies. On the other hand, the impact of modern agricultural practices comes with the positive effect of stabilising production outputs and yields.

There are concerns that many customs and traditions will eventually disappear with the uptake of new technologies and practices and with the new generation of farmers.

The project will not infringe on protected cultural heritage sites, nor develop natural resources on land subject to traditional ownership or tenure, which inter alia includes natural areas with cultural and/or spiritual value, such as sacred groves, sacred bodies of water and waterways, sacred mountains, sacred trees, sacred rocks, burial grounds and sites. As the non-physical expressions of culture, such as customs, traditions, language, identity constructions, ceremonies, festivities and religious/ spiritual modes of expression are subject to general societal change / modernisation processes in Thailand, the potential impact of the Thai Rice Project on cultural heritage is considered low.

5.3.8.2. Outline of the mitigation and enhancement measures

- Customs and traditions are valuable in many respects, e.g. in terms of preserving local knowledge and wisdom, and strengthening social relationships among rural communities, including between different generations. Therefore, ways should be explored to help protect and conserve customs and traditions during implementation of the Thai Rice Project. This might, for example, include the integration of ceremonies, festivities and traditional knowledge / wisdom in capacity building and awareness-raising activities, also with younger generations. This would foster peer-to-peer learning and potentially foster social relationships in local communities.

5.3.9. ESS 9: Stakeholder engagement and information disclosure

5.3.9.1. Impact assessment

Rice farming in Thailand involves many stakeholders, from local farmers, megafarms, civil society organisations, service providers, suppliers, financial service providers, local and national policy makers and decision makers. Engaging this diverse set of relevant stakeholders (with their different roles, interests, needs and capacities will need to be ensured for the success of the Thai Rice Project. The project identifies three major types of stakeholders, including: 1) farmers, 2) project providers, and 3) environmental enabling groups. Farmers are defined and classified into three groups according to their sizes: mega-farm farmers, community enterprise farmers, and smallholder farmers, as can be seen below:

Table 37: Types of stakeholders

Type of farmer stakeholders	Description
Mega-farm farmers	The Department of Agricultural Extension (DoAE), Ministry of Agriculture and Cooperatives (MoAC) initiated the mega-farm project to invite group of farmers to register for a megafarm as the

	basis of agricultural extension support services. A project manager or committee acts as the main focal point for managing the mega-farm's activities along the rice value chain and encourages the members to work together as a group when managing their inputs, cultivation, quality assurance and market linkages. The mega-farm project is aimed to reduce production costs, improve yields, and build the technical knowledge and bargaining capacity of farmers. As a general rule, establishment of a mega-farm project must consist of at least 300 rai (48 ha) of paddy field and not less than 30 smallholder farmers.
Community enterprise farmers	The minimum member requirement is at least 7 farmers that are engaging in rice production, related services or other relevant activities to generate income and ensure self-reliance on family or community level. Community enterprises need to register with DoAE and additionally register with the provincial commerce office in case of wanting to sell the product to the market. Community enterprise members are farmers who are closely related, usually live within the same community, and share a common way of life. Some community enterprise farmers may be members of mega-farm projects.
Smallholder farmers	Smallholder farmers are defined as farmers with less than 50 rai of agricultural land that are registered with the DoAE. Normally the smallholder farmer family size is small. They are not organized in groups like mega-farms or community enterprises. Smallholder farmers grow rice mainly for subsistence purposes.

1) Service providers are economic actors who provide the service of agricultural machines and support relevant technologies and practices from the land preparation to harvest period. The service machines include tractors, transplanting machines, combined harvesters, laser land levelling equipment, straw baler machines, millers, and fertilizer and pesticide spraying equipment.
2) Environmental enabling groups are defined as institutions/organisations involved in the implementation of CSA technologies and practices in the project area. This includes those who are involved in field practices, policy advice and financial support.

During the consultation with stakeholders, some farmers mentioned that most of the farmers are willing to join the project, but there are farmers that are not participating in projects provided by governmental agencies due to a lack of understanding of the merit and purpose of doing so. Clear explanation, outreach and awareness via appropriate means of communication can help solve this issue for this particular group of farmers. Communication to farmers and service providers using social media and mobile applications are considered to be effective (but not the only appropriate) means. It is common that farmers receive information through group leaders. Information distribution to smallholders (non-group farmers) can be achieved through village heads (Phu Yai Bann). In general government institutional arrangements of support for farmers include the Rice Department and Rice Research Centers on the technologies and scientifically grounded information and support, the Department of Agricultural Extension and local extension on general cultivation practices and the Bank of Agriculture and Agricultural Cooperatives on

financial support. The mentioned stakeholders are working closely with farmers. Information disclosure and adequate distribution of information can be achieved through these established structures. Elderly smallholders have limited internet access and social media, thus appropriate and easy to understand means of communication through the described channels should be used to reach this group.

During interviews, farmers mentioned that they need updated knowledge and orientation particularly on technologies and practices, like straw and stubble management, as well as on marketing, reduction of cultivation costs and other means to increase farm income. There are also concerns from service providers on the necessary investment costs linked to machine purchases. Some aired the need of some kind of support from the government.

Impact rating: Low

The project ensures stakeholder engagement and information disclosure as described in the Stakeholder Engagement Plan (SEP, Annex 7a) that was developed on the basis of stakeholder consultations. The SEP provides detailed information on the identification and types of stakeholders of the Thai Rice Project, including a mapping of their roles and responsibilities. Female farmers, skipped generation households, ethnic groups and other vulnerable groups' needs and concerns will be taken into consideration and inform project interventions. Stakeholder engagement methods for project implementation as well as timeframes and responsible entities are also described to ensure meaningful engagement and effective information disclosure to all relevant stakeholders.

5.3.9.2. Outline of the mitigation and enhancement measures

- Demonstration sites and activities communicating relevant evaluation results of the application and advantages of CSA practices are recommended. Communicate strategies along the rationale 'You get what you see' can motivate farmers to engage and change practices. Stakeholders believe in the success of demonstration plots showing that small investments can lead to yield and thus income stabilization or increase.
- The establishment of systems in farmer groups, including smallholders, should be considered. The nomination of a focal point, representative or leader to communicate and transfer information to members might be useful.
- Provide meaningful and easy access to information for all stakeholders who have limited access to digital platforms. Needs of female farmers, skipped generation households, ethnic groups and other vulnerable groups must be taken into consideration to ensure that they can engage in a meaningful manner.

5.3.10. ESS 10: Climate change resilience and adaptation

5.3.10.1. Impact assessment

According to the study by Wongsa et al. (2021), in the next 50 years the Chao Phraya and Tha Chin River Basins will have a 30-40% greater chance of receiving water from rainfall than in the past. Variation of annual average precipitation from 2021-2070 compared to the 30 years annual average of 1998-2017 as shown in Figure 39 below. The rainy season is likely to shift to the third quarter of the year starting from September until November, as shown in Figure 40. There will likely be more rain than usual in these months. Although it is anticipated for a large amount of

water, the period with no precipitation will be longer, implying changes in rainfall intensity in the region. Thus, water management needs to be carefully planned to cover long-term water shortages in the cultivation of various crops in the areas that are unsuitable or less suitable for growing rice. For further details on future climate projections in the project area, please see the climate modelling report (Annex A.2c).

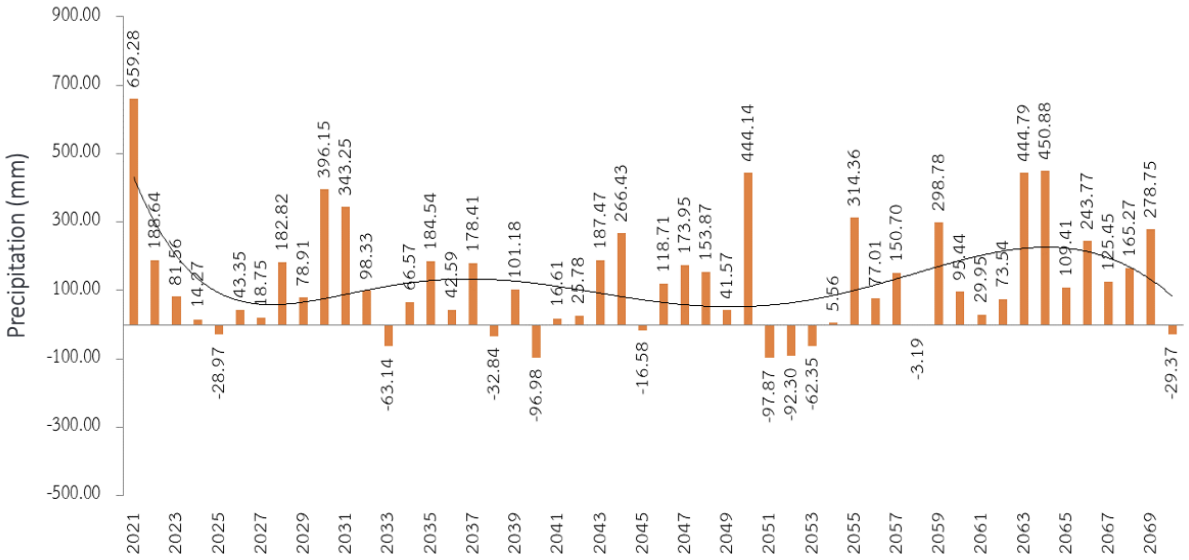


Figure 39: Annual average of precipitation at Chaopraya and Tachin watershed area in 2021-2070 using CRNM model RCP4.5 compared to 30 years average of 1988-2017
Source: (Wongsa et la., 2021).

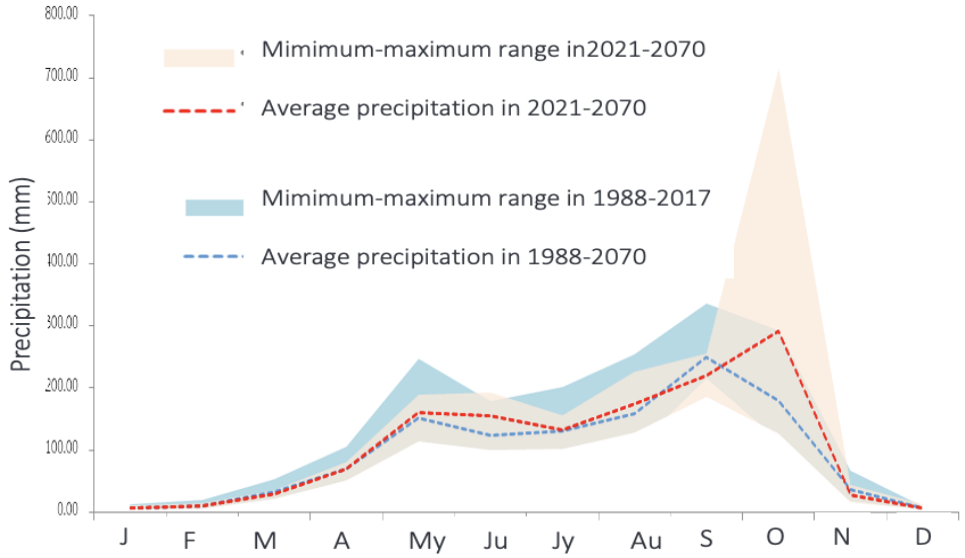


Figure 40: Monthly average of precipitation at Chaopraya and Tachin watershed area in 2021-2070 using CRNM model RCP4.5 compared to 30 years average of 1988-2017
Source: (Wongsa et al., 2021).

The results from Figure 41 using 4 climate models show that in the next 30 years (by using the evaluation of important factors including climate, water and soil, provincial area) high suitability

and high opportunity to grow rice are in the upper part of the Central region, such as Phetchabun, Nakhon Sawan, Phichit, Kamphaeng Phet, Phitsanulok and Sukhothai, which cover more than 55.5% of the rice-growing area in the Central region. Provinces that show a lower level of suitability based on climatic factors, are mostly located in the lower Central region, such as Phra Nakhon Si Ayutthaya, Pathum Thani, Suphan Buri, down to Samut Sakhon and Samut Prakan (covering more than 16.7% of the rice-growing area in the Central region). Most of the future appropriate rice planting areas are in the upper Central region, which is suitable from both a climate and water management perspective, therefore the majority of rice planting areas. In the case of the lower Central region, rice planting policies are needed that include appropriate water management.

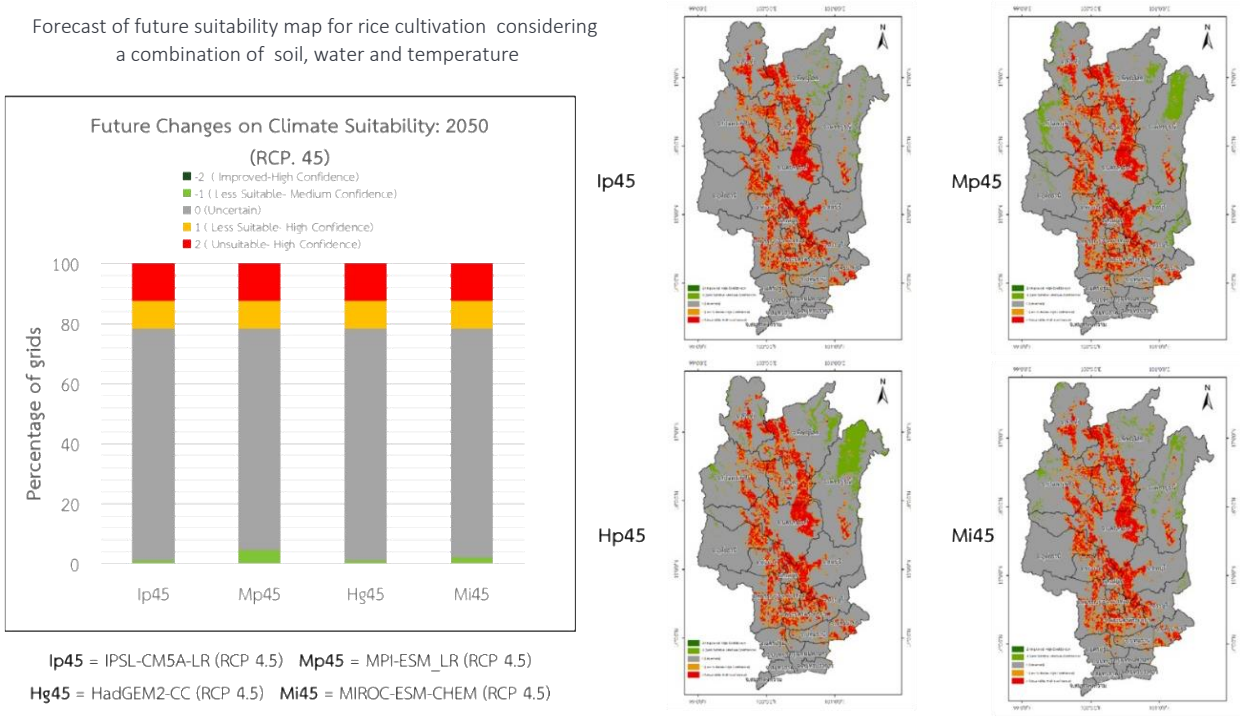


Figure 41: Suitability map for rice cultivation in 2050 using 4 climate models considering a combination of factors related to soil, water, and temperature.

Thai farmers show adaptive capacity, based on their experience and their observations of the changes occurring. During the stakeholder consultations, some farmers mentioned that they used their own experience to judge the best starting time of rice cultivation. For example, in Suan Tang district, Supanburi province, which is a lowland area, farmers know that there is a chance of flooding from the months of August to October, so the first crop cultivation cycle should end before August and the second crop cycle should start from November. Some farmers also mentioned that according to their observation, heavy rainfall would usually lead to their field being flooded, particularly during seedling and fruiting period and therefore in these instances the grain yield is reduced. Many farmers expressed their concerns on water depletion and long periods with no precipitation at all. The shifts in the precipitation period affect service providers as well, e.g. LLL application has time limitations as it is implemented only in the dry season when fields are dry. Straw bailing is also affected in years with a high moisture content caused by heavy rainfall.

The Rice Department and DoAE believe that standards such as the TAS and SRP are part of the solution to reduce environmental impacts, as these standards can facilitate water management,

increase yields, protect the environment, reduce GHG emissions and help reduce labour requirements. However, for this to be effective and to promote the TAS and SRP, the concerned governmental actors need to improve water management, e.g. water transport from rivers to irrigated canals and sub-canals, including individual water reservoirs for use in case of water scarcity.

At present there are several trainings on the topic offered to farmers and service providers hosted by RD, DoAE and BAAC. However, these training do not directly address the impacts of climate change and do not explicitly aim at awareness-raising of farmers and at their improved resilience. These contents should be integrated into any capacity development measures implemented by the Thai Rice Project. Reference points are the TMD climate field schools and the 'water man' curriculum by Khun Ying Kallya Sophonpanich Foundation.

Impact rating: Medium

It is anticipated that in the year 2050, if temperatures rise by 1.7-4.8 degree Celsius, GDP from the four major crops of Thailand - rice, sugar cane, cassava and corn - will be reduced by approximately 20.58 billion Baht (Department of Social Development and Welfare, 2561). Current observations also show that impacts from climate change are happening with higher frequency and greater intensity. Although Thai farmers have some adaptive capacity to cope with the changes, the adverse impacts are likely to be larger for them in the future, with negative repercussions for farmers' livelihoods and incomes (see also the crop model study provided in Annex 2f).

The Thai Rice Project will build the capacity of farmers and service providers and thus foster the application of climate-smart technologies and practices in rice farming (with mitigation and adaptation benefits, see also Feasibility Study, Annex 2a). Further, the project aims at improved crop insurance, thus assisting farmers in case of damages suffered from climate disaster and transferring the residual from rice farmers to the insurance market. BAAC and the Thai Rice Facility will play an important part in uptake incentivizing of CSA practices and in the insurance scheme. These activities can improve climate change resilience and adaptation of Thai rice farmers.

5.3.10.2. Outline of the mitigation and enhancement measures

Some potential adaptation measures to mitigate impacts are:

- Shifting of the rice calendar according to seasonal forecast to reduce area damage.
- Identify suitability maps for rice cultivation nationwide and zone the rice cultivation area.
- Improve the irrigation system and enhance water reservoirs.
- Use local knowledge and wisdom to increase adaptive capacity, e.g. on pest indicators.
- Use GIS data and ground check cameras to improve evidence for insurance claims (see also Insurance study, Annex 2.d).

5.4 Other ESS

5.4.1. Sexual Exploitation, Abuse and Harassment (SEAH)

The Gender Assessment of the Thai Rice Project outlines gender roles in the rice sector in Thailand, as well as needs and interests of the relevant stakeholders. Please refer to Annex 8a for details.

Impact rating: Low

For the Thai Rice Project, risks of Sexual Exploitation, Abuse and Harassment (SEAH) exist in the context of project-supported training and extension support, agricultural service provider activities (regarding both potentially exploitative relationships with farmers and contacts between service provider staff and members of the public), and access to financial support.

The Thai Rice Project does not exacerbate such risks, but it is necessary to include mechanisms to avoid SEAH, to monitor occurrence, and to implement a zero-tolerance policy.

5.4.1.1. Outline of the mitigation and enhancement measures

The SEAH mitigation measures are covered in the Gender Action Plan (see Annex 8.b) and in the Stakeholder Engagement Plan that outlines the Grievance Redress Mechanism as well as the SEAH-specific Grievance Redress Mechanism (see Annex 7.a).

5.4.2. Emergency preparedness and response (see also ESS4)

Impact rating: Low

During the Thai Rice Project implementation, health and safety standards should apply to premises receiving members of the public – for instance, farmers – during training, capacity building and extension support.

Project-supported agro-met apps and services should be capable of providing farmers with emergency alerts (e.g. for storms, strong winds, floods, etc.) in addition to their standard climate-smart farming functionalities. In addition to these agro-met apps, a reporting mechanism for occupational injuries associated with ESS4 will also be created.

5.4.3. Human rights

Impact rating: Low

GCF's E&S policy, as well as GIZ's safeguards management system, places a significant emphasis on avoiding infringement of the human rights of others and addressing adverse human rights impacts that project activities may cause or contribute to.

Each of the E&S safeguard dimension has elements related to human rights dimensions that a project may face in the course of its operations. For the Thai Rice Project, human rights risks and

impacts are essentially related to agricultural labour and livelihoods (ESS 2) and health, safety and security (ESS 4). The relevant aspects are assessed under the respective sections of the present document.

6. Environmental and Social Management Plan (ESMP) and Environmental and Social Management Framework (ESMF)

The ESMP and the ESMF together document the project's ESS risk management strategy. They serve as "Umbrella Documents" that integrate: (1) the findings of the (impact) studies carried out during the Thai Rice Project development phase, (2) the plans and other provisions for complying with the requirements of the Standards that were triggered, as well as (3) country- and site-specific information relevant for the project's ESS risk management strategy.

The ESMP and ESMF provide a suite of practical measures to manage the potential unintended negative environmental and social impacts associated with the project's activities and allow for meaningful and inclusive multi-stakeholder consultations and engagement throughout the life-cycle of the project. The ESMP and ESMF ensure that adequate processes are in place to appropriately monitor, report and improve activities.

The ESMP and ESMF are an integral part of the project proposal and will be implemented, monitored and updated accordingly.

The specific aims of the ESMP and ESMF are to:

- Establish measures to mitigate the E&S risks identified in the ESIA.
- Ensure the project is compliant with the national and international regulatory framework.
- Ensure the project is compliant with the Environmental and Social requirements of the GCF and GIZ.
- Ensure adequate human resources and budget have been allocated by the project to implement the ESMP.

Both documents are fully integrated in the project design and their costs are fully included in the project costs.

The ESMP covers all Activities and Sub-Activities of the project's logical framework (see Funding Proposal document). In contrast, the ESMF covers all open-ended mechanisms of the project for which specific mitigation matters cannot yet be determined, but for which a process is described how the E&S risks that might arise in this context, shall be addressed. The mentioned open-ended mechanisms of the project are included in the following Sub-Activities:

1.1.2.2: Incentive payments to support uptake of climate-smart services and technologies (BAAC)
2.1.2.1: Climate-smart lending capacity development for BAAC; and
3.1.3.2: EFD strengthening and ThaiCI implementation.

6.1 Environmental and social management system of the project

As required under ESS1, the environmental and social management system for the project includes/covers:

- The adoption of an E&S policy for the project
- A procedure for identification of new and upcoming risks and impacts
- Organizational capacity and competency: the definition of staffing and training needs
- Inclusion of environmental and social monitoring in the project MRV system

- Updating of the ESMP and ESMF
- Implementation of the Gender Action Plan
- Disclosure of the E&S documentation
- Implementation of the project's stakeholder engagement plan (SEP) and Grievance Redress Mechanism (GRM).

6.2 Human resource arrangements – ESM team

The implementation arrangements for E&S safeguarding are described above under Section 2.3. As described, all EEs are responsible for E&S risk mitigation. During the inception phase, GIZ as AE will develop an effective Environmental and Social Safeguards Management and Monitoring System - defined as a set of relevant procedures and plans, organisational structure, planning activities and resources for developing, implementing, achieving, reviewing and maintaining the E&S requirements.

This means, inter alia, that the appropriate human resources must be allocated. For this purpose, GIZ, in its role as AE, will recruit an ESS Manager to coordinate all ESS related processes within the project as well as the implementation of the ESMP and ESMF. All EEs will nominate their ESS Focal Points to ensure planning, implementation, and the monitoring of ESMP and ESMF.

The ESS Manager and the ESS Focal Points nominated by the EEs (RD; BAAC; ONEP and IRRI) will form the ESS Management team (ESM team). The competence fields that need to be covered are to be determined in the project inception phase, but will certainly need to cover project management, adult education/didactics, communication, and technical/scientific educational backgrounds for the safeguards dimensions. The ESM team will ensure ESMP and ESMF implementation and will be involved in the respective activities: e.g., capacity building, monitoring and reporting. Where needed, the ESM team will include external specialist resources on a temporary basis.

The ESS Manager will serve as general ESS Focal Point, coordinator and resource person of the Thai Rice Project. He/ she will ensure overall management and guidance of the ESM team and the delivery of all ESS-related outputs (including M&E). The Thai Rice Project Steering Committee (PSC) will oversee the ESMP and ESMF implementation and provide strategic advice on ESS matters.

The key responsibilities, qualifications and reporting hierarchy of ESM team members are outlined in Table 38. The matrix is designed to ensure both the development of the specific tools and approaches and their implementation at the national as well as provincial levels.

Table 38: Key Responsibilities, Qualifications and Reporting Hierarchy of the ESM team

Position Name	Number of Positions	Key Responsibilities	Qualifications	Reporting Hierarchy
ESS Manager	1	• Management and overall guidance of the ESM team and provide on-the-job capacity building;	• Thai and English proficiency • Master's Degree in a relevant field	Reports to PSC

		• Plan and monitor ESM team members' progress
		• Ensure that the objectives of the assignment can be fulfilled
		• Ensure that all requirements of the project, the GIZ and the GCF are met in the Safeguards System and data-base
		• Conceptually guide the ESM team
		• Liaison with GIZ and PSC
		• Preparation of update reports;
		• Participate in a proactive way in the prevention and resolution of conflict;
		• Initiate, lead, implement and monitor and successfully:
		  • Stakeholder Identification and Analysis and Mapping;
		  • Stakeholder Engagement Plan;
		  • Grievance Redress Mechanism;
		  • SEAH incidences.
			• Knowledge and experience in safeguards management
			• Experience working with development projects
			• Proven work experience with government agencies, local communities and NGOs.
			• Experience in community outreach and participatory approaches.
			• Experience coordinating field teams.
			• Strong background in Information Management	

ESS Focal Points	4	• Planning, implementation, and monitoring of ESMP and ESMF in their respective EE;
		• Support in properly integrating and implementing all the Safeguards tools during project activities;
		• Reporting to ESS Manager on updates considering ESMP and ESMF implementation;
		• Troubleshooting of the Safeguards monitoring system during its development and execution;
		• Support project staff in updating the implementation guidelines where needed;
		• Support in the successful implementation and monitoring of:
		  • Stakeholder Identification and Analysis and Mapping;
		  • Stakeholder Engagement Plan;
		  • Grievance Redress Mechanism;
		  • SEAH incidences.
			• Thai and English proficiency
			• Bachelor's Degree in a relevant field
			• Knowledge and experience in safeguards management
			• Experience working with development projects
			• Strong background in Information Management
				Report to ESS Manager and PSC

6.3 Training needs

In order to ensure that ESS will be implemented in all project activities throughout the project lifetime, capacity building of EEs and project staff on the ESS of GCF and GIZ, as well as ESMP and ESMF procedures, is required.

Trainings for the representatives of EEs and project staff will be conducted. The overall goal of the trainings is to deliver necessary information on GCF ESS and the project's environmental and social documentation, including ESIA, ESMP, ESMF and Stakeholder Engagement Plan (SEP). The main concept of the trainings is to provide necessary knowledge and skills required for implementation of ESMP / ESMF procedures throughout the project lifecycle.

The trainings will include – among other content – (i) the GCF's Environmental and Social Policy and ESS Standards; (ii) a general overview on ESIA, ESMP and ESMF of the Thai Rice project and (iii) the SEP and the Grievance Redress Mechanism of the project.

6.4 Monitoring, reporting and verification (MRV)

The implementation of the ESMP will be monitored. Compliance with the ESS, as well as the progress of implementation of the ESMP, will be monitored through results-based monitoring as well as through the ESS management system itself. In this context, each mitigation measure should be assessed: i.e. it shall be determined whether implementation is on track and according to schedule. Where delays are observed the reasons need to be explained and solutions suggested. Beside progress monitoring of the mitigation measures, effectiveness will also need to be monitored. Additional monitoring activities and indicators can be established where needed.

The project will use observations and stakeholder consultations to assess the measures' effectiveness. Synergies with the project's monitoring plan are used and include indicators that can be used for judging the effectiveness of ESS risk mitigation measures, such as key indicators at outcome and co-benefit level that measure ESS relevant aspects: Outcome 2 indicator: water use-scaled yields of climate-smart rice and Co-Benefit indicator 2: reduced water pollution from fertilizers, pesticides and other agricultural chemicals. ESMF milestones are formulated as deliverables in the logical framework. The project governance ensures regular monitoring of progress and adherence to environmental and social safeguards at PSC and PMU level. Annual monitoring will also identify any additional environmental or social risks that may have emerged during project implementation and establish appropriate mitigation measures for any significant new risk. These additional risks and their mitigating measures should be added to the ESMP or ESMF and reported on as part of the annual performance report. The annual ESS progress is reviewed by the GCF Oversight Unit of GIZ as part of the systematic risk dialogue and periodic project supervision missions.

6.5 Budget

The total ESMP budget implemented via GIZ as EE is estimated at direct costs of EUR 932,300, comprising staff (see details on Positions in Section 7.2) and consulting costs.

This does not contain costs, including general training and material costs, already mainstreamed for ESS and GAP implementation by the Executing Entities, in particular in the extension model. The high integration of the Safeguards with the Gender Action Plan, the Extension Approach, Capacity Development for the Financial Mechanism and the M&E System, ESMP budget and team composition (e.g. for the establishment and maintenance of the database) needs to be viewed in the context of this overall budget composition ESS elements are also mainstreamed within activities implemented by the four Executing Entities next to GIZ, including IRRI, RD, BAAC and ONEP.

Positions not listed in the amount cited above include, but are not limited to, the following items (direct costs):

- EUR 120,000 earmarked for Support to GAP implementation, Incorporation of Gender Elements into extension approach, gender-climate interlinkages, SEAH topics, including particular challenges faced by migrant women as agricultural labourers under activity 1.1.1
- EUR 230,000, earmarked for the agronomic curricula Development Package for farmer training kits 1-3 on CSA, including good agricultural practices, farm management, basic financial competencies, ESS topics. Also including innovative tools for rollout and digital platform, under activity 1.1.1.
- Budget earmarked for local travel costs by field staff related to extension activities

Table 39: Indicative Costs for Staffing, Consulting, Activities and Material Costs under the ESMP

Title	Indicative cost per unit (€)	Year 1	Year 2	Year 3	Year 4	Year 5	Total Direct Costs
		Quantities					
Staff costs (annual, aggregated) Gender & ESS Manager/Specialist, Regional Gender and ESS Focal Points (Field Teams). Further staffing details are provided under 6.2 and in the budget annex.	**92,400**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**462,000**
ESMP Implementation (External Services) and Setup	**30,000**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**150,000**
Indigenous People and Ethnic Minorities Package (External Services): design methods to ensure ethnic groups are included and benefit from project activities, monitor progress during implementation	**20,000**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**100,000**

Thai Rice Facility: recommendations for design and conceptualization developed, inputs and advisory to a Thai Rice Climate Financing strategy developed and formulated, knowledge products developed and launched through public-private partnerships, ESS mainstreaming	**74,100**			**1.0**	**1.0**	**1.0**	**111,300**

6.6 ESMP

The processes described above will ensure that the Thai Rice Project implements the Environmental and Social Management Plan as outlined in Table 40:

Table 40: Environment and Social Management Plan

No	Risk assessment	Project Mitigation Measure	Reference to Activity / Sub-Activity	Responsible Executing Entity[9]
ESS 1: **Assessment and** management **of environmental and** s**ocial risks and impacts**				
1	ESMS capacities vary between EEs, a coherent joint E&S risk mitigation system is not in place	• The project ESS management system will be established and operationalised • The ESMP and ESMF will be staffed, resourced and implemented throughout project implementation	All	• GIZ • All EEs
2	ESS systems of EEs have gaps, including in terms of human resource capacities on ESS topics	• ESS capacity building measures and enhanced institutional coordination between EEs (RD, BAAC, ONEP, IRRI, GIZ) and key government institutions with ESS mandates (MoAC and its constituent departments, MoNRE, TMD, TCG, TGO, etc.) • Training needs will be assessed in a participatory manner.	Sub-Activities 1.1.1.2, 2.1.2.2, 3.1.2.2, 3.1.2.3 and 3.1.3.2	• GIZ • All EEs
3	TAS does not yet include all ESS dimensions in a comprehensive manner	• Development and promotion of the TAS to mainstream sustainable, climate-smart rice farming	Sub-Activity 3.1.1.1	• GIZ
4	TRIS does not yet effectively and efficiently transfer farmers' climate risks to insurance markets	• TRIS enhancements to more effectively and efficiently transfer farmers' climate risks to insurance markets	Sub-Activity 2.1.1.3	• GIZ
5	The Thai Rice Facility is not yet established and thus does not yet encompass all ESS dimensions	• Design and operationalisation of the Thai Rice Facility as a coordinating and peer-exchange mechanism for climate-smart agriculture along all relevant ESS dimensions • ESS screening procedures and instruments will be specified for each type of subproject and activities that involve financial support	Sub-Activity 3.1.3.1	• GIZ • BAAC, ONEP
6	The T-VER Rice Scheme is not yet established and thus does not yet cover all ESS dimensions	• Development of the T-VER Rice Scheme as an environmentally robust carbon finance mechanism for incentivising low-carbon farming practices, including coverage of all relevant ESS dimensions	Sub-Activity 3.1.2.3	• GIZ • (TGO)
7	In case GRM is not in place or if respective processes are non-	• Contact details for the project's grievance redress mechanism (GRM) will be communicated to participating farmers *and* to local communities (e.g.	All Activities	• GIZ • All EEs

[9] The main responsible EE is named first, followed by the EE(s) that will have to contribute to the respective mitigation measure. Non-EEs are marked in brackets.

No	Risk assessment	Project Mitigation Measure	Reference to Activity / Sub-Activity	Responsible Executing Entity[9]
	transparent, individuals who would like to air concerns or claims will not submit official complaints.	on public notice-boards, local government institutions, community and CSO websites, etc.), so that individuals who would like to air concerns or claims will be able to submit official complaints. • Regular evaluations of the GRM will be conducted to ensure that eventually recurring patterns of ESS concerns are addressed (in case of need).	and Sub-Activities	
ESS 2: Labour and working conditions				
8	Needs and interests of female smallholder farmers are not yet addressed systematically in Thailand's rice sector	• Gender-based inequalities and divisions of labour will be addressed by the project's Gender Action Plan, GAP. The GAP also includes measures to address the employment vulnerabilities of migrants and to facilitate their inclusion in the transition to climate-smart rice.	Sub-Activity 1.1.1.1	• GIZ • RD
9	The labour force in rice farming has considerably diminished in the past. If the tendency continues, the shortage of labour in rice farming activities will become more pronounced in the future	• Measures will be included to address the ageing profile of rice farmers, including – as part of its farmer training – devoting particular effort to reaching women and youth, as well as coordinating with the ISRL-T baseline project that is implementing activities to reduce rural exodus.	Sub-Activity 1.1.1.1	• GIZ • RD
10	Although forced labour or child labour is not reported to be a serious problem in rice farming, measures need to be taken to inhibit these practices	• Training materials for farmers and service providers will emphasise that child labour and forced labour are illegal and will not be tolerated by the project. Farmers risk ejection from the project – with consequent loss of technical and financial support – if they employ such practices. • Site visits to farms undertaken by project staff for the purposes of MRV and stakeholder consultations will also be used to check for the use of forced labour or child labour. Farmers who are found to employ forced labour or child labour in contravention of national legislation will be reported to the relevant authorities.	Sub-Activities 1.1.1.1 and 2.1.1.1	• GIZ • IRRI
ESS 3: Resource efficiency and pollution prevention				
11	Risk of deficient amounts of water received by farmers due to high demand of water and inefficiencies in water distribution.	• AWD will be coordinated with local Water Usage Organisations to reduce the risk of deficient allocations especially for most vulnerable groups • Information on the numbers of farmers participating in the Thai Rice Project will be communicated to water management committees • Improved farm-level water management will be supported	Sub-Activities 1.1.1.1, 1.1.1.2, 2.1.2.1. and 3.1.2.1	• GIZ • RD • (RID)
ESS 4: Community health, safety and security				
12	The operation and maintenance of equipment associated with climate-	• Occupational health and safety training will be provided for farmers and extension services. This will include guidance on the safe operation and	Sub-Activities 1.1.1.1,	GIZ

No	Risk assessment	Project Mitigation Measure	Reference to Activity / Sub-Activity	Responsible Executing Entity[9]
	smart farming (e.g. tractors, LLL trailers, etc.) is frequently not safe.	maintenance of equipment associated with climate-smart farming (e.g. tractors, LLL trailers, etc.)	1.1.1.2, 1.1.2.2 and 2.1.1.2	
13	Occupational injuries in rice cultivation are frequent.	• The project will create a reporting mechanism for occupational injuries to be administered by the project ESS Manager.	Activities 1.1.1 and 2.1.1	GIZ
ESS 5: Land acquisition and involuntary resettlement				
14	The locations of farm plots served by the project, i.e. where climate-smart technologies and practices are adopted, are not yet known	• The locations of all farm plots served by the project (i.e. where climate-smart technologies and practices are adopted) will be known and logged. Only land that is officially categorised as rice farming land by the government (i.e. only land that is associated with farmers registered with DoAE) will be eligible to participate in the project.	Sub-Activities 1.1.1.1 and 2.1.1.2	• GIZ
15	The risk to commence project activities without the consent of the land-owner cannot be excluded	• The ownership of each plot will be determined/identified from the official registration document/information and the land-owner's prior agreement will be obtained prior to project activities commencing. Where a plot is rented by the land-owner to a farmer, the prior consent of both the land-owner and the farmer will be obtained.	Activity 1.1.1	• GIZ
ESS 6: Biodiversity conservation and sustainable management of living natural resources				
16	Biodiversity is not typically an issue of great interest to rice farmers	• A biodiversity module will be included in farmer and extension officer training on climate-smart agricultural practices. Although biodiversity is not typically an issue of great interest to rice farmers, the beneficial impacts on rice yields of some types of insects and birds, and the benefits of reduced pesticide application to personal well-being, will be emphasised.	Sub-Activities 1.1.1.1 and 1.1.1.2.	• GIZ • RD
17	There is uncertainty if the diversion of biomass residues (straw and stubble) for other purposes has not inadvertently led to a compensating increase in their use of chemical fertilizers.	• Each year, a representative sample of farmers practising SSM will be analysed to ensure that their diversion of biomass residues for other purposes has not inadvertently led to a compensating increase in their use of chemical fertilizers. If this is found to be a problem, farmer training and adaptive measures will be put in place.	Sub-Activities 1.1.1.1 and 1.1.1.2	• GIZ • RD
18	The impact of the CSA technologies and practices has not yet been covered in its entirety by scientific research.	• A multi-taxon biodiversity study (covering plants, invertebrates, frogs, fish and birds) will be undertaken as part of the baseline assessment and project's mid-term review. Paired sites of conventional and climate-smart rice farming and over time will be surveyed: where noteworthy positive or negative impacts are detected, these will be reported (e.g. in the mid-term review as well as relevant project reports and literature) and project activities will be amended to reinforce / reduce these impacts in the second half of project implementation. Site surveys and routine monitoring and reporting will also focus biodiversity.	Sub-Activity 1.1.1.1	• GIZ

No	Risk assessment	Project Mitigation Measure	Reference to Activity / Sub-Activity	Responsible Executing Entity[9]
ESS 7: Indigenous peoples				
19	Ethnic groups in Thailand are not always fairly and equitably addressed in development and climate interventions and encounter challenges as a result of their ethnicity.	• For the North project region, the ethnic status of rice farmers participating in the project will be considered in the extension approach (at the same time as free, prior, and informed consent is sought). A sample of those farmers who self-report as being part of an ethnic group (or all such farmers, if the number is manageable) will be surveyed on an annual basis to ensure that (i) their access to project support is fair and equitable (i.e. there is no discrimination against them) and (ii) any challenges they encounter as a result of their ethnicity (cultural, language, etc.) will be addressed (e.g. in subsequent training materials, workshops, etc.).	All	• GIZ
20	Poverty, population growth and limited land in which to expand farming are placing considerable pressures on upland tribe communities. There is considerable potential for young, capable ethnic group members to move to the lowlands where they can rejuvenate ageing rice farming communities.	• The project will aim to direct some of its CSA training at ethnic groups who are not located in the project's target areas but who could, in the medium-term, provide a pool of talent and labour for climate-smart rice farming. This is foreseen to be operationalised in cooperation with stakeholders that have experience in engaging ethnic groups in the North, especially the Mah Fah Luang (MFL) Foundation.	Sub-Activity 1.1.1.1	• GIZ
ESS 8: Cultural heritage				
21	A training curriculum will be developed to promote the uptake of CSA technologies and practices.	• Training provided to farmers will include references to traditions and customs and the positive roles they play in sustaining rice communities	Sub-Activity 1.1.1.1	• GIZ • RD
ESS 9: Stakeholder engagement and information disclosure				
22	Interests and needs of vulnerable stakeholders, including female-headed households, female-headed skipped generation households, ethnic groups and migrant workers are not yet systematically included in rice cultivation in the project area.	• Particular efforts will be made to engage with and support vulnerable stakeholders, including female-headed households, female-headed skipped generation households, ethnic groups and migrant workers.	Sub-Activity 1.1.1.1	• GIZ • All EEs
ESS 10: Climate change resilience and adaptation				
23	The following future changes to the climate are projected: an increase in maximum and minimum temperatures, an increase in the frequency and severity of droughts and floods, an increase in heatwaves, and greater seasonality. All present challenges to	• The project's primary aim is improving resilience and adaptation in rice farming in Thailand, thus the necessary interventions are covered systematically in the logical framework • Where farmers' climate risks cannot be fully eliminated, the project will also support enhancements to the national rice insurance scheme that serve to displace these risks to the insurance market.	Sub-Activities 1.1.1.1, 1.1.1.2, 2.1.1.2 and 2.1.1.2	• GIZ • All EEs

No	Risk assessment	Project Mitigation Measure	Reference to Activity / Sub-Activity	Responsible Executing Entity[9]
	current models of rice farming. At the same time, adaptive capacity of farmers is limited (e.g. because of high indebtedness)		2.1.1.3	
Sexual Exploitation, Abuse and Harassment (SEAH)				
24	SEAH is a central topic to ensure gender mainstreaming and the protection of women and girls.	• All beneficiaries of the project's training programmes (e.g. farmers, extension service officers, financial institutions, government agencies, Executing Entities, etc.) will receive awareness-raising and training on SEAH	Sub-Activities 1.1.1.1, 1.1.1.2, 2.1.1.1, 2.1.2.2, 3.1.2.1 and 3.1.3.2	• GIZ • All EEs
25	SEAH is a phenomenon that can occur potentially at any time.	• All reports of SEAH violations will be collated centrally by the project ESS Manager.	All Activities	• GIZ
Emergency preparedness and response				
26	There is no effective mechanism for emergency alerts outreach to farmers in the project region.	• Project-supported agro-met advisory services will be capable of providing farmers with emergency alerts (e.g. for storms, strong winds, floods, etc.) in addition to their standard climate-smart farming functionality.	Sub-Activity 2.1.1.2	• GIZ

The Thai Rice project concept has already streamlined E&S Safeguards mitigation measure in a coherent manner. As these measures are already covered in the design of project interventions (and the logical framework, for both please see Funding Proposal), they do not require additional coverage in the ESMP. Rather they are presented in a structured way (along the ESS standards) in Table 41:

Table 41: ESS Mitigation measures already covered by the project concept

Mitigation measure already built in as integral part of the project concept	Activity/ Sub-Activity
ESS 2 – Labour and working conditions	
• Training and capacity building of farmers will build skills and open up new income-generating activities (premium rice, biomass residues, etc.).	Sub-Activities 1.1.1.1, 1.1.2.1, 3.1.1.1 and 3.1.1.2
• The project's support to technological innovation and the use of digital tools will reduce physical labour requirements of farming.	Notably Sub-Activity 1.1.1.3
ESS 3 – Resource efficiency and pollution prevention	
• LLL, AWD, DSR, rice variety diversification and crop diversification will reduce water consumption	Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.2, 2.1.2.1, 3.1.1.1 and 3.1.2.1
• SSNM will reduce fertilizer consumption (and hence water pollution)	Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.2, 2.2.2.1 and 3.1.2.1
• IPM will reduce insecticide, pesticide and fungicide consumption (and hence water pollution)	Sub-Activities 1.1.1.1, 1.1.1.2, 2.2.2.1 and 3.1.2.1
• SSM will reduce air pollution	Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.2, 2.2.2.1 and 3.1.2.1
• Agro-met advisory services will improve input efficiencies and applications timings, reduce environmental leakages and generally improve farmers' environmental protection	Sub-Activity 2.1.1.2
ESS 4 – Community health, safety and security	
• IPM and SSM will reduce farmers' exposure to hazardous chemicals and farmers' and communities' exposure to smoke	Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.2, 2.2.2.1 and 3.1.2.1
• Agro-met advisory services will reduce farmers' exposure to extreme weather hazards (floods, storms, etc.)	Sub-Activity 2.1.1.2
• Promotion of the TAS standard will provide a financial incentive for farmers to adopt less harmful chemicals management practices	Sub-Activities 1.1.1.1, 1.1.1.2 and 3.1.1.1
ESS 8 – Cultural heritage	
• The project will only implement activities on land that is classified as existing rice farming land (see ESS 5). Cultural heritage sites will, therefore, be excluded.	1.1.1.1 and 1.1.1.2
• The project will, at all times, be respectful of local traditions and customs. For instance, many farmers still rely on traditional cues (e.g. bird behaviour, tree flowering behaviour) to guide their planting practices. The project will provide scientifically-grounded agro-met data and advisories, but will frame this as augmenting existing information rather than being dismissive of it.	1.1.1.1 and 1.1.1.2

Mitigation measure already built in as integral part of the project concept	Activity/ Sub-Activity
• The project's media and publicity activities (e.g. brochures, videos, etc.) will reference, where relevant, cultural events and practices – to convey the message that climate-smart rice farming can be as integrated into the cultural fabric of rural life just as much as traditional rice farming.	All Activities
• The project's Stakeholder Engagement Plan includes project participation in local festivals and events as a means of maintaining good community relationships as well as supporting the conservation of local cultures and heritage.	All Activities
ESS 9 – Stakeholder consultation and information disclosure	
• Building on extensive stakeholder consultations undertaken during project preparation, the Thai Rice Project will implement a robust and inclusive Stakeholder Engagement Plan (SEP).	All Activities
• Training materials, workshops and other project activities will be provided to stakeholders (farmers, extension service officers, etc.) in appropriate forms (language, tone, technical level, etc.)	Sub-Activities 1.1.1.1, 1.1.1.2, 1.1.2.1, 2.1.1.2, 2.1.1.3 and 3.1.1.2
• The project will develop or enhance digital tools (mobile apps, atingi online learning platform, agro-met advisory services, etc.) that will enhance information flows to farmers.	Sub-Activities 1.1.1.1, 1.1.1.3 and 2.1.1.2
• The project will operate training plots that serve to provide farmers with 'real world' assurance that the climate-smart technologies and practices being advocated by the project are effective	Sub-Activity 1.1.1.1, 1.1.1.2, 2.1.1.2, 2.1.1.3 and 3.1.2.2
ESS 10 – Climate change resilience and adaptation	
• The climate-smart technologies and practices supported by the project are intended to enhance the resilience of Thai rice farmers (as well as reduce their GHG emissions).	All Activities
• Where farmers' climate risks cannot be fully eliminated, the project will also support enhancements to the national rice insurance scheme that serve to displace these risks to the insurance market ().	Sub-Activity 2.1.1.3
SEAH	
• All project stakeholders (recipients of training and/or financial support) will have access to the SEAH grievance mechanism (which operates separately from the project's general Grievance Redress Mechanism). SEAH will be addressed immediately on case-by-case basis.	All Activities
Human rights	
• The impact screening and assessment process of the Thai Rice Project will enable potential human rights issues to be addressed under the different ESS categories.	All Activities
• As part of its outreach and training activities, the project will explicitly support certain groups – such as female-headed households, ethnic groups and migrant workers – whose human rights may be more vulnerable than those of the 'normal' population	Notably, Sub-Activity 1.1.1.1

6.7 Environmental and Social Management Framework (ESMF)

The Thai Rice Project includes a number of activities that cannot be fully specified in advance because they involve financial support to individuals or institutions: the nature of this financial support (e.g. the amount, the type of technology supported, etc.) and the identities of the beneficiaries will only be known during project implementation, when financing decisions are made by the relevant financial institutions (BAAC and ONEP/EFD). As a consequence, the potential E&S risks and impacts of this financial support cannot be assessed in detail in advance.

Consequently, this ESMF has been prepared. The ESMF sets out the principles and procedures for screening, assessing and managing the potential E&S impacts of the forthcoming interventions. It describes the procedures to be used as a practical tool during implementation and monitoring to ensure that the Thai Rice project avoids, and where avoidance is not possible, to reduce, mitigate and/or offset, adverse risks and impacts. The ESM team will use the checklists for environmental and social screening, provided in appendix 1 to this document, to develop an ESS Screening Checklist. The lists are general guidelines and not exhaustive. Additional issues will be evaluated on a case-by-case basis as they are identified.

6.8 Implementation arrangements and activities covered by the ESMF

While the ESMP outlines E&S mitigation measures for all EEs, the ESMF only concerns BAAC and ONEP (as EEs) and GIZ (as AE). Alle three stakeholders will closely collaborate in the context of the Thai Rice Facility that brings together and coordinates all financial instruments applied in the project. The Thai Rice Facility will transition from concessional instruments (incentive payments) to less concessional instruments (CSL loan scheme), as permitted by the market's maturity.

The three Sub-Activities covered by the ESMF are outlined hereafter.

Sub-Activity 1.1.2.2: Incentive payments to support uptake of climate-smart services and technologies (BAAC)

Sub-Activity 1.1.2.2 will provide an incentive payment – a grant payment that essentially serves as a subsidy – to rice farmers to cover a partial share of the costs of their climate-smart services. The incentive payments will be made available for 2 years of the Thai Rice Project. The first project year will be devoted to establishing and operationalising the payment scheme and commencing the relevant training for farmers. The scheme is expected to become operational after one year of project implementation and to remain in place in Years 2 and 3, during which farmers who have received training on climate-smart agriculture and financial management will be able to apply for incentive payments.

Farmers' incentive payment applications will be processed by BAAC and by the BAAC provincial working groups. Farmers who have been trained on climate-smart agriculture and financial management through the extension services (under Sub-Activity 1.1.1.1) will be eligible to apply for the incentive payment. The incentive payment will be paid to farmers in a single tranche and will be used by them to pay climate-smart agriculture service providers for services rendered.

These service providers must be on the register of quality-assessed providers maintained by the project; the register will be established at project inception and updated thereafter.

Eligibility criteria will be established to limit the approval of financial incentives only to farmers who: (a) are expected to generate a catalytic network effect to draw in their peers, meeting a climate-performance-related and early-adopter-related criteria approach; and/or (b) are particularly vulnerable due to one or more of the following factors: (i) household income below a certain threshold, (ii) inability to borrow from BAAC or other financial institutions (for instance due to lack of collateral or pre-existing loan exposures), (iii) farm location in an area determined to be particularly exposed to climate change and other crop risks, (iv) lack of irrigation (resulting in only one farming season) and (v) gender considerations.

Each year, two categories of incentive payment packages with differing support levels will be offered: (i) a higher support level for climate-smart agriculture packages that include LLL, this being the technology that requires the largest cash outflow in the first year of adoption (due to the high LLL service fee); and (ii) a lower support level for climate-smart agriculture packages that do not include LLL and therefore result in a smaller reduction in farm cashflows in the first year of implementation relative to the business-as-usual baseline. The package including LLL will be centred on the Central Plains and North-East, while the package excluding LLL will be offered in the North. Exact incentive levels will be potentially revised at project inception based on actual climate-smart technology costs at the time. In addition, absolute caps will be set (on a baht per farm rai basis) to avoid abuse, such as artificial inflation of LLL service fees by providers who may want to capture a portion of the incentive payment.

Although payment applications will be processed by BAAC and payments will be disbursed by BAAC to eligible farmers upon submission of required documentation, the incentive payments will be available to farmers irrespective of their broader relationship with BAAC: i.e. farmers who do not intend to apply for the BAAC Climate-Smart Loan (CSL) under Sub-Activity 2.1.2.2 or any other loans offered by BAAC, or who are ineligible for BAAC loans, can nonetheless benefit from the incentive payment.

The total volume of the incentive scheme will be limited to a total amount of Euro 6.6 million, which constitutes approximately 16% of the overall requested GCF grant amount. With this funding, approximately 15% of the 253,400 beneficiaries can be reached with incentive payments to serve as early adopters in order to generate a catalytic peer-to-peer effect.

Once a farmer agrees to adopt a climate-smart technology package from a registered service provider, the farmer will receive the incentive payment from BAAC when provision of the climate-smart service / input commences, under a seamless process that minimises the time between service / input provision and payment by BAAC. If the farmer is not eligible for a CSL loan, the farmer himself / herself will pay the balance of the climate-smart service / input cost, net of the incentive payment. If the farmer is eligible for a CSL loan, this loan will be used to pay for the balance of the climate-smart service / input net of the incentive payment; repayment of the loan will take place according to the CSL loan terms, as described in Sub-Activity 2.1.2.2.

The ESS procedures and requirements will be developed during the project inception phase, and will contain elements to maximise efficiency while maintaining transparency and the highest fiduciary standards. The incentive payments are also subject to general and instrument-specific E&S safeguards (see next section).

Sub-Activity 2.1.2.1: Climate-smart agricultural lending by BAAC

BAAC will provide a Climate-Smart Loan (CSL) credit line of up to Euro 30 million, to be disbursed to farmers and service providers that adopt one or more (out of 7) of the Thai Rice Project's supported climate-smart agricultural technologies and practices. The terms of the CSL will be concessional and tailored to the cashflow profile of climate-smart investments, which typically involve a large investment in the first year, followed by an increase in farm income (net of climate-smart agriculture costs) over the subsequent 4 years. This is particularly the case for climate-smart packages that include LLL services, which are especially expensive in the first year of application.

The precise terms of the CSL will be confirmed at project inception, but are expected to feature:

- Use of proceeds restricted to the purchase of inputs, equipment and services critical to the implementation of 7 of the project's climate-smart agriculture technologies and practices.
- Average loan amount expected to be approximately baht 60,000 (~Euro 1,622).
- 5-year maturity with a 1-year grace period.
- Repayment in 4 equal annual instalments in Years 2-5, with the instalment payment due – in the case of farmer loans – after each main season harvest.
- Concessional interest rate of 2%.

For BAAC to verify that the use of funds is compliant with the loan terms, applicant farmers / service providers will be required to show proof of intention to purchase the relevant input / equipment / services. For instance, for a farmer this could be an order form from a registered service provider (see Sub-Activity 2.1.1.1) that details the list of items to be purchased with clear technical specifications, individual prices and total order size, and identity and contact information of the prospective buyer.

The establishment of the CSL scheme does not impose an obligation to lend on the part of BAAC. BAAC will maintain full discretion over credit decisions and may refuse to approve loans for farmers / service providers not deemed creditworthy. BAAC applies a standard list of conditions to all of its loan applications. For farmers, these include:

- Applicants must be Thai nationals of at least 20 years of age and must qualify as farmers under BAAC regulations.
- They must be permanent residents and undertake major agricultural activities within the operating area of the BAAC branch where client registration will be made, for a period of not less than one year.
- They must produce a reasonable annual marketable surplus of farm produce or be able to improve their agricultural activities to increase their incomes enough to repay their loans.
- They must not be bankrupt or insolvent.
- They must not have been expelled by any BAAC branch and must not currently have an outstanding loan with another agricultural cooperative, farmer association or other institution providing agricultural credit.

In addition to standard BAAC conditions, farmers / service providers will be required to meet a set of additional project-imposed requirements informed by the project's ESS activities: for example, they must receive occupational health and safety training (relating to the use of heavy machinery, agro-chemicals, etc.) before they can receive a climate-smart loan.

Sub-Activity 3.1.3.2: EFD strengthening and ThaiCI implementation

EFD, a department within ONEP, occupies a unique position in Thailand's public finance architecture. It is mandated to financially support climate change, the environment, sustainable conservation, and restoration and utilisation of national resources. EFD-supported interventions can include: (i) capacity development, awareness-raising and communications, (ii) supporting network and community-based participation in production and consumption, and (iii) supporting mitigation and adaptation actions, including data management and MRV systems.

Sub-Activity 3.1.3.2 will provide GCF grant resources to be channelled through ThaiCI – in the form of grant payments – to support innovative climate-smart rice projects.

ThaiCI is currently able to provide grant support to small-scale, innovative projects in the electricity and transport sectors. With support provided under this Sub-Activity, ThaiCI will be provided with the technical and administrative skills to expand the scope of its grant support to climate-smart rice agriculture.

Further, the Thai Rice Project will provide ONEP with Euro 1 million of GCF grant funds so that ThaiCI can operationalise its newly-expanded sectoral scope by financing innovative climate-smart rice projects. Approximately 15 projects will be supported by the Thai Rice Project. All supported ThaiCI projects will commence and end within the duration of the Thai Rice Project implementation period, and will typically have a duration of 2 years. Entities that are legally eligible to receive ThaiCI funding are: government institutions and local authorities, private sector companies, public and private environmental organisations, village committees, the Community Network Council, academic institutions and non-profit institutions.

The GCF grants channelled through ThaiCI will be managed by EFD in conjunction with the Comptroller General's Department (CGD) of the Ministry of Finance. EFD will utilise the existing Environment Fund Committee as a decision-making body for ThaiCI grant-making. EFD's existing Climate Change Working Group (CC-WG) will propose funding priorities, technical criteria and the project screening and approval processes, which will be detailed in funding guidelines at the commencement of project implementation.

Projects eligible to receive GCF grants will be defined by the CC-WG. All will support climate-smart rice, will be innovative in nature and particular emphasis will be placed on supporting marginalised stakeholders who are under-served by existing technical and financial support instruments, such as women farmers, women with disabilities, youth farmers and migrant farm workers. Projects can address capacity building needs, awareness-raising, the purchase of equipment and technology, the procurement of specialist services, MRV and data collection / management, and other legitimate, pre-approved activities. Project-financed ThaiCI grants are subject to general and instrument-specific E&S safeguards.

ESMF and Instrument-specific principles

BAAC will ensure incentive payments as a financial instrument for fostering the uptake of climate-smart technologies and practices of smallholder farmers (Sub-Activity 1.1.2.2). Further, BAAC will provide co-financing for climate-smart agricultural lending to farmers (Sub-Activity 2.1.2.1).

ONEP will be involved in EFD strengthening and ThaiCi implementation (Sub-Activity 3.1.3.2): i.e. the promotion of climate-smart rice projects in Thailand.

All activities and Sub-Activities related to the mentioned financial instruments will meet the general principles below:

- Investment activities supported by the Thai Rice Project must, in all instances, be legal and aligned with the low-emission, climate-resilient objectives of the project.
- No funding shall be approved or disbursed that exceeds, or represents a significant risk of exceeding, a Category B ESS risk.
- Financial transfers will be made only to identified individuals or institutions who meet the eligibility criteria of the relevant financial instrument.
- Subject to the constraints set by instrument-specific eligibility criteria, all funding decisions must be non-discriminatory in relation to recipients' gender, ethnicity, age and religion.
- Funding decisions and resulting payments are subject to the project's Grievance Redress Mechanism.
- Activities falling under the IFC exclusion list (provided in appendix 2 to this document) are excluded from the project.

Table 42 outlines the instrument-specific principles of the ESMF that will be applied by BAAC and ONEP. Based on these instrument-specific principles, a screening checklist for each of the mentioned Sub-Activities will be developed by BAAC and ONEP in cooperation with GIZ during the inception phase of the Thai Rice Project. Checklists (appraisers' checklists and applicants self-assessment, possibly building on a 2-stage checklist approach) will build on existing checklists tailored to small-scale grants and finance instruments, and at the same time following GCF/IFC Safeguards Standards such as IKI Small Grants[10]. Special attention will be paid to the formulation of funding guidelines / calls for proposals or similar instruments, ensuring that no high-risk and harmful activities are eligible, and co-benefits promoted. Self-appraisal checklists / sections of the EFD/ThaiCi application documents regarding ESS are currently being developed in line with GCF/IFC standards, and input will be provided. These checklists will be adhered to, monitored and reported on during project implementation. Participation of applications in the financial instruments will be contingent upon the successful screening process.

[10] For more information please refer to https://iki-small-grants.de/wp-content/uploads/2022/12/IKI-Small-Grants-Application-Guidelines_2023A.pdf, Section 8.

Table 42: Environmental and Social Management Framework

No	Risk assess-ment	Instrument-specific principles	Reference to Activity/ Sub-Activity	Respon-sible EE
1	Farmers receive payments for activities that infringe upon one or several ESS dimensions	All incentive payments applied to farmers should follow these criteria: • Incentive payments can be used by farmers to finance any of the Thai Rice Project's supported climate-smart technologies and practices, or a combination thereof. • Climate-smart activities financed or part-financed by Incentive payments must be conducted on land that is classified as rice farmland. • Service providers procured by farmers using incentive payments to deliver one of more of these technologies and practices must be included in the register of approved service providers that is maintained by the Thai Rice Project. • A geo-referenced registry of incentive payment recipients will be maintained by BAAC. • Site visits and farmer interviews conducted as part of the project's MRV and stakeholder engagement process will include a sufficiently large sample of farmers who have received incentive payments to ensure that statistical inference of the results is reliable at the 95% confidence level. • The Project Steering Committee (PSC) reserves the right to amend the eligibility requirements, purposes or amounts of incentive payments offered to farmers in order to respond to identified environmental or social harms or risks that are not sufficiently mitigated against by the current requirements. • Successful completion of the ESS screening process.	Incentive payments to farmers (Sub-Activity 1.1.2.2)	BAAC
2	Farmers receive loans for activities that infringe upon one or several ESS dimensions	The loan scheme to farmers and service providers should be applied under the conditions below: • BAAC standard lending conditions (e.g. relating to Thai nationality and creditworthiness) will apply to climate-smart loans. In addition, only (i) registered farmers who have received training on climate-smart agriculture and financial management and (ii) service providers included in the register of approved service providers that is maintained by the Thai Rice Project will be eligible to receive climate-smart loans. • Climate-smart loans can be used by farmers / service providers to finance one or more of 4 climate-smart technologies and practices (Table 12 in the FP): LLL, AWD, SSM, and FWM. • Climate-smart activities financed or part-financed by climate-smart loans must be conducted on land that is classified as rice farmland. • A geo-referenced registry of climate-smart loan recipients will be maintained by BAAC. • Site visits and farmer interviews conducted as part of the project's MRV, and stakeholder engagement process will include a sufficiently large sample of farmers who have received climate-smart loans to ensure that statistical inference of the results is reliable at the 95% confidence level. • BAAC, in consultation with the Project Steering Committee, reserves the right to amend the eligibility requirements, purposes or amounts of climate-smart loans offered to farmers and service	Climate-smart agricultural lending (Sub-Activity 2.1.2.1)	BAAC

No	Risk assess-ment	Instrument-specific principles	Reference to Activity/ Sub-Activity	Respon-sible EE
		providers in order to respond to identified environmental or social harms or risks that are not sufficiently mitigated against by the current requirements. • BAAC CSL loans will only be issued to farmers who have undertaken the project occupational health and safety training. • Successful completion of the ESS screening process.		
3	Projects receive payments for activities that infringe upon one or several ESS dimensions	The support of climate-smart agriculture projects under ThaiCI will be contingent upon the following eligibility criteria: • The applicant entity is a government institution, local authority, private sector company, public or private environmental organisation, village committee, the Community Network Council, academic institution and non-profit institution. • The scope of the project is climate-smart rice agriculture with interventions that include: (i) capacity development, awareness-raising and communications, (ii) supporting network and community-based participation in production and consumption, and (iii) supporting mitigation and adaptation actions, including data management and MRV systems. • The project must be innovative in nature with a particular emphasis on supporting marginalised stakeholders who are under-served by existing technical and financial support instruments, such as women farmers, women with disabilities, youth farmers and migrant farm workers etc. • The project satisfies the funding priorities as well as technical criteria set up by EFD's existing Climate Change Working Group (CC-WG)'s funding guidelines. • Successful completion of the ESS screening process, including risk assessment and potential mitigation measures for the 10 climate-smart technologies and practices to be supported by the project (see table 41).	EFD strengthening and ThaiCi implementation (3.1.3.2)	ONEP

Table 43: Risk assessment and potential mitigation measures for the 10 climate-smart technologies (draft)

E&S Risk	Potential mitigation measure
Laser land levelling (LLL)	
ESS4: There is a general lack in awareness for and training on basic health and safety measures when applying climate smart technologies including LLL.	Provide training for LLL implementation, health and safety standards, and advice/ extension support to relevant stakeholders.
ESS6: There is no direct information on the impacts of LLL on biodiversity.	Site surveys, routine monitoring & reporting; mid-term review to amend project activities if needed in the course of project implementation.
ESS8: Certain ceremonies and traditions such as plowing ceremony might not be conducted as farming is mechanized and modern technologies are adopted. There are therefore risks of losing local wisdom and of diluting local cooperation amongst farmers/ communities.	Communication with farmers and encouragement to continue practicing local ceremonies and traditions associated with rice cultivation, aligning with regional ways of life (Stakeholder engagement plan); integration of ceremonies and traditions on project activities where possible.
Alternate wetting and drying (AWD)	
ESS3: AWD will reduce the emission of CH4 effectively only when water drainage is managed effectively. There is a risk that water level in the field is not maintained according to AWD standard practice	Routine monitoring & reporting of water level is planned; Coordination with local Water Usage Organisations to reduce competition over scarce water resources; biodiversity surveys in rice fields.

E&S Risk	Potential mitigation measure
due to water shortage and potential drought situations.	
ESS6: Although there are some study results indicating that AWD does not significantly affect rice field biodiversity, continuing observation and assessment are still required.	
Site-specific nutrient management (SSNM)	
ESS3: The amount of applied fertilizer will be determined by soil analysis. There is a risk that farmers do not understand and are not ensured that they will get the yield as expected so that they still apply fertilizer in excess amounts.	Capacity building and training including demonstration sites as well as communication with stakeholders and among peers; chemical sampling of paddy water; monitoring and reporting.
Straw and stubble management (SSM)	
ESS3: Burning of rice straw may still occur in the future.	Routine monitoring & reporting of rice straw burning and communication to avoid burning; capacity building and training will be provided.
ESS4 Safety and health risk from air pollutants, or from using machinery	
ESS3: When residues are diverted to market use (bio-fertilizer, bio-energy, pulp and paper production, etc.), this may lead to a localised ecosystem loss of nutrients.	Soil analysis to ensure that sufficient and appropriate nutrients will be fertilized.
Emergency Preparedness and Response: Use of straw harvesters may lead to safety and health risks.	Training for using straw harvesting machinery/ technologies; training on health and safety standards; extension support to farmers and service providers.
Integrated pest management (IPM)	
ESS3: Although reduced amounts of fertilizer and other agro-chemicals will be applied, their use is still necessary. It is, therefore, important that farmers adopt appropriate and safe procedures to use and handle chemicals to ensure that environmental contamination and negative impacts on their health are avoided or minimised.	Training for adoption of appropriate and safe procedures to use and handle fertilizer and other agro-chemicals. Measures also include sound disposal of registered pesticides and active ingedients. Preventive methods like the principle of ”non-chemical first” and corrective actions, e.g. chemical pesticide use as the last option.
ESS4: Management and use of chemicals (fertilizers, pesticides, fungicides, etc.) is often casual. Farmers are either unaware of safety protocols or choose to ignore them – e.g. protective clothes, goggles and gloves are often not worn because they are inconvenient when working in paddy fields.	
Rice variety diversification	
ESS6: Lack of data/ information on the effects of rice variety diversification on biodiversity.	Need to monitor/report systematically; Site surveys, routine monitoring & reporting; mid-term review to amend project activities if needed in the course of project implementation.
Crop diversification, rotation	
ESS6: Lack of data/ information on the effects of crop diversification rotation on biodiversity.	Need to monitor/report systematically; Site surveys, routine monitoring & reporting; mid-term review to amend project activities if needed in the course of project implementation.
Dry direct-seeded rice (DSR)	
ESS6: Lack of data/information on the effects of DSR on biodiversity	Need to monitor/report systematically; Site surveys, routine monitoring & reporting; mid-term review to amend project activities if needed in the course of project implementation.
Farm-level water management (FWM)	
ESS3: Risk in term of water shortage and drought	Provide training to relevant stakeholders; Use project-supported agro-met apps and services to farmers and service providers.
Agro-met advisory services	

E&S Risk	Potential mitigation measure
Farmers are exposed to inclement (and occasionally hazardous) weather conditions. • ESS 9 :Risk on coverage of service due to incomplete information disclosure	Project-supported agro-met apps and services should be capable of providing farmers with emergency alerts (e.g. for storms, strong winds, floods, etc.); Use communication means and methods to ensure accessibility and disclosure of information.

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Appendix

Appendix 1: Checklists for environmental and social screening (draft)

The ESM Team will use the checklists for environmental and social screening below to develop an ESS Screening Checklist. The lists below are general guidelines, not exhaustive and subject to change. Additional issues will be evaluated on a case-by-case basis as they are identified.

Checklist 1 for environmental and social screening

When answering the first checklist, **activities will not be eligible for funding** if: a) items 1-2 are checked **no**; and b) items 3-19 are checked **yes.**

Screening Question	Yes	No
Are the areas of intervention officially categorized as rice farming lands by the government?		
In case the land is rented, has prior consent been given from the landowner and the farmer?		
Does the activity fall within the IFC exclusion list?		
Is the activity in line with national environmental legislation?		
Is the activity in line with national legislations on labour and OHS?		
Will the activity lead to economic displacement, involving the loss of assets or access to resources, or physical resettlement?		
Does the activity endorse unsustainable practices in the management of natural resources that surpass the carrying capacity or production capacity of the selected area?		
Does the intervention entail a substantial increase in the usage of agro-chemicals?		
Is there a possibility that the project could introduce invasive alien species, including non-native species that are not currently present in the vicinity or known to be non-invasive in similar settings? Additionally, does the project involve the introduction of genetically modified plant varieties into a designated project area?		
Does the activity entail the construction or renovation of rural roads or other rural infrastructure within protected or sensitive areas?		
Does the activity involve the construction of roads or other infrastructure that would require clearing an area of 50 hectares or more in its entirety? Does the project entail the construction or rehabilitation of rural roads that traverse through locations of oil infrastructure, such as flow stations, tank farms, or oil and gas pipelines?		
Does the project encompass the rehabilitation or development of large-scale irrigation schemes, exceeding an area of 100 hectares?		
Does the project entail substantial extraction of groundwater beyond its recharge capacity?		
Does the project encompass the development of water resources, either ground or surface-based, in areas where significant depletion is believed to have occurred as a result of climate change or excessive utilization?		
Does the project entail substantial extraction, diversion, or containment of surface water?		
Does the project involve the drainage or modification of natural water bodies, such as the draining of rivers or correction of their course?		
Could the project potentially result in significant adverse effects on habitats, ecosystems, and their associated services, such as habitat loss, erosion, land degradation, fragmentation, or hydrological changes?		
Is there any evidence or reasonable doubt of farmers engaging in forced labor or child labor, in violation of national legislation?		
Is there a possibility that the project could result in adverse significant impacts on local people, including ethnic groups, that are deemed unacceptable to them, even considering the mitigation measures developed with their participation?		

Checklist 2 for environmental and social screening

For checklist 2, if any of the criteria are checked as **yes** further explanation and mitigation measures are necessary and, if not part of the already developed ESMP, an ESMP must be developed. There are 2 exceptions to this, questions 40 and 45: if these questions are checked as **no** further explanation and mitigation measures are necessary and, if not part of the already developed ESMP, an ESMP must be developed.

	Screening Question	**Yes**	**No**	**Comments/Mitigation and/or training measures**
ESS 1: Assessment and management of environmental and social risks and impact				
1.	Is there a person responsible for environmental management? Who?			
2.	Does the activity need environmental permits, or does it already own such permits?			
3.	Do the activities involve interactions with the general public?			
4.	Could the activity cause change in population, governance, institutions or practices, traditional territorial rights, land use, and economic activities?			
5.	Is there a possibility that the introduction of new technologies and equipment could lead to the exclusion of certain beneficiaries, including women, the elderly, and individuals with disabilities?			
ESS 2: Labour and Working Conditions				
6.	Who is responsible for occupational health and safety?			
7.	Could any occupational risks emerge from: a) The utilization of new equipment? b) The adoption of new technologies? c) The application of agro-inputs, such as fertilizers and agrochemicals?			
8.	Are there any specific known risks of accidents or injuries in the activity?			
9.	Does the project require the employment of seasonal workers for planting and/or harvesting agricultural produce? Does the project entail the presence of labor migrants or the potential to attract labor migrants?			
10.	Does this project entail the use of subcontracting?			
11.	Does this project involve the direct employment of workers?			
12.	Does this project operate in contexts where significant gender inequality exists within the labor market?			

	Screening Question	Yes	No	Comments/Mitigation and/or training measures
ESS 3: Resource efficiency and pollution prevention				
13.	Will the project have adverse effects on air quality (i.e., from project related GHG) and noise levels?			
14.	Does this project have the potential to alter the water quality and quantity within the project area or in interconnected areas?			
15.	Would the project manage, generate and/or have a negative effect on hazardous materials and waste?			
16.	Does this project involve the procurement, supply, and/or utilization of pesticides on crops, livestock, aquaculture, or forestry?			
17.	Is there a possibility that the project could result in instances of land contamination?			
ESS 4: Community health, safety and security				
18.	Could the project lead to an increase in the utilization of agrochemicals, thereby potentially impacting the natural environment or human health?			
19.	Could the activity restrict access to health care facilities, educational facilities or social services?			
20.	Could the activity create conditions that might have an impact on the incidence of HIV/AIDS, for example, through influx of “foreign” labor?			
21.	Are activities likely to take place in remote rural areas?			
22.	Are activities likely to take place in areas of conflict?			
ESS 5: Land acquisition and involuntary resettlement				
23.	Will the activity include land acquisition?			
ESS 6: Biodiversity conservation and sustainable management of living natural resources				
24.	Could the project affect land use and land use planning?			
25.	Could the project negatively affect agricultural lands (terraced, irrigated, and others)?			
26.	Could the project adversely affect subsistence farmers, forest users and other vulnerable groups?			
27.	Does this project involve the introduction of crops and varieties that have not been previously cultivated?			
28.	Could the project activities result in changes in forest land use or the loss of forest cover?			
29.	Does the project have an impact on: a) Modified, natural, critical, or sensitive habitats? b) General terrestrial ecology and biodiversity zones, including the presence of rare,			

	Screening Question	Yes	No	Comments/Mitigation and/or training measures
	endangered, threatened, or endemic species/habitats? c) Ecosystem services, encompassing provisioning, regulating, cultural, or supporting services? d) Formally designated protected categories?			
30.	Will the project have adverse effects on geophysical conditions, including flooding risk, seismic instability, erosion, soil stability, and landslides?			
ESS 7: Indigenous Peoples (ethnic groups)				
31.	Can the activity impact ethnic groups? If yes: a) How far away and how many? b) Have these been previously identified?			
32.	Could the activity potentially affect the status of customary rights held by the community over resources?			
33.	Could the project activities potentially diminish communities' access to resources?			
34.	Could the activity introduce changes to economic activities of local communities?			
35.	Have there been any instances of resettlements or (unresolvable) conflicts with communities, particularly within the past 5 years, in the intervention area?			
36.	Does the activity plan to make commercial use of indigenous knowledge?			
37.	Has the venture already performed meaningful engagement with the considered communities, and obtained free, prior and informed consent?			
ESS 8: Cultural Heritage				
38.	Could the activities affect cultural traditions and activities of communities in the area of influence?			
39.	Would the sub-project affect cultural resources (archaeological, paleontological, historic, touristic or other)?			
ESS 9: Stakeholder engagement and information disclosure				
40.	Would the project provide opportunities for participation by civil society organisations and NGOs?			
ESS 10: Climate change resilience and adaptation				
41.	Could the activity increase the vulnerability of local populations to natural disasters (flooding, landslides, etc.)?			
Sexual Exploitation, Abuse and Harassment (SEAH)				
42.	Could the activity put beneficiaries in situations of risk for SEAH?			
Emergency preparedness and response				

	Screening Question	Yes	No	Comments/Mitigation and/or training measures
43.	Are the premises used in the activity in compliance with legal obligations?			
Human Rights				
44.	Would the activity have negative impacts on poverty, inequality and vulnerable communities?			
45.	Does the activity provide opportunities for empowerment of women, and the poor, disadvantaged, and vulnerable?			
46.	Would the activities create conditions that may introduce or exacerbate Trafficking in Persons (TIP)?			
47.	Does a media check reveal potential infringement of human rights or discrimination?			

Appendix 2: Exclusion list

Activities falling under the IFC exclusion list, which is reproduced below, are excluded from the project.[11]

IFC exclusion list (2007):

IFC does not finance the following projects:

- Production or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements, or subject to international bans, such as pharmaceuticals, pesticides/herbicides, ozone depleting substances, PCBs, wildlife or products regulated under CITES.
- Production or trade in weapons and munitions.
- Production or trade in alcoholic beverages (excluding beer and wine).
- Production or trade in tobacco.
- Gambling, casinos and equivalent enterprises.
- Production or trade in radioactive materials. This does not apply to the purchase of medical equipment, quality control (measurement) equipment and any equipment where IFC considers the radioactive source to be trivial and/or adequately shielded.
- Production or trade in unbonded asbestos fibres. This does not apply to purchase and use of bonded asbestos cement sheeting where the asbestos content is less than 20%.
- Drift net fishing in the marine environment using nets in excess of 2.5 km in length.

A reasonableness test will be applied when the activities of the project would have a significant development impact but circumstances of the country require adjustment to the Exclusion List.

[11] IFC Website available at www.ifc.org/en/home.