The Economics of Ecosystems and Biodiversity (TEEB) Implementation: Promoting a Sustainable Agriculture and Food Sector Conference

National Workshop

Measuring what matters in sustainable rice production in Thailand

13 November 2023

Swissotel Bangkok Ratchada Hotel, Bangkok, Thailand

Report

Contents

Workshop objectives

The TEEBAgriFood Thailand National Workshop was held on 13 November 2023 in Bangkok, Thailand, and was attended by 145 participants representing 60 institutions. For a list of participants, institutions, as well as the workshop agenda, please refer to Annexes I and II.

This workshop presented the study's findings by local partners under the TEEBAgriFood initiative, with a focus on protecting biodiversity and contributing to more sustainable agriculture and food sectors. "Measuring What Matters in Agriculture and Food System" on sustainable production practices is advocated under the Sustainable Rice Platform (SRP) presenting the Standard for Sustainable Rice Cultivation (SRP Standard). The main attention was also given during the workshop to the follow-up TEEBAgriFood assessment, which is funded through the European Union Partnership Instrument and explores the potential impacts related to the adoption of SRP rice in Thailand's commercial rice sector.

The main objectives of the workshop were to:

1. Present the findings of the pilot TEEBAgriFood assessment on Integrating the Value of Ecosystems and Biodiversity in rice production system of Thailand. Importantly, the focus of the project is on biodiversity and ecosystems, which underpin the delivery of the Sustainable Development Goals (SDGs).
2. Convey the project findings to key decision-makers in order for them to understand the potential scale of the costs and benefits of different rice production systems and policy options.
3. Identify, in collaboration with national and local authorities and other important stakeholders, how this project may contribute to policy development in Thailand by building on current initiatives and programs.

Presentations

Introductory video

The workshop began with a brief introductory video - 8.58 minutes. This presented the key aims of the project on the overall economic benefits provided by sustainable rice practice. The framework developed under The Economics of Ecosystems and Biodiversity (TEEB) initiative were the underlying conceptual framework applied to assess and make visible the impacts on human capital, human capital, and social capital presented in the. The video is available on the project website.

Opening Remarks

Mr. Jiravat Ratisoontorn, Deputy Secretary - General, Office of Natural Resources and Environmental Policy and Planning (ONEP), Ministry of Natural Resources and Environment (MoNRE), Thailand

- Mr. Jiravat Ratisoontorn began by explaining the importance of the study and how relevant it is to ONEP's mission. ONEP alone cannot make a difference, but all invited agencies can altogether make a shift to sustainable agriculture, which has a strong impact on people and the environment in Thailand and is passed on around the world.
- The evaluation of SRP rice production transformation was carried out by a research team from the Faculty of Economics at Khon Kaen University (KKU). The project aims to promote sustainable agricultural systems in Thailand, specifically rice production, which is the country's primary agricultural commodity. To clearly visualize the whole synergy of SRP rice production in Thailand, this study accounts for the integration of biodiversity and agroecosystems involved in rice production.
- To further support and promote the findings with other similar work in the future, the relevant parties, both private and public, must work together to drive research in the area of ecosystem services for rice production using economic instruments. The ultimate goals can provide fruitful results for policy recommendations.

Introducing TEEBAgriFood and global initiatives

Dr. Salman Hussain, the Coordinator for The Economics of Ecosystems and Biodiversity (TEEB), and Head of the Economics of Nature Unit, UNEP. A copy of his presentation slides is available on the project website

The visible and invisible flows of agricultural production

- UN Environment Programme (UNEP) is focussed on addressing the triple planetary crises of climate change, biodiversity loss, and pollution.
- The TEEB approach seeks to underscore the urgency and relevance of taking action for the current generation while acknowledging the long- term implications for future

sustainability. Sustainable practices can bring positive outcomes for people in the present, such as improved health, livelihoods, and overall well-being.

- The Sustainable Rice Platform (SRP) not only provides a global benefit but also holds immediate advantages for the people of Thailand.
- The transition from conventional to SRP rice production is a pro- nature and pro-biodiversity alternative.
- The key message is that Thai people today will experience better livelihoods, stronger health outcomes, and increased social system resilience through this shift.
- This challenges the notion that biodiversity- friendly production systems are unaffordable and asserts that, from a selfish perspective, choosing sustainable alternatives is not only beneficial for the planet but also for the well-being of the current generation in Thailand.

Thailand is not alone in this project.

- Thailand are one of seven countries that are taking this agenda forward. This agenda has global consequences.
- The fundamental objectives address the common prevailing assumption that conventional rice systems provide higher economic returns for farmers in terms of VAT and income in US dollars. That prevailing view only considers direct economic gains and overlooks the broader social and environmental externalities.
- A more comprehensive evaluation, one that takes into account hidden impacts within the conventional rice system, reveals a different perspective on the overall benefits of conventional rice systems.
- An analysis which is focused on economic factors, shifts as social and environmental considerations are taken into account. Sustainable rice production and indeed organic rice farming (which was the focus of the previous assessment) emerges as a better course of action for Thai farmers and the population today. This highlights the importance of considering broader factors beyond economic gains when determining the most beneficial agricultural practices for the current generation in Thailand.
- The analysis however shows that adopting SRP rice production is economically advantageous, even without considering social and environmental factors.
- The key points include projected increases in yields, improved yield stability, and higher income for farmers. This conclusion is based on climate change projections from sources like the Intergovernmental Panel on Climate Change, making a compelling case for the economic benefits of transitioning to SRP irrespective of other potential advantages such as biodiversity, health, or mitigation benefits.
- Ongoing efforts to redefine metrics in food systems, see Nature journal thought piece.
- Collaborating with UNEP and TEEBAgrifood, the focus has shifted from solely examining agricultural production to considering broader inputs from biodiversity and human capital

- Ecosystem services play vital roles in food systems. Natural capital, representing nature's benefits to economic systems, is depleted when ecosystems are degraded. Even for those indifferent to biodiversity, recognizing its impact on rice farmers' benefits is crucial. Degraded natural capital directly affects agricultural outcomes and economic well-being.

- The vision of Recognizing and Managing the Value of Nature's Contribution to People through Food Systems Transformation has been endorsed by China's Minister of Ecology and Environment, and the President of COP15, responsible for the Global Biodiversity Framework.

- In India, case studies in three states. In India, this responsibility falls on the Indian Council of Agricultural Research (ICAR). ICAR has initiated a comprehensive program dedicated to training the next generation of agricultural extension workers.
- The role of agricultural extension workers is crucial in facilitating the transition to sustainable rice plant or organic production. These are the people who will actually take this message out in agriculture.
- The focus of this program is on applying the TEEBAgrifood approach, underscoring the commitment to integrating sustainable and biodiversity- friendly practices into agricultural education and extension services.
- The idea of building a sustainability and value ecosystem services will be inherently powerful and the next generation of ecosystem service managers hopefully will take on board. Currently there are only a few states, but the idea is to extend that across the entire nation overall. Other UN processes and also the G20 can support this also.

- In Brazil, the TEEBAgrifood work has upscaled and invigorated attention on urban and peri-urban agriculture.
- UNEP works with natural partners in the environment, but also with partners in agriculture. The Rice Department should be adopting SRP, not only because of biodiversity and climate and pollution, but because the livelihoods of Thai farmers today would benefit if we make this switch.

Introducing sustainable rice production policies in Thailand

Mr. Pisan Pongsapich, Secretary-General, National Bureau of Agricultural Commodity and Food Standards (ACFS) under Ministry of Agriculture and Cooperatives (MoAC), delivered a keynote speech on the alignment of Global Rice Standard and Thai Rice Standard, which is essential for Thailand to manage rice production in a way that contributes to the well-being of the world.

Key statistics

- Rice is the main food for over 3.5 billion people globally
- Rice production is a crucial source of income for farmers, benefiting over 150 million households worldwide.
- FAO estimated the rice output for 2022/2023 to exceed 516 million metric tons.
- The forecast for consumption could reach a record-breaking 520 million metric tons.
- Rice fields account for approximately 10% of global methane emissions. In Asia-Pacific, rice generates a quarter to a third of total methane emissions.
- Methane emissions are created in anaerobic conditions when rice fields are waterlogged
- Overapplication of nitrogen fertilizer might result in the release of nitrous oxide.

- Rice straw combustion emits pollutants including carbon dioxide (CO_2), carbon monoxide (CO), nitrous oxide (N_2O), sulfur dioxide (SO_2), and dust particles.

Thailand and the Development of SRP

- The objective of the global SRP Standard for sustainable rice cultivation is to foster economic, social, and environmental sustainability. Guidelines for sustainable rice farming include performance indicators, and audits to ensure certification.
- Thailand's Rice Department actively participates in the Sustainable Rice Platform (SRP) and contributes to the development of SRP rice production standards.
- The Rice Department, in collaboration with GIZ, serves as the main national agency that represents SRP members in Thailand. It serves as a center for information distribution and communication with Global SRP, establishing connections, and overseeing SRP operations in Thailand.
- The National Bureau of Agricultural Commodity and Food Standards (ACFS) has created an agricultural product standard on sustainable rice (TAS 4408-3565) to raise Thailand's rice production standard towards sustainability.
- Farmers are eligible for certification in 2024/2025 for sustainable rice standards that encompass the full rice production chain. This contain 52 sustainable agriculture product requirements grouped into 10 primary practice guidelines.

Benefits of SRP for Thai Rice Trade

For the Farmer/Producer
- Efficiency in rice production leads to reduced expenses and higher profits.
- Reduces farmers' risks from exposure to agricultural chemicals, emphasises IPM.
- Maintains a good environment in fields and in the surrounding community area.

For the Nation
- Eliminates environmental contamination from outdated agricultural practices.
- Reduces the amount of water used for growing rice.
- Thai populace maintains good health, consuming rice free from any potential hazards.
- Enhances rice exports by adhering to internationally recognised sustainability criteria.

For the Globe
- Minimises the release of greenhouse gases responsible for global warming.
- Supports global food security.
- Contributes to the goal of Carbon Credit Trading

ACFS and driving sustainable rice

Carbon Credit Trading

1. Project to study the reduction of greenhouse gas emissions in the agricultural sector

2. Project to develop a web application for reporting and calculating greenhouse gas emissions from agricultural exports. Co2cal.acfs.go.th

Standard and Certification

- Operational plan for 2023–2024: develop procedures for certification of sustainable rice consistent with national frameworks and regulations and the Sustainable Rice Platform (SRP) Standard.

  - Facilitate development of farmer groups in the Kamphaeng Phet Province. - training sessions and assisting the certification process for group certification (ICS) through the Khanu Model Project Group.
  - Adoption of sustainable rice standard over a significant land area.
  - Training of auditors, Farmer Advisors and expansion of the certification scope.
  - Research to investigate efficiency of growing sustainable rice in accordance with criteria for sustainable rice (TAS 4408-3565), Kamphaeng Phet province.

- Operational plan for 2025
  - Certification inspection unit prepared to conduct inspections and provide certification in accordance with TAS 4408-3565.
  - Farmers can apply for certification, and showcase certification mark.

- Operational plan for 2026
  - Certification department is prepared to conduct certification audits in accordance with SRP criteria and input data into the SRP database.
  - Operators request certification and display the SRP certification mark.

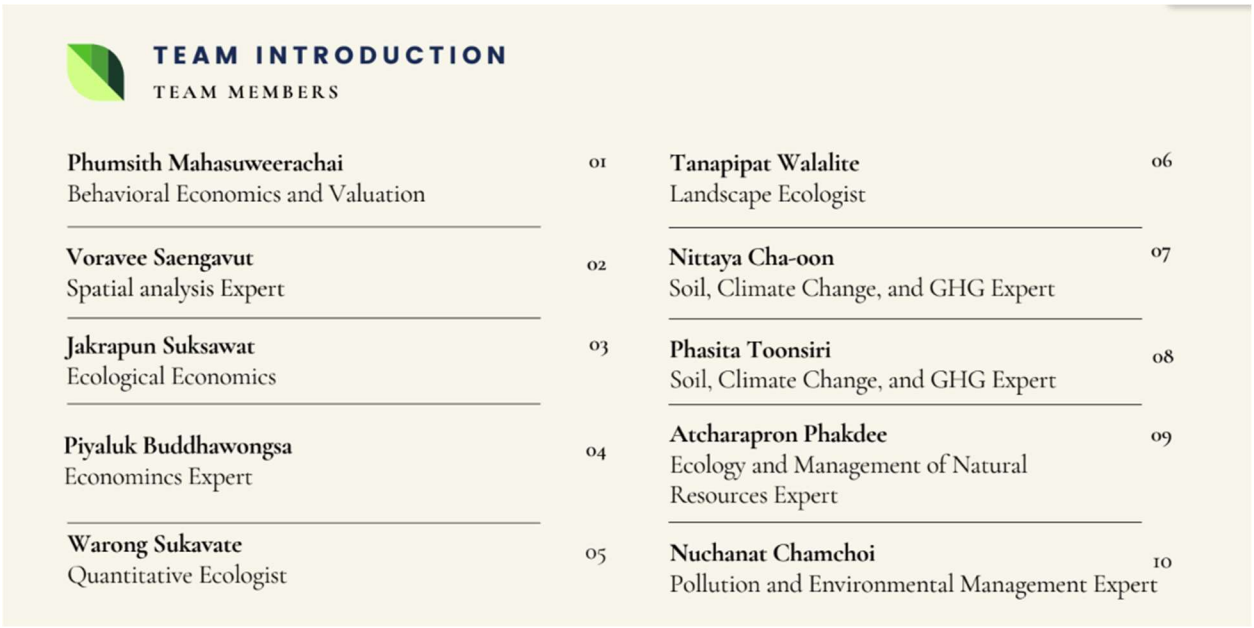
Challenges in implementing Sustainable Rice Standard TAS 4408-3565

- Developing farmers comprehension and knowledge to alter growing patterns.
- Developing auditors capable of granting certification in accordance with sustainable rice standard, with intention of augmenting the quantity of certified sustainable rice.
- Promoting and developing markets on international and domestic scale to facilitate a distribution channel for producers' sustainable rice products.

Presentation of research findings:

Measuring what matters in sustainable rice production

Assoc.Prof. Phumsith Mahasuweerachai, Khon Kaen University, the lead researcher of the project introduced the research team members (as listed below).



Overview of main ideas in the presentation:

To be able to accomplish the sustainable development goals, a state of transition is needed towards fully sustainable rice production and sustainable landscape management.

Rice is the predominant staple crop in Thailand, with more than half of the agricultural households engaged in rice farming. Approximately 20% of Thai households engage in rice farming. The rice production area in Thailand encompasses approximately 50% of the total agricultural area. Thailand has consistently ranked among the top three global rice exporters for several decades.

Different practices of rice cultivation have effects on rice field ecosystem services. The emphasis on boosting agricultural yields to increase global market competitiveness has resulted in the use of chemical fertilizers and pesticides. Rice straw is often burnt in the fields to save the time required to prepare the land. The open burning of rice stubble after harvesting has the potential to harm biodiversity and ecosystem services, leading to the loss of biomass through degraded soil fertility. It also generates a number of negative environmental and health consequences, including the emission of different chemicals and greenhouse gases, as well as the exposure to the very fine dust particles matter (PM 2.5).

Sustainable rice farming is one strategy for achieving long-term and sustainable food production. The SRP Standard is an internationally accepted sustainability standard for rice, which comprises 41 requirements structured under eight themes. The Standard presents a framework to support claims to sustainability. It focuses on improving smallholder livelihoods, reducing the social and environmental footprint of rice production, promoting resource efficiency, reduced carbon emissions and resilience to climate change. However, fulfilling all these objectives is likely to have trade-offs between nature and the productivity of rice. We aim to examine these trade offs.

The TEEBAgriFood Thailand case study focuses on rice production. It was developed under the supervision of ONEP. The research was conducted by KKU and Thai leading universities, namely Kasetsart University, King Mongkut's University of Technology Thonburi (KMUT), Mahasarakham University, Chiang Mai University, and Ubon Ratchathani University. The government agencies on the project steering committee provided full support of this project, consisting of the Rice Department, the Land Development Department, the Ministry of Agriculture and Cooperatives (MOAC), the Ministry of Natural Resources and Environment, along with the Ministry of Finance, Ministry of Public Health, the Ministry of Commerce and the National Economic and Social Development Council.

The study focuses on clarifying the effects of specific cultivation practices promoted by the SRP Standard on natural capital, human capital, social capital, and produced capital following TEEBAgriFood Evaluation Framework in Thailand's Central and Northeastern region.

Methods of measurement and study findings:

Greenhouse gas emissions (GHG)

Three major sources of GHG emissions in the cultivation of conventional and SRP are assessed in this study, including:

1. Greenhouse gas emissions during rice cultivation
2. Soil organic carbon (SOC) sequestration.
3. Greenhouse gas emissions from rice residue burning.

The Denitrification-Decomposition (DNDC) model was used to examine long-term changes in GHG emissions (CH4, N2O, and CO2) and soil organic carbon (SOC) from two rice practices (sustainable and conventional). The DNDC model is unable to account for greenhouse gas emissions from postharvest burning. We applied the open burning rice field model of Junpen et al. (2018) to estimate the difference impacts from conventional and sustainable rice practice.

During the cultivation process, GHG emissions from conventional rice farming were found to be average 532.2 and 405.55 tons of CO2 equivalent per hectare, in the Central and Northeast regions respectively. Sustainable rice farming was found to emit 565.61 and 705.46 tons of CO2 equivalent per hectare on average in the Central and Northeast regions. That is, slightly more greenhouse gases were emitted than for conventional rice cultivation.

Regarding soil organic carbon (SOC) stocks, sustainable rice cultivation was found to improve soil carbon content when compared to conventional rice cultivation. Sustainable rice cultivation resulted in an average soil carbon buildup of 1,999.59 and 715.42 tons per hectare in the Central and Northeast regions respectively. Meanwhile, the carbon buildup of soil from conventional rice farming is about 1625.23 and 452.81 tons per hectare. As such, sustainable rice fields can sequester a greater amount of carbon in the soils than the conventional rice fields. The greater the sustainable rice area, the greater the carbon build-up in the soil.

Regarding rice straw burning, these were calculated to be 0.74 tons per hectare on average. Sustainable rice production does not allow for the open burning of rice stubble, therefore, sustainable rice fields would produce no greenhouse gas emissions in the post-harvest burning.

Overall, sustainable rice production emits lower quantities of greenhouse gases than conventional rice agriculture when all three sources during rice production process of greenhouse gas emissions and storage are taken into account.

Biodiversity

The examination focused on insect and vegetation diversity in rice fields, and how different farming practices affect these. The study highlighted the complex relationship between agriculture and ecosystems. The team assessed pooled insect biodiversity and discovered interesting patterns at a landscape scale. Results show that sustainable rice practice support a higher level of insect biodiversity in both the Northeast and Central regions.

However, the results vary between regions. In the conventional rice fields in the Northeast region, researchers found higher species richness as indicated by the Shannon and Simpson diversity indices, but more diversity in the sustainable rice fields. This clearly highlights the superiority of sustainable rice practice in promoting a diverse and balanced ecosystem. The Central region showcased higher species richness and beta diversity in sustainable rice farming, while conventional farming exhibited greater Shannon and Simpson diversity indices.

An investigation of ecosystem function among insects on rice fields revealed a complex relationship between predators and pests in the Central region. The sustainable rice practice fields showed greater species richness for predators and pests, and higher Shannon/Simpson indices for predators. These results suggest that sustainable rice practice in the Central region supports a higher diversity of predatory insects that benefit pest control. This pest and predator interaction demonstrated a potentially enhanced predator-prey relationship in the Central region's sustainable rice fields.

These results accentuate regional variations in biodiversity patterns, emphasizing the contextual impact of conventional and sustainable rice practices. Impacts are also influenced by landscape variables such as bioclimatic variables, land use patterns, and specific habitats including wetlands.

Additionally, the study analyzed differences in trees on farm (agroforestry practices) between conventional rice farming and sustainable rice farming. This revealed greater densities and vegetative diversity of total trees and of native tree species in the sustainable rice fields relative to the conventional rice fields, particularly in the Northeast.

Water use

This part of the study aimed to investigate water supply, water quality and water footprints in sustainable and conventional rice cultivation practices. Hydrological ecosystem services were quantified and evaluated relative to the output of rice yield (in kilogram of rice) based on alternative future scenarios.

Regarding water use efficiency, the fourth scenario involving the most transformative expansion of sustainable rice practice area, yielded the highest blue water efficiency. Specifically, each cubit meter of water could generate a yield of 0.765 kilograms of rice, compared to the baseline scenarios (BAU) which achieves a yield of 0.757 kilograms per cubic meter. Regarding grey water, the

higher the sustainable rice area, the higher the rice production, which requires more water to dilute pollution.

In the Central region, one cubic meter of gray water in the BAU scenario is required to dilute the impacts of about 1.47 kilograms of rice. while the same amount of grey water in the fourth scenario is associated with only 1.31 kilograms of rice.

On the other hand, expansion of sustainable rice practice in the central region would reduce demand for blue water compared to conventional rice. In the fourth scenario, one cubic meter of blue water from the irrigation system produces around 1.44 kilograms of rice, while the BAU scenario only yields 1.36 kilograms of rice.

Human health impacts

The health impacts analysis was focussed on two main issues: the financial implications of exposure to PM2.5, and exposure to agricultural pesticides.

Regarding pesticide poisoning, the study examined the associated health effects and medical expenses. This was done by conducting surveys in farmer households to gather information. Additionally, the study assessed farmers' willingness to accept financial compensation for the increased risk of severe or fatal illness caused by pesticide exposure.

Regarding the correlation between the fine dust particles emitted from open field burning of rice straw and its impacts on human health, the study focussed on the association between the fine particle component (PM2.5) and the risk of cardiovascular diseases, respiratory illnesses, lung cancer, and mortality. The researchers were able to estimate changes in the health effects of particle exposure, as a result of changes in land use. Based on information regarding social production as generating income to society and population growth, using the Human Capital Approach (AHC), and available datasets on the concentration of PM2.5, the Gross Provincial Product (GPP), and the population growth rate.

The burning of burning rice straw has negative externality effects on Thai society. The economic value stemming from health risks associated with exposure to PM2.5 emissions originating from rice straw burning in the year 2021 was calculated to be 12.76 USD per hectare in the NE region and 512.90 USD per hectare in the Central region of Thailand. This was calculated using the concept of human production loss caused to respiratory mortality. Productivity loss increases with increasing PM2.5 concentration. As sustainable rice production area increases, the cost of health cost decreases dramatically.

For chemicals exposure, the assesment took into account the cost of medical treatment of farmers, based on a household survey conducted in the study areas. In our survey, each household was asked about the incidence of illness caused by chemicals used in rice farming, of these 88 households reported that their members' health was affected by pesticide use, including 9.6% of sustainable rice practice households and 14.8% of conventional households.

The health cost of sustainable rice farmers is slightly below that of conventional rice farmers. The average health costs per area for sustainable rice practice and conventional farmers were found to be 1,225.67 and 1,268.13 baht per ha, respectively. The benefit transfer method was used to further estimate the monetary value of chronic health effects based on previous literature. Several studies

found that the estimated cost of chronic pesticide exposure limited to cancer was at least four times greater than the estimated cost of acute poisoning events (Pimentel 2005, 2009); Pimentel and Burgess, 2014). According to this method, health costs including chronic effects are 1,693.54 baht/ha and 1,907.58 baht/ha for sustainable and conventional farmers respectively.

However, the values from this method should be used with caution. The benefit transfer method has the disadvantage that the costs could not be comparable because they are influenced by several factors, such as the type of pesticide used, the number of treatments, the degree of protection of the farm personnel spraying the pesticides, etc., which can vary greatly from country to country, with particularly large differences between countries.

Rice production /Cost of cultivation

At the time of study, there is no guaranteed price or standard premium for sustainable rice at the mill. While some farmers in Ubon Ratchathani province are being given project support, in general, the price of rice that was applied to sustainable rice practice in our assessment is the same as for conventional rice.

Our survey information reveals that sustainable rice practice involves lower production cost than conventional rice practice, in particular savings in land preparation and fertilizer costs in the Central region, and in pesticide and fertilizer costs in the Northeast region.

Community and social analysis

Changes in social capital were explored through a qualitative analysis of the results of the household survey. Levels of happiness, social ties, and participation in social networks were examined, differentiating between conventional and sustainable rice practices.

Data from household surveys indicated that farmers who practice sustainable rice are likely to be happier than conventional rice farmers. Among the factors that drive the happiness of farmers, family and income come first and second for both types of farmers. Sustainable rice farmers appear to have higher social ties than their conventional counterparts, especially for voluntary activity. In addition, female sustainable rice farmers seem to participate more in the farmer groups than female conventional rice farmers. The degree of participating in the groups between female and male sustainable rice farmers is the same, while female farmers participate less than their male counterparts in conventional rice farming groups.

Our results suggested that social networks between conventional rice farmers and sustainable rice farmers are very similar in terms of size of social network and characteristics of the nodes (people at the center of networks). We also found that farmers receive information and follow guidance on new agricultural technology from the nodes and also from their relatives and close friends. The findings of the social network study would be a starting point to using social network information to select farmers who could be trained as early sustainable rice adopters. They could spread information and lead others in their network to adopt sustainable rice practice.

Scenario analysis

The scenario analysis highlights the trade-offs between the future negative and positive consequences of sustainable rice production. The scenarios maps present different degrees of sustainable rice area expansion, including low, moderate, and high expansion, for the Central and the Northeast regions of Thailand from 2022 to 2050. The analysis projects economic returns, as well as significant costs and benefits in the rice production system that are sometimes invisible, known as "externalized impacts."

The increase of sustainable rice regions provides societal-wide advantages, both for the environment and human health. However, unless the government provides appropriate management guidance and sufficient promotion, the expansion of sustianable rice may not have a direct impact on farmer's earnings.

Consumers' preferences

The research team developed various conditions of sustainable and conventional rice through variables that would be discernably different for the two management practices. These variables cover changes in GHG emissions, biodiversity, air pollution, fairness, SRP certification, and the price of rice. Participants were also given alternate choices of jasmine rice and white rice, varieties commonly consumed by Thai consumers, within the choice experiment questions.

The results show that generally consumers seem to prefer sustainable rice practice to conventional rice because all benefit generated from sustainable rice practice is significantly accepted and contains higher monetary value than those of conventional counterpart.

When considering the details of each variable from sustainable rice practice, SRP certification is the most important factor that determines consumers to buy the sustainable rice. The next factor that consumers pay attention to when deciding to buy rice is biodiversity. These first and second important factors are the same for both jasmine rice buyers and white rice buyers alike. Jasmine rice buyers pay greater consideration to fairness than white rice buyers. That is if they know that farmers receive higher share from price of rice, there is a higher chance that they will buy jasmine rice with this condition.

Consumers also see environmental factors, including emissions of GHG and PM2.5, as important factors when deciding to buy rice. However, these two factors receive relatively less attention compared to other factors.

Policy recommendations

One of the main tools to support farmers is subsidy. The main subsidy policies in agriculture currently focus on mitigating financial hardship of farmers. However, this form of subsidy sends an economic signal to farmers that the government will always step in to help them whatever practices they apply for rice cultivation. It does not encourage farmers to adopt sustainable agricultural practices like sustainable rice. We propose that existing subsidies be reoriented conditional on adopting sustainable agricultural practice such as sustainable rice.

Conversion to sustainable rice practice requires some management and access to necessary inputs such as soil nutrient evaluation, land leveling equipment, and appropriate fertilizers. Many farmers may not be able to efficiently access these techniques and inputs. Even though they would like to

try sustainable rice practices, without support the adoption of sustainable rice practice may not success. We propose that the government should set up efficient systems for providing these kinds of supports to farmers.

Rice farmers in irrigated area growing at least two crops of rice a year often practice rice field burning because they want to speed up the process of preparing the field for the next crop. Waiting for rice straw and stubble to decompose naturally is not an option for many farmers. Supports with technology and innovations to speed up stubble decomposition would help farmers to reduce time and provide practical ways to eliminate stubble burning.

Sustainable rice practice could mitigate GHG emissions through soil carbon sequestration. In the irrigation area, alternate wet and dry technique (AWD) could be employed to significantly reduce methane GHG emissions from rice cultivation. However, these public benefits are invisible to farmers. An economic or market mechanism that could transfer this invisible benefit to financial benefit for farmers could play an important role in encouraging change. Voluntary carbon markets could be one solution, but for rice production the high cost of validation process makes it very unlikely to achieve financial feasibility for capture carbon credit. Lower transaction costs and internationally acceptable methodologies to capture carbon credit are needed.

Widely transformation from conventional to sustainable rice practice would require significant support from the government, especially during the early part of the 2 to 3 year conversion period. Where budgets are limited, our study suggests that starting the transformation from conventional to sustainable rice practice in the Northeast region would be more cost-effective than in the Central region, as the net benefits of transformation gained here are clearly visible by both private and public.

Questions and discussion

1. Mr.Tanit Changtavorn, Deputy Director of the Biodiversity-Based Economy Development Office (BEDO), suggested an idea of biological diversity index called the BEDO Biodiversity index. The issues of social capital and the measurement of happiness require efforts in qualification. BEDO has a tool called 'Community Happiness' that can be used to qualify happiness as a percentage. This is an issue where collaboration may be possible. An assessment of the economic and social impact is needed. Development of biodiversity economy opportunities may be available in the interim period of the transition from regular to sustainable rice, to support farmers to be able to cover their costs and repay debts.

   Response from research team: regarding biodiversity, we have collected more data than just insects. We gather information on fish and other animals as well. However, the data analysis is quite complicated. What we have chosen links clearly to rice production. But we also have additional datasets.

2. An officer of the Thai Environment Institute suggested that the guideline of the Sustainable Rice Standard from the ACFS is still vague about biodiversity assessment and water resources. There are no clear patterns or suggestions for farmers to follow. To be more efficient, the Standard should

consider farm ridge or ridge management in order to increase the biodiversity in crops which directly linked to the food security of farmers. For example, trees on farm ridge or ridge height.

Response from research team: ACFS may respond on this issue.

3. An officer of the Research Center on Climate Change and Environment proposed alternative models for water management and cost of water usage. The results from the models showed that both Khok Nong Na Model and integrated crop models can significantly reduce the cost of water usage from water recycling. Moreover, the models also demonstrated favorable biological diversity indices when employing water reuse. Thus, it is possible that the natural costs might be lower previously predicted. Furthermore, it is possible to reduce the probability of water contamination from releasing water to rivers or irrigations. The average yield per Rai is not different from other methods, around 1,000 kilograms per Rai.

   Response from research team: Issue will be considered in future research to find the best solution.

4. Dr Wyn Ellis, Executive Director of the Sustainable Rice Platform agreed with the results of the research which goes along with their study in 2009-2010. The outcomes of KKU-research such as health and biodiversity are clear and extended enough to move to the next stage. However, some factors are academic for farmers, such as carbon outcomes. Carbon outcomes serve no purpose if farmers are not making money or supported. Thus, the important thing is how organizations can work together to help farmers to adopt sustainable rice practice, Ministry of Agriculture, ACFS, UNEP and the others. Moreover, it is a huge opportunity for Thailand to get access to global markets, in Europe, in the US and now also in Australia, as jasmine rice is beginning to gain traction.

5. Bruno Fischer, Foodtech Solutions raised a question about biochar and straw management. From his work, organic agriculture needs new methods to improve the quality of soil. They found an average rate of organic matter in the soil of 0.4% - that is near desert conditions. Increasing organic matter is an important thing but may increase greenhouse gas emissions at the same time.

   Response from research team, this issue was considered by KKU. However, there is no evidence to support the benefits of biochar, particularly producing from rice in economic feasibility.

6. Orachon, Faculty of Economics at Kasetsart University pointed out four challenges.
   a. Social issues should be of greater concern. Workers are aging, there are specific challenges on labour rights and other labour matters in both Northeast and Central regions.
   b. Demand of consumers for sustainable rice. Consumers express that they would purchase SRP rice. They are conscious of the benefits and show interest in the adaptive practices of farmers in cultivating SRP rice. However, if unforeseen events hinder farmers from adhering to their intended practices, would consumer intentions be impacted?
   c. Glutinous rice is the main variety grown in certain areas for some groups of farmers. This is for household consumption, not for sale, do they need to apply sustainable rice practice?
   d. Even though the European market is a crucial market, transportation also releases a significant amount of carbon.

Response from research team, The project aims to provide high quality of rice for the Thai people. SRP targets not only the international markets but also Thai markets, however, SRP rice is not introduced to Thai market officially. It is just the beginning of SRP rice. A premium price is not an appropriate factor for convincing farmers and consumers in this stage. The transition process is a time in which we need to convince farmers, there is not just one step in the switch to SRP, it requires a lot of involved factors and processes.

7. Mr. Kittisak, representing the Environmental Fund mentioned that if a subsidy is important to convince farmers, what is the minimum requirement of subsidy or what is the direction for getting the tipping point. The models should include all external factors such as health, biodiversity, and climate impact, to determine the minimum cost of subsidy that the government can follow.

   Response from research team: Using data that was previously readily available, we have now computed the amount of profit that will be made. Currently, we are interested in determining an approximate estimate of the cost of the subsidy.

8. Mr. Thanu, a Thai farmer originally from Ubon Ratchathani believes that farmers would be the best followers, especially if institutions or specialists provided assistance and support in terms of knowledge and practice skills. Farmers are prepared to comply with the Standard.

   Response from research team: Based on previous research conducted by GIZ, Thai farmers, especially those in the northeastern region, are already practicing sustainable rice farming that closely aligns with the requirements of the SRP Standard. Data from our research through household surveys supported the findings of GIZ. The transition of farmers from conventional cultivation practices to Sustainable Rice Platform (SRP) cultivation is highly feasible.

9. Dr. Salman Hussain, Coordinator, The Economics of Ecosystems and Biodiversity (TEEB), noted that the KKU team last year developed their assessment of the Million Rai organic rice extension program. This program showed a similar tendency to the SRP expansion area in terms of its positive impact on both the economy and the environment. The Thai government, looking to develop policies that would encourage farmers, could ask how to determine the order of importance between organic and sustainable rice practice?

   Response from research team: a cultivator places a high value on yield. Climate conditions influence the degree of risk that impacts their yield. Our research on organic rice indicated that under normal weather conditions, the outcome of both organic and conventional rice remains unchanged. However, in bad weather, particularly in the northeastern region, the yield of organic rice decreases significantly more than that of conventional rice. This pattern has not yet been identified in the SRP data. As such, no conclusive findings can be made at this time. According to the study, one aspect was risk and the significant variability of the local meteorological conditions. It is possible that SRP should be prioritized over organic in this particular domain. However, additional research would be necessary to confirm this.

Panel Discussion "Sustainable rice: How to sustain it?"

Panellists

- Dr. Vallop Manathaya, Thai Exporters Association of Thailand
- Dr. Atthawit Watcharapongchai, Project Director: Better Rice Initiative Asia II Thailand/GIZ
- Mr. Vanus Taepaisitphongse, National Innovation Agency
- Ms. Sawanee Phorang, SRP Farmer

Why should we transform to sustainable rice practice?

- The Sustainable Rice Platform (SRP) aims at sustainability in economic, social, and environmental dimensions.
- With the increasing effect of climate change on rice cultivation, farmers should react through both mitigation and adaptation by adopting SRP.
- Sustainable rice could provide greater net benefit than conventional rice. SRP rice is shown to involve a 10-20% increase in yield and reduced costs, mainly from land leveling, fertilizing management, alternate wetting and drying (AWD), and rice straw management.
- One SRP farmer in Nong Bua Ngam could produce about 778 kilograms per rai, compared to the average of 330 kilograms per rai from conventional rice.

The current situation of SRP Rice Cultivation in Thailand

- GIZ organization in collaboration with the Rice Department have been promoting SRP rice in the northeast and central regionss, which have different agricultural ecosystems.
- In the northeast, the project in Ubon Ratchathani started six years ago, covering around 300,000 *rai* with 20,000 farmer households. Meanwhile, in Roi Et province, SRP has been adopted in 40,000 *rai* by 1,200 farmer households.
- In the central region, over 100,000 farmer households have adopted SRP. One project site, in DoemBangNangBuat district, Suphanburi, involves 124 farmer households, and 5,217 *rai*.
- The next phase targets 1 million rai expansion in Surin and Sisaket provinces in the Northeast.

Current support for SRP Rice Cultivation

- SRP is supported by GIZ, government agencies, and private sector eg rice exporters.
- The project provides support in knowledge, machines, certification, as well as market access.
- To motivate farmers to continue in SRP rice, support is needed from government agencies.

Challenges in SRP Rice Cultivation:

- Most farmers lack of knowledge on how to produce SRP rice.
- SRP rice is treated as a premium rice with a higher price than conventional rice.
- Most Thai consumers are highly sensitive on rice price, so domestic expansion of demand for SRP rice could be a challenge.
- SRP market segmentation is still unclear or not specific. Thus, for a major expansion of SRP rice area, SRP rice produce may be processed in combination with conventional rice.
- To export SRP rice, global SRP certification is required. This comes with high cost, and is inaccessible for farmers.

ANNEX 1: Workshop Agenda

The Economics of Ecosystems and Biodiversity (TEEB) Implementation: Promoting a Sustainable Agriculture and Food Sector

"Sustainable Rice for Life and Nature "

13 November 2023 from 08.30 a.m. to 3.30 p.m.
Swissotel Bangkok Ratchada Hotel, Bangkok

8.30-8.50 a.m.	Registration
08.50 - 09.00 a.m.	Video presentation
9.00-9.15 a.m.	Opening Mr. Jiravat Ratisoontorn, Deputy Secretary-General, Office of Natural Resources and Environmental Policy and Planning ONEP, Ministry of Natural Resources and Environment, Thailand
9.15-9.30 a.m.	Introductory remarks Dr. Salman Hussain, Coordinator, The Economics of Ecosystems and Biodiversity (TEEB), United Nations Environment Programme (UNEP)
9.30-10.15 a.m.	Keynote Speech: The global trend in rice standards is moving towards alignment with Thai rice standards. It is essential for us to manage rice production in a way that contributes to the well-being of the world. Mr. Pisan Pongsapitch, Secretary General National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperatives
10.15-11.15 a.m.	Presentation of research results from initial assessment " Measuring what matters in sustainable rice production. Assoc. Prof. Dr. Phumsith Mahasuweerachai, Economics Faculty, Khon Kaen University and Research team
11.15-11.45 a.m.	Questions and discussion on research findings and recommendations for policy approach.
12.00-1.00 p.m.	Lunch Break
1.00-2.45 p.m.	Seminar “Sustainable rice: How to sustain it” - Dr. Vallop Manathaya, Thai Exporters Association of Thailand - Dr. Atthawit Watcharapongchai, Project Director: Better Rice Initiative Asia (BRIA)II Thailand / GIZ - Mr. Vanus Taepaisitphongse, National Innovation Agency - Ms. Sawanee Phorang, SRP Farm
2.45-3.00 p.m.	Close of meeting and photograph

ANNEX 2: List of workshop participants

Participant list The National workshop supported by The Economics of Ecosystems and Biodiversity (TEEB) Implementation: Promoting a Sustainable Agriculture and Food Sector Conference 13 November 2023, 08.30 a.m. to 3.30 p.m. Swissotel Bangkok Ratchada Hotel, Bangkok				
Order	**Name-Last name**	**Position**	**Institution**	**Gender**
1	จิรวัฒน์ ระติสุนทร	รองเลขาธิการสำนักงานนโยบายและแผนทรัพยากรธรรมชาติและสิ่งแวดล้อม	Natural Resources and Environmental Policy and Planning	male
2	Salman Hussain	Coordinator, The Economics of Ecosystems and Biodiversity (TEEB)	UNEP	male
3	พิศาล พงศาพิชญ์	เลขาธิการสำนักงานมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ	National Bureau of Agricultural Commodity and Food Standards (ACFS)	male
4	วัลลภ มานะธัญญา	อุปนายกสมาคมผู้ส่งออกข้าวไทย	The Thai Rice Exporters Association	male
5	อรรถวิชช์ วัชรพงศ์ชัย	ผู้อำนวยการปฏิบัติการโครงการข้าว / GIZ	GIZ	male
6	คุณวนัส แต้ไพสิฐพงษ์	ที่ปรึกษาคณะกรรมการสำนักงานนวัตกรรมแห่งชาติ (องค์การมหาชน)	National Innovation Agency, Thailand	male
7	สวณีย์ โพธิ์รัง	ผู้แทนเกษตรกรปลูกข้าวยั่งยืน	Collaborative Farming, Suphan Buri province	female
8	Rebeca Leonard	TEEBAgriFood Thailand	UNEP	female
9	William Speller	Programme Management Officer	UNEP	male
10	Yashiro	Programme Management Officer	UNEP	male
11	Wyn Ellis	Executive Director	SRP Organization	male
12	Sorakrit Sailah สรกฤช สายหล้า	Manager	Ajinomoto, FD Green (Thailand) Co., Ltd.	male
13	Kriangkrai Thitimakorn	Senior Programme Officer	Embassy of Sweden in Bangkok	female
14	Nawarat Chalermpao	Assistant FAO Representative (Programme), FAO-Thailand	FAO Thailand	female
15	Bruuo Fischer	#N/A	Foodtech Solutions	male
16	Naua Kuukel	#N/A	GIZ	male
17	ลัดดา วิริยางกูร	ที่ปรึกอาวุโสด้านนโยบายข้าวยั่งยืน	GIZ	female
18	สริดา คณาณุศิษฎ์	Project director	GIZ	female
19	อภิญาณี หทัยธรรม	#N/A	GIZ	female
20	Phongpob Methakullawat	National Project Coordinator	ITC	male
21	บัญญัติ คำบุญเหลือ	#N/A	SLIG	male
22	วรรณภร วัฒนาเกษมสัตย์	ผู้อำนวยการฝ่ายความยั่งยืนทางธุรกิจ	Syngenta Thailand	female

ANNEX 2: List of workshop participants

Participant list The National workshop supported by The Economics of Ecosystems and Biodiversity (TEEB) Implementation: Promoting a Sustainable Agriculture and Food Sector Conference 13 November 2023, 08.30 a.m. to 3.30 p.m. Swissotel Bangkok Ratchada Hotel, Bangkok				
Order	**Name-Last name**	**Position**	**Institution**	**Gender**
23	นพรุจ จินดาสมบัติเจริญ	#N/A	TDRI	male
24	พร้อมพัฒน์ ภูมิวัฒน์	นักวิจัย	TDRI	male
25	นิคม รวมสิทธิ์	Technical Specialist	Winrock International	male
26	ศรัณย์ภัคร์ กิตติวรภูมิ	ผู้ประสานงานโครงการ	WWF Thailand	female
27	ปรียา อุ่นวิเศษ	นักวิชาการสิ่งแวดล้อมปฏิบัติการ	Department of climate change and environment (DCCE)	female
28	ปัญญา วรเพชรายุทธ	ผู้อำนวยการศูนย์วิจัยการเปลี่ยนแปลงสภาพภูมิอากาศและสิ่งแวดล้อม	Department of climate change and environment (DCCE)	male
29	วาลิกา เศวตโยธิน	นักวิชาการสิ่งแวดล้อมชำนาญการพิเศษ	Department of climate change and environment (DCCE)	female
30	สุธีระ บุญญาพิทักษ์	นักวิชาการสิ่งแวดล้อมปฏิบัติการ	Department of climate change and environment (DCCE)	male
31	จรัญจอต เพ็งรัตน์	รักษาการผู้เชี่ยวชาญด้านพัฒนาผลิตภัณฑ์	Rice department	female
32	ดวงตา บุรีเทพ	นักวิเคราะห์นโยบายและแผนชำนาญการพิเศษ	Rice department	female
33	วิภาดา วรรณธัญญารัตน์	นักวิชาการเกษตร	Rice department	female
34	โสภา ทมธิแสง	#N/A	Department of Foreign Trade	female
35	กุลริศา หมอนสอาด	#N/A	Department of Foreign Trade	female
36	เบญจมาศ วรรณธรรม	นักวิชาการพาณิชย์ชำนาญการ	Department of internal trade	female
37	กัณฐิกา เมฆา	นักวิชาการพาณิชย์ปฏิบัติการ	Department of internal trade	female
38	ฉิราพร ด่านศรีบูรณ์	นักวิชาการพาณิชย์ชำนาญการ	Department of internal trade	female
39	ประภาพร กิตติเสนาชัย	นักวิชาการพาณิชย์ชำนาญการพิเศษ	Department of internal trade	female
40	เอกพัดชา แก้วตระการวงศ์	นักวิชาการสิ่งแวดล้อมชำนาญการ	Pollution control department	female
41	กนกวรรณ สันติภราภพ	นักวิชาการสิ่งแวดล้อม	Pollution control department	female
42	กรณัฏฐ์ เมฆชัย	เศรษฐกรชำนาญการพิเศษ	Royal Irrigation Department	female
43	ชวกร ริ้วตระกูลไพบูลย์	#N/A	Royal Irrigation Department	male
44	พรศิริ คณะใหญ่	นักวิชาการสิ่งแวดล้อมชำนาญการพิเศษ	Royal Irrigation Department	female
45	วันทนีย์ สกุลศักดิ์	นักวิชาการสิ่งแวดล้อมชำนาญการพิเศษ	Royal Irrigation Department	female
46	วันทนีย์ สกุลศักดิ์	นักวิชาการสิ่งแวดล้อมชำนาญการพิเศษ	Royal Irrigation Department	female
47	ลภิณโกพร์ จาตะวงษ์	#N/A	Bureau of Project Management, Royal Irrigation Department	female
48	กมลทิพย์ ศศิธร	นักวิชาการเกษตรชำนาญการพิเศษ	Land Development Department	female

ANNEX 2: List of workshop participants

Participant list The National workshop supported by The Economics of Ecosystems and Biodiversity (TEEB) Implementation: Promoting a Sustainable Agriculture and Food Sector Conference 13 November 2023, 08.30 a.m. to 3.30 p.m. Swissotel Bangkok Ratchada Hotel, Bangkok				
Order	**Name-Last name**	**Position**	**Institution**	**Gender**
49	จตุรงค์ ละออพันธ์สกุล	นักสำรวจดินชำนาญการพิเศษ	Land Development Department	male
50	จักรพันธ์ เภาสระคู	นักวิชาการเกษตรชำนาญการพิเศษ	Land Development Department	male
51	ดาราพร บุญเกษม	นักสำรวจดินปฏิบัติการ	Land Development Department	female
52	นิสา มีแสง	นักวิชาการเกษตรเชี่ยวชาญ ด้านการจัดการดินด้วยระบบพืช	Land Development Department	female
53	ปรียารัตน์ ชัยลังกา	นักสำรวจดินชำนาญการ	Land Development Department	female
54	พิมพ์พร พรพรหมินทร์	นักวิเคราะห์นโยบายและแผนชำนาญการพิเศษ	Land Development Department	female
55	วรรยา สุธรรมชัย	นักวิชาการเกษตรชำนาญการพิเศษ	Land Development Department	female
56	สุมลมาลย์ จงดี	ผู้อำนวยการกลุ่มระบบงานวิจัย	Land Development Department	female
57	อังควิภา นาคคง	นักวิเคราะห์นโยบายและแผนปฏิบัติการ	Land Development Department	female
58	อัจฉรารัตน์ นกเดช	นักวิชาการเกษตรชำนาญการ	Land Development Department	female
59	ปิยรัตน์ รุจิณรงค์	นักวิชาการเกษตรชำนาญการพิเศษ	Seed Research and Development division	female
60	กัญญาภรณ์ พิพิธแสงจันทร์	รักษาการผู้เชี่ยวชาญด้านอนุรักษ์พันธุกรรม/ผู้อนวยการกลุ่มวิจัยพัฒนาธนาคารเชื้อพันธ์พืชและจุลินทรีย์	Biotechnology Research and Development office	female
61	นภาพร ตระการตาทิพย์	นักวิชาการเกษตรปฏิบัติการ	Department of Agricultural Extension	female
62	อำพร เนติ	ผู้อำนวยการกลุ่มส่งเสริมระบบการผลิตข้าว	Department of Agricultural Extension	female
63	คณิศร โชติวุฑฒากร	นักวิชาการป่าไม้ปฏิบัติการ	Department of National Parks Wild animals and plants	male
64	ธนู ทัพหกิจ	ประธานข้าวยั่งยืนจังหวัดอุบลราชธานี	Sustainable Rice Platform Group, Ubon Ratchathani province	male
65	สงกรานต์ สายบุตร	เกษตรกร	Sustainable Rice Platform Group, Ubon Ratchathani province	male
66	อุดร คำวงษา	เกษตรกร	Sustainable Rice Platform Group, Ubon Ratchathani province	female
67	ทยิดา จันทร์นุ่ม	เกษตรกร	Collaborative Farming	female
68	วรวรรณ คำแผง	เกษตรกร	Collaborative Farming	female
69	รัตนาวรรณ จิทาปะ	#N/A	The Federation of Thai Industries	female
70	เมตตา คชสำโรง	รักษาการผู้เชี่ยวชาญด้านการผลิตเมล็ดพันธุ์ข้าว	Rice Seed Division	female
71	อรสา ขัตสากาญจน์	ผู้เชี่ยวชาญด้านการควบคุมคุณภาพเมล็ดพันธุ์ข้าว	Rice Seed Division	female

ANNEX 2: List of workshop participants

Participant list The National workshop supported by The Economics of Ecosystems and Biodiversity (TEEB) Implementation: Promoting a Sustainable Agriculture and Food Sector Conference 13 November 2023, 08.30 a.m. to 3.30 p.m. Swissotel Bangkok Ratchada Hotel, Bangkok				
Order	**Name-Last name**	**Position**	**Institution**	**Gender**
72	มงคล จันทร์ประทัด	ผู้อำนวยการ	Divistion Of Rice Rice Products Inspection And Certification Rice Department	male
73	ธนิศร์ ทิพยมงคลกุล	นักวิชาการประมงปฏิบัติการ	Inland Fisheries Research and Development Division	male
74	อรชส นภสินธุวงศ์	#N/A	Faculty of Economics, Kasetsart University	female
75	น้องนุช สมสุยามูล	พนักงานส่งเสริมนวัตกรรม	BAAC	female
76	ณัฐพงศ์ ทรัพย์มณีนันท์	ผจก.	FD GREEN (THAILAND) co., ltd.	male
77	ธนโชติ โชติพฤกษ์	Supervisor	FD GREEN (THAILAND) co., ltd.	male
78	มณีนุช กอแก้ว	Supervisor	FD GREEN (THAILAND) co., ltd.	female
79	ชัยณรงค์ สุขุมประเสริฐศรี	ที่ปรึกษาโครงการด้านการพัฒนาอย่างยั่งยืน	Thai President Foods PCL	male
80	นิมล กิจขันธ์	ที่ปรึกษาโครงการด้านการพัฒนาอย่างยั่งยืน	Thai President Foods PCL	female
81	อภิเดช รักเป็นไทย	อาจารย์	Faculty Of Agriculture Kasetsart University	male
82	เสาวลักษณ์ พูลสวัสดิ์	นักวิชาการคอมพิวเตอร์ปฏิบัติการ	Information and Communication Technology Center	female
83	ณภัทร โพธิ์ทอง	เจ้าหน้าที่ระบบงานคอมพิวเตอร์	Information and Communication Technology Center	female
84	สนิท ดำบรรณ์	ประธานกลุ่ม	ศูนย์ข่าวชุมชนสวนดึกดำบรรณ์ ต.แก้งเหนือ	male
85	กรรณิการ์ ธรรมพานิชวงค์	นักวิชาการอาวุโส	TDRI	female
86	ปริญญารัตน์ เลี้ยงเจริญ	นักวิจัย	TDRI	female
87	กนกพร คุ้มภัย	นักวิจัยผู้ช่วย	Environmental Research Institute	female
88	บัวหลวง ฝ้ายเยื่อ	ผู้ช่วยผู้อำนวยการ	Environmental Research Institute	male
89	คุณเวทย์ พยนรัตน์	พนักงาน	Royal initiative discovery foundation (Pidthong)	male
90	รัตติยา โพธิ์แก้ว	พนักงาน	Royal initiative discovery foundation (Pidthong)	female
91	ธนิรัตน์ ธนวัฒน์	ผู้จัดการโครงการอาวุโส	Thailand Environment Institute	female
92	บุญจิรา ตันเรือง	ผู้จัดการสหกรณ์กรีนเนท	Green Net	female
93	พงษ์ทิพยา พรองพรหม	เจ้าหน้าที่ฝ่ายส่งออก	Green Net	female
94	ธิดากุญ แสนอุดม	ผู้อำนวยการสำนักคุ้มครองพันธุ์พืช	Plant variety protection office	female
95	บดินทร สอนสุภาพ	นักวิชาการเกษตรชำนาญการ	Plant variety protection office	male

ANNEX 2: List of workshop participants

Participant list The National workshop supported by The Economics of Ecosystems and Biodiversity (TEEB) Implementation: Promoting a Sustainable Agriculture and Food Sector Conference 13 November 2023, 08.30 a.m. to 3.30 p.m. Swissotel Bangkok Ratchada Hotel, Bangkok				
Order	**Name-Last name**	**Position**	**Institution**	**Gender**
96	ปาจรีย์ อินทะชุบ	นักวิชาการเกษตรชำนาญการ	Plant variety protection office	female
97	กมลพร แก้วทอง	เศรษฐกรปฏิบัติการ	Office of agricultural economics	female
98	ฐิติพงษ์ ศรีสมบัติ	#N/A	Office of agricultural economics	male
99	ปองวดี จรังรัตน์	เศรษฐกรชำนาญการพิเศษ	Office of agricultural economics	female
100	นภา วรวรางกูร	เศรษฐกรชำนาญการ	Fiscal Policy Office	female
101	พรทิพย์ เปรมยิ่ง	นักวิชาการปฏิรูปที่ดินปฏิบัติการ	Agricultural Land Reform Office	female
102	อาทิตยา พองพรหม	ผู้เชี่ยวชาญด้านการเพิ่มประสิทธิภาพการใช้ที่ดินในเขตปฏิรูปที่ดิน	Agricultural Land Reform Office	female
103	ศรัญญู ฉนิมลักษณ์	นักวิเคราะห์นโยบายและแผน	National Research Council of Thailand (NRCT)	male
104	เปรมศักดิ์ ชัยวิวัฒน์ตระกูล	นักวิชาการ	Thailand Science Research and Innovation (TSRI)	male
105	ฐิติมา พิกุลทอง	นักวิชาการอาวุโส	Thailand Science Research and Innovation (TSRI)	female
106	ปัทมาวดี โพชนุกูล	ผู้อำนวยการ สกสว.	Thailand Science Research and Innovation (TSRI)	female
107	สิริวรรณ แสงนาค	เลขานุการ ผอ. สกสว.	Thailand Science Research and Innovation (TSRI)	female
108	อทิตยา ประเสริฐ	#N/A	Thailand Science Research and Innovation (TSRI)	female
109	เบญจมาภรณ์ วัฒนธงชัย	นักวิชาการสิ่งแวดล้อมชำนาญการพิเศษ สผ.	Office of Natural Resources and Environmental Policy and Planning	female
110	กรรณิกา กันพุดตา	นักวิชาการอาวุโส	Office of Natural Resources and Environmental Policy and Planning	female
111	กัญญ์ศิริ ใจมุ่ง	นักวิชาการสิ่งแวดล้อมชำนาญการ	Office of Natural Resources and Environmental Policy and Planning	female
112	กิตติศักดิ์ พฤกษ์กานนท์	นักวิชาการสิ่งแวดล้อมชำนาญการพิเศษ สผ.	Office of Natural Resources and Environmental Policy and Planning	male
113	จิตตินันท์ เรืองวีรยุทธ	ผู้อำนวยการกองจัดการความหลากหลายทางชีวภาพ สผ.	Office of Natural Resources and Environmental Policy and Planning	female
114	ชัชวรรณ เย็นอาคาร	นักวิชาการสิ่งแวดล้อมชำนาญการ สผ.	Office of Natural Resources and Environmental Policy and Planning	female
115	ทัศนธร ภูมิยุทธ์	#N/A	Office of Natural Resources and Environmental Policy and Planning	female
116	นวรัตน์ รุ่งศรีรัตนวงศ์	นักวิชาการสิ่งแวดล้อมชำนาญการพิเศษ สผ.	Office of Natural Resources and Environmental Policy and Planning	female

ANNEX 2: List of workshop participants

Participant list The National workshop supported by The Economics of Ecosystems and Biodiversity (TEEB) Implementation: Promoting a Sustainable Agriculture and Food Sector Conference 13 November 2023, 08.30 a.m. to 3.30 p.m. Swissotel Bangkok Ratchada Hotel, Bangkok				
Order	**Name-Last name**	**Position**	**Institution**	**Gender**
117	นิภาพร ก้องโลก	#N/A	Office of Natural Resources and Environmental Policy and Planning	female
118	พรพัฒน์ กาวิละ	เจ้าหน้าที่วิเคราะห์นโยบายและแผน สผ.	Office of Natural Resources and Environmental Policy and Planning	male
119	พรรณวดี อารยวงศ์วาฬ	นักวิชาการสิ่งแวดล้อมชำนาญการ/กองทุนสิ่งแวดล้อม	Office of Natural Resources and Environmental Policy and Planning	female
120	พัชรพร นำตระกูลพัฒนา	นักวิชาการสิ่งแวดล้อมชำนาญการ	Office of Natural Resources and Environmental Policy and Planning	female
121	พุทธธิดา รัตนะ	นักวิชาการสิ่งแวดล้อมปฏิบัติการ สผ.	Office of Natural Resources and Environmental Policy and Planning	female
122	รพีพร ขันโอพาร	ผู้อำนวยการกลุ่มงานนโยบายและแผน/กองทุนสิ่งแวดล้อม	Office of Natural Resources and Environmental Policy and Planning	female
123	วนิดา แซ่จิว	นักวิชาการสิ่งแวดล้อมชำนาญการ สผ.	Office of Natural Resources and Environmental Policy and Planning	female
124	วรรณาทิพย์ เติมมหาวงษ์	นักวิชาการสิ่งแวดล้อมปฏิบัติการ	Office of Natural Resources and Environmental Policy and Planning	female
125	วราภรณ์ บุรีรักษ์	นักวิชาการสิ่งแวดล้อมชำนาญการ	Office of Natural Resources and Environmental Policy and Planning	female
126	ศศิวิมล สำเนียงวรรณ	#N/A	Office of Natural Resources and Environmental Policy and Planning	female
127	สาวิตรี บุญญลักษม์	นักวิชาการสิ่งแวดล้อมปฏิบัติการ	Office of Natural Resources and Environmental Policy and Planning	female
128	กิตติพันธ์ ศรีอนันต์	ประสานงานโครงการ	Biodiversity-Based Economy Development Office (Public Organization)	male
129	ฉัตรชัย อินทันแก้ว	เจ้าหน้าที่พัฒนาเศรษฐกิจชีวภาพ	Biodiversity-Based Economy Development Office (Public Organization)	male
130	ธนิต ชังถาวร	รองผู้อำนวยการ สพภ.	Biodiversity-Based Economy Development Office (Public Organization)	male
131	ปิยะรัตน์ หุ่นทอง	เจ้าหน้าที่พัฒนาเศรษฐกิจชีวภาพ	Biodiversity-Based Economy Development Office (Public Organization)	female
132	เยาวลักษณ์ ศรีรังสิต	นักวิเคราะห์อาวุโส 1	Agricultural Research Development Agency (Public Organization)	female
133	วินัย ขาวมี	นักวิเคราะห์ปฏิบัติการ 2	Agricultural Research Development Agency (Public Organization)	male

ANNEX 2: List of workshop participants

Participant list The National workshop supported by The Economics of Ecosystems and Biodiversity (TEEB) Implementation: Promoting a Sustainable Agriculture and Food Sector Conference 13 November 2023, 08.30 a.m. to 3.30 p.m. Swissotel Bangkok Ratchada Hotel, Bangkok				
Order	**Name-Last name**	**Position**	**Institution**	**Gender**
134	มีชัย เชียงหลิว	#N/A	National Science and Technology Development Agency	male
135	ณมาพร อัตถวิโรจน์	นักวิชาการมาตรฐานชำนาญการพิเศษ	National Bureau of Agricultural Commodity and Food Standards	female
136	ดวิษา ไพบูลย์ศิริ	นักวิชาการมาตรฐานชำนาญการพิเศษ	National Bureau of Agricultural Commodity and Food Standards	female
137	วิชชุลดา ยั่งยืน	นักวิชาการมาตรฐาน	National Bureau of Agricultural Commodity and Food Standards	female
138	ศันสนีย์ เมืองมาลย์	นักวิชาการมาตรฐานปฏิบัติการ	National Bureau of Agricultural Commodity and Food Standards	female
139	สุวนันท์ วิมลรัชต์มโนรม	นักวิชาการมาตรฐานปฏิบัติการ	National Bureau of Agricultural Commodity and Food Standards	female
140	ชนิกา ไหล่แท้	นักพัฒนานโยบาย	National Science Technology and Innovation Policy Office	female
141	ณัฐสิทธิ์ สมประสงค์	นักวิเคราะห์นโยบายและแผน ระดับ 3	Office of the. National Economic and Social Development Council	male
142	กนกกาญจน์ ภู่สุวรรณ	นักวิชาการสัตวบาลชำนาญการ	Department of Livestock Development	female
143	พิสุทธิณี เจริญศรี	นักวิทยาศาสตร์ปฏิบัติการ	Forest research and development office	female
144	วีรณา สมพีร์วงศ์	นักวิทยาศาสตร์ชำนาญการพิเศษ	Forest research and development office	female
145	อิศรเรศ ชื่นปรีดา	หัวหน้ากองธุรกิจข้าว	Marketing organization for farmers	male