

Country:	Thailand
Request Identification Number:	2015000083

Title:	Technology development for climate resilience and efficient use of resources in the agricultural sector Thailand
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Summary of the CTCN Technical Assistance

The primary objective of the CTCN assistance in this context is to enhance the capacities of Thai stakeholders in the knowledge and application of agricultural technologies that will help better manage the allocation of resources required for optimal resilience to climate change and associated impacts on productivity. The assistance package has two components.

The first component involves a 5-day capacity building workshop aimed to build capacities of the participants in the application of technology for efficient use of resources in the agricultural sector in Thailand. The workshop will cover five main topics, viz, (1) Plant phenotyping, density mapping and yield estimation, (2) Hyper/Multi spectral and thermal imaging, (3) Geoinformatics, (4) Sensor technology, and (5) Smart irrigation and fertigation.

The second component will focus on providing technical guidance for the development of a pilot project, which has been identified by the recipient as one of the post-assistance activities to be carried out. The assistance in this context will involve on-the-job mentoring for identified officials to design the various phases of the pilot project.

The assistance has both climate change mitigation and adaptation benefits. In terms of mitigation, the assistance package seeks to improve resource productivity (e.g. lower energy use, optimizing nitrogen fertilizer use) and thereby reduce the greenhouse gas emissions per kg grain. In terms of adaptation, it creates a premise to be better prepared for climate change, for example by using water more efficiently or improving soil structure.

1. Overview of the CTCN technical assistance

1.1 Technology aspects

This CTCN assistance will generally address technologies required for the efficient use of resources in the agricultural sector in Thailand. The assistance will cover a range of tool-based methodologies leading up to specific applications. A key aspect of the assistance will emphasize on 'precision farming', to decide on the optimal use of water, land, fertilizers and pesticides as resources.

The assistance will focus on soft technology by building capacities of the various stakeholders in the knowledge and application of technologies that would enable judicious use of resources. The assistance package will comprise of (a) a workshop designed to impart technical knowledge on range of pertinent topics, and will also include field exercises and a field trip, (b) technical assistance to design a pilot project to demonstrate the real-time application of agricultural technologies for resources management.

The assistance has both climate change mitigation and adaptation implications. In terms of mitigation, the assistance package seeks to improve resource productivity (e.g. lower energy use, optimizing

nitrogen fertilizer use) and thereby reduce the greenhouse gas emissions per kg grain. In terms of adaptation, it creates a premise to be better prepared for climate change, for example by using water more efficiently or improving soil structure.

1.2 Objectives (outcomes)

The primary objective of the CTCN assistance in this context is to enhance the capacities of Thai stakeholders in the knowledge and application of agricultural technologies that will help better manage the allocation of resources required for optimal crop productivity. The assistance is expected to lead to the following outcomes:

- Formation of an in-country network of practitioners with enhanced capacities in agricultural technologies required to manage resources judiciously.
- New technological products and decision support systems are developed to manage agricultural resources efficiently.
- Farmers and end-users benefit from the application of agricultural technologies (long-term outcome).
- Reduction in greenhouse gases emissions per unit grain through controlled use of energy and fertilizers.

1.3 Results (outputs expected from CTCN assistance)

The following output is expected from this CTCN assistance:

- Conduction of a capacity building workshop with a range of in-country stakeholders on topics relevant to improving resource use efficiency through technological interventions.
- Design of a pilot project to demonstrate real-time application of agricultural technologies for resources management.

1.4 Expected use of outputs

The expected use of outputs resulting from this CTCN assistance are as follows:

- The outputs will help concerned Government agencies develop new technological products such as resource maps (e.g. water map, nitrogen map) to enhance resource use efficiency at various spatial scales.
- The outputs will create a premise for the *implementation* of pilot project to serve as a test bed for real time application and, more importantly, upscaling.

2. Description of the Assistance

2.1 Activities

Activity 1 – Capacity building workshop on “Technologies for efficient use of resources in Agricultural sector in Thailand”

The first component of the CTCN assistance for this request will be in the form of a 5-day capacity building workshop aimed to enhance capacities of the participants (up to a maximum of 25 participants) in the knowledge and use of technology for efficient use of resources in the agricultural sector in Thailand. The workshop will use a mix of training techniques such as classroom lectures, interactive discussions, field exercises, project work, and will include one local field visit. To ensure

gender equity, equal number of males and females will be selected. Furthermore, the workshop material will be designed to be gender-inclusive. Special emphasis will be on *case studies* and *cost effectiveness of various technologies* to illustrate the practical implications of the use of agricultural technologies in this context.

Details of the proposed workshop program are presented in the Table below.

S.no.	Knowledge Area/ Activity	Remarks	Proposed duration
1	Knowledge area 1: Plant phenotyping, density mapping and yield estimation		1 day
	Topic 1.1: Object based image analysis (OBIA) technique: Theory and Practice	Activity details: Participants will be provided with conceptual background related to OBIA. They will realize how this technique can be used to classify high resolution remote sensing images. Method: Classroom presentation and interactive discussion	0.5 day
	Topic 1.2: To practice classification approach for sugarcane density mapping by object-based image analysis (OBIA) technique. Topic 1.3: To estimate sugarcane yield from number of stalks and density maps, relative to its physical characteristics on field.	Activity details: Segmentation of image into similar image objects (or segment), followed by classification of image objects based on threshold attributes and relationship between segment objects Method: In-class practical session (group work) with interactive discussion, including presentation of results	0.5 day
2	Knowledge area 2: Hyper/Multi-spectral and thermal imaging		1 day
	Topic 2.1: Applications of satellite imagery in precision agriculture: Theory and Practice	Activity details: Participants will be provided with a refresher background on different satellite imagery (both commercially and freely accessible). They will comprehend their distinct features as well as limitations in terms of their temporal and spatial resolutions. They will realize potential applications of those images in precision agriculture. Method: Classroom presentation and interactive discussion	0.5 day
	Topic 2.2: To estimate biomass and primary production using satellite imagery. Topic 2.3: To estimate plant stress (e.g. water stress) using thermal imagery.	Activity details: There exists several empirical models/indices to analyze hyper/multi-spectral satellite images. Available images will be used to demonstrate field estimation of biomass, primary production, and the plant evapotranspiration.	0.5 day

		Method: In-class practical session (group work) with interactive discussion, including presentation of results	
3	Knowledge area 3: Geoinformatics		1 day
	Topic 3.1: Geodatabase and web-GIS as decision support system for precision agriculture: Theory and Application	Activity details: Participants will be provided with a conceptual background on geodatabase and web-GIS. They will discuss innovative and potential applications of these geoinformatics-tools towards creation of decision support system in precision agriculture. Method: Classroom presentation and interactive discussion	0.5 day
	Topic 3.2: To design a sample geodatabase of plants disease and pests infestation. Topic 3.3: To integrate geodatabase and web interface as Web-GIS. Topic 3.4: To apply the developed Web-GIS as a decision support system for pests and insects.	Activity details: Web-GIS empowers the use of simple handheld devices, such as smartphones, to upload geo-tagged images, process and to inquire into its geospatial characteristics – at a remotely located server. Applications of Web-GIS enables even unskilled farmers to create and use these database online, and to receive expert advisory from remotely located offices. This DSS eventually helps improving resources use efficiency in the crop production with timely and appropriate applications of agricultural inputs. Method: In-class practical session (group work) with interactive discussion, including presentation of results	0.5 day
4	Knowledge area 4: Sensor technology		0.5 days
	Topic 4.1: Use of ground-based (handheld) devices in precision agriculture: Theory and Application	Activity details: Participants will be provided with a critical review of underlying concepts in different handheld devices. There exists several empirical indices that can be conveniently measured using existing sensor technologies. Participants will realize some innovative applications of these indices in estimation of plants' nutritional status. They will also be able to distinguish in their relative performances under different working conditions (e.g. illumination). Method: Classroom presentation, field trials and interactive discussion	0.25 day
	Topic 4.2: To estimate plant	Activity details: Handheld devices	0.25 day

	<p>nitrogen using ground-based non-destructive on-the-go sensors (active and passive sensors).</p> <p>Topic 4.3: To compare the relative performance and economics of using different sensors (active and passive) under given working conditions.</p>	<p>such as cameras (RGB, NIR), SPAD sensor, Spectrometer, IR filters, and other laser reflectance sensors have been popularly employed to estimate several vegetation indices. Performance of these sensors/devices considerably vary under given working conditions. Not necessarily an expensive and highly sophisticated device will always perform better than other cheaper and convenient alternatives. Different sensors/devices will be compared for their in-field performance – enabling the participants to select most suited ones to their specific intended applications.</p> <p>Method: In-field practical session (group work) with interactive discussion, including presentation of results</p>	
5	Knowledge area 5: Smart irrigation and fertigation		0.5 days
	<p>Topic 5.1: Use of wireless sensor network in smart irrigation and fertigation system development: Theory and Application</p>	<p>Activity details: Participants will be provided with a conceptual background of wireless sensor network (WSN) for precise scheduling of homestead irrigation. They will realize how conveniently computers and electronics can be integrated using internet technology for conserving precious agricultural inputs by improving their application efficiencies.</p> <p>Method: Classroom presentation, field trials and interactive discussion</p>	0.25 day
	<p>Topic 5.2: To program and deploy air, soil, water and plant sensors – necessary for determining crop evapotranspiration and crop water requirement.</p> <p>Topic 5.3: To integrate, monitor and manage homestead irrigation through a pre-determined schedule.</p>	<p>Activity details: Drastically reduced prices of computers and electronics, and wide accessibility of internet have opened innovative opportunities of its application in agriculture. Appropriate sensors can be placed at desired locations to collect real-time status of different indicators, which can eventually be used to operate a smart irrigation and fertigation facility.</p> <p>Method: In-field practical session (group work) with interactive discussion, including presentation of results</p>	0.25 day
	FIELD TRIP		1 day

Activity 1 – Deliverables

Deliverables	Delivery date
List of participants	Week 8
Workshop presentations and other training materials	Week 12
Workshop report	Week 20

Activity 2 – Technical assistance in designing a pilot project based on the workshop outputs

One of the post-assistance plans, as identified by the NSTDA (National Science and Technology Development Agency), is for a pilot project to demonstrate the use of agricultural technologies in the efficient use of resources. CTCN will assist the recipient in developing the plan for this pilot project, providing technical guidance for the different components of the project. Expected activities will include:

- Organizing one stakeholder meeting (up to 15 participants) where the implementer will provide technical guidance on the selection of the project site, scope and extent of project coverage, type and level of technology to be tested, among others.
- Assistance (on-the-job mentoring) in designing the pilot project, in terms of choosing the experimental variables, modality of deployment of technology, engaging local stakeholders, etc. The project scope, focus area, and coverage will be the prerogative of NSTDA, who will design the plan in consultation with their stakeholders, while the CTCN assistance will only be in the form of mentoring and technical guidance.

Activity 2 – Deliverables

Deliverables	Delivery date
Draft pilot project plan	Week 25
Final pilot project plan	Week 40

2.2 Synergies and Baseline Setting

The CTCN assistance builds on the activities carried out under a number of workshops that the recipient has already been part of. Some of these include:

- Workshop on innovative research for sustainable bio economy and plant science, organized in collaboration with Research Centre Julich (Germany).
- Workshop on plant phenotyping, organized in association with Research Centre Julich (Germany).
- Short-term training program on smart irrigation and fertigation and precision agriculture technology, organized in collaboration with some universities in Israel and Thailand.

Apart from these, NSTDA and its partners are carrying out research projects on precision farming, mostly related to cassava crops. Some of these are listed below.

- Research project to study water stress and nitrogen content in leaf and canopy of cassava using spectral reflectance and thermal sensing.

Activity 2: Technical assistance in designing a pilot project based on the workshop outputs	
2 experts	For mentoring, 12 person days each.
1 Stakeholder meeting	15 participants; 1 day;

2.5 Main partners

Stakeholder	Role to support the implementation of the CTCN assistance
National Science and Technology Development Agency	Request applicant and primer receiver of the technical assistance. Will provide assistance in the identification of workshop participants and give recommendations in the selection of the workshop experts
National Science Technology and Innovation Policy Office	Facilitate coordination between CTCN, implementer, and recipients.
Geo-informatics and Space Technology Development Agency	Involvement in the training workshop
Hydro and Agro Informatics Institute	Involvement in the training workshop
Land Development Department	Involvement in the training workshop
Department of Agriculture	Involvement in the training workshop
Department of Agriculture Extension	Involvement in the training workshop
Royal Irrigation Department	Involvement in the training workshop
Department of Water Resources	Involvement in the training workshop
King Mongkut's University of Technology	Involvement in the training workshop
Khon Khaen University	Involvement in the training workshop
Kasetsart University	Involvement in the training workshop
Other universities (AIT, Thamassat, etc.)	Involvement in the training workshop

2.6 Indicative budget

Activities	Estimated Budget (USD)
Activity 1	28,000
Activity 2	18,000
Measures, evaluation and learning	3,000
Total	49,000

2.7 Gender considerations

The assistance will address gender considerations in the following ways:

- (a) *At least half of the participants for the workshops will be female to ensure gender balance.* Compared to other Asian countries, Thailand has a relatively better gender parity in the workplace. This CTCN assistance will seek to maintain, or even enhance, this parity.

- Development of specific nitrogen, phosphorous, and potassium fertilizer application rates for cassava production.
- Sensor technology for water application in cassava production.
- Physiological responses in relation to water and fertilizer management for increasing productivity.

The CTCN assistance is expected to build capacities of participants into developing and enhancing the technical components of such projects.

2.3 Timeline

Activity	Month (of implementation)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Capacity Building Workshop on "Technologies for efficient use of resources in Agricultural sector in Thailand"	█	█	█	█								
1.1. Inception activities and identifying and inviting the appropriate participants	█	█										
1.2 Developing workshop material	█	█										
1.3 Workshop			X									
1.4 Developing the workshop report and relevant materials				█								
2. Technical assistance in designing a pilot project based on the workshop outputs				█	█	█						
2.1 Preliminary discussions and feasibility studies				█	█	█						
2.2 In-country stakeholder meeting					X							
2.3 Designing the pilot project				█	█	█						

2.4 Expertise required

Activity 1: Capacity Building Workshop on "Technologies for efficient use of resources in Agricultural sector in Thailand"	
1 expert	Plant phenotyping, density mapping and yield estimation, 3 person days (including preparation)
1 expert	Hyper/Multi-spectral and thermal imaging, 3 person days (including preparation)
1 expert	Geoinformatics, 3 person days ((including preparation)
1 expert	Sensor technology, 3 person days ((including preparation)
1 expert	Smart irrigation and fertigation, 3 person days (including preparation)
1 coordinator	Coordinating workshop preparations and activities, 15 person days
1 Workshop	20 participants; 5 days; 1 Field visit;

Ensuring gender balance among the participants will be an integral part of deliverable-1 of Activity-1 (list of participants). NSTDA will be responsible for this listing, which will be discussed with CTCN and the implementer prior to finalization.

- (b) *The workshop contents shall be designed to ensure gender inclusiveness.* Women form a significant fraction of the workforce in the agricultural sector in Thailand. When seasonal migration takes men away from the farm for several months a year, more responsibility is placed on the women left behind as de facto household heads. This contents of the workshop will, thus, look at technologies that can be implemented in the field by both men and women. The workshop discussions and exercises will also be designed around this aspect.

2.8 Risk identification and risk mitigation

Risk	Consequence	Probability	Mitigation measure
This assistance will involve one training workshop and it is imperative that key participants are involved who are likely to translate knowledge into action. There is a risk that some of these key participants may not be available for the workshops.	Will have a cascading effect on the expected outcomes.	Low	To be safe, participants will be invited through the proper channels, well in advance. If required, the dates of the training will be adjusted to match the availability of maximum key participants. The request applicant will also provide support to the implementer in reaching and raising the interest of the key participants.
Because the workshops will cover a diverse range of topics with participants from different sectors and backgrounds, engaging the attention of participants over the entire duration of the workshop would be a challenge.	The desired output may not be achieved.	Medium	Participants will be carefully selected by the request proponent (with support from the implementer). If found feasible, there will be different participants for different sessions. Also, workshop activities will be designed to avoid monotony

3. Long-term impacts of the assistance

3.1 Expected climate change-related benefits

	CTCN climate technology impact	Anticipated contribution from CTCN assistance
1	Climate technologies adapted to national context are identified and prioritized to enable their	The assistance has the potential to facilitate the upscaling of precision

	deployment and/or transfer in the requesting countries	farming technologies in Thailand.
2	New national Technology Needs Assessment (TNA) and Technology Action Plan (TAP) as a result of the response	
3	Progress made against mitigation objectives (i.e. energy and carbon intensity reduction) as a result of the response	Precision farming technologies, as targeted in this assistance, lower fuel and energy use leading to less carbon dioxide production. It also involves optimizing nitrogen fertilizer use, thereby helping to reduce the amount of nitrous oxide released from the soil.
4	Progress made against adaptation or resilience objectives (e.g. climate vulnerability index improvement) as a result of the response	The participants trained in precision farming will be able to provide technical guidance to practitioners/farmers who in turn will be able to improve the use of their resources and yields, foreseeing and adapting to climate change
5	New mitigation or adaptation technology projects/initiatives implemented as a result of the response	A pilot project will be drafted during this technical assistance. It is expected that this pilot project will be up-scaled.
6	New or strengthened policies/ laws developed, approved and enacted as a result of the response	
7	New policies/laws where climate change was mainstreamed as a result of the response	
8	Country integrating climate change mitigation and/or adaptation issues into its planning and policies as a result of the response	
9	New or strengthened Public-Private Partnerships (PPP) created directly as a result of the response	
10	New or strengthened twinning arrangement created as a result of the response	A network of practitioners formed with enhanced capacities in agricultural technologies required to manage resources judiciously.
11	Capacities to access and attract public and private finance increase to enable financing of technology deployment	
12	Post-response intervention funding attributable to the response.	The country plans to initiate a pilot project to test bed the concerned technologies. It is assumed that in-country funding is available for such an endeavour.
13	Framework and analysis of local production developed to enable deployment of national	



production of climate technologies

3.2 Co-benefits

	Sustainable Development Goal	Contribution from CTCN assistance
1	End poverty in all its forms everywhere	Efficient use of resources in agriculture will help in achieving food security, thereby contributing to reduction of poverty.
2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	Efficient use of resources in agriculture will help in achieving food security.
3	Ensure healthy lives and promote well-being for all at all ages	
4	Ensure inclusive and equitable quality education and promote life-long learning opportunities for all	
5	Achieve gender equality and empower all women and girls	Women trained in efficient use of resources will empower them in their work community.
6	Ensure availability and sustainable management of water and sanitation for all	A primary resource for agriculture is water. Efficient use of water in agriculture will help in achieving water security.
7	Ensure access to affordable, reliable, sustainable, and modern energy for all	
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	
10	Reduce inequality within and among countries	
11	Make cities and human settlements inclusive, safe, resilient and sustainable	
12	Ensure sustainable consumption and production patterns	
13	Take urgent action to combat climate change and its impacts	This technical assistance is a response to climate change. By training practitioners in efficient use of resources, this technical assistance will participate in Thailand's preparedness to climate change impacts and efforts to reduce GHG emissions.
14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat	

	desertification, and halt and reverse land degradation and halt biodiversity loss	
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development	

3.3. Post-assistance plans and actions

- Carrying out a pilot project to demonstrate the application of technologies covered as part of the CTCN assistance package.
- Develop new technological products such as resource maps (e.g. water map, nitrogen map) to enhance resource use efficiency at various spatial scales.

3.4 Monitoring and Reporting of technical assistance results and impacts

Expected activities and milestones under this assistance are explicitly described in sections 1.3, 2.1, 3 and the performance indicators table below (see also log frame in annex). Activities progress and deliverables will be monitored closely by the Lead Implementer of this Response Plan with the collaboration of the NDE in Thailand, the request proponent (NSTDA) and CTCN. The Lead Implementer is responsible for verifying project progress against timeline, associated milestones, and communicates these results to the NDE and CTCN. At the end of each activity, the Lead Implementer will provide a short summary of lessons learned of the activity reflecting on the progress, successes and challenges encountered during the activity. Every month a teleconference with country and the implementers is held to communicate the state of advancement of the project, challenges, possible needs for adjustments etc. The Lead Implementer is responsible for planning these. All suggested changes to the activities, processes and/or approaches as outlined in current response plan must be accepted by the CTCN and NDE before they can be applied.

4. Signatures

Signatures of the requesting country

NDE National Science Technology and Innovation Policy Office, Thailand

Name: Surachai Sathithunarat
Title: Director of Energy and Environment Dept.
Date: 12 May 2016

Signature: 

Request Proponent National Science and Technology Development Agency (NSTDA)

Name: Thaweek koanantakool
Title: President of NSTDA
Date: 31 May 2016

Signature: 

Signatures of the CTCN

CTCN Director

Name: JUKKA UOSUKAINEN
Title: DIRECTOR
Date: 03. MAY 2016

Signature: 

Climate Technology Manager

Name: JASON SPENSLEO
Title: CLIMATE TECHNOLOGY MANAGER
Date: MAY 3, 2016

Signature: 

Performance indicators of CTCN Assistance

Response output (linking to sec 1.3)	How output will be used to ensure creation of result	Expected result	Expected outcome of result (linking to sec 1.1)	Anticipated impact that outcome will produce (linking to section 3)
Conduction of a capacity building workshop with a range of in-country stakeholders on topics relevant to improving resource use efficiency through technological interventions.	Participants will be carefully selected to maximise the impacts of the output. Workshop materials and modules will be carefully designed to address imminent capacity needs, and to facilitate upscaling.	Enhanced capacities of Thai stakeholders in the knowledge and application of agricultural technologies that will help better manage the allocation of resources required for optimal crop productivity	<ul style="list-style-type: none"> Formation of an in-country network of practitioners with enhanced capacities in agricultural technologies required to manage resources judiciously. New technological products and decision support systems are developed to manage agricultural resources efficiently. Farmers and end-users benefit from the application of agricultural technologies (long-term outcome) 	<ul style="list-style-type: none"> A network of practitioners formed with enhanced capacities in agricultural technologies required to manage resources judiciously. Efficient use of resources in agriculture will help in achieving food security. Efficient use of water in agriculture will help in achieving water security. Reduction in greenhouse gases emissions per unit grain through controlled use of energy and fertilizers
Design of a pilot project to demonstrate real-time application of agricultural technologies for resources management	On-the-job mentoring will be provided to key personnel identified by the recipient.	Demonstrable use of agricultural technologies in the efficient use of resources	The output will create a premise for the <i>implementation</i> of pilot project to serve as a test bed for real time application and, more importantly, upscaling.	The assistance has the potential to facilitate the upscaling of precision farming technologies in Thailand.



Annex 1: Response Logframe

Activity (link to sec 2)	Description of sub-activities conducted by the CTCN	Output/ Deliverable (link to sec 2.9)	Expected Outcome (link to sec 3)	Main national partners involved	Objectively Verifiable Indicator (see Annex 5 guidance)	Means of Verification (data source, method of collection, responsibility and periodicity)
Activity 1:	Capacity Building Workshop on "Technologies for efficient use of resources in Agricultural sector in Thailand	1. Workshop presentations and other training materials 2. Workshop report	Formation of an in-country network of practitioners with enhanced capacities in agricultural technologies required to manage resources judiciously.	NSTDA	Number of participants trained or training days received Number of women trained	Registration sheets for each day of the workshop
Activity 2:	Technical assistance in designing a pilot project based on the workshop outputs	Final pilot project plan	New technological products and decision support systems are developed to manage agricultural resources efficiently	NSTDA and an organization to be identified by NSTDA	Number of hours/month spent in mentoring	Draft pilot project plan