REPORT - INITIAL DSS4NAFA CHINA CASE STUDY

Lazar Adjigogov[1], Franck Albinet[1], Qiangyi Yu [2], Wu Wenbin[2], Gerd Dercon[1]
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[1] Soil and Water Management & Crop Nutrition Laboratory, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Seibersdorf, Austria
[2] Institute of Agricultural Resources and Regional Planning at China Academy of Agricultural Sciences (CAAS)

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Summary

Report for contract of data-management/data-visualization services for software system DSS4NAFA in context of China related to “Response to Nuclear Emergencies affecting Food and Agriculture” project.

Preliminary note: The originally planned mission to China (CAAS) has been cancelled/rescheduled due to the COVID pandemic. Despite this situation, the fruitful collaboration made it possible to achieve the targeted objectives.

Precise and relevant crop maps during nuclear emergency responses is of utmost importance to plan and monitor food samples data collection and analysis. In its current state, the Decision Support System for Nuclear Emergencies Affecting Food and Agriculture (DSS4NAFA) allows optimization of sampling task assignments based on administrative boundaries and crop calendars.

Main objectives

As per statement of work:

1. Assess the feasibility to harness large-scale crop maps produced by remote sensing techniques to further enhance currently existing advanced sample and task allocation (ASTA) module. The Institute of Agricultural Resources and Regional Planning at the Chinese Academy of Agricultural Science (CAAS) has a broad expertise in the exploitation of satellite imagery in agriculture;

2. Screening China context for applicability and usage of DSS4NAFA into the China nuclear and radiological emergency response system;

3. Explore opportunities for further joint improvement, maintenance of DSS4NAFA code base to ensure sustainability, scalability and robustness of existing and new envisioned features.

Agreed plan

1. Configure/Set up a non-public preliminary DSS4NAFA instance for a case study for China: **SIMULATED** Daya Bay Nuclear Power Plant incident in Guangdong province (广东省);
2. DSS4NAFA instance is not accessible via internet due to confidentiality reasons;
3. Gather minimal set of needed configuration datasets to boot up DSS4NAFA;
4. Define a procedure/data pipeline to ingest raw large-scale crop maps into DSS4NAFA so that it can be used in the context of nuclear emergency response;
5. Provide recommendations for future actions.

Achieved results

1. Integration with Remote Sensing imagery is feasible and practically achievable during the course of the CRP D1.50.19;
2. Primary focus of the study was to explore and propose ways forward, as stated in the contract. Remote Sensing imagery is currently not integrated with DSS4NAFA. Recommendations and conclusions section further below describes how it can be further developed;
3. Configured DSS4NAFA with minimal provided datasets by CAAS:
    a. Administrative units - Townships with their administrative boundaries (geometries provided as Shapefile) in Guangdong province;
    b. Crop calendar with most important crops (compiled calendar is provided in annex I);
    c. Demonstration of usage of DSS4NAFA for sampling assignments in Guangdong province.
4. Development of initial procedure/pipeline to process raw large-scale raster maps and produce polygons (shapes) which represent lands on which specific crops are grown.
5. Joint development of research contract proposal led by the institute of Agricultural Resources and Regional Planning at China Academy of Agricultural Sciences (CAAS). Research contract proposal can be found in Annex II.

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Detailed list of tasks carried out

- Presentation of DSS4NAFA application to CAAS;
  - February 2020 - At the initial meeting with CAAS, demonstration of DSS4NAFA was done using Belgium setup as the most used configuration during 2019. During presentation focus was given on following features:
    - Capabilities of Advanced Sample Task Allocation module (ASTA) module;
    - Existing workflow from registration of sample's data by sample collectors up to registration of analysis result by laboratories;
    - Hotspot map visualization module;
    - Restrictions dashboard visualization module.

- March 2020 - Identification of China case study location;
  - It was agreed with CAAS that this test phase focuses on the area surrounding Daya bay NPP, geo-references (22°35′50″N 114°32′40″E).
  - The nuclear power station is active, built in 1993-1994, located 7 kilometers east of Dapeng in the municipality of Shenzhen, on the coast of Daya Bay in China's Guangdong province. It is about 45 kilometers from the city center of Shenzhen, and about 50 kilometers from Tsim Sha Tsui in Hong Kong.

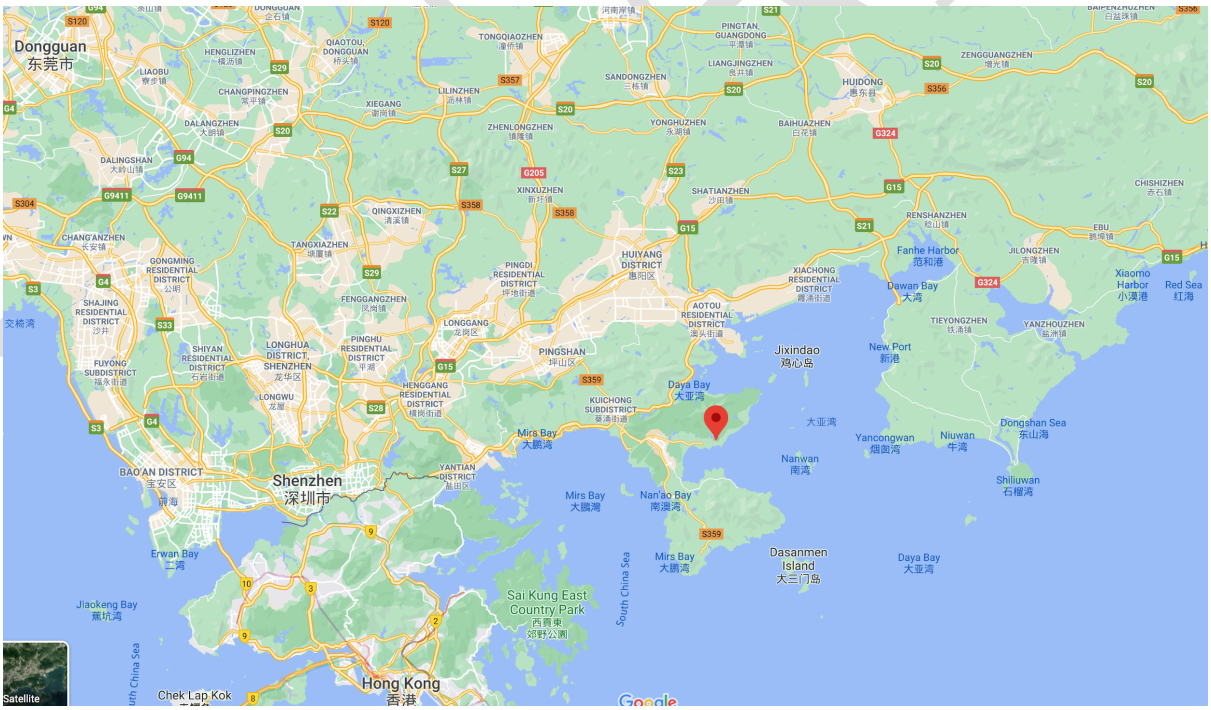

Image 1 - Area surrounding Daya bay NPP, source google maps

  - Focus area was radius of 300 km2
  - It is selected due to preferred landscape with important crops (rice)

- April 2020 - Identification and processing of required input data for the selected case study and simulated scenario of possible fallout during an NPP incident:

    - NPP location:
        - Daya Bay Nuclear Power Plant selected by Institute of Agricultural Resources and Regional Planning at CAAS

    - Official administrative boundaries of Guangdong province:
        - 242 townships were imported with their administrative boundaries (shapes/polygons) grouped in 16 districts. Screenshot 1 and 2 in Annex I present imported townships;
        - Internationalization of Administrative Boundaries: both Chinese and English names are supported in DSS4NAFA (automatic translation of Chinese version to English has been carried out).

    - Relevant crop types
        - Several crop types were configured, namely:
            - double cropping rice;
            - potato;
            - cassava;
            - winter sweet potato;
            - autumn sweet potato;
            - vegetables (horticultural crops);
            - spring peanut;
            - autumn peanut.

    - Crop calendar
        - By crop calendar it is understood planting and harvesting time throughout a year per specific crop type provided in previous point;
        - For each month of the year the crop calendar was provided by the Institute of Agricultural Resources and Regional Planning at CAAS for above configured crop types and imported in DSS4NAFA for each township. Screenshot 3 in Annex I show the imported crop calendar.

    - April 2020 - for preliminary demonstration land-use information was missing of DSS4NAFA for China context. The creation of such information using satellite imagery is the main object of the current collaboration with CAAS. In the meantime, and to be able to demonstrate the capacities of the DSS4NAFA Advanced Sample and Task Allocation module, an artificial land-use dataset was generated for each township. Screenshot 4 in Annex I present generated artificial land use dataset. This step was temporary as it is envisioned that procedure/pipeline for processing satellite imagery will be made fully functional throughout the collaboration with CAAS.

    - May-June 2020 crop map produced using remote sensing imagery made available by Institute of Agricultural Resources and Regional Planning at CAAS capacities:
        - Several land use/crop maps produced for double rice crop (as it is the most planted/harvested crops in Guangdong province);

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- Post-processing of crop maps produced to make them usable in a nuclear emergency response decision-making context. Procedure/pipeline details can be found explained further below (Overview of developed data pipeline).

- May 2020 - Generated dataset - radionuclide concentration on foods over the case study area
  - Fallout simulation did not take into account NPP characteristics and weather conditions;
  - For the purpose of demonstration of hotspot map and restriction dashboard: simulated dataset with radionuclide concentrations in above defined crop/food types for Cs-137 and I-131 was generated. 7823 points for Cs-137 and 2205 points for I-131. Screenshot 7 in Annex I show a hotspot map displaying the simulated dataset.

- May 2020 - DSS4NAFA China instance setup

  - Configuration of DSS4NAFA instance with chosen event location, crop calendar, administrative boundaries and simulated radionuclide concentration;
  - Demo of DSS4NAFA capabilities to CAAS based on decided Chinese case studies. Screenshots 5 in Annex I present advanced sample and task allocation module (ASTA) with configuration for China;
  - The instance is not available via internet due to confidentiality reasons.

- June 2020 - Development of a framework/data pipeline allowing to harness large scale remote-sensing maps produced crop in DSS4NAFA.

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Overview of developed data pipeline

Agricultural mapping using satellite imagery is an inestimable value for informed decision-making in the context of nuclear emergency response but cannot be used in its raw form and should be post-processed for several main reasons:

1. **Communication purpose**: locations where to collect food samples should be specified at the appropriate geographical scale, at field and landowner level no at pixel levels (the resolution of satellite imagery used was 10x10m);
2. **Decision-making purpose**: prioritization of areas presenting a health and economic risk in relation to the available logistical response capacities (analysis laboratories and data collectors);
3. **Validation purpose**: large-scale automatic satellite imagery-based crop maps often requires ground-truth validation and exhibits algorithmic artefacts (e.g. false positives or small isolated pixels);
4. **Computer-resources:** processing of such raw data would require considerable computing resources with no added value in terms of decision-making.

The developed data pipeline includes the following 5 steps (in a schematic form):

- **STEP 1: PREPARE THE REMOTELY SENSED IMAGERIES**

  To generate large-scale crop maps in Guangdong province for 2019, surface reflectance (SR) data of Sentinel-2 multispectral instrument (MSI) between March 2019 and March 2020 were processed using Google Earth Engine (GEE) cloud computing platform.

  Land use samples were obtained (Cropland, Waterbody, Forest, Construction land, Wetland) based on the National Land Cover Database for China (NLCD-China) and visual interpretation of very high-resolution images in GEE.

  Following action was filtering. The good-quality MSI images with cloud level less than 5% between October 2019 and January 2020 were selected, and monthly median composites were generated.

  Subsequently, the normalized difference vegetation index (NDVI) and the land surface water index (LSWI) of the composites were computed. Hereafter the land use samples and monthly median composites containing both spectral and temporal features were fed into random forest (RF) classification Model available in GEE, and the cropland layer was extracted from RF Model outputs.

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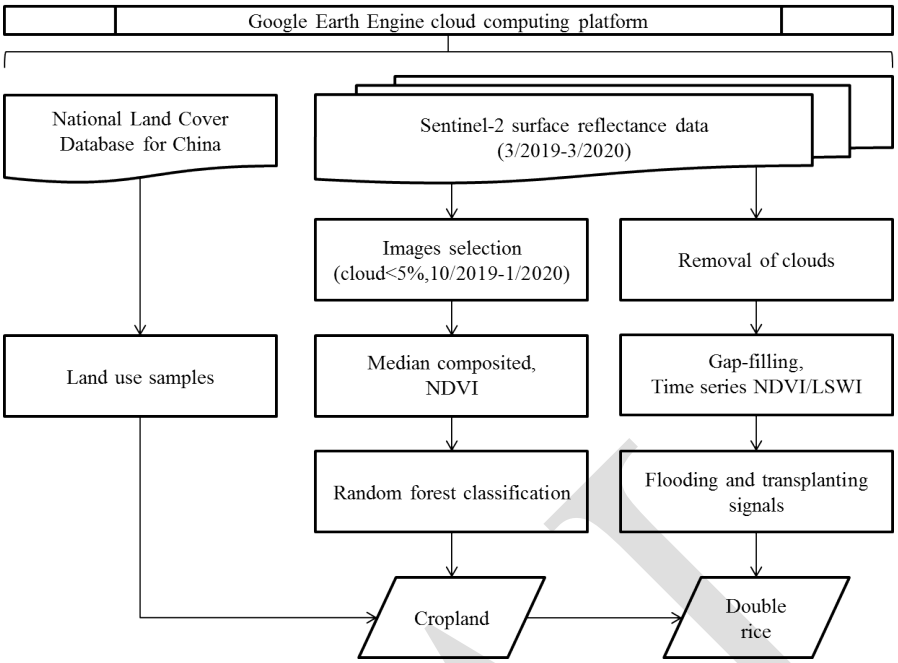
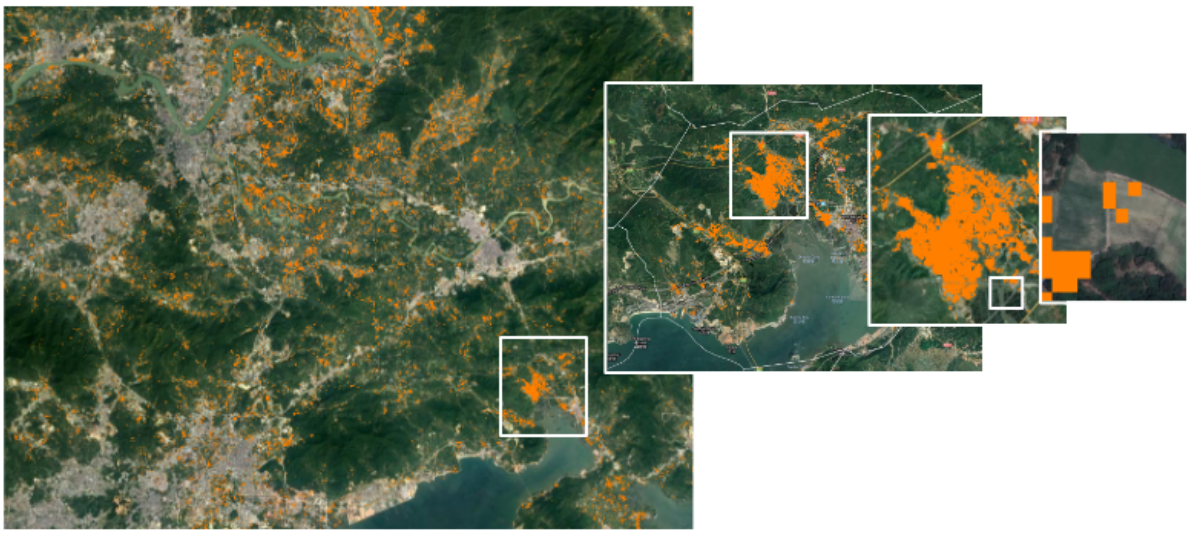
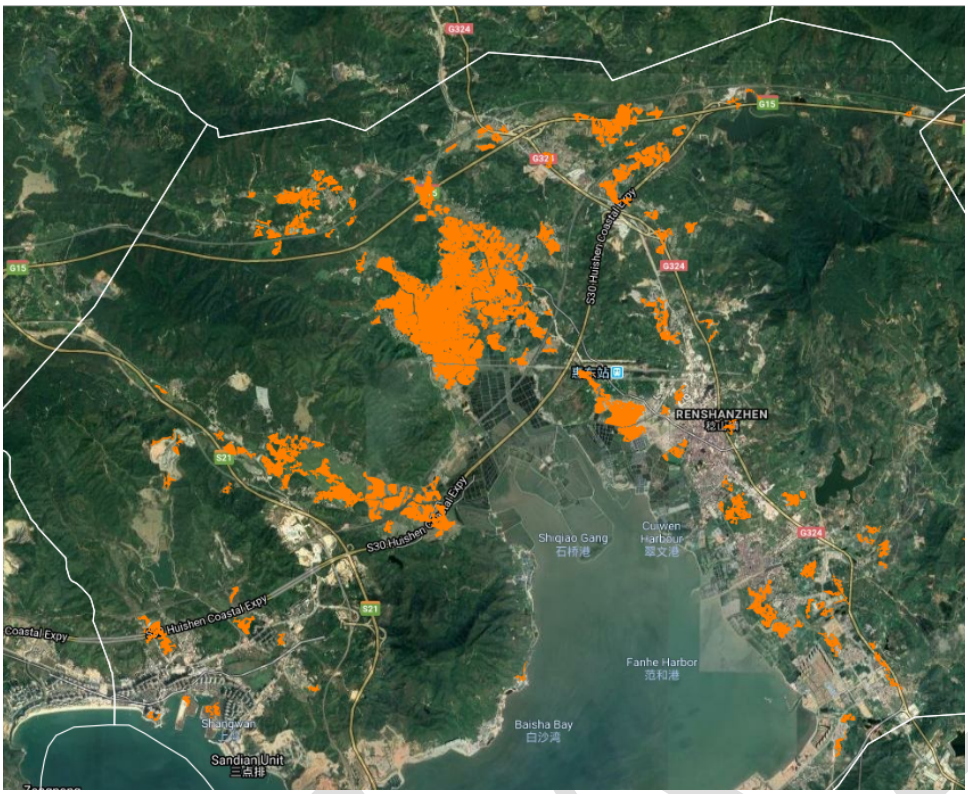


- **STEP 2: PRODUCE CROP MAPS FROM SATELLITE IMAGERY** (here rice in orange)

  The time series NDVI and LSWI were obtained based on MSI images between March 2019 and March 2020.
  Subsequently phenology-based algorithm was applied to map rice, considering the temporary inversion of the vegetation indices in which the LSWI values either approach or exceed the NDVI.
  According to the crop calendars, the algorithm was applied to the time series NDVI and LSWI to identify rice fields by detecting the flooding and transplanting signals.
  Image below show Guangdong Province zoom level (left), to Renshan Township, field and single pixel zoom levels (toward right).

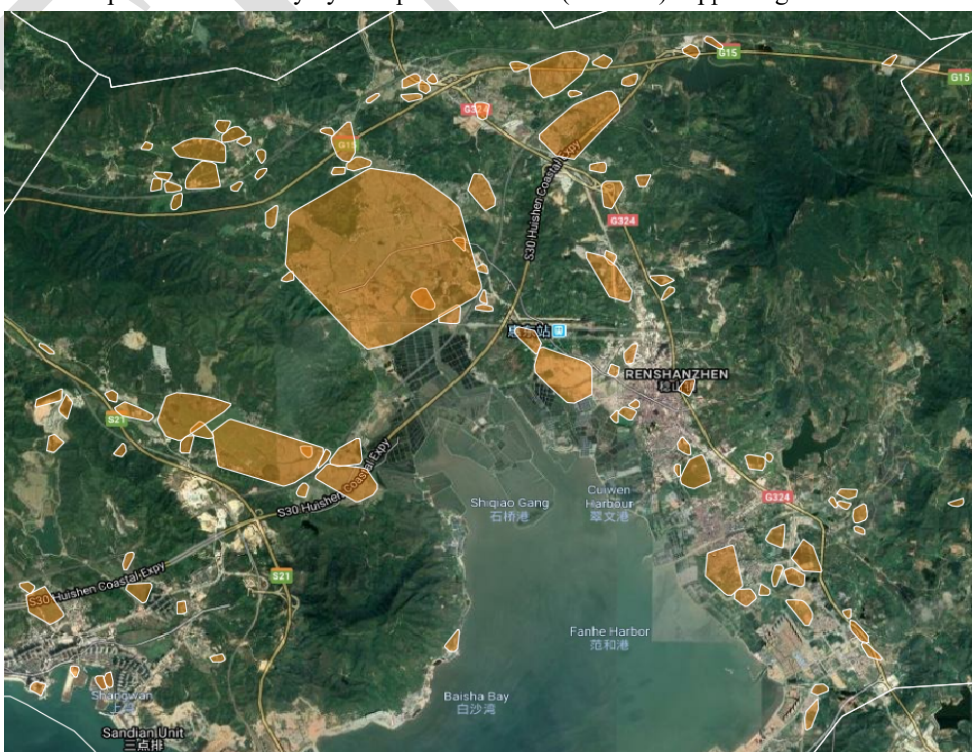


- **STEP 3: FILTER OUT AGRICULTURAL FIELDS BELOW THRESHOLD AREA**
  To eliminate potential false positives, isolated pixels and prioritize according to size of agricultural fields (adjustable threshold here 1 hectare). Below, the 108 possible rice fields below one hectare out of 4871 initial ones in Renshan Township.



- **STEP 4: SIMPLIFY THE GEOMETRY OF AGRICULTURAL FIELDS TO EASE COMMUNICATION AND DECISION-MAKING AT APPROPRIATE GEOGRAPHICAL SCALE**

  To ease communication with emergency team, food sample data collectors, land registry local authorities and to streamline sampling task assignments. Geospatial processing has been done using QGIS Open-source GIS software and a Convex Hull algorithm to generalize polygons. In next phases, such task would be performed directly by the spatial database (PostGIS) supporting DSS4NAFA.



- **STEP 5: PERFORM ADVANCED SAMPLE TASK ALLOCATION**

  DSS4NAFA ASTA (Advanced Sample Task Allocation) module has flexible mechanisms to use polygons of crop-specific agricultural fields to perform an informed foodstuffs sample task allocation at the appropriate aggregation level:

  i. Importing/uploading dataset of shapes/polygons of agricultural fields with crop details produced in steps 1 to 3 (conceptualized but DSS4NAFA dedicated module still need to be developed);
  ii. As a fallback solution, when such crop-specific agricultural fields information is not available, another option would be to adapt current ASTA module for importing so called agro-ecological zones (AEZ), zones with similar soil properties and climate conditions.

Further development with the Institute of Agricultural Resources and Regional Planning at China Academy of Agricultural Science (CAAS) will decide which option would fit practically better for DSS4NAFA for China context and future general contexts.

Conclusions

Based on this preliminary research phase main objectives were met

1. Regarding assessing the feasibility to harness large-scale crop maps produced by remote sensing techniques to further enhance currently existing advanced sample and task allocation (ASTA) module, the conclusion is that the Institute of Agricultural Resources and Regional Planning at the China Academy of Agricultural Science (CAAS) can contribute significantly to the development of DSS4NAFA in general and in particular to the Coordinated Research Project CRP D1.5019 on “Remediation of Radioactive Contaminated Land”. As a result, CAAS now contributes to this CRP with a Research Contract titled: “Mapping cropland use dynamics for DSS4NAFA: A Case Study in Southern China" and the collaboration initiated in the current case study will be extended over the duration of this CRP (-2024). This case study allowed to prototype the pipeline and to create the framework required to harness crop maps produced by satellite imagery at large scale, such as the ones produced by CAAS.

2. As regards, the potential applicability and usage of DSS4NAFA into the China nuclear and radiological emergency response system, the conclusion is that DSS4NAFA can indeed be used in the Chinese context. DSS4NAFA configured with minimal datasets for Guangdong province was demonstrated to the Institute of Agricultural Resources and Regional Planning at the China Academy of Agricultural Science (CAAS). Specific scenario for sampling assignments in Guangdong province was presented. Screenshot 5 and 6 in Annex I show the presented scenario.

3. Regarding exploring opportunities for further joint improvement, maintenance of DSS4NAFA code base to ensure sustainability, scalability and robustness of existing and new envisioned features, the conclusion is that the initial case study proved that

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integration with Remote Sensing platform at CAAS is feasible and practically achievable throughout the duration of the CRP. Hence joint improvement of new envisioned features can be done.

4. Overall conclusion is that DSS4NAFA can add significant value to the China context if configured and used in advance (e.g. preparedness phase). Without a tool as DSS4NAFA authorities are left with manual coordination and manual work between needed ministries (official institutions) for decision makers to decide where to sample and logistics to follow up and organize the sampling campaigns.

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Recommendations

To leverage the work done in this case study, it is recommended the following:

- To develop a new DSS4NAFA module allowing to systematically import and convert at scale crop map produced by satellite imagery along the procedure defined in this case study;

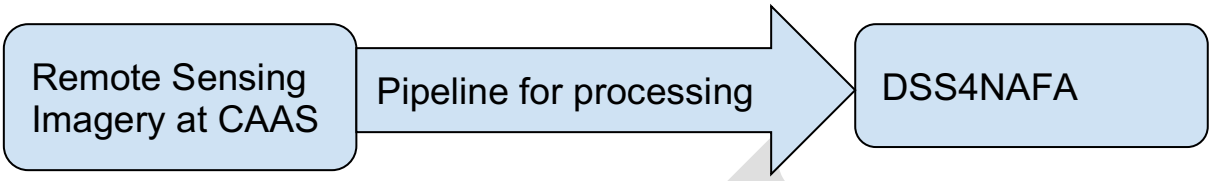

Figure 1 - Planned pipeline to be developed

Recommended following actions to be taken

a. by Institute of Agricultural Resources and Regional Planning at China Academy of Agricultural Science (CAAS):
    i. Further validation and improvement of crop maps produced at large-scale using satellite imagery.
b. by IAEA:
    i. Propose processing and integration mechanism with remote sensory imagery;
    ii. Implement proposed integration mechanism.

- To involve governmental institution from China in charge of nuclear emergency response and remediation in order to take into account the modalities specific to China's response strategies;

- Adjustment of logic of advanced sample and task allocation (ASTA) module for China context
    - 2 level logic for filtering/proposing township during prioritization:
        - **First level** - which townships to be prioritized based on summarized values, such as land use (hectares and percentage distribution), farming land and number of available farmers as sample collectors. Prioritization factors could include:
            - **Economic importance** of a township from an agricultural point of view. (DSS4NAFA can sort/filter those with higher economic value, proposing where to start sampling. E.g. Townships which are more economical valued and affected and have large land use of important seasonal crops and have higher numbers of farmers for samples collectors can be first sampled);
            - **Capacity of labs to analyse** (number of samples per day to analyse - including their location- can be used to prioritize townships with enough capacity and further suggest adjustments of both data collection and analysis capacities).
        - **Second level** - Once the townships have been selected/prioritized, DSS4NAFA can further propose where to sample in specific townships. If farm maps (parcel maps) are available per township, these maps can be overlaid with land use produced by processed remote sensing imagery. DSS4NAFA can filter and

suggest specific farms (parcels) to be sampled instead of entire townships.

- To further define the roles that farmers themselves could play during the sample collection in collaboration with sample data collectors (as the most able to interpret geographical location specified by the ASTA module).

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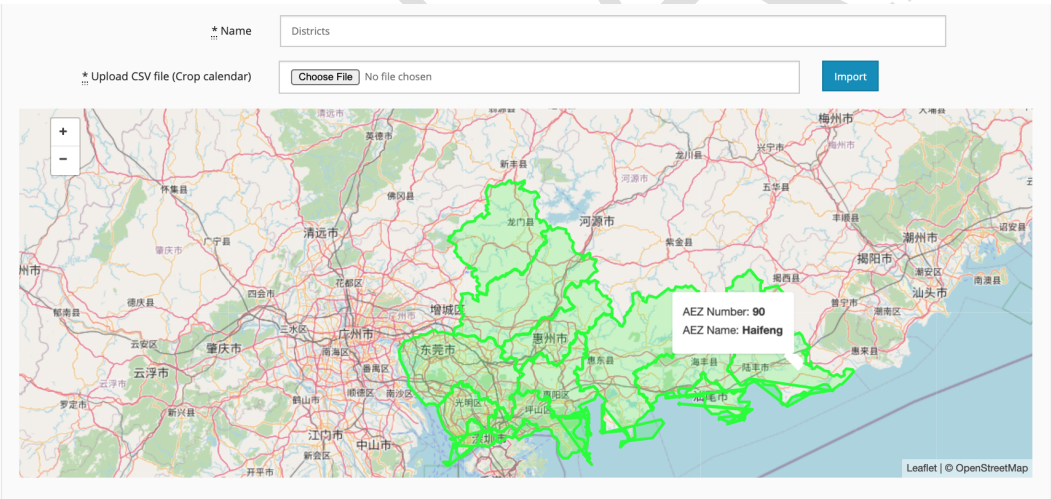
Annex I

Following annex contains screenshots referenced throughout the report

Screenshot 1 - 242 townships in Guangdong province



Screenshot 2 - Townships grouped in 16 districts in Guangdong province

Crop Calendar

AEZ Number	Harvest/Plant	Month	Crop
90			
90	H	January	cassava
90	H	February	potato
90	H	February	winter sweet potato
90	P	February	cassava
90	P	March	spring peanut
90	H	March	potato
90	H	March	winter sweet potato
90	H	March	vegetables
90	P	March	vegetables
90	P	April	double cropping rice

Screenshot 3 - Crop calendar for each township in Guangdong province

Upload Land Use

* Type admin unit

* Upload file

Choose File No file chosen

Import data Download template

Imported Land Use Data

Admin Unit Name	Crop	Land Use (hectares)	Farming Land (%)
Dongguan Chashan	Vegetables	100.0	12.5
Dongguan Chashan	autumn peanut	100.0	12.5
Dongguan Chashan	autumn sweet potato	100.0	12.5
Dongguan Chashan	cassava	100.0	12.5
Dongguan Chashan	double cropping rice	100.0	12.5
Dongguan Chashan	potato	100.0	12.5
Dongguan Chashan	spring peanut	100.0	12.5
Dongguan Chashan	vegetables	100.0	12.5
Dongguan Chashan	winter sweet potato	100.0	12.5
Dongguan Dalang	Peanuts	100.0	12.5

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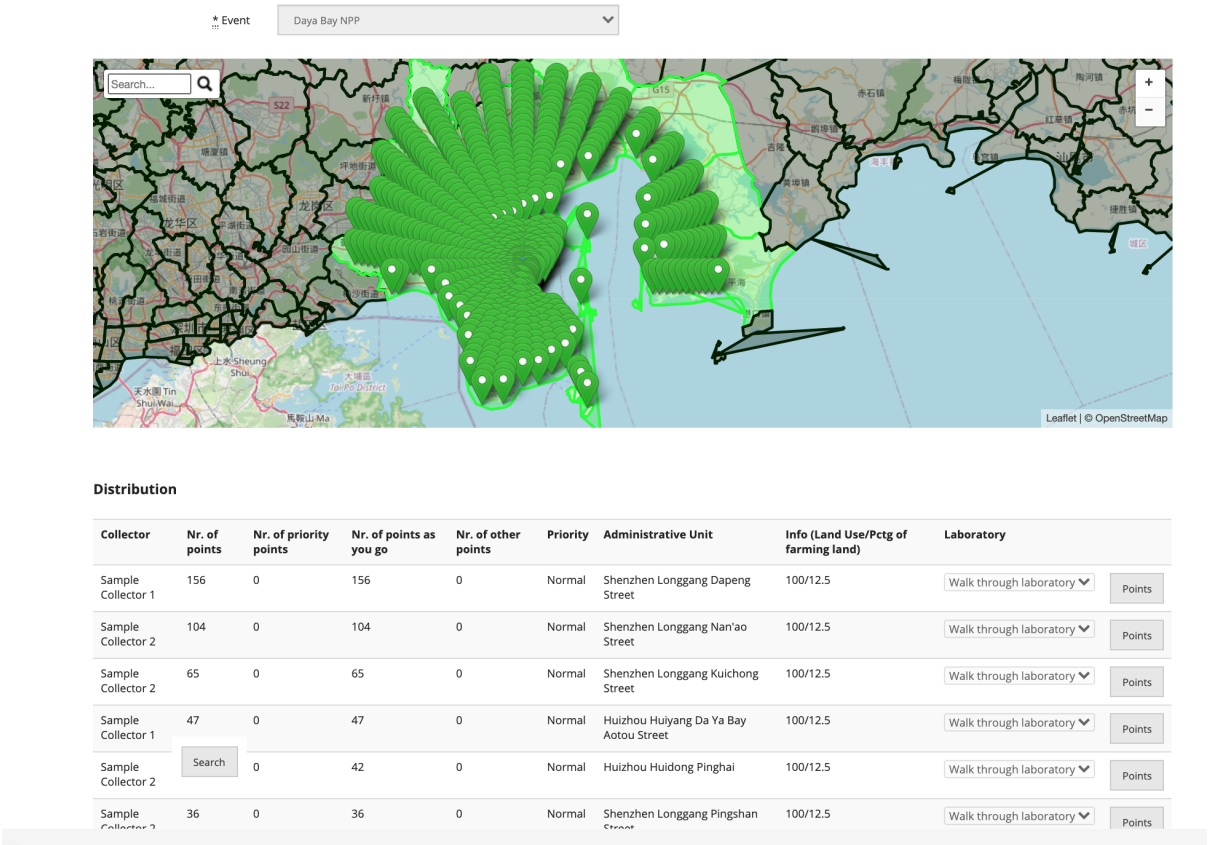
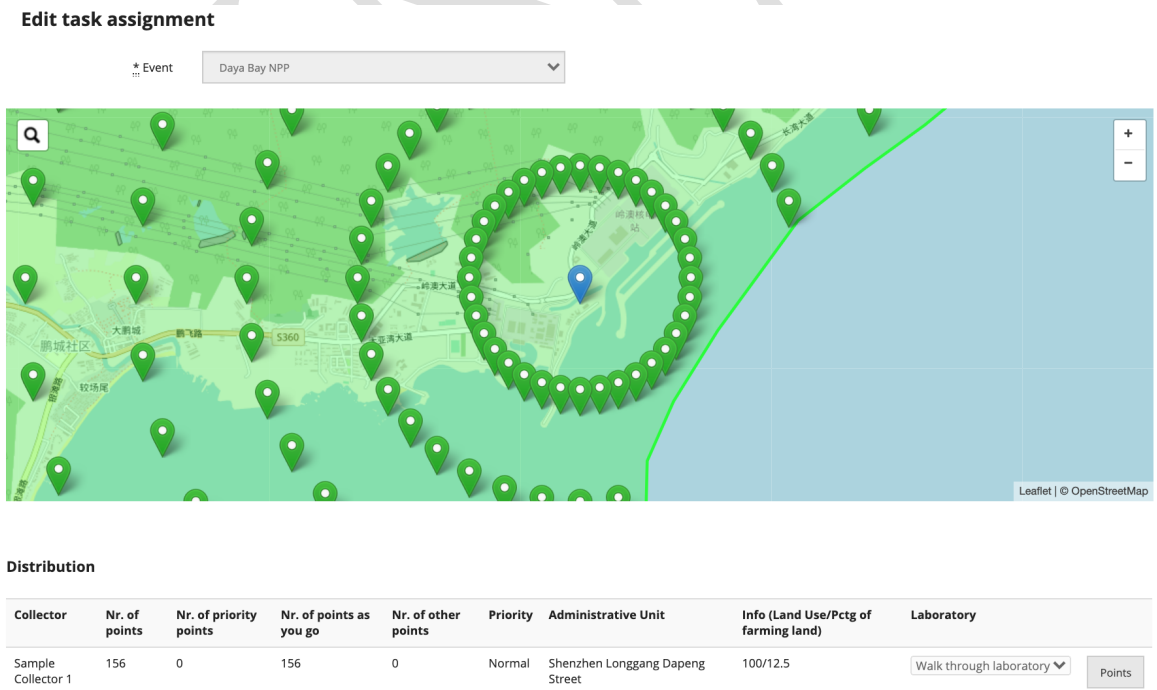
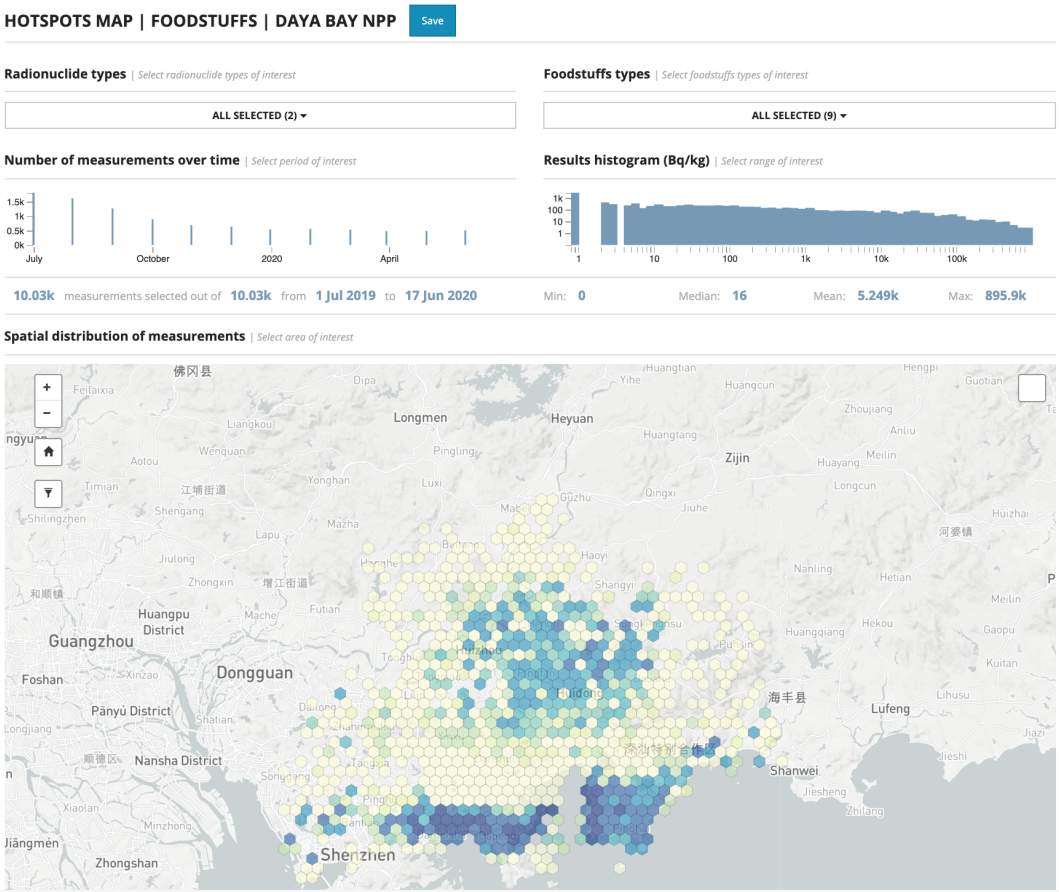
Screenshot 4 – Simulated land use dataset per township. Each crop/food types are present/grown in each township and their distribution per township is equal



Screenshot 5 - Generated radial distribution sampling points and assigned tasks to sample collectors for China context



Screenshot 6 - zoomed generated radial distribution sampling points and assigned tasks to sample collectors for China context



Screenshot 7 - Hotspot map of simulated fallout dataset with radionuclide concentration for Cs-137 and I-131 for different crop/food types

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Annex II

Following annex contains joint development of research contract proposal led by the institute of Agricultural Resources and Regional Planning at China Academy of Agricultural Sciences (CAAS)

IAEA

International Atomic Energy Agency

Vienna International
Centre, PO Box 100,
1400 Vienna, Austria
Phone: (+43 1) 2600 -
Fax: (+43 1) 26007,
Email:
Official.Mail@iaea.org

PROGRAMME OF COORDINATED RESEARCH ACTIVITIES
Webpage: https://www.iaea.org/services/coordinated-research-activities

PROPOSAL FOR RESEARCH CONTRACT

PLEASE SEND YOUR PROPOSAL FOR RESEARCH CONTRACT TO research.contracts@iaea.org. ONLY DULY FILLED AND SIGNED PROPOSALS WILL BE PROCESSED.

Research Contracts are generally awarded to institutions in developing countries or countries in transition insofar as they can effectively carry out the research. The template for Proposal for Research Contract is also used for Doctoral Contract and for Technical Contract.

1. CODE OF THE COORDINATED RESEARCH PROJECT (CRP) UNDER WHICH THE RESEARCH CONTRACT SHOULD BE PLACED: DI.50.19
2. TITLE OF THE COORDINATED RESEARCH PROJECT (CRP) UNDER WHICH THE RESEARCH CONTRACT SHOULD BE PLACED: Remediation of Radioactive Contaminated A •cultural Land
3. TITLE OF PROPOSED RESEARCH CONTRACT (should reflect the proposed research work): Mapping cropland use dynamics for DSS4NAFA: A Case Stud in Southern China

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4. CONTRACTING INSTITUTION (The contracting institution can ONLY be an institution with independent legal personality)	5. IMPLEMENTING INSTITUTION: (Where the research is performed - can be the contracting institution or a sub-institution, a branch of the main institution or a laboratory) If not the contracting institute, please provide:
Inst. Name: Institute of Agriculture Resource and Regional Planning (IARRP), Chinese Academy of Agricultural Sciences (CAAS) Street: No. 12 Zhongguancun South Street P.O. Box: Postal Code: 100081 City: Beijing Region/District: Haidian Country: China Tel.: +86-10-8210-9640 Fax: +86-10-8210-6225 Email: iarrp@caas.net.cn	Inst. Name: Institute of Agriculture Resource and Regional Planning (IARRP), Chinese Academy of Agricultural Sciences (CAAS) Street: No. 12 Zhongguancun South Street P.O. Box: Postal Code: 100081 City: Beijing Region/District: Haidian Country: China Tel.: +86-10-8210-9640 Fax: +86-10-8210-6225 Email: iarrp@caas.net.cn

6. SUMMARY OF PROPOSED RESEARCH:

China has been undergoing a rapid industrialization and urbanization process supported by the growing number of nuclear power plants. Given the risks of nuclear incidents, it is urgently required to improve data sampling and analysis, data management, and data visualization for swift decision-making in agriculture and food management. Implementing the DSS4NAFA is a possible solution for China, yet the agricultural systems there, like most developing countries, are characterized by smallholder farming and are usually highly intensified (as represented by multi-cropping, inter-cropping, and cropping rotation). The use of cropland might be highly fragmented and the status of cropland (i.e. represented by the crops that have been grown on cropland) will change rapidly, which makes the DSS4NAFA cannot be directly applied in China. This research selects Daya Bay in the Southern coastal of China as a case study area: it not only has located two nuclear power plants (namely Daya Bay and Lingao), but also is the frontier of urbanization with significant changes in land use. It aims to develop a standardized procedure for implementing DSS4NAFA in China in case of nuclear/radiological emergencies, and to further provide international collaborating opportunities for exploration of the new approaches and exchange of ideas in the context of food safety for developing countries.

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7.PROJECT PERSONNEL (if space provided below is insufficient, please attach additional sheets)

A. Chief Scientific Investigator (CSI)

Family Name:	First Name:	Gender: M/F	Date of birth: yyyy-mm-dd	Nationality:
	Ian 1		1986-06-25	Chinese

Telephone (office):	Fax (office):	Email (office):	Position held:
+86-10-8210-5076		yuqiangyi@caas.cn	Associate Research Fellow

Academic degree:	Subject:	Institution:	From:	To:
PhD	Agricultural Remote Sensing	Chinese Academy of Agricultural Sciences CAAS	2010	2013

Related scientific experience: Remote sensing, cropland mapping, cropping system mapping, agricultural management

Recent publications related to the project (within the past 2-3 years):

1. Yu, Q., Shi, Y., Tang, H., Yang, P., Xie, A., Liu, B., Wu, W., 2017. eFarm: A tool for better observing agricultural land systems. Sensors 17, 453.
2. Yu, Q. , Hu, Q. , van Vliet, J., Verburg, P.H., Wu, W., 2018. GlobeLand30 shows little cropland area loss but greater fragmentation in China. International Journal of Applied Earth Observation and Geoinformation 66, 37-45.
3. Yu, Q., Xiang, M., Wu, W., Tang, H. , 2019. Changes in global cropland area and cereal production: An inter-country comparison. Agriculture, Ecosystems & Environment 269, 140-147.
4. Xiang, M., Yu, Q., Wu, W. , 2019. From multiple cropping index to multiple cropping frequency: Observing cropland use intensity at a finer scale. Ecological Indicators 101, 892-903.
5. Chen, D. , Yu, Q. , Hu, Q. , Xiang, M., Zhou, Q., Wu, W., 2018. Cultivated land change in the Belt and Road Initiative region.

Journal of Geographical Science 28, 1580-1594.

% of total working time devoted to the project: 30

Family Name:	First Name:	Gender:	Date of birth: yyyy-mm-dd	Nationality:
Yulin	Duan		1982-07-05	Chinese

B. Secondary CSI (if applicable)

Telephone (office):	Fax (office):	Email (office):	Position held:
86-10-8210-5071		duanyulin@caas.cn	Assistant Research Fellow

Academic degree:	Subject:	Institution:	From:	To:
PhD	Civil En ineerin	The Universi of Tok o	2008	2011

Related scientific experience: Remote sensing, data fusion, change detection

% of total working time devoted to the project: 30

Family Name:	First Name:	Gender: M/F	Date of birth: yyyy-mm-dd	Nationality:

C. Main additional Scientific Staff

Telephone (office):	Fax (office):	Email (office):	Position held:

Academic degree:	Subject:	Institution:	From:	To:

Related scientific experience:

% of total working time devoted to the project:

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D. Main additional Scientific Staff				
Family Name:	First Name:	Gender: M/F	Date of birth; yyyy-mm-dd	Nationality:

Telephone (office):	Fax (office):	Email (office):	Position held:

Academic degree:	Subject:	Institution:	From:	To:

Related scientific experience:
% of total working time devoted to the project:

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8.PROPOSED RESEARCH PROJECT (if space provided below is insufficient, please attach additional sheets)

A. Scientific Background

Swift decision-making in agriculture and food management is supported by the DSS4NAFA in response to the risks of nuclear incidents. Yet the existing implementations ofDSS4NAFA are mainly in developed countries (e.g. in Belgium) where the agricultural production is highly commercialized and the agricultural landscapes are largely homogenous. Such a simplified land use setting makes the DSS4NAFA cannot be directly applied in developed countries (e.g. in China), where the use of cropland is highly fragmented and the status of cropland is changing rapidly as represented by small smallholder and subsistence agriculture.

B. Scientific Scope of the Project (Scientific problems to be addressed with overall and specific objectives)

The overall objective of the project is to develop a standardized procedure for implementation of DSS4NAFA in developing countries in case of nuclear/radiological emergencies, and to further provide international collaborating opportunities for exploration of the new approaches and exchange of ideas in the context of food safety.

The specific objectives of the project include:

1. Configurating DSS4NAFA for sampling task assignment in Daya Bay (the Southern coastal of China), where has located two nuclear power plants with highly varied agricultural landscapes.
2. Mapping the spatial-temporal characteristics of croplands in the case study area by agricultural remote sensing and providing accurate and dynamic cropland use maps to DSS4NAFA.
3. Developing guidelines and tutorials for emergency response and preparedness in case of nuclear/radiological circumstances for developing countries based on the DSS4NAFA implementation in China.

C. Overall programme of work for the whole duration of the Contract, including proposed methods or techniques.

The overall programme of work mainly includes three parts:

1. Producing cropland use maps by testing various schemes for classifying remotely-sensed images.
2. Preparing cropland maps with all needed datasets for DSS4NAFA.
3. Configurating DSS4NAFA in the study area
4. Assessing the performance of DSS4NAFA with small or large tests.

D. Detailed programme of work for the coming year (used as reference for the annual Progress Report) According to the programme, the works for the coming year include:

l. Collecting the raw satellite images in the study area, including the high spatial resolution images such as GaoFen and Sentinel, and the high temporal resolution images such as MODIS.
2. Preparing the cropland layer, administrative boundaries and all other required datasets.
3. Testing various schemes for classifying the remotely-sensed images, such as Support Vector Machine, Random Forest, Decision Tree, and Bayes classification.
4. Producing the cropland use maps by choosing the classification scheme with best performance.

E. Expected Outputs

1. First feasibility study for implementing DSS4NAFA in the China context.
2. Joint-Venture between IAEA and CAAS, and international collaboration in in the context of food safety.
3. Joint publications including project reports, technical tutorials, peer-reviewed journal articles.
4. Guidelines for emergency response and preparedness in case of nuclear/radiological circumstances for developing countries.

9. RELATED WORK ALREADY PERFORMED OR IN PROGRESS AT INSTITUTE (including work performed in connection with the IAEA through Technical Cooperation projects):

1. Cropping system mapping in Poyang lake Area
2. Cropland degradation monitoring in Guangdong Province

10. FACILITIES and EQUIPMENT

A. Please list facilities (building, equipment - including type and name of manufacturer, and materials) presently available which would be used for the project:

FINAL

N/A

B. Equipment needed for the project which is not available under 10.A.:

Items	Estimated project costs in €		
	To be provided by the institution	To be provided by Other (non-IAEA)	Requested contribution from the IAEA
Sub-total:			

If equipment contribution from the IAEA is requested,

a) will this equipment be purchased by the institute, using the cash award? C] OR

b) shall the IAEA purchase the requested equipment on behalf of the institute? C] Please specify:

11. BUDGET ESTIMATE of the project by year (please show all amounts in EUR €)

Project Year	1. Staff Costs	2. Equipment	3. Miscellaneous*	Project Total 1+2+3) or (z 4+5+6)	4. Contribution by Institute	5. Contribution by Other (non-IAEA)	6. Requested contribution from the IAEA
1st				10000	5000		5000
2nd				10000	5000		5000
3rd				10000	5000		5000
4th							
5th							
6th							
Total							

*If 'Miscellaneous' costs are entered in the table, please elaborate here:

NB.: Travel cost to Research Coordination Meetings (RCMs) should not be included in the Budget Estimate.

12. PROPOSED PROJECT COMMENCEMENT DATE:

July 1st, 2020

13. ADDITIONNAL INFORMATION (if required):

N/A

14. SIGNATURES

CHIEF SCIENTIFIC INVESTIGATOR:

(Signature)

Qiangyi Yu, Associate Research Fellow

(Name and Title)

June 17, 2020

(Place and Date)

HEAD OF INSTITUTE:

(Signature)

Peng YANG, Direct General

(Name and Title)

June 17, 2020

(Place and Date)

FINAL

Annex III

Based on recommendations provided following annex contains TOR for next project phase

1. To develop a new DSS4NAFA internal or external module allowing to systematically import and convert at scale crop map produced by satellite imagery along the procedure defined in this case study. Specifically:

    a. Propose processing and integration mechanism with remote sensory imagery

    b. Implement proposed integration mechanism

2. Adjustment of logic of advanced sample and task allocation (ASTA) module in DSS4NAFA for China context

    a. 2 (two) level logic for filtering/proposing township during prioritization

3. Adjusting sampling procedures in DSS4NAFA to use farmers as sample collectors

4. Facilitating/supporting a small field test case of DSS4NAFA in Guangdong Province in China.

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