



Regional training workshop for satellite crop monitoring using the CropWatch system

CropWatch Innovative Cooperation Programme for SDG 2 Zero Hunger

Wu Bingfang

Aerospace Information Research Institute,
Chinese Academy of Sciences

wubf@aircas.ac.cn; cropwatch@aircas.ac.cn;

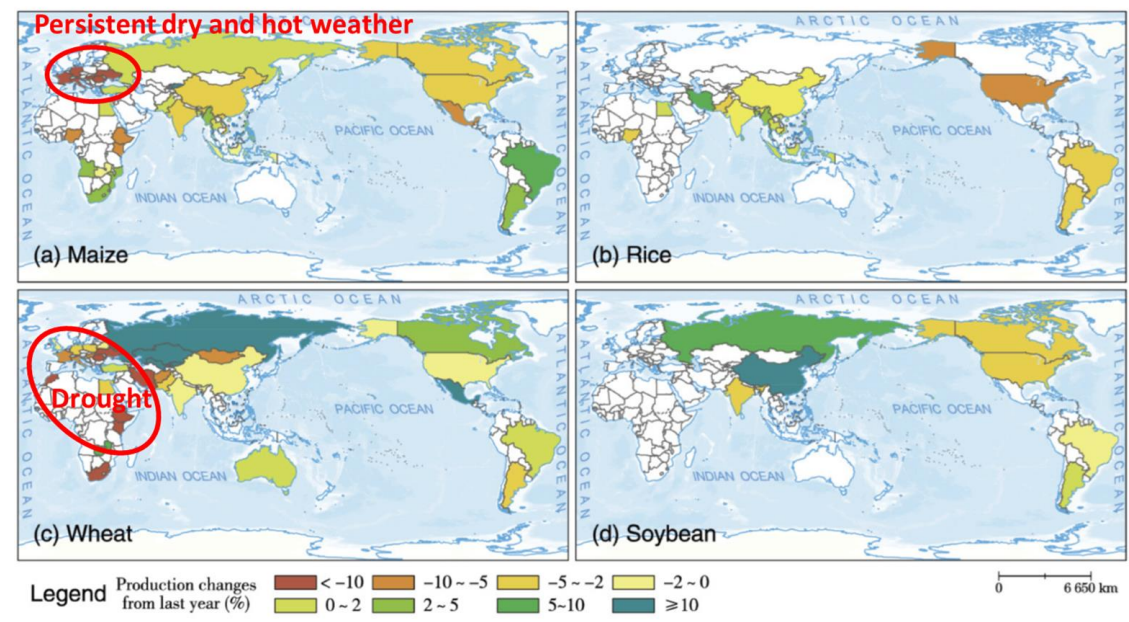
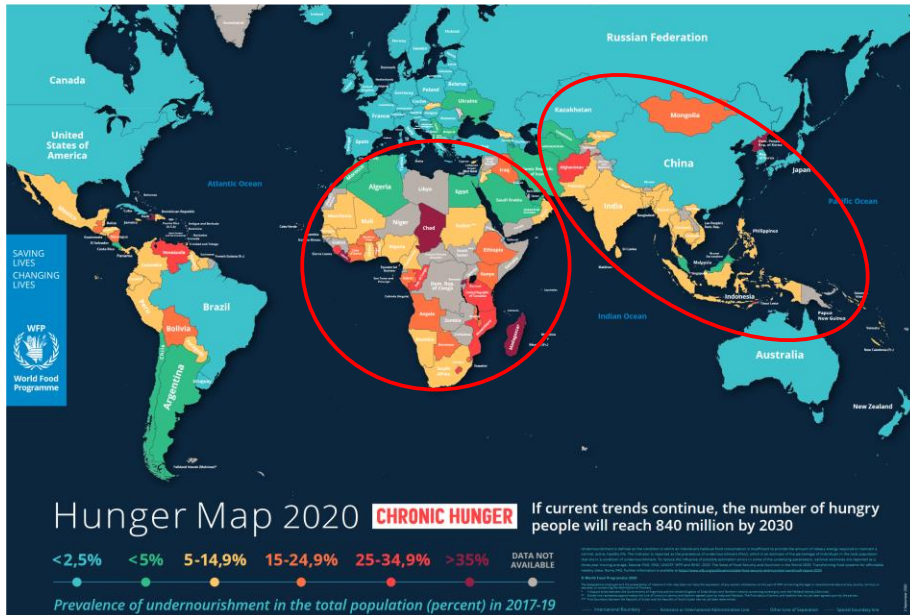
August 7th, 2023

Outline

- **Background**
- **CropWatch-ICP objectives**
- **CropWatch-ICP activities**
- **Outlook**

Issues for Food Security

- Food security is still a challenge issue over the world, in particular in Africa, south & southeast Asia. COVID-19, Desert Locust, drought, flooding, etc. further threaten food security.
- The paucity of adequate capacity in obtain and accessing up-to-date staple crop production information pose the danger of taking decisions based on delayed and on not easily verifiable information.
- China introduced the Global Development Initiative (GDI) during the 76th session of the United Nations General Assembly (UNGA) in September, 2021, aiming to address various global challenges and foster sustainable development worldwide, with food security being a top priority



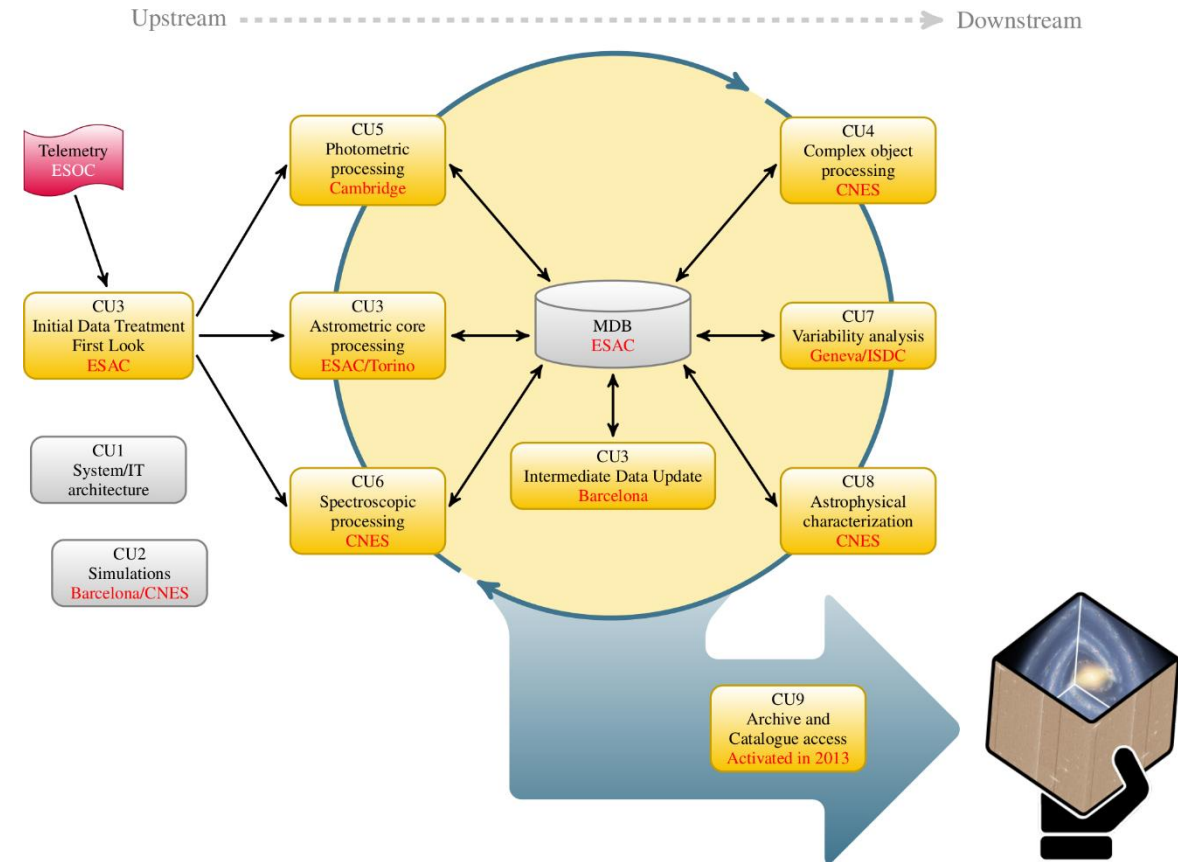
Crop Monitoring System

- Many countries want to set up their own crop monitoring systems
- Components:
 - Agro-climatic analyses,
 - crop-condition and stress monitoring,
 - crop production predictions, and
 - early warning of likely food insecurities.
- Operational
 - Efficient and long-term services for stakeholders
 - Cost effective, timely, location specific
- Basic elements
 - Complete Data stream from raw Earth Observation (EO) data as inputs to produce targeted information.
 - Software processes that automatically convert data into valuable information.
 - Archived product for time series analysis and comparison
 - Baseline datasets




Crop Monitoring

- Satellite data are no longer the constraints of crop monitoring.
- The focus of crop monitoring is how to retrieve crop information from satellite data economically and effectively
- Combining of crops, phenology, location makes crop monitoring data streams very complex
- Initiative input and operational cost as well as adequate technical skills constrain many countries to set-up, operate, and maintain crop monitoring system,



CropWatch Cloud


- CropWatch is a satellite-based hierarchical method of crop monitoring, including 4 agro-climatic indicators and agronomic indicators, area, yield and production at different scales
- 32 Indicators ready in CropWatch Cloud considering most indicators used in existing system
- Release Quarterly and annually bulletins on global crop monitoring, covering 173 countries and regions down to provincial scales, with special focus on 43 key agricultural countries



CropWatch-Pro

- An online tool for people to produce crop monitoring products at any time and anywhere.


[Enter](#)



CropWatch-Explore

- An online interface for people to explore and analysis all the crop information data easily.


[Enter](#)



CropWatch-Project

- An online platform for people to create and write the crop bulletin.

[Enter](#)



CropWatch-Bulletin

- An webpage for people to read CropWatch bulletin.

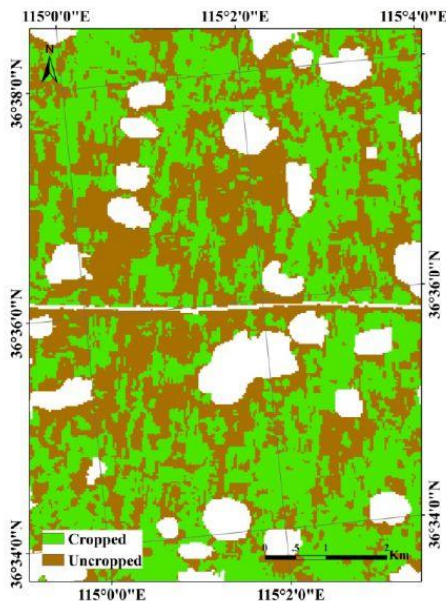
[Enter](#)

Rainfall index	Maximum VCI	Normalized Difference Vegetation Index	Crop Condition based on NDVI anomaly
Temperature Index	Minimum Vegetation health Index	Leaf Area Index	Index Based Crop Development
Photosynthetic Active Radiation	Cropped Arable Land and Classification	Fraction of Absorbed PAR	Crop condition clustering
Potential Biomass	Cropping intensity	Normalized Difference Water Index	Crop Condition Classification
Index Based Yield Model	CPTP Method for Area Estimation	Production Outlook Indicator	Evapotranspiration
Agro-Meteorological Yield Model	Planted Area Early Warning Indicator	Supply Situation Indicator	Minimum Vegetation health Index (China)
Remote Sensing Based Production	Agro-Meteorological Suitability Index	Standardized Precipitation Index	Thematic Map
Trend Based Production for Minor Producers	Agro-Climatic Index Composite	Soil Moisture	Zonal Statistics

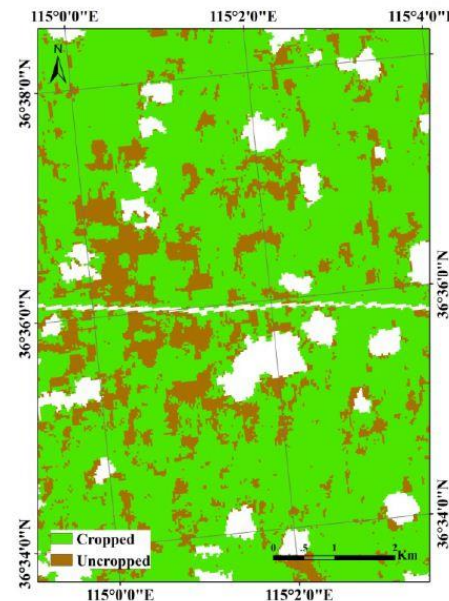


Crop Condition

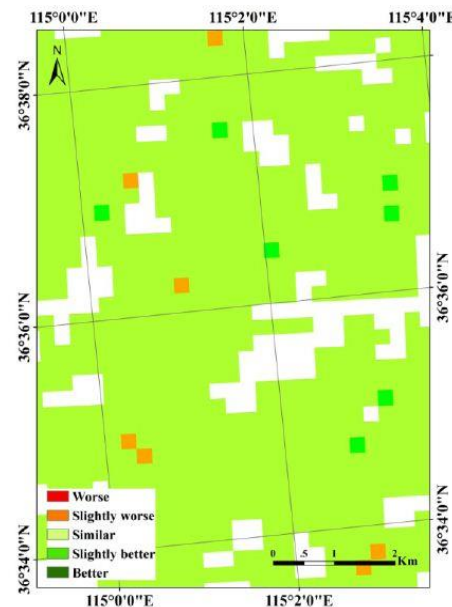
- Most CMSs implement only simple methods and indicators, such as anomaly maps and temporal NDVI development information.
- LAI, biomass, NPP, and fAPAR, are not applied in most CMSs due to complex software processes and the need for ancillary and baseline data.
- NDVI adjustments for characterizing crop rotations or interannual phenological shifts, and avoiding misleading and/or false information.



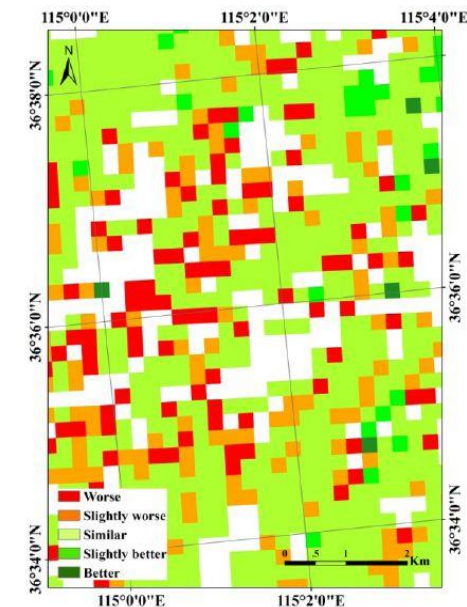
Cropped/uncropped map in 2010



Cropped/uncropped map in 2011



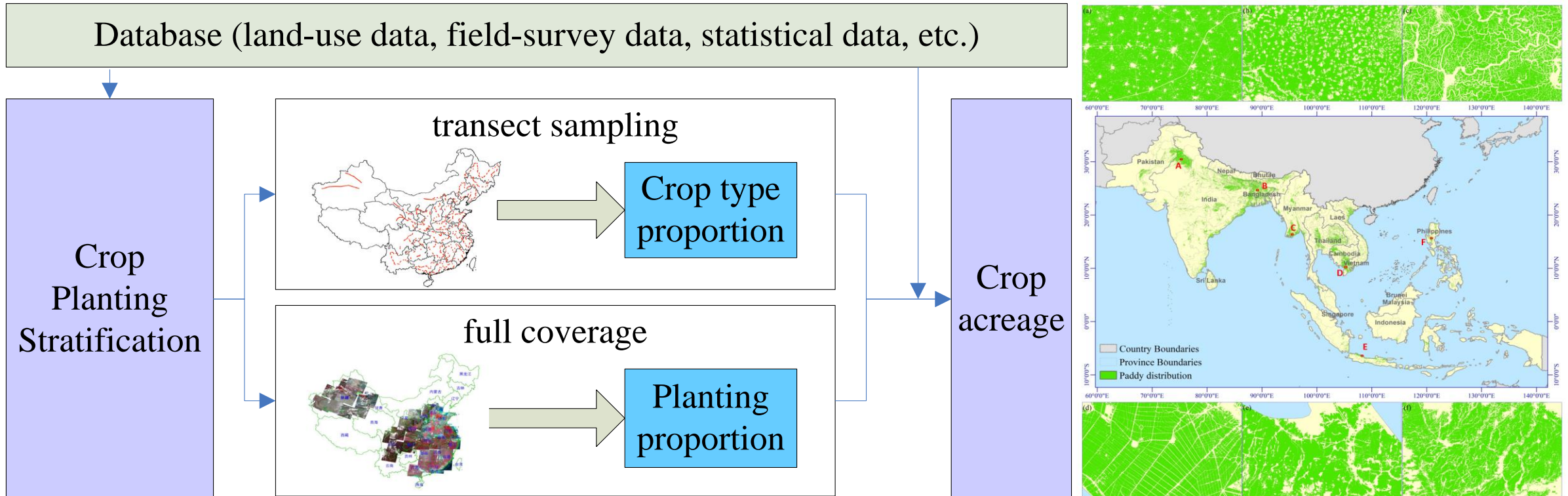
Crop condition



Crop condition with CALF-adjusted NDVI

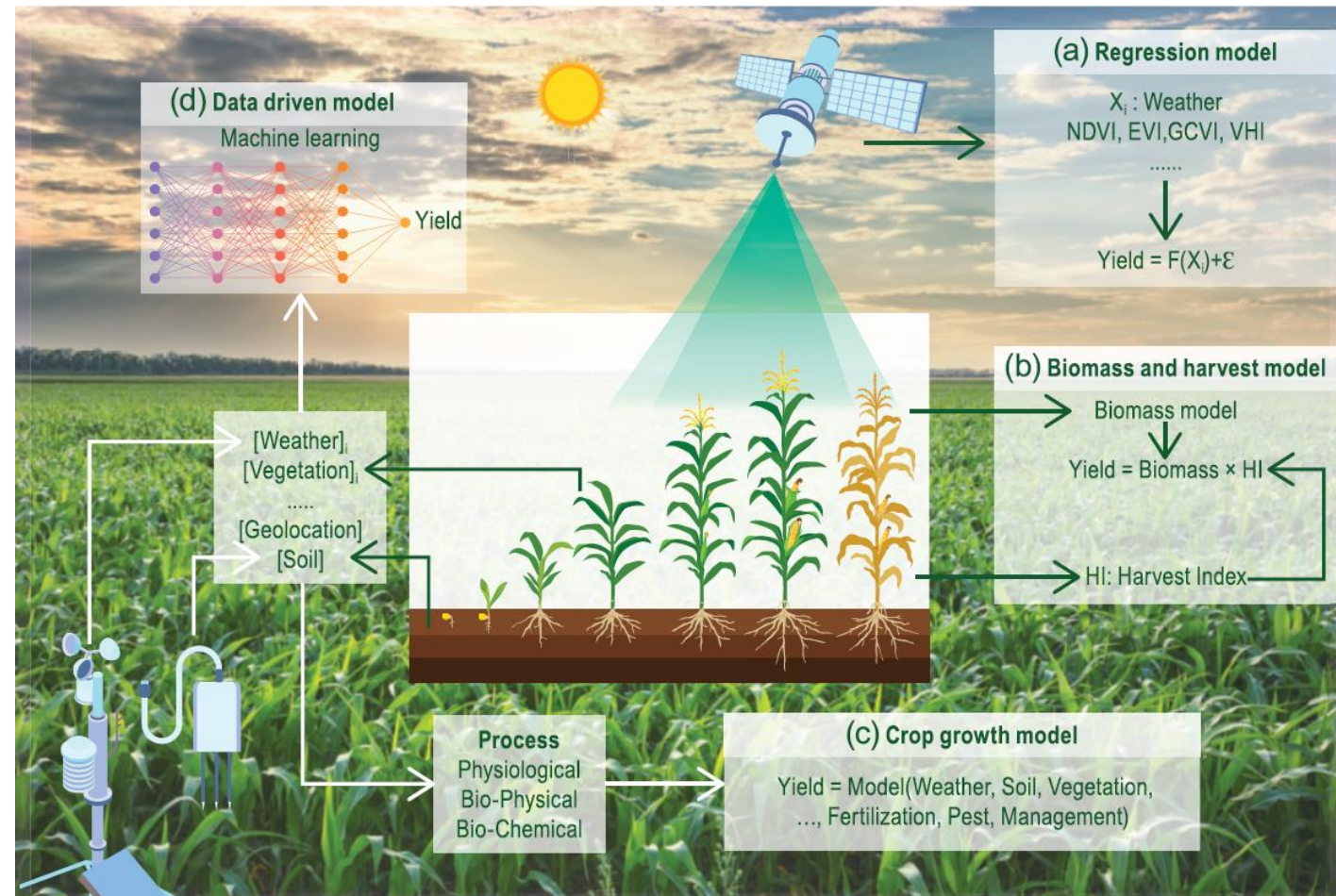
Crop Areas

- Most of the current crop monitoring systems lack accurate crop area information.
 - Needs for field data make those algorithms hard to implement in a global/regional CMS.
- CropWatch integrates crop area estimation with geo-statistics & crop mapping
 - The CPTP method for the operational purpose in complex agricultural landscapes
 - Transfer learning methods are integrated to reduce the reliance on in situ data



Yield models

- Yield prediction component is the weakest component in crop monitoring
 - VI saturation leads to poor performance when predicting yields, especially in dense or irrigated crop regions.
 - The uncertainty of current crop growth models makes it difficult to scale up to facilitate operational yield predictions.
 - Current models have not precisely captured crop yield determinants, especially under extreme climatic conditions.
- CropWatch adopts averaged values of three yield models to reduce the uncertainty of yield prediction



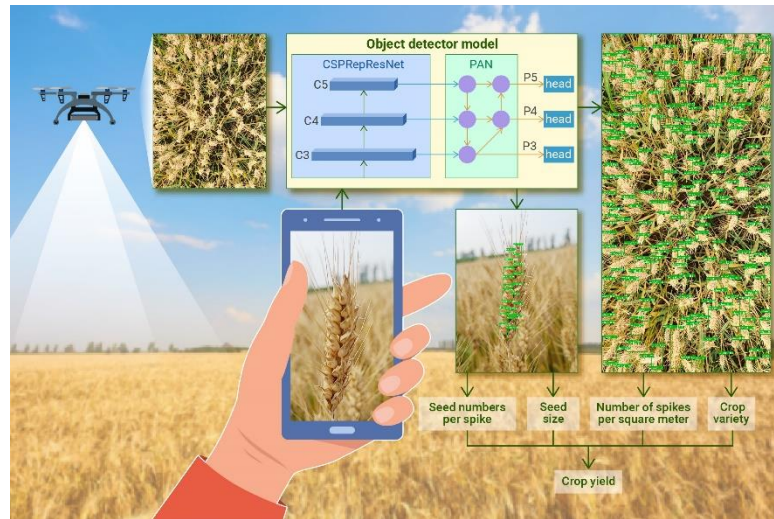
Updates on baseline data



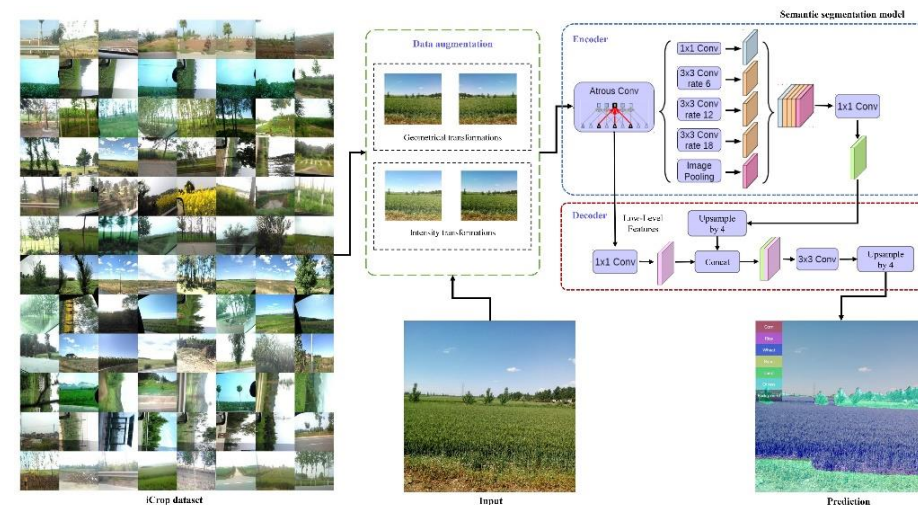
Zhang, Miao; Wu, Bingfang; et al, 2020, "GCI30: Global Cropping Intensity at 30m resolution", <https://doi.org/10.7910/DVN/86M4PO>, Harvard Dataverse, V2
Miao Zhang, Bingfang Wu. Global 30-m cropping intensity in 2020 (GCI30_2020), doi: 10.12237/casearth.62ff4caa819aec75a535cbe7
Miao Zhang, Bingfang Wu. Global 30-m spatial distribution of cropland in 2020 (GCL30_2020), doi: 10.12237/casearth.62ff4caa819aec75a535cbe6

Tools for ground truth data collection

- The field data collection prevents most systems have crop area and yield components
 - Cost, labor and time consuming
- Two tools developed for free use
 - GVG app for crop identification and FieldWatch for yield measurement with image recognition



FieldWatch for yield data measurements



GVG Crop type identification from geo-tagged photos

Analysis and reporting

- a lack of transparent and standardized methods for synthesizing various information produced by CMSs to support decision-making
 - knowledge-based analyses are mostly applied in crop-monitoring activities, especially in the process of generating actionable reports.
 - the personal knowledge, views or preferences of the analysts all affect their working practices.
- a transparent and interactive process with users.
 - The international analysis team of CropWatch
 - The GEOGLAM Crop Monitor performs a collective negotiation process
- difficult to question these reports without direct access to the algorithm code and the underlying data used to generate such information.
- **alternatively, development of their own systems or obtain information from different sources to avoid unconscious biases.**

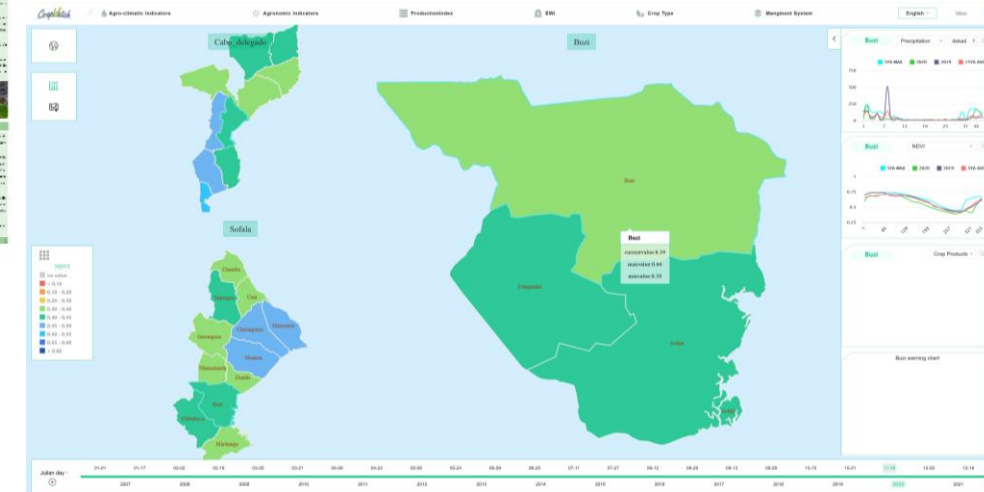
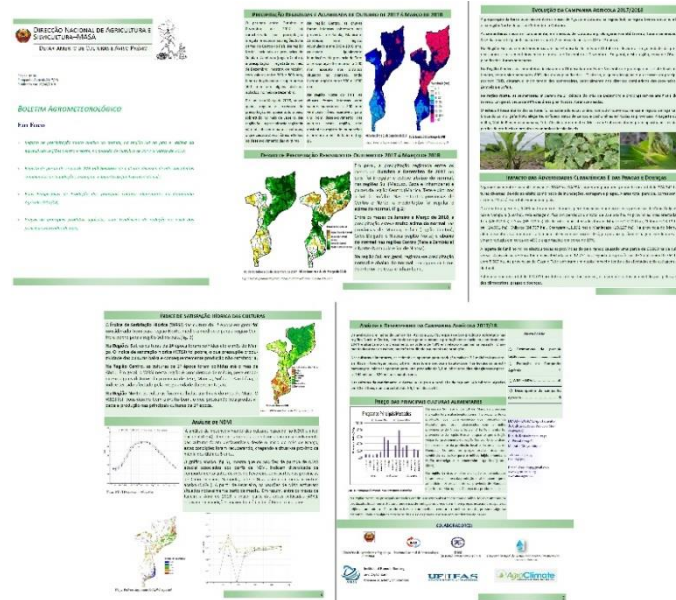


Technical training and national bulletin for Mozambique

- In-situ data collection training
- First CropWatch training for selected experts (3 persons)
- Extended CropWatch training (29 participants)
- CropWatch Cloud supports crop monitoring for food security in Mozambique – National Meteorological Bulletin powered by CropWatch
- CropWatch Cloud for Mozambique was included in Rural Solutions Portal by IFAD in 2020.



Activities	Outputs
Requirement analysis	Detailed Requirement report
Discussion and finalize the implementation plan	Detailed implementation plan
Discussion and joint field trip in Mozambique	In situ data in Maputo and Nampula
First technical training of CropWatch in Beijing	Agricultural monitoring report done by MOZ experts using CropWatch
Second technical training of CropWatch in MOZ	CropWatch based crop condition monitoring included in MOZ national meteorological bulletin
Training for national and provincial office	Mozambicans get some knowledge about crop monitoring on their own
Customize the CropWatch system for Mozambique	Provide system in Portuguese; Include all provinces for MOZ; Yield model calibrated



CropWatch for Mozambique

...the outputs



"We use CropWatch mainly for crop production forecast. Our team has been applying the tool to generate monthly agriculture bulletin during the rain season, which informs policy making at national and provincial-level agriculture departments."

Mr. Hilten, Department of Crops and Early Warning, Ministry of Agriculture and Rural Development, Mozambique

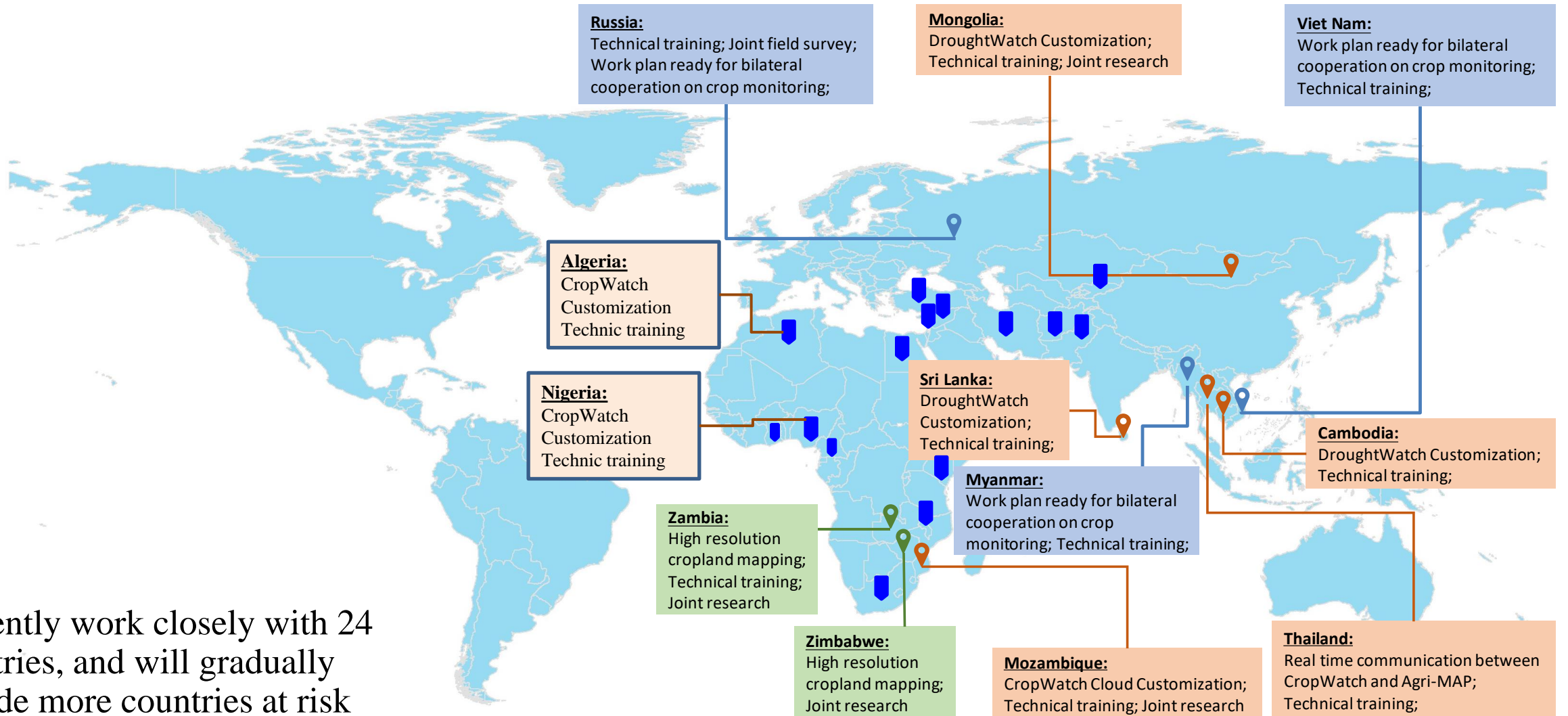
In 2019, CropWatch Cloud for Mozambique was selected as one of the **best "rural solutions"** by the **International Fund for Agricultural Development (IFAD)** due to its contributions in improving the capacities of Mozambique to access domestic and global agricultural information.

Collaborative **Crop conditions and Disaster's Updates** in **Portuguese language**



Powered by: 

Capacity building activities across the globe



Currently work closely with 24 countries, and will gradually include more countries at risk

Outline

- Background
- CropWatch-ICP objectives
- CropWatch-ICP activities
- Outlook

Announcement of the partnership by President Bai

- Understanding that the crop production will help the decision-makings in the food insecurity countries, reducing the data divide between developed and developing countries could improve good, strategic decisions about food supply.
- The partnership between ANSO and UNCTAD was announced at the 23rd annual meeting of the CSTD by Prof. Bai Chunli president of CAS and the ANSO, following with MOU to offering developing countries access crop monitoring tool, CropWatch



ANSO President Prof. Chunli Bai
Attends the Video Conference of
23rd UNCSTD Annual Session



On 23 July 2020, a MoU between ANSO and UNCTAD, enhance STI-related collaboration on building capacities within developing countries

(Source: Prof. Bai's speech in the 23rd UNCSTD Annual Session)

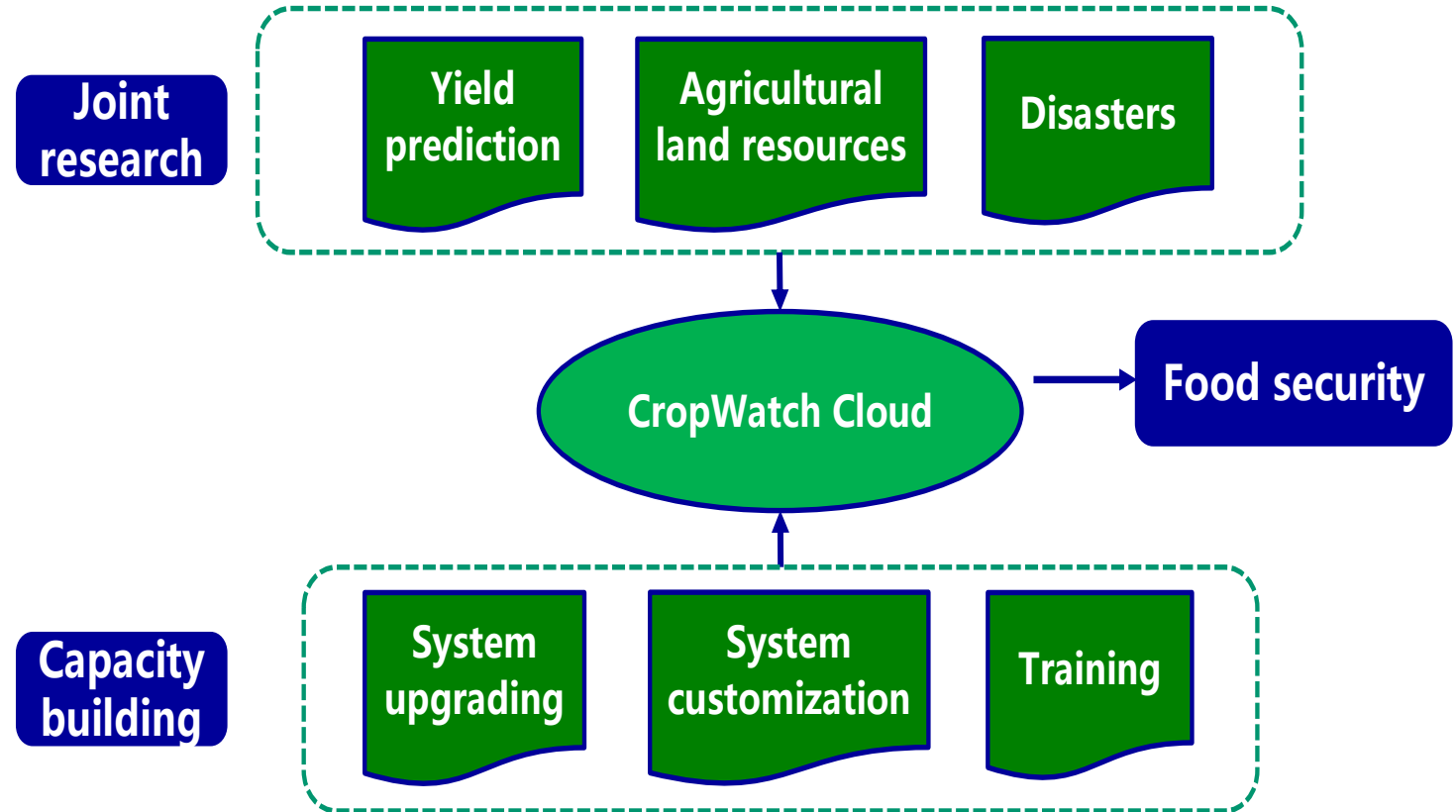
Project Objectives

Under coordination of UNCTAD, CropWatch Innovative Cooperation Programme for Crop Monitoring (CropWatch-ICP) is to **facilitate and stimulate crop monitoring at developing countries for the advancement of the SDG goal of zero hunger** through joint research and capacity building , which is funded by Association of National Science Organization (ANSO), facilitated by Chinese Academy of Sciences

- To enable pilot countries to do respective national or subnational crop monitoring on their own in real and near time
- To promote resilient agricultural practices by integrating geospatial information for crop monitoring

Key Actions on Capacity Building

- Training workshops
- On-job training in house and in field, in Beijing and local
- CropWatch customization for Specific requirements
- Regional workshops on food security



Expectations

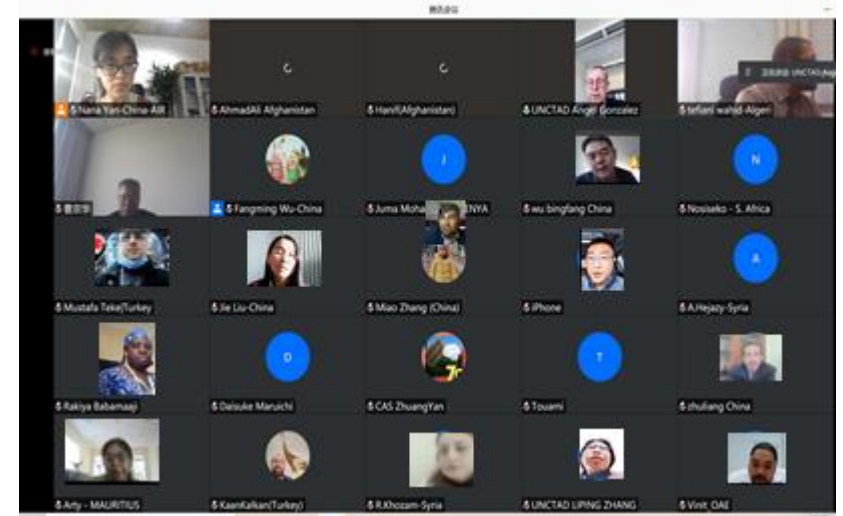
- The participating countries are able to use the CropWatch cloud to produce regular bulletin for informing policy-making at national and provincial levels on the food market, annual food import-export prospects and disaster relief.
- Trained staff of the participating country can **perform as trainers** for sub-national officials to empower more technical staff for crop monitoring

Outline

- Background
- CropWatch-ICP objectives
- **CropWatch-ICP activities**
- Outlook

Kick-off meeting for CropWath-ICP

- The online opening ceremony of “Kick-off Meeting for CropWatch Innovation Cooperation Programme for Agricultural Monitoring (CropWatch-ICP) was held on 22 March,2021.
- This project will enable participating countries to build their know-how and technical capabilities in crop monitoring, which can increase their resilience to future shocks in food production systems (*source: Ms. Shamika N. Sirimanne, UNCTAD’s director of technology and logistics*)
- 25 participants from Afghanistan, Algeria, Kenya, Lao PDR, Lebanon, Malawi, Mauritius, Myanmar, Nigeria, South Africa, Syria, Thailand, Turkey and Zambia joined the virtual meeting, and expressed their interesting and expectations for the programme.



Country Report

CropWatch technical training for 14 countries (2021)

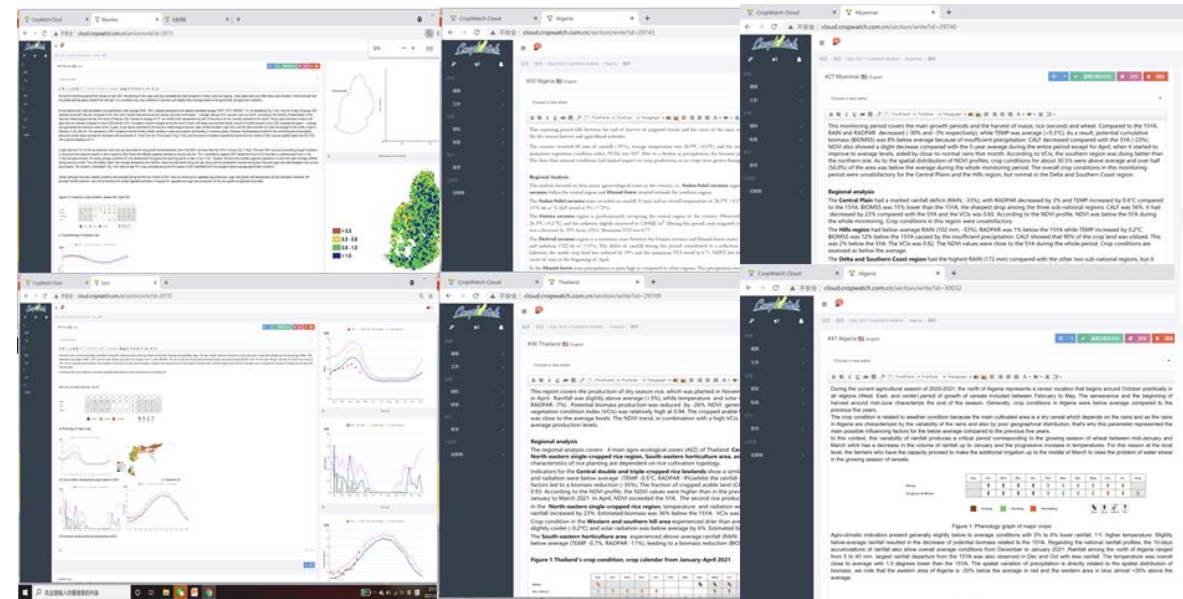
- Online Training Workshop of Earth Observation Applications for crop Monitoring, coordinated by UNCTAD, for three months over 23 March- 25 May, 2021
- Theory, Methodology and Application: 12 courses from invited experts and 6 courses from CropWatch team
- Online practices: Participants from Algeria, Myanmar, Nigeria, Syria, Thailand and Mauritius finished the country analysis for May Bulletin 2021



Agenda
(Venue: Videoconference, 9 weeks, UTC+8, Beijing time, 23 March- 28 May 2021)

23 rd March	
Plenary session on Agricultural remote sensing Moderator: Nana Yan	
16:00 - 17:00	Introduction of agriculture monitoring at participating countries Each country gives a presentation. Participants from each country are requested to coordinate internally to prepare a synthetic report. (5-minutes) Participants from Countries: Afghanistan, Algeria, Kenya, Lao PDR, Lebanon, Malawi, Mauritius, Myanmar, Nigeria, South Africa, Syria, Thailand, Turkey, Vietnam, Zambia
17:00 - 17:30	Introduction of Agriculture monitoring based on remote sensing Nana Yan, AIR 25 min Report, Smit GAA
17:30 - 18:00	Multi-model Integrated Subseasonal-to-Seasonal Prediction and Application in Disaster Risk Reduction Prof. Qing Bao, Institute of Atmospheric Physics, CAS 25 min Report, Smit GAA
18:00 - 18:30	Agriculture drought monitoring & drought mitigation Nana Yan, AIR 25 min Report, Smit GAA

Join Zoom Meeting: <https://meeting.tencent.com/join/93w1uw/93w1uw>
Conference ID: 392 667 903



Technical support by country

- Work plan and requirement analysis: [Nigeria](#), [Mauritius](#), [Algeria](#), [Thailand](#), [Syria](#), [Cambodia](#), [Laos](#)
- Joint field works, supported virtually (2021-2022, 3 days for [Mauritius](#), [Algeria](#)) and physically (2023, 2 days for [Cambodia](#), [Laos](#), [Kenya](#), [Zimbabwe](#))
- CropWatch country analysis training: [Mauritius](#), [Nigeria](#), [Algeria](#), [Syria](#), [Thailand](#), [Laos](#)

← 推文



UNCTAD Innovation
@UNCTADinnovate

#Mauritius completed the first field study on #crop growth monitoring and yield prediction, under the #UNCTAD-#China Academy of #Science #CropWatch #Innovative Cooperation Programme. unctad.org/project/cropwa...

翻译推文

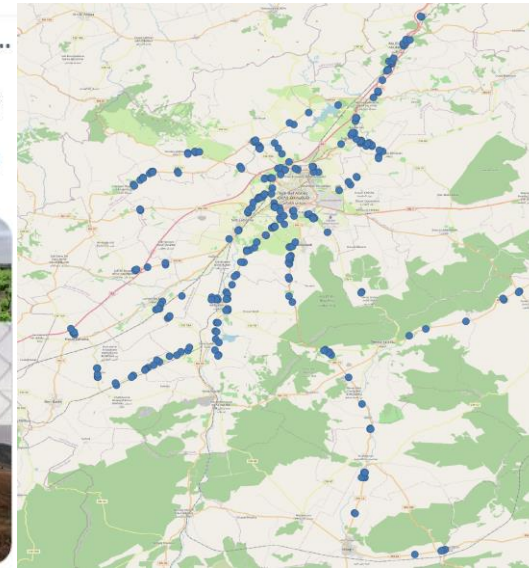


下午8:02 · 2022年11月9日 · Twitter Web App



UNCTAD Innovation @UNCTADinnovate · 2m

#Algeria has completed field data collection to advance the crop monitoring and yield prediction under the #UNCTAD - #China Academy of #Science CropWatch #Innovative Cooperation Programme. (unctad.org/project/cropwa...) #cropwatch #food #endhunger #innovation #sdg



Activities in Nigeria NASRDA

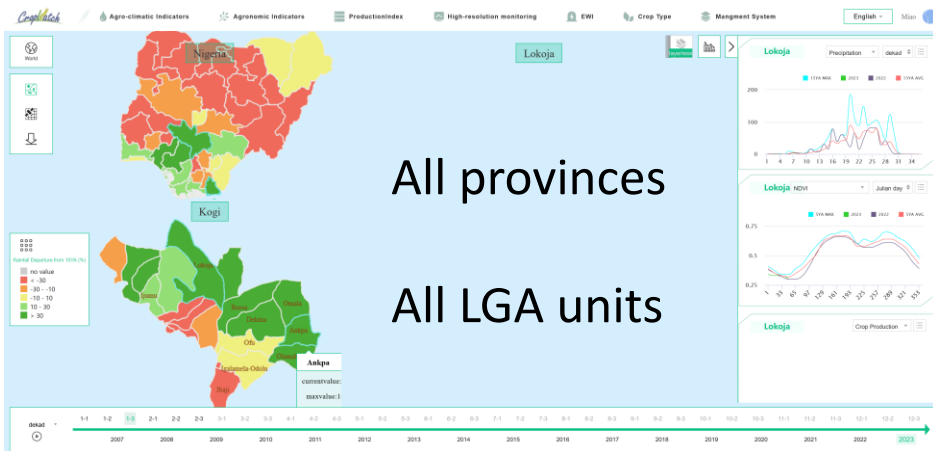
- **MOU between AIRCAS CropWatch team and Nigerian Aerospace Agency (NASRDA)** on Cooperation to strengthen capacity building on crop monitoring was signed in 4 July 2022

- **Activities**

- Implementation team and work plan
- All indicators for all provinces, and 775 LGA units available
- Showcase at GEO annual workshop
- Two stakeholder meetings involving 11 agencies



2nd Stakeholder meeting



All provinces

All LGA units

CropWatch customization for Nigeria

DATA FOR CROPWATCH Shared by NASRDA¹

S/N ¹	Data ²	Source ²	Resolution ²	Coverage ²	Date ²	Size ²
1 ¹	Agro-Ecological-Zone ²	IITA, Ibadan ²	Shapefile ²	Nigeria ²	2021 ²	0.253692-MB ²
2 ¹	LULC ²	Landsat ²	30m ²	Nigeria ²	2000,2010,2020 ²	4.348-GB ²
4 ¹	Multispectral-Satellite-Image ²	NigeriaSat-X-(NASRDA) ²	22m (Green, Red, Blue and NIR) ²	Nigeria ²	2011 ²	4.0471-GB ²
5 ¹	Multispectral-Satellite-Image ²	NigeriaSat-1-(NASRDA) ²	32m (Green Red and NIR bands) ²	Nigeria ²	2007 ²	13.0462-GB ²
6 ¹	Nigeria-Administrative-Boundary ²	OSGOF ²	Shapefile ²	Nigeria ²	2021 ²	10.6502-MB ²
7 ¹	Nigeria Soil ²	FAO ²	1000m ²	Nigeria ²	2011 ²	30.5527-MB ²
8 ¹	Rainfall ²	TRMM ²	0.25 degrees ²	Africa ²	1989-2017 ²	27.1-MB ²
9 ¹	SPOT ²	²	2.5m ²	Nigeria ²	2015 ²	294.6-GB Packed on Zip ²
10 ¹	Wetlands ²	FAO ²	1000m ²	Nigeria ²	2020 ²	1.9866-GB ²
11 ¹	Weather Stations ²	NIMET ²	Shapefile ²	Nigeria ²	2022 ²	0.00769329-MB ²

Data shared from NASRDA



Signing MOU online

Local Workshop in Zimbabwe

- **Location: Harare, Marondera**
- Training course of CropWatch, 2 days, August 1-2, 2023
- More than 10 colleagues from administration of agriculture understand the basic functions of CropWatch and mastered the skill to use GVG for crop type classification.
- Field work, 2days, August 3-4 2023
- **Types: wheat, barley, grassland, vegetable**
- Collected 200 samples



Chinese Academy of Science and UNCTSD held a Workshop on Food Security and Sustainable Development in Zimbabwe based on Earth Observations on Aug 1. Chinese experts will conduct on-job training of CropWatch to empower Zimbabwe agricultural authority and farmers to monitor crops with digital tools.



8:19 AM · 02 Aug 23 · 25 Views



Regional workshop today (2023)

- Coordinated by UNCTAD, for four days during 7- 10 AUG, 2023
- 27 trainees from 11 participating countries: Algeria, Cameroon, Ghana, Kenya, Lebanon, Malawi, Mauritius, Nigeria, Syria, Zambia, Zimbabwe
- Theory, Methodology and Application: courses from CropWatch team for in situ data collection, high resolution crop type mapping and area estimation
- Field work: GVG practice for sample collection



Regional training workshop for satellite crop monitoring using the CropWatch system
07 - 10 August 2023, Palmar Conference Center, Ambre Hotel, Mauritius

Programme

SESSION OUTLINE	Time (Mauritius, UTC)
Day 1: 7 August, Monday	
Registration	
S1: Opening Ceremony (Ambre Conference Hall)	
Welcome note by Master of Ceremony Mrs. Micheline Seenevasser CEO of FAREI, Mauritius	
Speakers:	
Professor Bingfang Wu, Director of CropWatch at AIR/CAS <i>Introduction to Crop Watch ICP</i>	
Professor Chunli Bai, President, Alliance of International Science (ANSO) <i>Address from ANSO</i>	
Ms. Shamika Sirimanne, Director, Division on Technology and Logistics <i>Address from UNCTAD</i>	
Ms. Lisa Simrique Singh, UN Resident Coordinator For Mauritius and <i>The CropWatch programme in the wider UN-Mauritius cooperation</i>	
H.E. Mr. Joyker Nayeck, Secretary for Foreign Affairs at the Minis Affairs, Regional Integration and International Trade, Mauritius <i>The importance of international collaboration and South-South & developing countries in the field of science and technology</i>	
Hon. Mr. Maneesh Gobin, Minister of Agro Industry and Food Security <i>The role of STI in advancing agricultural development and food security countries</i>	
Hon. Mrs. Leela Devi Dookun-Luchoomun, G.C.S.K Vice Prime Minist Education, Tertiary Education, Science and Technology, Mauritius <i>Welcome Address</i>	
Tea break and group photo	
Day 2: 8 August, Tuesday	
S5: CropWatch fieldwork and practice	09:00-16:00
Pineapple (morning) and onion (afternoon)	Lunch: 12:30-13:30
Practice: access field sampling	
Day 3: 9 August, Wednesday	
S6: CropWatch Processing, Dr. Miao Zhang, AIR/CAS	09:00-12:30
Introduction to CropWatch Processing	Tea break: 10:15-10:45
Practice: indicator calculation and thematic mapping	Lunch: 12:30-13:30
S7: CropWatch Explore, Dr. Hongwei Zeng, AIR/CAS	13:30-18:00
Introduction to CropWatch Explorer	Tea break: 15:30-16:00
Practice: Indicators Explorer	
Day 4: 10 August, Thursday	
S8: Cropwatch Analysis, Dr. Miao Zhang, AIR/CAS	09:00-17:00
Introduction to CropWatch Analysis	Tea break: 10:15-10:45
Practice: country analysis	Lunch: 12:30-13:30
	Tea break: 15:30-16:00
S9: Closing ceremony	17:00-18:30
Wrap-up by Professor Bingfang Wu, AIR/CAS	
Feedback from trainees	
Certification of the training	
Closing remarks from Mr A. Goolaub, Assistant Director (Extension) FAREI, Mauritius	
Closing remarks from Ms Shuwen Xu, Program officer, ANSO	
Closing remarks from Ms Liping Zhang, Chief of Science, Technology and Innovation for Development, UNCTAD	

Coming activities

- Food security session at ANSO conference ([October 29-30th, Beijing](#))
- Hand on training on the field in Nigeria, Cameroon, Ghana ([September](#))
- On-job training in Beijing for pilot countries [from now on](#)
- CropWatch customization for required countries
- Upgrading the system to provide high resolution crop monitoring APIs to address the small holder farming systems

Ongoing system customization for pilot countries

- Requirements for function and models: Nigeria, Syria, Mauritius, Algeria, Thailand, Laos
- System interface languages: Thai, Arabic,...
- Continuing participation on country analysis for CropWatch Bulletin: Algeria, Mauritius, Nigeria, Syria, Thailand, **Cameroon, Ghana, Kenya, Lebanon, Malawi, Zambia, Zimbabwe**

Requirement analysis

NASRDA & CROPWATCH PROJECT DIRECTOR
Online Meeting
Tuesday, 25th May 2021

Brief Overview on CropWatch-ICP Project:

Exploiting the potentials of earth observation in crop monitoring trends to promote better decision support system that enhance food security and foster sustainable development. On the other hand, reducing food security requires effective crop monitoring using real time data which facilitates efficient and informed decision. Therefore, space-based data supported with ground truth data create helps to generate up-to-date production statistic that can serves as inputs to achieve sustainable agriculture.

(AIRCAS) in partnership with UNCTAD to bridge the technology gap through the CropWatch-ICP programme.

The capacity building initiative provides technical assistance to developing countries on how to access earth observation data for crop monitoring and early warning system on food security. This project was presented to foster the implementation of sustainable development goals in developing countries, as funded by the Alliance of International Science-Organisation (ANSO).

Nigeria has a lot to benefit from this initiative, thus the proposed meeting was schedule to deliberate on the modalities of customizing CropWatch monitoring platform for Nigeria to boost food security.

Item	Activity	Moderator	Time
1	Welcome address and Introduction	Dr. Adesope	5min
2	Brief overview of NASRDA	Dr. Rabiu	10min

CropWatch for Nana العربية yannn

Local Language

- مؤشر الهطول المطري
- V أعلى قيمة لمؤشر CI
- مؤشر القرينة النباتية
- حالة المحاصيل على أساس شذوذ مؤشر NDVI
- مؤشر درجة الحرارة
- الحد الأدنى لمؤشر صحة الغطاء النباتي
- مؤشر المساحة الورقية
- مؤشر تطوير المحاصيل
- الأشعة النشطة صوتية
- تصنيف الأراضي الصالحة للزراعة المحصولية
- جزء الأشعة النشطة صوتية الممتصة
- مجموعة حالة المحاصيل
- الكثافة الحية المحتملة
- كثافة المحاصيل
- مؤشر القرينة المائية
- تصنيف حالة المحاصيل

العربية العربية yannn

- 中文
- English
- Portuguese
- ภาษาไทย
- ភាសាខ្មែរ
- ភាសាភាសា
- ภาษาไทย
- Tiếng Việt
- العربية

Outline

- **Background**
- **CropWatch-ICP objectives**
- **CropWatch-ICP activities**
- **Outlook**

Steps to implement CropWatch

Support developing countries for implementation of UN SDG 2 zero hunger, to enhance geospatial tools and support for food security

- Requirements analysis, targeting crops, monitoring units
- Formulation of work plans and baseline data preparation
- Trainings both in house and field, at national and subnational levels
- Stakeholder meeting for further requirement analysis
- Joint customization, independent models incorporated
- Analysis, reporting and services independently, technical support remotely
 - guarantee that CropWatch cloud is available, accessible, functionable, flexible
- Promoting ownership and no investment needed for infrastructure

Thank you for your attention!

wubf@aircas.ac.cn

cropwatch@aircas.ac.cn

