REPORT ON STAKEHOLDER ENGAGEMENT WORKSHOP FOR ESWATINI UAV & RS FOR VULNERABILITY ASSESSMENTS

INTRODUCTION

The Kingdom of eSwatini is experiencing an upward trend in mean annual temperature across the different parts of the country, as well as increased drought and flood incidences. Coupled with an increase in pests and diseases and exacerbated by unemployment and increasing food commodity prices, major constraints have been placed on food security. In 2015/16 the country experienced droughts amounting to a loss of approximately 7% of GDP, and about 18% of the government's expenditure. The country's vulnerability assessment information still relies on pre-planting and postharvest assessments, and oftentimes the annual National Agricultural Survey which aims to provide information on cropped area through questionnaires and field surveys is not consistently conducted due to resource and technology constraints. As a result, the country lacks continuous crop growth monitoring and assessment tools and technologies for quick and early detection of undesirable threats and occurrence of risks and hazards to food security. With Unmanned Aerial Vehicles (UAV) technology, it is expected that such assessments can be done with minimal human resources and during any phase of crop growth in order to deliver timely interventions.

OBJECTIVE

Following the award of the Technical Assistance (TA) by the Climate Technology Centre Network (CTCN) through the United Nations Industrial Development Organization (UNIDO), RCMRD held a half-day consultation with key stakeholders in Eswatini on 5th March 2021 to build consensus on planned activities and agree on key crop monitoring indicators to be covered used drones and satellite imagery. Participants were drawn from a range of sectors including agriculture, disaster management, weather services and security and UN agencies. The main agencies that will work closely with the RCMRD team are the National Disaster Management Agency (NDMA) as well as the National Designated Entity of eSwatini. From these consultations, it was apparent that there was need to bring more stakeholders on board for wider consultations and update them on the TA.

The specific objectives discussed were;

1. Introduction to the UAV and Remote Sensing for agricultural monitoring project
2. Discussions about the indicators to be monitored using drones and satellite data to support agricultural vulnerability assessments

3. Discussions on partner roles and responsibilities

NDMA played the critical role of identifying and inviting stakeholders from eSwatini (Annex), while RCMRD led the virtual workshop. A total of forty-three participants (43) from various institutions attended the workshop. The following agencies were represented the in the workshop: The Climate Technology Centre Network (CTCN), Regional Centre for Mapping of Resource for Development (RCMRD), the Kenya Red Cross Society (KRCS), the National Disaster Management Authority (NDMA), Eswatini Water and Agricultural Development Enterprise (ESWADE), University of Eswatini (UNESWA), Eswatini National Trust Commission (ENTC), Eswatini Civil Aviation Authority (ESWACAA), His Majesty's Correctional Services (HMCS), Umbutfo Eswatini Defence Force (UEDF), Ministry of Agriculture (MOA), Deputy Prime Minister's Office (DPMO), Central Statistical Office (CSO), Department of Meteorology and MM Geomatics Surveys. The workshop was officially opened with remarks from Mr. Russel Dlamini, the NDMA Chief Executive Officer. In his remarks, Mr. Dlamini expressed his appreciation that this technical assistance was underway and that the proposed activities will contribute to food security monitoring in the country. He offered his support to ensure that proposed activities are implemented successfully.

OUTCOMES AND DISCUSSIONS

In regards to the first objective, a presentation was made by the project technical lead from RCMRD outlining the technical assistance and the expectations in the development of a case study from a combination of drone and satellite data. This presentation further highlighted the progress made so far which included development of planning and communication documents and a structured stakeholder engagement. Introductions to the technical assistance team from RCMRD, the Kenya Red Cross and key points of contacts from collaborating agencies in eSwatini, and discussions about the key outcomes of the TA were provided. It was explained that the development of the case study in this project, the results thereof and experience shall be used to put together a proposal to solicit funding from the Green Climate Fund (GCF) for scaling up of piloted technologies.

Three presentations were made on the second objective. The first focused on the operations of a drone for image collection. Participants were taken through the process workflow; from flight planning to image analysis. This presentation was made by one of the drone pilots and GIS officer at the Kenya Red Cross Society (KRCS). Some of the considerations that were highlighted in this presentation include the need to acquire the right drone and cameras as these vary by purpose and efficiency. There are two main types of cameras: those that collect true colour images (Red, Green and Blue channels) and those that collect multispectral images (Red, Green, Blue, Near-InfraRed, RedEdge channels). The presentation also highlighted technical preparations that are required before carrying out a drone mission including the development of flight plans/surveys and standard operation procedures. In general, the essential process checks involved in drone mission planning are: equipment and supplies checklist, pre-

site survey, safety, security and emergency plans, weather conditions, crew briefing and in-flight checklist. Lastly, some examples of how the KRCS has used drones in Kenya were showcased.

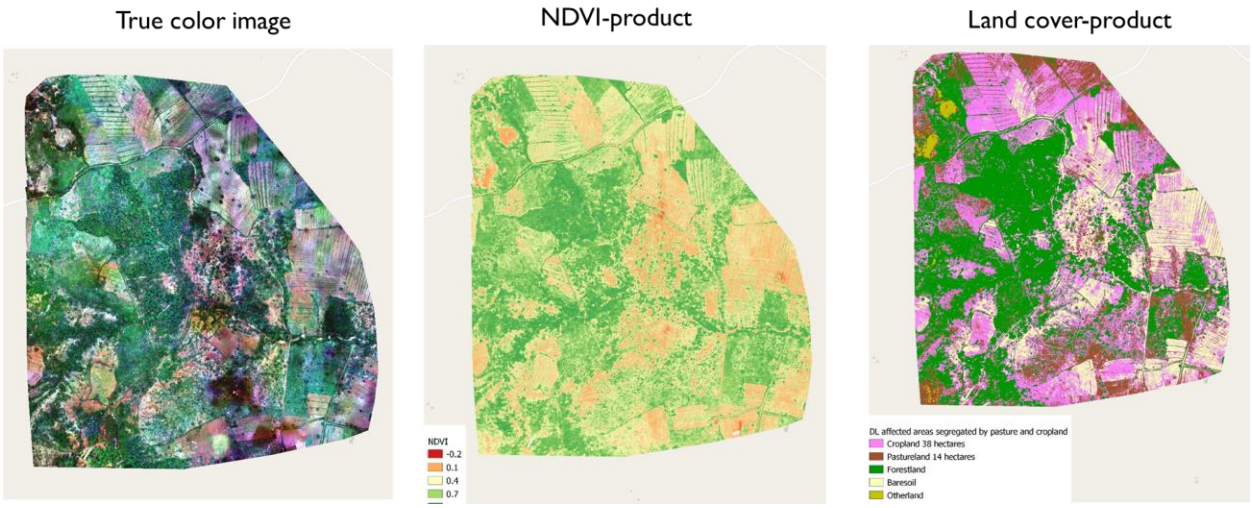

Figure 1: An example of an UAV imagery and derived products

The second presentation covered applications of drones in agriculture. It was noted that this is one of the emerging areas under which drone technology is being used to improve agricultural yields. Drones have been used in almost all phases of crop growth: soil analysis, gap analysis during crop emergence stages, monitoring growth and harvest stages (crop scouting, health, irrigation demand and optimization as well as yield estimations), review of end of season maps and planning for the next season. In this TA, the case study will be developed focusing primarily on monitoring growth and end of season/harvesting stages. The key parameters that will be included will be crop health through the development and tracking of vegetation greenness/biomass, and prediction of end of season yields through the use of UAV and satellite-based indicators. These indicators will include vegetation indices such as the normalized difference vegetation index- NDVI and cropped area, complemented by other biophysical indicators that impact yields especially rainfall, temperature and soil moisture.

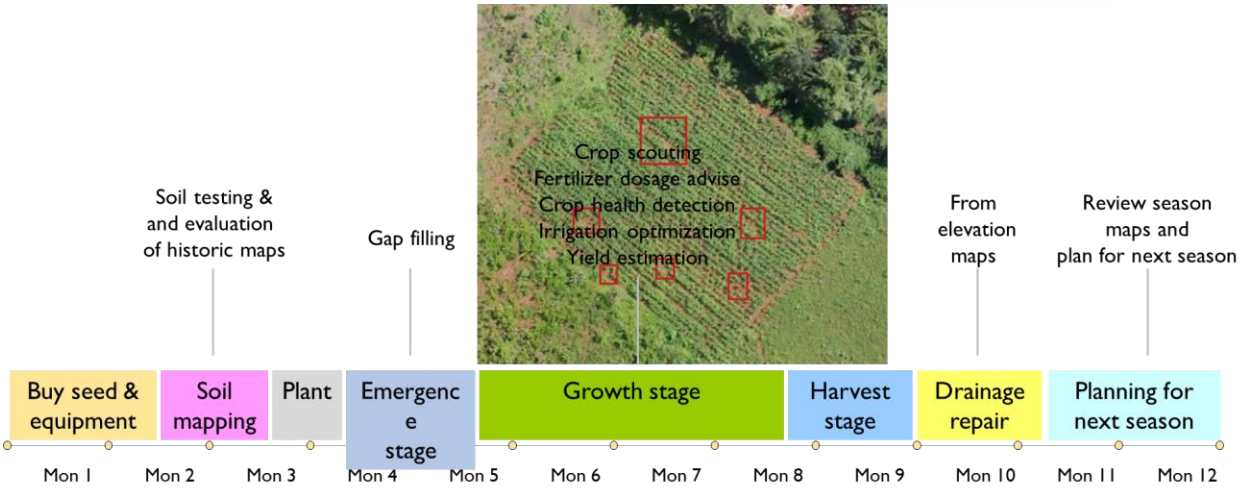

Figure 2: An illustration of UAV use during a cropping season

The third presentation focused on methods for fusing or combining UAV and satellite data. The presenter, Dr. Benson Kenduiywo explained that the objective of this technique is to take advantage of the very high spatial resolution imagery from drones to combine with relatively courser resolution satellite imagery inorder to improve on the quality of the information contained in the output image. Drones can collect data from smaller areas than satellites and that a combination of these two types of images can improve crop monitoring across larger areas that cannot be mapped using drones. It is expected that image fusion will result in: extended range of operation, spatial and temporal coverage, reduced uncertainty and increased reliability, and compact representation of information. Three types of fusion techniques will be explored: pixel-based, feature-based and decision-based fusion. Crop indices that will form a core part of the case study development will benefit from this fusion because while the focus is on a small geographical area, methods developed will be scaled up nationally.

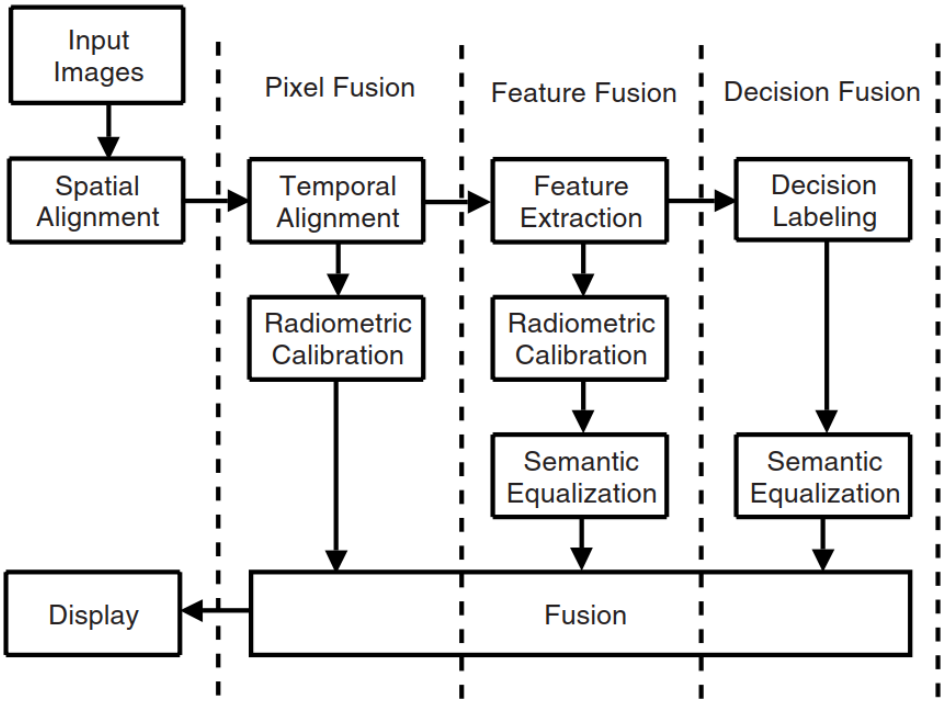

Figure 3: A generic image fusion workflow

Following these presentations, several responses and questions emerged. First, Mr. Dlamini pointed out that the presentations provided an understanding of how NDMA and other national agencies can take advantage of drones and associated analysis to improve early warning systems and decision making in agriculture. Outputs from this technical assistance would be applicable in anticipatory planning processes by NDMA and that the data that will be collected can be fed into the drought monitor. In response to this, it was also noted that a complementary service that the country could explore is the establishment of a national crop monitor.

Participants sought to know whether there exists a sensor to monitor soil, to which participants debated in and it was generally agreed that with the current technology soil properties can be measured indirectly and further scaled up through modelling. Additionally, Mr Rajiv Garg of CTCN elaborated that with the use of high-resolution satellite imagery and Artificial Intelligence (AI), measurement of soil properties was achievable. ICRAF, Kenya has done intensive work on soils and thus more information can be obtained from their website. This TA will not cover this aspect but this will be explored as part of the GCF proposal that will be submitted at the end of the technical assistance.

It was further noted that current regulations and policy need to be streamlined and harmonized in order to promote the use of UAV technologies for humanitarian purposes and other activities that are intended to improve livelihoods such as the proposed technical assistance. It was noted that the current regulations are very restrictive and laborious with approvals

required by a number of agencies. This issue will be addressed in the GCF proposal and a synthesis of the current regulations and possible challenges that are being experienced will be provided.

Lastly, discussions were held on partner roles and responsibilities. It was agreed that the point of contact for the teams will be as follows: RCMRD (Denis Macharia), NDMA (Mr. Eric Seyama and Mr. Sibusiso) and NDE (Mr. Bafana Nicholus Simelane). The NDMA and NDE team will coordinate all in-country activities (field data collection, training) while also giving feedback and providing advice to the RCMRD team on various tasks that may require their input. Specifically, it was agreed that the NDMA and NDE teams will work with their counterparts from the ministry of agriculture to identify sites where drones will collect data for the case study development as well as provide assistance in the approval of drone importation from Kenya.

Participants emphasized on the need to have contingency plans given that the Covid-19 pandemic might disrupt some of the planned activities. It was elaborated that NDMA has a drone pilot licensed by Eswatini and that he could help in data collection. Further, it was agreed that incase of unforeseen circumstances, the scheduled one-on-one training could take place virtually. Further, it was agreed that several sites will be identified for data collection.

RECOMMENDATIONS

The following recommendations were agreed upon;

1. RCMRD would provide required documentation for the approval and authorization by the eSwatini Civil Aviation Authority (ESWACAA) to import a WingtraOne drone from Kenya to eSwatini. In this regard, it was noted that NDMA would coordinate with the authorizing agencies to expedite this process.
2. Mr. Eric Seyama, the point of contact at NDMA would coordinate with the ministry of agriculture to determine suitable sites for drone data collection. It was agreed that these sites would have the spatial variability (production and agro-ecological variability) to provide quality data representative of the production areas across the country.
3. RCMRD would provide a list of data requirements to NDMA for developing the case study. This would include biophysical and socio-economic data required to develop agricultural vulnerability case studies.
4. NDMA will provide their DJI drones for field data collection and accompany RCMRD team during field operations.
5. Field work was tentatively planned between 22nd and 31st March 2021 assuming authorization from ESWACAA would be available by then and international flights to eSwatini available.

Participants

1. Denis Macharia-RCMRD
2. Anastasia Wahome-RCMRD
3. Benson Kenduiywo-JKUAT/RCMRD
4. Bonokwakhe Sukati
5. Celinhlanhla Magagula - ESWADE
6. Daniel Dhladhla - MOA
7. Eric Seyama - NDMA
8. Felix Mamba - UNESWA
9. Gcebile Dlamini - NDMA
10. Fred Onyango - RCMRD
11. Israel Mduduzi Simelane
12. Judith Mugambi-CTCN
13. Ken Kasera - RCMRD
14. Lucky Shongwe
15. Majahonke Mamba - NDMA
16. Martin Murimi - RCMRD
17. Mbonane Nobuhle - NDMA
18. Nosizo Mthupha - DPMO
19. Mdumiseni Wisdom - UNESWA
20. Michael Otieno-KRCS
21. Mkihwa Maseko - HMCS
22. Mbuso Vilakati
23. Nozakhele Dlamini - NDMA
24. Ntabeni Msibi - NDMA
25. Pitsoe Ndlandla - UEDF
26. Precious Ncamsile Mdluli - NDMA
27. Robison Mugo-RCMRD
28. Rusell Dlamini - NDMA CEO
29. Sabelo Simelane CSO
30. Sacolo Sanele - DPMO
31. Samukelisiwe Myeni - DPMO
32. Siboniso Mavuso - NDMA
33. Sibusiso Ginindza - NDMA
34. Sibusiso Mdluli - CSO
35. Sizwe Mabaso - UNESWA
36. Sonia Dupont - ESWACAA
37. Taariq Twaha - KRCS
38. Zakhe Dlamini - ENTC
39. Zandile Mavuso - DPMO
40. Zinhle Motsa - ESWADE
41. Rajiv Garg-CTCN
42. Stephen Sande- RCMRD
43. Manqoba Mabuza – MM Geomatics

Annex

Data requirements

Parameter	Variable	Period	Scale
Weather	Rainfall	1950-2021	Weather station-scale of equivalent
	Temperature	1950-2021	Weather station-scale of equivalent
Hazards	Droughts	1950-2021	District level or smaller
	Floods	1950-2021	District level or smaller
	Pests and diseases	1950-2021	District level or smaller
Production	Yield data for cereals (maize, and other cereals)	1950-2021	District level or smaller
	Area under crops (area cropped for each key cereal)	1950-2021	District level or smaller
Others	Total arable land	1950-2022	District level or smaller
	Population density	1950-2023	District level or smaller
	Total irrigated area	1950-2024	District level or smaller
	Crop diversity	1950-2025	District level or smaller
	Number of farmers	1950-2026	District level or smaller
	Number of farms under 2ha	1950-2027	District level or smaller
	Farmer income/Household income	1950-2028	District level or smaller
	Unemployment rate	1950-2029	District level or smaller
	Amount of fertilizer consumed	1950-2030	District level or smaller