Food and Agriculture Organization of the United Nations

WORKSHOP ON LOCUST DATA COLLECTION, ANALYSIS, FORECAST AND REPORTING IN CAUCASUS AND CENTRAL ASIA (CCA)

16-18 MARCH 2021

ONLINE

REPORT

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List of acronyms and abbreviations

ASDC   Automated System of Data Collection

CCA   Caucasus and Central Asia

CCALM   Caucasus and Central Asia Locust Management System

CIT   *Calliptamus italicus* (Linnaeus 1758), Italian Locust

DLIS   Desert Locust Information Service (FAO)

DMA   *Dociostaurus maroccanus* (Thunberg 1815), Moroccan Locust

ET   Economic Threshold

FAO   Food and Agriculture Organization of the United Nations

GIS   Geographic Information System

GPS   Global Positioning System

ha   Hectare

ISTT   Institute of Space Technique and Technologies (Almaty, Kazakhstan)

JICA   Japan International Cooperation Agency

LMI   *Locusta migratoria migratoria* (Linnaeus 1758), Asian Migratory Locust

NSP   Plant Production and Protection Division (FAO)

NSPMD   "Locusts and Transboundary Plant Pests and Diseases" Team (FAO)

NDSI   Normalized Difference Snow Index

NDVI   Normalized Difference Vegetation Index

NDWI   Normalized Difference Water Index

RAMSES   Reconnaissance And Management System of the Environment of Schistocerca (Desert Locust national GIS)

TCP   Technical Cooperation Programme (FAO)

TCPf   Technical Cooperation Programme Facility (FAO)

ToT   Training-of-Trainers

SWARMS   Schistocerca WARning Management System (global Desert Locust GIS)

USAID   United States Agency for International Development

OPENING

Introduction, round of presentation and adoption of the Agenda (Items 1 and 2)

1. The Workshop on locust data collection, analysis, forecast and reporting in Caucasus and Central Asia (CCA) took place online on 16-18 March 2021. It was organized by the Food and Agriculture Organization of the United Nations (FAO) in the framework of the interregional and multi-funded "Programme to improve national and regional locust management in Caucasus and Central Asia (CCA)".

2. The following nine countries participated in this Geographical Information System (GIS) Workshop: Afghanistan, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Turkmenistan and Uzbekistan (all but Tajikistan), together with Representatives from FAO-Headquarters and decentralized offices. The list of participants is provided in Annex 1.

3. The Workshop was opened by Mr Alexandre Latchininsky, Agricultural Officer/Locust Management, Locusts and Transboundary Plant Pests and Diseases Team (NSPMD), who welcomed all participants. He said that this was second specialized GIS workshop organized; the first one had taken place in November 2019 in Uzbekistan and the plan is to hold it annually in the next few years. He indicated that this workshop is held thanks to support from the Japanese International Cooperation Agency - JICA (GCP/INT/384/JCA) and the FAO Regular Programme (see USAID). Its objectives is to discuss the practical use and management of the Automated System for Data Collection (ASDC) and of the "Caucasus and Central Asia Locust Management System" (CCALM), with a view to improve data collection, validation, analysis, forecast and reporting for early warning and timely locust control. Such Workshop also aims at allowing to improve jointly the GIS in addition of promoting experience exchange, problem solving and network creation between designated Information Officers from CCA countries. The Workshop indeed targets specifically the staff responsible for the use and management of ASDC and CCALM at the national level, in the ten CCA countries covered by the FAO Programme.

4. A round of presentation allowed the Delegates from the nine participated countries to introduce themselves and afterwards the provisional agenda was presented and endorsed, as provided in Annex 2. The history of ASDC and CCALM creation was also briefly provided (given in Annex 3).

Insights on global Desert Locust forecasting and relevance to CCA (Item 3)

5. Mr Keith Cressman, Senior Locust Forecasting Officer, NSPMD, presented the topic and explained the flow of data from field collection to the final product such as monthly bulletin, situation update or alert. He made a comparison of data collection devices – smartphones and tablets – and demonstrated that smartphones have several advantages over tablets. Besides the information from the field, Desert Locust forecasting includes inputs from Earth observation and meteorological satellites as well as locust trajectory and dispersal models. All these inputs are processed through the national (Reconnaissance And Management System of the Environment of Schistocerca - RAMSES) and global (Schistocerca WARning Management System - SWARMS) locust GIS. Emphasis was made on the visualization of the final products and their publication on FAO portals such as Locust Hub and Locust Dashboard. Finally, the pros and cons of introducing the innovative technology of unmanned aircraft were discussed.

SESSION 1: LOCUST DATA COLLECTION

Use of the Automated System for Data Collection (ASDC) during the 2019 and 2020 locust campaigns: challenges, solutions, etc. (Item 4)

6. Countries were invited to present ASDC use and related questions during the 2019 and 2020 locust campaigns, including: availability of tablets/smartphones for ASDC use; training sessions; extent of use (number of records) during locust surveys and control operations; problems/difficulties met by staff; lessons learned and recommendations to improve ASDC functionalities.

7. The Delegate of Afghanistan reminded that ASDC started to be used in 2018 in his country. So far, 75 locust experts have been trained on its use thanks to regional and subsequent national sessions; there is also a GIS specialist as permanent staff. The following number of records were made: 249 in 2019, including 160 during survey and 89 during control operations; and 241 in 2020, including 123 during survey and 118 during control - in Baghlan, Balkh, Kapisa, Nimruz, Paktia, Samangan and Takhar provinces. The Delegate also informed that the insecurity situation and difficulties met with Internet access did not allow using tablets/smartphones in the field and this is why locust experts continue to use FAO Paper forms in the field and CCALM Web-interface in the office.

8. The Delegate of Azerbaijan noted that ASDC was used at large scale, for the first time, in 2020. He shared the country's experience in delivering training to local staff. National sessions were organized before the start of the locust campaign; ASDC use was monitored and some errors were corrected during the campaign. He recommended to organize discussions between the CCA specialists who are responsible for ASDC and CCALM on national level on a monthly basis.

9. The Delegate of Georgia thanked FAO and underlined that such meeting should be organized more often. He noted that in 2020, the Italian Locust (CIT) was the most widely distributed locust and that the country faced a difficult situation, with an outbreak on 84 500 hectares (ha). Locust experts made a total of 154 records in 2019, including 82 during survey and 72 during control, and of 167 record in 2020, including 162 during survey and 5 during control. Regarding the small number of filled Spray Monitoring Forms in 2020, he noted that some of the operators did not enter information as they had no information on treatment efficiency, due to lack of time because of locust complex situation in Georgia.

10. The Delegate of Kazakhstan informed that ASDC was not used so far, including because the 20 envisaged tablets are not transferred yet.

11. The Delegate of Kyrgyzstan stressed the difficult locust situation in 2020, including because of Covid19. A total of 120 records were made during survey over 93 800 ha, out of which including 70 670 ha were found infested (no records were made during control operations). He noted that the locust experts had been busy and could not enter this information through CCALM Web-interface in until the end of 2020 and he asked about possibility to make this in 2021.

12. The Delegate of the Russian Federation explained that Russian Agricultural Center, Rosselhozcenter, is presently developing its own digital phytosanitary monitoring system, which is connected with CCALM as far as locusts are concerned. He indicated that 125 tablets had been purchased in 2020 to

that end. A total of 552 reports were made in 2019 and of 265 reports in 2020, during locust surveys. Overall, he noted that ASDC was convenient for collecting data and easy to use. Some difficulties included: (1) photo are not of good quality in bright sun; (2) the coordinates are not determined at the survey site; (3) there is no dropdown list in the field «Country»; and (4) exported excel file in text format are not suitable for calculation, for example, the sum of surveyed areas.

13. The Delegate of Turkmenistan remarked that the country was at an early stage with respect to ASDC, as only five locust experts had been trained so far. During the training, some difficulties were met in getting coordinates.

14. The Delegate of Uzbekistan mentioned the training of 12 locust experts held in 2019 in Yusufkhona and regretted that no training could be held in 2020 due to Covid-19 situation. He noted that the ASDC was convenient and that specialists had quickly mastered it. ASDC use and other issues will also be discussed in next training planned in 2021.

15. Ms Nadiya Muratova, FAO International Consultant, GIS Expert, provided an overview on ASDC use in CCA. She indicated that as of 30 September 2020, a total of 4 285 reports had been made by 100 users from eight CCA countries (against a total of 1 368 records from 89 users from seven countries in 2019). The GIS Expert also compared, for some countries, the area covered by ASDC against the total surveyed/treated area, the situation being as followed: Afghanistan: 5,4% of surveyed areas and 4,7% of treated areas; Azerbaijan: 67,4% and 88,4%; Georgia: 18,4% and 0,2%; Tajikistan: 5,0% and 7,8%; and Uzbekistan: - 0,3% and 6,4% (as above-mentioned, Kyrgyzstan used only paper forms in 2020 while Armenia, Kazakhstan and Turkmenistan did not used the system). The GIS Expert expressed the hope that the trainings delivered/to be delivered in late 2020 and early 2021, to most CCA countries will facilitate progress and that ASDC will be used as widely as possible during locust surveys and control operations in 2021.

16. In response to questions raised, the GIS Expert confirmed to Kyrgyzstan that locust survey data for 2020 can still be entered in 2021 through CCALM Web-interface. She also indicated the following: (1) if the coordinates are not determined by locust experts in the field, it is necessary to turn on the Global Positioning System (GPS) on tablets and then to wait for a few minutes before requesting coordinates; (2) if there is no dropdown list in the field «Country», it is necessary to use the button «synchronization» in the "settings" menu; (3) in order to be abler to make further calculation, it is necessary to convert some fields of exported excel file from text into digital format. This procedure will be described in ASDC manual.

Locust monitoring: how many and which annual surveys are needed? Which is real economic threshold: how do you decide to treat or not to treat? (Item 5)

17. The Agricultural Officer/Locust Management, NSPMD, led a roundtable discussion regarding the locust monitoring structure in CCA countries. Most countries conduct four annual surveys (adult survey of egg-laying, autumn egg-pod survey, spring egg-pod partial survey and hopper survey). Objectives of each survey were discussed in detail. It was demonstrated that out of the four, the adult survey of egg-laying, conducted after fledging, is the most informative one providing a solid basis for the next year forecast of locust infestations. Egg-pod surveys are very time- and resource-consuming,

and their results are often not conclusive, as it is very difficult to find all egg-beds. Therefore, during locust recessions, such surveys are not conducted at all in certain countries.

18. When locust infestations are found during surveys, the next step is to make a decision if it is necessary or not to treat them. Such decisions should be made by assessing if the locust density exceeds the Economic Threshold (ET). ET varies with locust species, developmental stage, crop type, vegetation stand and many other parameters. However, in most cases in CCA, the ET is set at a density of five locusts per square meter. It was explained when such ET could be increased (for example, in dense vegetation or for non-swarming grasshoppers) or decreased (in cases of severe drought and in a close proximity to high-value crops). For example, to minimize potential crop damages from locusts, some CCA countries propose to use three individuals per square meter as an ET for locusts.

Introduction of ASDC beta version (Item 6)

19. The GIS Expert reminded that ASDC, which was created to facilitate collection and sharing of standardized geographical locust data, includes the geographical coordinates of the sites where locust survey are carried out. To do so, it is sufficient to turn on geolocation mode in the tablet before ASDC starts. However it was not possible to determinate some parameters, such as calculating the survey/infested areas or finding the sites surveyed during the previous seasons; locust experts had to use positioning devices.

20. In 2020, ASDC was thus improved to introduce such functionality for survey operations. In the resulting newly-issued beta-version, a new module now allows displaying cartographic information with the current location of the locust expert in the field as well as the perimeter of the observed area. Based on six coordinates (ASDC can register six or less coordinates), this module allows to calculate the surveyed area. It was also indicated that the automatic selection of country and oblast will be made available when filling ASDC Locust Survey/Spray Monitoring Forms, based on GPS coordinates and pre-loaded borders of countries and oblasts

21. The GIS Expert underlined that the beta-version must be tested to determine the usability of the new functionality during locust survey as well as to estimate the volumes of connecting traffic to Google cartographic/satellite sources for visualization of observer's location. For this, it was suggested to select two or three Master-Trainers who will test ASDC beta version during 2021 locust campaign and later discuss the results of the test during the next GIS Workshop. Two countries, Georgia and the Russian Federation, volunteered to test ASDC beta-version. The Delegate of the Russian Federation requested to send a letter to the Director of Rosselhozcenter to that end.

SESSION 2: LOCUST DATA ANALYSIS

Use of the Caucasus and Central Asia Management System (CCALM) to analyze locust data (Item 7)

22. The FAO International Consultant, GIS Expert, reminded that CCALM was developed to the benefit of the ten CCA countries to improve data analysis as well as forecast and reporting at the national and regional levels. The main source of data comes from ASDC. In addition, every year, the following data is entered into CCALM: areas infested by locusts; areas infested by locusts exceeding the ET; and the treated area for first/second administrative levels (oblast/province/rayons) in CCA countries. Some satellite products, such as soil temperature, NDVI and NDWI fields, are also exported into CCALM to strengthen the analysis of ecological situation. CCALM basic functions (data import, query, display, output) and advanced ones (summary, analysis and forecast algorithms) were developed by the Institute of Space Technique and Technologies (ISTT), Almaty, Kazakhstan, in line with FAO technical

standards. CCALM is fully available since March 2017 in two languages, English and Russian, at ccalm.org. A progress made in 2020 is that CCALM is now also available in Dari, Azeri, Georgian, Kyrgyz and Uzbek.

23. With respect to the system use, the GIS Expert pointed out that every CCA specialist can utilizes CCALM, by registering her/himself in the system. However, only the so-called Privileged and Authorized operators have access to the database (for the national level) and can enter data from paper forms and make some changes in case of errors in ASDC data. She noted the good progresses made in 2020, with an increase number of total reports, especially in Azerbaijan.

24. Progress was made also regarding the linkage between CCALM and existing national databases in the Russian Federation and Kazakhstan, which have been developing their own electronic systems in plant protection services, including locust survey data, over the past few years. During 2020, a module linking CCALM and the Russian national database was thus developed allowing automatic transfer of data. In that way, a total of 5 869 records were imported from the Russian system into CCALM, including 447 records for 2019 and 5 422 for 2020 (see also below Item 8). Concerning Kazakhstan, this was not possible because the data shared by the State Institution «Republican Methodological Center for Phytosanitary Diagnostics and Forecasts» contained different files with various data including other pests and diseases of cereals in excel format. Thus, it was impossible to create module for downloading (or receiving and inputing) excel file with locust data established sample. Nevertheless, a lot of work was done manually to prepare such file and a file with 1 907 records of 2019 locust surveys was prepared and imported into CCALM.

25. To support ASDC and CCALM use, FAO had organized a number of training during the past years, such as Training-of-Trainers on locust monitoring and information management, including ASDC and CCALM as well as in-depth trainings on CCALM management and QGIS use for Master-Trainers and specialists designated as responsible for CCALM management at the national level. This process is in progress despite Covid-19, with remote training organized to the benefit of all CCA countries in late 2020 and early 2021. This already gives results: starting from 1 October 2020 until 12 March 2021, 181 records have been entered from Azerbaijan, 58 from Tajikistan and 230 from Uzbekistan during autumn and early spring locust eggs surveys. The GIS Expert showed how such data allowed issuing maps of locust eggs density for these countries.

26. At last, the GIS expert brought attention on historical data of locust-infested areas exceeding the ET, which allow identifying trends and changes at first/second administrative levels during past decade. She showed examples, i.e. maps allowing to observe an increase of infested areas in Georgia, Kyrgyzstan and Uzbekistan in 2020.

Examples of different locust GIS (Item 8)

27. Mr Andrey Pashonin, Programmer from the Russian Federation, presented the digital phytosanitary monitoring system which has been developed to cover more than 3 000 harmful organisms, including plant pests and diseases, weeds etc. Information is collected using smartphones and transferred to the central server in Rosselhozcenter. The system is being implemented thanks to theoretical and practical training delivered to staff. Subsequent quality control of the incoming information is also ensured. Following the creation of a module connecting the Russian system and CCALM in 2020, the Russian Representative proposed to further expand the list of collected information in the national system, in accordance with the FAO Locust Survey Form. In addition, he requested that the information collected with ASDC in countries neighboring to Russia be imported into the national system. The GIS Expert replied positively, highlighted that ASDC data are open and accessible to all countries and it was agreed to discuss further the implementation modalities.

28. After having informed that the development of the Kazakh electronic system had been temporarily suspended due to the lack of funds in 2020, the Delegate of Kazakhstan asked about the possibility to access the Russian data, concerning the bordering oblasts. The Russian Representative clarified that data is for internal official use only; if a representative of the plant protection service of Kazakhstan wants to get acquainted, then it would be necessary to send an official letter to the management of Rosselhozcenter.

29. The Agricultural Officer/Locust Management indicated that if the Russian system was created to include a large number of pests and diseases, for internal use only, the goal of ASDC was different. Indeed, ASDC concerns transboundary plant pests and several countries: in addition to facilitate data collection and analysis at the national level, it also aims at facilitating exchange of standardizing data between countries, especially regarding common border areas. In this regard, the Russian Representative reiterated interest in continuing cooperation and stressed that for his country, the scope was not only to receive but also to share data. The Agricultural Officer/Locust Management added that if ASDC and CCALM management is supported by different projects at present time, a permanent body for locust management in CCA, such a FAO Locust Commission, is extremely needed in the future.

Use of QGIS as additional instrument for analysis of data from different sources (Item 9)

30. The FAO International Consultant, GIS Expert, reminded that all CCALM products, which are based on ASDC and historical locust statistical data as well as on satellite products (soil temperature, vegetation and water indexes), can be exported into QGIS project. The software Quantum GIS (QGIS) allows to combine data from different projects in order to analyze the geospatial information and create different cartographic materials. This free software can be found at http://docs.qgis.org.

31. The GIS Expert recommended to use version 3.6.0 or higher of QGIS for CCALM data's analysis and to download every year at the end of locust season ASDC data for the country level. All necessary instructions are provided in CCALM manual (in Russian and English), titled as QGIS guide, including: (1) how to analyze locust survey multiyear data; (2) how to plan for future treatment based on survey data; (3) how to use satellite products and analyze them for separate sites; (4) how to build a map; etc. Previous trainings showed that basic knowledge of geoinformation systems and cartography is required to master QGIS use.

SESSION 3: LOCUST FORECAST

How to improve locust forecast using CCALM? (Item 10)

32. The FAO International Consultant, GIS Expert, reminded that one of the goals of CCALM development is to improve forecasting of locust situation at the national and regional levels. For this, some of the parameters are already in the database while others should be added in 2021. The list of currently available parameters are as follows:

- During summer locust surveys, collected data in CCALM allow to make forecast for the next season, including: (1) average density of imago per square meter; (2) geographic coordinates of egg laying sites; (3) ascertaining the transitional phase from solitary to gregarious development of locusts; (4) total area with a density of adults above 5 individuals per m² at the level of an administrative territorial unit and determining its increase/decrease in comparison with the previous year.

- During autumn locust surveys, collected data in CCALM allows defining: (1) average density of egg-pods per square meter; (2) average number of eggs in egg-pods.

- At the end of locust season, the locust expert can check the trends, i.e. increase or decrease, of the total infested/treated areas or their ratios.

31. It is envisaged to increase CCALM functionalities. In particular, users will be able to analyze daily average air temperature and total precipitation from February to September for all CCA countries (information from open sources of the World Meteorological Organization). This will allow identifying hot and dry weather conditions favorable for the increase in the number of locusts.

32. Currently, the following satellite products are imported into in CCALM:

- Soil temperature data for current day and two days ahead. Temperature is presented as an average value for soil depths from 0 to 10 cm; this is combined data from satellite, international weather stations and aerostat observations. This data can be used to forecast locust hatching.

- NDVI received from MODIS satellite and posted every 16 days in GeoTIFF format on ladsweb.modaps.eosdis.nasa.gov. This data allows to calculate the vegetation conditions index on the basis of long-term NDVI data and gives the possibility to identify areas with relatively sparse vegetation cover and hot and dry weather conditions, which leads to an increase in the number of locusts.

- NDWI received from MODIS satellite and posted every 16 days in GeoTIFF format on ladsweb.modaps.eosdis.nasa.gov. This data allows to analyze water spills in the current and last years in the territories of Uzbekistan, Kazakhstan and the south of the Russian Federation, from April to September, and to identify the territories under water in areas of intensive egg-laying of the Asian Migratory Locust (LMI).

33. It is envisaged to add the Normalized Difference Snow Index (NDSI) from MODIS satellite. This will allow users to analyze the snow masks over the past 12 months.

34. During the discussion, the Delegate of Georgia underlined the usefulness of daily average air temperature and total precipitation data and suggested to extend the period of data storage to two years considering the importance of accessing data from the previous year. The Delegate of Kazakhstan asked about the possibility to calculate accumulated sums of effective temperatures above 10C (or degree-days) during spring period to predict timing of locust hatching. The Delegate of Kyrgyzstan thanked for adding the possibility to enter data on snow cover and emphasized the importance of this parameter for the region. The Delegate of Turkmenistan noted the importance of NDVI data for arid areas, not only for hatching period, but also for the pathways of locust movement. She also requested to extend to two-three years the period of data storage. The Delegate of Azerbaijan confirmed the usefulness of meteorological data and satellite products. The Delegate of Uzbekistan noted that satellite water index is important for flood monitoring during spring and autumn seasons of previous years. The Delegate of Russian Federation noted the importance of such work indicating however that the interpretation of satellite products is not simple; he said that it is necessary to develop methods as there are few of them and he proposed to create a working group.

35. The Agricultural Officer/Locust Management agreed that the interpretation of satellite products is important, noting that there are no ready-made recipes. Forecasting is a combination of science plus

art, relying also on experience. He recalled that applied scientific research for CCA countries had been introduced in the Roadmap of the Locust Programme in CCA at its launch. However, so far, it has not been possible to identify funding and develop any project with resource partners' support for such activity.

SESSION 4: LOCUST REPORTING

How to improve national bulletins, including with CCALM products? (Item 11)

36. The International Consultant, GIS Expert, proposed to develop in CCALM a webpage presenting up-to-date ASDC and CCALM outputs. This webpage would allow access to cartographic and other materials useful to improve the CCA regional monthly bulletins. It would also be accessible to any visitor, in Russian and English. As an example, she presented the ARCGIS page of the Desert Locust Information Service (DLIS) of FAO, which allows to visualize locust survey and other data in real-time. More specifically, the CCALM webpage would contain elements such as: (1) presentation of the FAO Locust Programme and locust GIS in CCA; (2) a map of CCA countries showing locust survey marks for the previous months, with a date selection menu; (3) description and demonstration of the products (including satellite ones) used in the system; (4) description/classification of the risk level related to locust infestations; (5) Link with preview to monthly bulletins on locusts in CCA http://www.fao.org/locusts-cca/bulletins/en/.

CLOSING

Recommendations for ASDC and CCALM improvement and use in 2021 (Item 12)

37. The FAO International Consultant, GIS Expert, presented the status of implementation of the 21 recommendations formulated by CCA countries at the first GIS Workshop held in November 2019. Fifteen were implemented (including one partially) and other six were not; detailed information is available in Annex 4. The recommendations which were not implemented (or partially) in 2020 were reconfirmed by CCA countries for 2021 and new ones were formulated, as indicated below.

- **ASDC/CCALM use and management – to FAO and countries:**

1) Advocate for introduction and wide use of ASDC and CCALM at the national levels (action: countries and FAO).

2) Designate/confirm at least two information officers with appropriate education and skills who will be responsible for managing CCALM at the national level (action: FAO)

3) Provide remote support for ASDC and CCALM maintenance and use, including QGIS, and deliver related refresher courses/training (action: FAO);

- **Manuals and guidelines – to FAO and countries:**

4) Review, update and finalize English and Russian versions of ASDC and CCALM manuals (action: FAO) and translate them into national languages (action: countries).

5) Ensure the release of video manuals on the use of ASDC, CCALM and QGIS in Russian and English (action: FAO), subsequently with subtitles in national languages (action: FAO and countries).

6) Identify funding for publishing the monograph on the Italian Locust (action: FAO)

- **ASDC functionalities – to countries and FAO**

7) Test ASDC beta version during the 2021 locust campaign (action: pilot countries, Georgia and the Russian Federation).

- **CCALM incrementing and functionalities – to countries and FAO:**

8) In order to expand the possibility of creating CCALM products, prepare and enter into CCALM database relevant historical data, starting from 2000 (if available), on: areas infested by locusts; areas infested by locusts exceeding the economic threshold (ET); and treated area; - including for the second administrative level (district):

    - Historical data - they were inserted into CCALM for most countries but the following data are still missing: Afghanistan for 2020; Armenia for 2017 and 2018; Azerbaijan for 2020; Turkmenistan for 2018 to 2020 (action: Afghanistan, Armenia, Azerbaijan and Turkmenistan).

    - Data at the second administrative level (district): they were entered into CCALM for Kyrgyzstan and Tajikistan (up to 2020) as well as for the Russian Federation (2000-2019); The Russian Federation is invited to complete the data for 2020 and all other countries to share them to fill the database (action: all countries).

9) Translate CCALM interface into national languages → this was implemented in Dari, Azeri, Georgian, Kyrgyz and Uzbek in 2020; translation into Armenian, Kazakh, Tajik and Turkmen still to be prepared (action: countries and FAO).

10) Ensure testing of CCALM in national languages (action: users and FAO).

11) Improve CCALM functionalities (action: FAO), in particular:

    - Develop a module for storing historical data in CCALM for weather forecast of soil temperature, NDVI and NDWI over the past 12 months; Also add importing of NDSI snow masks over the past 12 months;

    - Develop modules for importing average daily air temperature and average daily precipitation over the past 24 months;

    - Develop a webpage in CCALM presenting updated ASDC and CCALM outputs.

12) Pursue cooperation on importing/exporting data from the Russian Federation system into CCALM; Further explore possibilities to ensure automated import data from Kazakhstan into CCALM

- **Development prospects– to countries and FAO:**

13) Create an e-Committee of representatives from interested CCA countries and FAO experts (Information Officers) to jointly discuss CCALM GIS products (including interpretation of satellite ones) and expand them; monthly meetings could be considered (action: FAO and countries).

14) Generally, link the management and use of ASDC/CCALM systems to the discussion on long-term regional cooperation (action: countries and FAO).

38. During the discussions, it was stressed that it is important to cover as much survey and control operations as possible using ASDC in order to fill CCALM and have meaningful products. Exchanges also took place whether the Locust Survey and Spray Monitoring Forms used in ASDC should be simplified. While this could be further discussed by the E-Committee, several delegates expressed the opinion that they should not be simplified, especially now that more and more staff had been trained and got acquainted in filling them.

Ending remarks (Item 13)

39. The Agricultural Officer/Locust Management, in his concluding remarks, noted that the work was moving in the right direction, with very good progress made since the first GIS Workshop in late 2019. The Desert Locust system provides a good example of what can be achieved and how useful can be such system; as such, it is very inspiring. The main point now, in CCA, is to increase ASDC cover at the national level. This will in turn allow feeding CCALM and issuing products helping to analyze data and make forecast, thus contributing to early warning and reduction of risks related to locusts.

ANNEXES

Annex 1. List of participants

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Food and Agriculture Organization of the United Nations

WORKSHOP ON LOCUST DATA COLLECTION, ANALYSIS, FORECAST AND REPORTING IN CAUCASUS AND CENTRAL ASIA (CCA)

16-18 March 2021 (8 am – 12.30 am Rome time - UTC +1)

AGENDA

ITEMS	DOCUMENTS	PRESENTERS	TIMING
Opening			
1. **Introduction & Round of presentation**	-	Alexandre Latchininsky, Agricultural Officer (Locust Management), Locusts and Transboundary Plant Pests and Diseases (NSPMD) & Workshop Moderator	**Tuesday 16 March**
2. **Adoption of the Agenda**	Provisional agenda & timetable	Alexandre Latchininsky, Agricultural Officer (Locust Management)	
3. **Insights on global Desert Locust forecasting and relevance to CCA**	-	Keith Cressman, Senior Agricultural Officer (Forecast), NSPMD	
Session 1: Locust data collection			
4. **Use of the Automated System for Data Collection (ASDC) during the 2019 and 2020 locust campaigns: challenges, solutions, etc.**	Working Paper - WP (template)	Countries' presentations	**Tuesday 16 March**
5. **Locust monitoring: how many and which annual surveys are needed? Which is real economic threshold: how do you decide to treat or not to treat?**	WP (template)	Round Table/Open discussion	
6. **Introduction of ASDC beta version**	WP	Nadiya Muratova, International Consultant, Geographical Information System (GIS) Expert, NSPMD	

Session 2: Locust data analysis			
7. **Use of the Caucasus and Central Asia Management System (CCALM) to analyze locust data**	-	Nadiya Muratova, GIS Expert, and presentation by one show case country, Azerbaijan	**Wednesday** **17 March**
8. **Examples of different locust GIS**	WP (template)	Presentations by Kazakhstan and Russian Federation	
9. **Use of QGIS as additional instrument for analysis of data from different sources**	WP	Nadiya Muratova, GIS Expert	
Session 3: Locust forecast			
10. **How to improve locust forecast using CCALM?**	-	Alexandre Latchininsky, Agricultural Officer (Locust Management), and Nadiya Muratova, GIS Expert & Round-table discussions	**Wednesday** **17 March**
Session 4: Locust reporting			
11. **How to improve national bulletins, including with CCALM products?**	-	Alexandre Latchininsky, Agricultural Officer (Locust Management), and Nadiya Muratova, GIS Expert	**Thursday** **18 March**
Closing			
12. **Recommendations for ASDC and CCALM improvement and use in 2021**	WP	Alexandre Latchininsky, Agricultural Officer (Locust Management), and Nadiya Muratova, GIS Expert	**Thursday** **18 March**
13. **Ending remarks**	-	Alexandre Latchininsky, Agricultural Officer (Locust Management)	

Annex 3. Background: overview on the development, introduction and use of the locust GIS in CCA (2013-2020)

The Geographic Information System (GIS) on locusts in Caucasus and Central Asia (CCA) was developed to the benefit of the ten countries participating in the FAO "Programme to improve national and regional locust management in CCA", under Result 3 of its Roadmap "Locust issues and disasters better anticipated and mitigated" and Activity 3.3 "Develop monitoring and analyzing systems", for use both at the national and regional levels. This was possible thanks to several funding sources over the past years, including projects chronologically funded by USAID, the FAO-Turkey Partnership Programme (FTPP), JICA as well as the FAO Regular Programme.

- **Automated System of Data Collection (ASDC)**

The Automated System of Data Collection (ASDC) was created in 2013 with the objective to facilitate collection and sharing of standardized locust data by Plant Protection/Locust Experts during survey and control operations, using tablets, smartphones and computers. It simulates the FAO standard "Locust Survey Form" and "Spray Monitoring Form" for CCA and serves as a basic data for the locust GIS in CCA, entitled Caucasus and Central Asia Locust Management System (CCALM). After ASDC first testing by Georgia, Uzbekistan and the Russian Federation in 2014-2015, the system was endorsed by CCA countries in October 2015, finalized and made available in eleven languages (Armenian, Azeri, Dari, English, Georgian, Kazakh, Kyrgyz, Russian, Tajik, Turkmen and Uzbek) in 2016/2017.

To support the widespread use of ASDC, FAO delivered or supported the organization of training sessions on ASDC use for a total of 693 experts from the ten countries (to various extents) from 2017 to 2020[1]. During the trainings, recommendations were formulated to improve the functionalities of the system as well as translations into the national languages of individual ASDC fields. FAO also delivered, from 2014 to 2020, 191 tablets to CCA countries including: 43 tablets to Afghanistan, seven to Armenia, 31 to Azerbaijan, 18 to Georgia, 20 to Kazakhstan (still located in the FAO office), 27 to Kyrgyzstan, one to Russian Federation, 45 to Tajikistan, five to Turkmenistan, and 14 to Uzbekistan. Additional training sessions and tablets are being delivered in early 2021 to further support ASDC use.

As a result, a gradual increased use of the system in the crop protection services of CCA countries was observed overall. The number of ASDC standardized locust survey and spray monitoring forms increased from 165 records (from 18 users) from five countries in 2016 to 904 records (from 58 users) from seven countries in 2017, 911 records (from 68 ASDC users) from seven CCA countries in 2018, 1,481 records (from 89 users) from seven CCA countries in 2019 and 4 285 reports (from 100 users) from eight countries in 2020 (as of 30 September).

During the first Workshop on Locust Data Analysis, Forecast and Reporting in CCA and the annual Technical Workshop (TW) on Locusts in CCA, held in November 2019 in Tashkent, Uzbekistan, as well as the TW held in November 2020 online, most delegates reiterated their interest as well as the need for

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[1] This includes: 148 experts from eight countries (Afghanistan, Azerbaijan, Armenia, Georgia, Kyrgyzstan, Russian Federation, Tajikistan and Uzbekistan) in 2017; 225 experts from four countries (Afghanistan, Azerbaijan, Kyrgyzstan and Tajikistan) in 2018; 225 experts from nine countries (Afghanistan, Armenia, Azerbaijan, Georgia, Kazakhstan, Russian Federation, Tajikistan, Turkmenistan and Uzbekistan) in 2019; and 95 experts from three countries (Azerbaijan, Kazakhstan and Kyrgyzstan) in 2020.

continued technical and/or operational support (training sessions) for full covering of the national territory with ASDC.

- **Caucasus and Central Asia Locust Management system" (CCALM)**

The "Caucasus and Central Asia Locust Management system" (CCALM) was created in 2016/2017 with the objective to improve data analysis as well as forecasting and reporting at the national and regional levels. It is filled using ASDC as well as other sources of satellite products.

More specifically, CCALM basic functions (data import, query, display, output), i.e. the database and its management system, was developed by the Institute of Space Technique and Technologies (ISTT), Almaty, Kazakhstan, and launched in early 2016. Based on the technical specifications worked out and agreed upon by CCA Forecasting and FAO Experts, the advanced functions (summary, analysis and forecast algorithms) were developed by ISTT in line with the technical standards of FAO. They include a set of output products for analyzing Italian (CIT), Moroccan (DMA) and Asian Migratory (LMI) locusts data and elaborating forecasts. Among them, there are maps of: (a) locust densities, (b) treated areas, (c) areas infested (or treated) with densities above the Economic Threshold (ET). CCALM is fully available since March 2017 in two languages, English and Russian, at ccalm.org.

During the 2017-2019 locust campaign, CCALM (basic and advanced functions) was gradually introduced to several CCA countries. In-depth training were delivered to staff from Afghanistan, Armenia, Azerbaijan, Georgia, Kyrgyzstan, Russia and Tajikistan. Two/three experts per country were designated to be responsible for CCALM management and use at the national level. During this testing phase, they made a number of recommendations for improving the system, which were discussed and endorsed by CCA Delegates during the annual Technical Workshop on Locusts in CCA. As already mentioned, a specific Workshop on Locust Data Analysis, Forecast and Reporting in CCA was also held in November 2019 (Tashkent, Uzbekistan); a number of recommendations were formulated at this occasion.

Annex 4. Implementation status of recommendations formulated at the first GIS Workshop (Nov. 2019)

The recommendations formulated by CCA countries and FAO during the first GIS Workshop held in November 2019, on CCALM (basic and advanced functions) use and management, are inserted in box below for easy reference[2]. Progress made as of March 2021, i.e. during Programme Year 9 (from 1st October 2019 to 30 September 2020) and ongoing Year 10 (from 1st October 2020 to 30 September 2021), are indicated immediately after. Overall, they were subject in particular to availability of funds (in 2020 or later) while a main constraint was the sanitary situation related to Covid-19 and related travel restrictions. The recommendations that still have to be implemented were highlighted in grey for easy reference.

- **Strengthening of human resources – to countries and FAO, subject to available resources:**

- Conduct field training during survey and control operations considering the difficulties in determining the age of locusts and infested areas (Azerbaijan, Tajikistan).

- Organize a ToT regional session on locust monitoring and information management, including ASDC and CCALM, in Orenburg region (Russian Federation, Kazakhstan).

- Conduct ASDC refresher/training courses at the national level before the start of the locust campaigns (Kyrgyzstan, Tajikistan).

- Organized ToT for new ASDC Master-Trainers (Afghanistan, Turkmenistan)

- Conduct an Asian Migratory Locust survey and training on locust monitoring and information management, including ASDC and CCALM, in Karakalpakstan (Uzbekistan).

- Organize specialized annual trainings/seminars to the benefit of information officers on data verification (ASDC), analysis, forecast and reporting, as well as on CCALM management and use, including QGIS, also allowing exchange of experience; and arrange Skype meetings every month, seasonally or as needed (FAO and all countries).

In 2020, a number of the above recommendations, to the benefit of the Central Asian countries, were subject to the signature and operational start of the new project GCP/INT/384/JICA, which took more time than expected (signature in July 2020 and operational start in November 2020). In addition, the training scheduled in Baku, Azerbaijan (on USAID project), and in Orenburg, Russian Federation (on countries' own funds with a contribution of the FAO Regular Programme) could not take place due to the sanitary situation related to Covid-19 and related travel restrictions.
Nevertheless, the following was organized during Programme Year 9 with FAO assistance:

- Azerbaijan: Remote Refresher course on ASDC and CCALM to the benefit of 22 Azerbaijan locust experts on 11 September and two Master-trainers on 18 September (funding: GCP/GLO/963/USA).
- Kyrgyzstan: Five briefing sessions on locust spraying and pesticide risk reduction to the benefit of

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[2] Extract from the Report of the Technical Workshop on Locusts in CCA held in November 2019 in Tashkent, Uzbekistan, and from the Working Paper for Item 7 of the Agenda of the annual Technical Workshop held in November 2020 online.

50 staff between June and August 2020 (TCP/KYR/3801).

In addition, the following remote Refresher Courses on locust monitoring, including ASDC and CCLAM, as well as pesticide risk reduction, were organized or are envisaged during Programme Year 10 (as of 5 March 2021):

- Kyrgyzstan: 5 & 26-30 October 2020 to the benefit of seven locust specialists from the Department of Chemicalization and Plant Protection (DCPP), Ministry of Agriculture, Water Resources and Regional Development (MOAWRRD) (TCP/KYR/3801).
- Georgia: 14-18 December 2020 to the benefit of ten locust specialists from the National Food Agency (NFA), Ministry of Environment Protection and Agriculture (TCP/GEO/3801).
- Afghanistan: 18-22 January 2021 to the benefit of eight locust specialists from the Ministry of Agriculture, Irrigation and Livestock (MAIL) (GCP/INT/384/JICA).
- Turkmenistan: 1- 5 February 2021 to the benefit of five locust specialists from the Ministry of Agriculture and Environmental Protection (MAEP) (GCP/INT/384/JICA).
- Tajikistan: 26-28 February 2021 to the benefit of five participants from of the State Entity «Locust Control Expedition» (SE-LCE) (TCP/TAJ/3806)
- Russian Federation: 1- 5 March 2021 to the benefit of 27 participants and 81 observers from the Federal State Institution "Russian Agricultural Center", Ministry of Agriculture (FAO Regular Programme)
- *Kazakhstan: scheduled on 29 March-2 April 2021(GCP/INT/384/JCA or FAO Regular Programme)*
- *Azerbaijan: scheduled on 12-16 April 2021 (GCP/GLO/963/USA).*
- *Armenia: scheduled on 27-29 April 2021 (GCP/GLO/963/USA)*
- *Uzbekistan: scheduled in August/Sept. 2021 (GCP/INT/384/JCA).*

In the cases of at least Afghanistan, Azerbaijan, Georgia, Kyrgyzstan and Tajikistan, such Refresher Courses delivered to Master-Trainers should be followed by national or field briefing sessions delivered in 2021.

In addition, the second GIS Workshop is being organized on 16-18 March 2021 to the benefit of the ten CCA countries.

- **Equipment – to countries and FAO:**

> - Ensure that enough tablets are available to cover the whole locust survey and control activities (Georgia, Azerbaijan, Turkmenistan).

In line with the annual workplan for Programme Year 9 (based on available funds), no tablets were delivered by FAO in 2020 to CCA countries. Only the five tablets purchased for Turkmenistan at the occasion of the training delivered in late 2019 were under transfer to the country in September 2020 (and the transfer of 20 tablets to Kazakhstan still pending). In case of tablets' lack, CCA countries can install the App on mobile phones or use paper-based form and subsequently enter data into the system.

As far as Programme Year 10 (2021) is concerned, as of 5 March 2021, the following tablets are being delivered, based of countries former requests, FAO recommendations and available funds: Armenia (10 units) and Azerbaijan (20 units) thanks to project GCP/GLO/963/USA; Georgia (10 units) thanks to project GCP/GLO/963/USA; Kyrgyzstan (20 units), thanks to projects GCP/INT/384/JICA (15 units) and

GCP/GLO/963/USA (5 units); Tajikistan (13 units) thanks to project TCP/TAJ/3806; Turkmenistan (10 units) thanks to project GCP/INT/384/JICA; and Uzbekistan (14 units) thanks to project GCP/GLO/963/USA.

- **Manuals and guidelines – to FAO:**

- Identify funding for publishing the monograph on the Italian Locust (Russian Federation).

- Translate ASDC and CCALM manuals into national languages (all countries).

- Ensure the release of video manuals on the use of ASDC, CCALM and QGIS in Russian and English with subtitles in national languages (all countries).

The above was not done in 2020. The monograph on the Italian Locust is subfinalized but still needs to be officially approved as a FAO publication before being printed. ASDC and CCALM manuals were updated but they still need to be reviewed and finalized and then to be translated into the national languages.

- **ASDC – to countries and FAO:**

The effective functioning of CCALM depends on ASDC use in all CCA countries as the main informational source for the system is the data collected through ASDC either from tablets/mobile devices in the field or entered in a desk computer/laptop through WEB-interface from the Locust Survey and Spray Monitoring paper Forms filled in the field. Therefore, the following recommendations had been made in liaison with CCALM (see also Working Paper for Item 6 on ASDC):

1. To all countries: continue to use ASDC as much as possible during locust survey (and send information even in the absence of locusts) and control activities (FAO).

2. To Kazakhstan: test ASDC in Kazakh language in areas adjacent to the Russian Federation and Uzbekistan (FAO).

3. To all countries and FAO: continue to support national staff in using the ASDC at the workplace (during continuing education courses on a national and/or other budget).

4. To FAO: provide remote technical assistance to countries to resolve any difficulties or problems associated with the use of ASDC.

1. A total of 4 285 reports (as of 30 September 2020) were made by 100 users from eight CCA countries (all excluding Turkmenistan) in 2020. Azerbaijan declared that almost all information during locust survey and treatment was entered to CCALM database, which was a very important achievement.

2. In 2020, ASDC was not tested by Kazakhstan using the App on smartphone or the paper forms entering the data afterwards on desk computer. Regarding the tablets, an issue was met for transferring the tablets purchased at the occasion of the 2019 training, which still needs to be solved.

3. The education courses held with FAO assistance are reported under the first bullet point above and, during the GIS Workshop, countries are invited to report on any other courses delivered at the national level.

4. Last, FAO provided remote technical assistance to countries to resolve any problems associated with the use of ASDC.

- **CCALM – to countries and FAO:**

1. To all countries: designate at least two information officers with appropriate education and skills who will be responsible for managing CCALM at the national level (FAO).

2. For the Russian Federation: appoint representatives for certain regions for CCALM management at the national level (Russian Federation).

3. To FAO: due to the lack of transliteration/use of national languages of place names in OpenStreetMap in CCALM, use other cartographic materials (Georgia, Russian Federation).

4. To FAO and countries: translate CCALM interface into national languages and provide the opportunity to fill out FAO forms through the WEB interface in these languages with the corresponding field names and drop-down lists.

5. To all countries and FAO: in order to expand the possibility of creating CCALM products for the second administrative level (district), prepare and enter into CCALM database relevant historical data on areas infested by locusts; areas infested by locusts exceeding the economic threshold (ET); as well as the treated area - starting from 2000 (if available) until now (FAO).

1. & 2. During the GIS Workshop, countries are requested to confirm that the delegates which were nominated to participate, should be considered as the information officers responsible for managing CCALM at the national level.

3. In 2020, because the lack of transliteration/use of national languages of place names in OpenStreetMap in CCALM, other cartographic materials (Yandex map, Wikimedia maps, Thunderforest Landscape and stamen.com dark) were introduced in CCALM. In addition, the possibility of downloading the own cartographic substrates was opened.

4. In 2020, after receiving translations of the words of CCALM interface from Afghanistan, Azerbaijan, Georgia, Kyrgyzstan and Uzbekistan, the national languages were introduced into CCALM. Presently the system is available in seven languages (Dari, Azeri, English, Georgian, Kyrgyz, Russian and Uzbek) and there is the opportunity to fill out FAO forms through the WEB interface in these languages with the corresponding field names and drop-down lists. The translation into Armenian, Kazakh, Tajik and Turkmen was requested to the concerned countries and is awaited.

5. The locust historical data were added for 2018-2019 – on: areas infested by locusts; areas infested by locusts exceeding the ET; and the treated area for *first* administrative level (oblast/province)- had been inserted into CCALM for the following countries: Afghanistan, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russia, Tajikistan. The data are still awaited for the other countries, i.e. Armenia, Turkmenistan and Uzbekistan.

Concerning the possibility of creating CCALM products for the *second* administrative level (district), data had been added to CCALM for the Russian Federation (2000-2019) as well as for Kyrgyzstan and Tajikistan (completed for 2019), based on the information provided by these countries. More countries are invited to share such data to fill the database.

- **Development prospects of CCALM – to countries and FAO:**

1. To FAO and countries: create an e-Committee of representatives from interested CCA countries and FAO experts (Information Officers) to jointly discuss and expand the list of CCALM GIS products.

2. To Kazakhstan and Russian Federation: to eliminate duplicate activities and fill out the FAO locust survey and spray monitoring forms, consider developing a module linking CCALM and the national databases developed in the Russian Federation and Kazakhstan (Russian Federation, Kazakhstan).

1. The e-Committee for jointly discussing and expanding the list of CCALM GIS products was not created in 2020 in connection of Covid-19 situation.

2. Developing a module linking CCALM and the national database existing in Kazakhstan was not possible because of the data sent by State Institution «Republican Methodological Center for Phytosanitary Diagnostics and Forecasts» contained different files with various data including other pests and diseases of cereals in excel format. Thus, it was impossible to create module for downloading (or receiving and inputing) excel file with locust data established sample. Nevertheless, a lot of work was done to prepare such file and 1 907 records of 2019 locust surveys were imported to CCALM (data will be exported for 2020 as they become available). For the time being, this is however still done manually.

A module linking CCALM and national database existing in Russia was developed for automatic transfer of data. In that way, totally 5 869 records were imported including 447 records for 2019 and 5 422 for 2020.