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Report on the United Nations/Romania International Conference on Space Solutions for Sustainable Agriculture and Precision Farming

(Cluj-Napoca, Romania, 6–10 May 2019)

I. Introduction

1. The Office for Outer Space Affairs of the Secretariat and the Government of Romania through the Romanian Space Agency jointly organized the United Nations/Romania International Conference on Space Solutions for Sustainable Agriculture and Precision Farming to address key issues related to global food security.

2. The Conference was held in Cluj-Napoca, Romania, from 6 to 10 May 2019. It was hosted by the University of Agricultural Sciences and Veterinary Medicine and supported by the Office for Soil Science and Agrochemistry, Cluj-Napoca, and the Romanian Society for Photogrammetry and Remote Sensing.

3. The present report contains a description of the background, objectives and programme of the Conference and provides a summary of the recommendations and observations made by the participants. It has been prepared pursuant to General Assembly resolution 73/91.

A. Background and objectives

4. Space technologies, including satellite remote sensing integrated with geospatial technologies and location-based services, have demonstrated significant capabilities in addressing challenges related to sustainable agriculture, be it from stress due to increasing demand for food, conversion of productive land to a different purpose, impacts of disasters of natural causes or long-term impacts of climate change.

5. Continuous use of Earth observation technologies is crucial to managing and monitoring agricultural resources for the benefit of humankind and the environment, as well as to providing important forecasting services to prevent water-related disasters such as floods and droughts that increasingly affect agricultural production and food security.

6. Remote sensing satellites that provide Earth observation data on several key variables related to soil, crops, water and/or weather at various spatial and temporal scales are highly appropriate for reliable agricultural planning and management. Earth

observation applications include the early estimation of crop acreage and productivity, the detection of crop conditions and the suggestion of sustainable land-use and agricultural practices.

7. Satellite-based navigation systems are widely used for the expansion of precision farming and a more-efficient use of resources. Precision farming technologies often utilize tools integrated with global navigation satellite systems to collect location-specific data on soil and crops that help to improve production efficiency by reducing the cost of seeds, fuel and agrochemicals, and by saving time.

8. The Office for Outer Space Affairs, through its Programme on Space Applications, addresses space technology applications in various workshops and conferences organized at the request of Member States. Such events provide a platform for Member States to exchange knowledge. It also helps developing countries to keep pace with rapidly developing space technologies and build capacity for its effective utilization.

9. In this regard, the Conference, following the framework of the United Nations Programme on Space Applications, focused on agriculture – one of the areas that could benefit significantly from space-related technology and aligned it with the Sustainable Development Goals, in particular Goal 2, on ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture. (For more information, see www.unoosa.org/oosa/en/benefits-of-space/agriculture.html.)

10. The Conference provided an opportunity to reflect on common interests in line with the global agendas, and discussed how space technologies could contribute to improved management of agricultural resources in general. It also explored space technology applications in precision farming, soil and water management, the combating of desertification, drought forecast and monitoring, the assessment of the impact of natural hazards and climate change on the agricultural production, and addressing food-security related challenges in developing countries.

11. The main objectives of the Conference were the following:

(a) Share practices and tools on space-based solutions for improved sustainable agriculture and precision farming;

(b) Promote space technologies for food security research and early crop-yield estimations;

(c) Raise awareness on international, regional and national initiatives, monitoring frameworks and international or interregional cooperation in the domains of agriculture and food security;

(d) Share opportunities for education, training and capacity-building relevant for various target groups on using space technologies to address water- or food-related challenges in agricultural processes, as well as related public awareness initiatives;

(e) Demonstrate cases on successful applications of space technologies for improving agricultural processes and food security in developing countries;

(f) Discuss new or emerging technologies and approaches in these domains;

(g) Highlight the issue of space in agriculture in support of the 2030 Agenda for Sustainable Development.

B. Attendance

12. The Conference was attended by 188 participants, 34 per cent of whom were women.

13. Out of the 188 attendees, 146 (78 per cent) were from Romania. The remaining 42 participants (22 per cent) were from the following countries: Australia, Bhutan, Bosnia and Herzegovina, Brazil, Bulgaria, China, El Salvador, France, Germany, India, Indonesia, Kenya, Mexico, Nepal, Netherlands, Nigeria, Pakistan, Peru,

Poland, Republic of Moldova, Spain, Sweden, Thailand, Tunisia, Turkey, Ukraine and United Kingdom of Great Britain and Northern Ireland.

14. In addition to the Conference, a one-day hands-on workshop on education was held, under the auspices of the co-organizers of the Conference. A total of 66 participants joined the workshop, of whom 36 per cent were women and 56 per cent were international participants.

II. Programme

15. The Conference comprised an opening session with four keynote speeches, a technical session with six plenary sessions, a parallel breakout session, an interactive session, a concluding session, 38 poster presentations and a field visit. A total of 28 presentations were given during plenary sessions, 18 paper presentations during the parallel breakout session and six talks during the interactive session, on the following topics:

(a) Plenary session 1: space for sustainable agriculture and precision farming;

(b) Plenary session 2: space for sustainable agriculture at the national level;

(c) Plenary session 3: emerging technologies and integrated applications in agriculture;

(d) Plenary session 4: agricultural mapping and risk assessment;

(e) Plenary session 5: monitoring agriculture – space and aerial platforms;

(f) Plenary session 6: monitoring land and soil degradation;

(g) Parallel breakout session: soil minimum tillage systems;

(h) Interactive session: focus groups on input and pest monitoring, real-time data and precision agriculture, crop monitoring and land use, soil and water monitoring, climate change and disaster warning, and socioeconomic aspects and sustainability.

16. On the last day of the Conference, a hands-on workshop entitled "Education Day" was held.

III. Programme of activities

A. Opening session

17. The opening session highlighted the importance of the contributions of Earth observation in monitoring the status of the achievement of – or actively working toward the achievement of – the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals, 169 targets and 232 indicators. Extensive references were made to Goal 2, because it focuses on people with limited access to nutritious food and is aimed at ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture.

18. The agriculture sector has benefited enormously from the availability of advanced space-based sensors and most of the relevant data are becoming available through open-source platforms. Integration of such data with geographic information, global navigation satellite systems and field-based sensors demands use of upcoming technologies, such as big data, cloud-based computing and machine learning, to generate information needed for promoting sustainable agriculture.

19. A new strategy entitled "'3S': science and technology, services and security", and similar initiatives, allow for the generation of information needed at the global, regional and local levels for the monitoring of the planet's health through indicators such as crop condition, soil moisture and salinity, thus providing strategic inputs for

the management of agriculture and food security. European initiatives such as the Copernicus Programme and the European Satellite Navigation System (Galileo) demonstrate efforts in this direction.

B. Technical sessions

20. Plenary sessions were held on the following topics:

(a) Space for sustainable agriculture and precision farming;

(b) Space for sustainable agriculture at the national level;

(c) Emerging technologies and integrated applications in agriculture;

(d) Agricultural mapping and risk assessment;

(e) Monitoring agriculture space and aerial platforms;

(f) Monitoring land and soil degradation.

1. Space for sustainable agriculture and precision farming

21. The session presented the latest research and proven methodologies incorporating the use of advanced Earth observation satellites and the integration with in-situ data for providing inputs for sustainable agriculture and precision farming.

22. The space-based sensors are able to provide precise inputs for (a) the digital soil mapping needed for precision agriculture; (b) the assessment of nutrients and organic matter balance to programme fertilization and crop yield; and (c) crop-type mapping and the reliability of crop analytics.

23. The time-series Earth observation data helps in analysing dynamics of agricultural landscapes to provide policy inputs, such as to the European Union Common Agriculture Policy, and fosters technological cooperation at the regional level.

24. The availability of open-source data from Copernicus and Landsat has proven beneficial to developing countries, especially countries without a space programme, in resolving multiple challenges related to food security by monitoring the impact of climate change on principal food crops, providing digital solutions for productive agriculture or understanding the global supply chain.

2. Space for sustainable agriculture at the national level

25. The session shared case studies on the use of remote sensing and geospatial technologies in agriculture in various countries.

26. Countries on different continents utilize space technologies in different ways and exploit the potential of Earth observation data to support sustainable agriculture. The level of technology utilization varies from country to country based on their capacity and access to the satellite data.

27. Integrated approaches that make use of advanced space technologies – such as Lidar, web-based geographic information systems and big data – benefit agricultural planning and address key challenges, including the assessment of crop yields, value chains, insurance payouts during crop failure and the monitoring of land degradation.

3. Emerging technologies and integrated applications in agriculture

28. The session discussed new technological processes, methodologies and tools to foster sustainable agriculture.

29. Integrated system approach becomes a key pillar for sustainable agri-food systems under changing climate, diet and demography. Recent advances in Earth observation, open-access, artificial intelligence, machine learning, information and communication technologies and cloud computing platforms, as well as

smartphone-enabled citizen science, are increasingly making geo-big data-based GeoAgro analytics smarter, interoperable and useful.

30. Hyperspectral remote sensing and fluorescence methods offer promising results in monitoring crop phenologies and provide precise inputs for optimal use of fungicides, thereby reducing toxin content in principal crops including wheat. Advanced geographic information system platforms are able to provide dashboards to disseminate information to stakeholders including farmers, merchants and policymakers. Such platforms combine inputs derived from advanced remote sensing platforms with data from other sources and provide data analytics needed to address challenges related to water management, drought assessment and controlled environment agriculture.

4. Agricultural mapping and risk assessment

31. The session highlighted the importance of methodological tools enriched with satellite data in generating maps and assessing risks to agriculture through the analysis of relevant factors such as water, moisture and climate.

32. Methodological tools that integrate various data and approaches can assess water footprints, map and assess soil ecosystems and evaluate land use. These tools are proving useful in assessing the best management practices for maintaining the sustainability of watersheds and for maintaining hydrological properties of agriculture land and sustainability of land for producing specific crops.

5. Monitoring agriculture space and aerial platforms

33. The session enabled the exchange of information on the use of aerial platforms and satellites in the collection of crop data for the purposes of contributing to the planning, monitoring and assessment of land and crop status.

34. Unmanned aerial vehicles equipped with multispectral cameras provide an excellent source of data for detecting physical and chemical properties of soil and crops, thereby providing early warning on stress in the soil and agricultural ecosystem.

35. Integration of data collected by drones and satellite sensors is often essential in order to provide Internet-based services to farmers, including instant and real-time access to crop and soil health diagnostics. Such applications also benefit from open access to data sets acquired from Sentinel-2 and Landsat-8 satellites.

6. Monitoring land and soil degradation

36. The session contributed to the use of satellite imagery in the development of methodologies for the assessment of the condition and preservation of the soil.

37. Initiatives including land degradation neutrality promoted by the United Nations Convention to Combat Desertification, in which 120 countries are engaged, rely on the use of Earth observation data to derive important land degradation neutrality indicators, namely land cover change and land productivity change.

38. Sentinel data sets, when calibrated for a specific region and integrated with field-based observation, are useful in deriving soil classification and mapping.

7. Interactive session

39. During the first two days of the Conference, participants were requested to fill in a short online survey, identifying the most significant agriculture-related issues whose solutions could potentially benefit from space-based technologies. The submitted responses were collected and categorized and the participants were divided into groups according to the above-mentioned categories. Six focus groups were created and they discussed the following issues that had been identified through the survey:

(a) Agricultural input and pest monitoring;

(b) Real-time data and precision agriculture;

(c) Crop monitoring and land use;

(d) Soil and water monitoring;

(e) Climate change and disaster warning;

(f) Socioeconomic aspects and sustainability.

40. Remote sensing is a relevant tool for monitoring the health of crops and soil. It makes it possible to determine the right amount of fertilizer and pesticide input, thus contributing to sustained and precision farming.

41. A range of spatial, spectral and temporal resolution data available through space-based sensors cater to the needs of small- and large-scale farming in terms of crop monitoring and land use management. Land use is generally governed by the socioeconomic conditions in the country, which influence the types and extent of crops cultivated in agricultural land. Diverse data available from Earth observation satellites allow for the formulation of multilateral approaches for crop classification, quality analysis and the estimation of productivity.

42. Space-based technologies were mentioned as an asset to be incorporated in capacity-building programmes to develop relevant expertise of utilizing space data to assist development of farm policies at local and national levels, as well as supply chain management. Capacity-building should also focus on enhancing the technological awareness of farmers and providing automated tools and techniques to assist farmers.

43. Environmental protection and ecosystem services are critical for sustainable agriculture. Space-based technologies allow for the regular monitoring of the environment and the ecosystem.

C. Poster presentations

44. A total of 38 posters were exhibited during a dedicated session. The posters examined a range of topics relevant to the theme of the Conference, including new technologies and methodologies, preservation, monitoring and analysis, in the context of agriculture.

IV. Observations and recommendations

45. The Conference reaffirmed the importance of space-based technologies for the promotion of sustainable agriculture and precision farming, in particular within the context of Sustainable Development Goal 2. It also noted the connection with other Sustainable Development Goals and the global agendas in general.

46. The participants noted the need for international cooperation in multiple facets of agricultural development, and especially with regard to technological advancement, capacity-building, knowledge exchange and policy development. Interdisciplinary thinking was identified as a driving factor towards technological advancement for sustainable agriculture.

47. The importance of international cooperation was also highlighted in the context of a long-term study on the impact of climate change on agriculture and the development of early warning systems to monitor risk to agriculture.

48. The adoption of universal definitions of technical terms may boost the use of spacetechnologies to provide apt services to farmers and contribute to unified policy approaches.

V. Conclusion

49. According to feedback given by participants, the Conference was successful in generating thoughts and ideas on developing opportunities for international cooperation and knowledge exchange between policymakers, researchers, representatives of academia and the private sector.

50. By bringing together actors from different sectors, the Conference served to raise cross-sectoral awareness of the importance of international cooperation and the development, adoption and integration of space-based technologies for sustainable agriculture at all levels. The discussions covered a wide range of issues, tools, technologies and trends related to space-based technology for sustainable agriculture and precision farming, providing benefits to both technical experts and policymakers involved in driving policies that demand development of new technologies.

51. Finally, the Conference addressed key issues related to the utilization of space technologies and provision of solutions for sustainable agriculture by addressing its relevance to indicators and targets under the framework of the Sustainable Development Goals.