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Report on the United Nations/Austria Symposium on Space Applications for Food Systems

(Graz, Austria (online), 7–9 September 2021)

I. Introduction

1. The United Nations/Austria symposium is one of the long-standing activities of the Office for Outer Space Affairs under the United Nations Programme on Space Applications. The symposium of 2021 was the twenty-seventh in the series.

2. In view of the upcoming holding of the United Nations Food Systems Summit on 23 September 2021, the Office for Outer Space Affairs of the Secretariat and the Government of Austria jointly selected the theme "Space applications for food systems". The symposium was organized to include two days of presentations and discussions followed by an "independent dialogue" on the theme of space applications for food systems, in order to contribute to activities relating to the Summit. The term "food systems" refers to the activities involved in producing, processing, transporting and consuming food, and the symposium aimed to present the variety of uses of space solutions with regard to food systems. It offered attendees – in particular, representatives of developing countries – an opportunity to explore tools, policies and approaches that could be adapted to the regional, national or local context. Users of space applications were invited to present lessons learned and experts were invited to discuss additional technical solutions that space applications could provide.

3. Owing to the coronavirus disease (COVID-19) pandemic, the symposium, originally scheduled to take place in Graz, Austria, was held online, from 7 to 9 September 2021. The event was co-organized by the Government of Austria and supported by Joanneum Research as local organizer, in cooperation with Graz University of Technology. It was co-sponsored by the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, the Austrian Federal Ministry for European and International Affairs, the city of Graz and Austrospace. The European Space Agency provided additional support.

4. The present report describes the objectives of the symposium, provides details of attendance and summarizes the activities carried out.

II. Background and objectives

5. The Office for Outer Space Affairs disseminates knowledge with respect to the added value of space applications in addressing societal issues, notably through

events of the Programme on Space Applications held at the request of Member States and organized jointly.

6. The Programme on Space Applications has been organizing events since 1971. Since 1994, the United Nations/Austria symposium has focused on innovative ways of responding to societal needs and has showcased the socioeconomic benefits of space applications in a wide range of areas. Since 2017, the symposium has also combined space policy and legal aspects with space technology, services and applications in a holistic manner.

7. In 2021 the symposium had the following objectives:

(a) To promote the exchange of best practices in the use of space applications for specific activities that are integral to food systems;

(b) To share experience and explore what services are available and how they can be used to support policies according to national priorities;

(c) To discuss how to comply with regulations related to food systems with the use of space technologies and applications;

(d) To present available toolboxes that have already been implemented through case studies or pilot projects, with the aim of encouraging the adoption of tested tools and approaches;

(e) To discuss the role of the Office for Outer Space Affairs in implementing capacity-building activities, especially in developing countries;

(f) To raise awareness of relevant space-related activities, services and cooperation programmes among different user groups, in particular government officials, the diplomatic community, United Nations entities and other international entities, as well as non-governmental organizations;

(g) To demonstrate how initiatives based on space applications have been successfully developed and how they are being used in different countries, with a view to reporting best practices to the United Nations Food Systems Summit.

8. For the second consecutive year, the symposium format was changed to an online event. The organizers applied lessons learned in the previous online symposium to improve logistics, including by enabling direct interaction between participants with the addition of the dialogue to the programme. All presentations were made available online in advance of the symposium, ensuring that time differences and limited Internet bandwidth would not hinder access to information. The format of sessions, discussions and short presentations called “project pitch” presentations was varied to avoid monotony and ensure engaging content and lively exchanges between speakers despite the lack of face-to-face interaction.

III. Attendance

9. A total of 333 individuals, 38 per cent of whom were women, registered to attend the symposium and were granted access to the web-based communication platform.

10. A number of participants were members of the diplomatic community, including representatives of permanent missions to the United Nations at Vienna. Representatives of space agencies – including the Austrian Research Promotion Agency, the Egyptian Space Agency, the European Space Agency (ESA), the Ethiopian Space Science and Technology Institute, the Indian Space Research Organization (ISRO), the Italian Space Agency, the Kenya Space Agency, the Mexican Space Agency, the National Aeronautics and Space Administration of the United States of America (NASA), the National Institute of Aeronautics and Space of Indonesia, the National Space Research and Development Agency of Nigeria and its National Centre for Remote Sensing, the Paraguay Space Agency, the Philippine Space Agency, the Turkish Space Agency, the Singapore Office for Space Technology

and Industry and Zimbabwe National Geospatial and Space Agency – were also present.

11. The following 76 countries were represented: Afghanistan, Argentina, Australia, Austria, Azerbaijan, Bangladesh, Belgium, Benin, Brazil, Bulgaria, Cambodia, Canada, Colombia, Costa Rica, Croatia, Denmark, Ecuador, Egypt, Ethiopia, France, Germany, Ghana, Greece, Guatemala, Hungary, India, Indonesia, Iran (Islamic Republic of), Iraq, Italy, Japan, Kazakhstan, Kenya, Republic of Korea, Lebanon, Liberia, Libya, Luxembourg, Malaysia, Mauritius, Mexico, Mongolia, Morocco, Nepal, Netherlands, Nicaragua, Niger, Nigeria, North Macedonia, Pakistan, Paraguay, Peru, Philippines, Portugal, Russian Federation, Rwanda, Senegal, Sierra Leone, Singapore, Slovenia, Somalia, Spain, Sri Lanka, Sudan, Syria, Thailand, Trinidad and Tobago, Turkey, Turkmenistan, Ukraine, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, Venezuela (Bolivarian Republic of), Zambia and Zimbabwe.

12. Attendees were invited to signal their interest to participate in the dialogue of 9 September and to choose the discussion group that interested them most, so as to clarify for the facilitators of each of the five discussion groups what should be expected in terms of attendance. The online platform allowed each attendee to select a discussion group freely when the dialogue began, then to switch to another group at their leisure. A total of 30 attendees participated actively in the dialogue discussion groups.

IV. Programme

13. The programme was structured according to four types of intervention:

(a) Keynote speeches;

(b) Panel discussions;

(c) Presentation sessions led by four or five successive speakers, followed by a question-and-answer period;

(d) Succinct “project pitch” presentations, each lasting three minutes.

14. The use of the “project pitch” format, intended as the online equivalent of a poster session, made it possible to increase the number of initiatives presented and enabled less experienced speakers to give presentations.

15. In total, the event lasted for 14 hours and 30 minutes; it included 38 speakers, comprising 16 women and 22 men.

16. All presentations given by the speakers were made available on the website of the Office for Outer Space Affairs (www.unoosa.org/oosa/en/ourwork/psa/schedule/2021/2021Graz.html) before the event to enable attendees who might have technical difficulties during the event, owing to limited bandwidth, to download the content in advance.

17. The event began with a welcome address from the Director of the Office for Outer Space Affairs, who recalled the rationale of the United Nations Food Systems Summit and explained the specificities of the symposium. She announced a joint initiative of the Office with ESA, ISRO and NASA to provide free additional technical training online throughout October 2021 so that symposium attendees could further develop technical skills in using Earth observation and remote sensing applications for agriculture. This joint initiative had been curated in view of the feedback received during the previous symposium regarding attendees’ motivation to attend: a large number of attendees were students and young professionals who saw the symposium as a learning opportunity.

18. A welcome ceremony followed, during which Austrian authorities, co-organizers and sponsors provided their insights on the theme of the symposium. The permanent representation of Austria to the United Nations highlighted that space

applications could help to shift towards more nature-positive food systems, in the sense of steering the influence of food systems on nature in a positive direction, towards sustainability. The representative of the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology noted that the world was still not on track to achieve zero hunger by 2030. Agriculture and food systems played a role in the context of global climate change, while climate change also had a direct impact on food systems and food security. It was highlighted that the European Galileo and Copernicus services provided benefits to global society and that they supported sustainable agriculture and food security.

19. In a keynote speech, the Director General of ESA presented the Agency´s space applications activities supporting food systems and agriculture, notably the achievements and challenges of the Earth observation programme in support of food security.

20. Session 1 addressed existing space-based solutions for food systems on Earth. The four speakers and written input from an initiative from Guatemala described how space applications were already being used in various regions to improve the way food was produced. Applications such as the use of satellite-based augmentation systems for satellite navigation to enable precision agriculture and the transformation of data from various sensors on board Earth observation satellites into actionable information for farmers demonstrated that using data from space was already an established practice in several countries. The unique viewpoint from orbit allowed the acquisition of a large amount of information and regular updates. Some countries used it to look for ways to optimize agricultural resources, others to find places where agriculture could be started in arid regions, and the portfolio of new applications was growing. Through the use of mobile phones, it was possible to provide appropriate advice directly to farmers so that they could take informed decisions on how to use their land best. Applications and resources online also provided information on such matters as high-yield crop varieties, hybrid seeds, irrigation schemes and the market value that producers could expect.

21. Panel 1addressed one of the five action tracks of the Food Systems Summit:[1] how to build resilience to vulnerabilities, shocks and stresses. The speakers noted that conflicts, economic shocks (such as what COVID-19 has created) and extreme weather events were the main challenges for food systems worldwide. Most countries were aware of the advantages of using satellite remote sensing data for damage assessments after a disaster, and many were using such data to predict, map and analyse floods so that local governments and aid agencies could react faster. The World Food Programme (WFP) presented several projects that were translating frontier technologies, such as blockchain and artificial intelligence, into useful applications; WFP was running innovation boot camps all around the world and providing funding for start-ups. The abundance of data nowadays required tools to transform it into information directly applicable for agriculture, in a format that could be used by farmers. Access to information technology remained a problem for many, and the use of local languages and podcasts to transmit information orally needed to be considered. Since young people tend to have good access to social media, several panellists stressed that it was important to use such channels to present agriculture as an attractive career opportunity for young people.

22. Session 2 addressed innovative solutions in early stages of development within the space sector that could benefit food systems, whether for production or transport or as a spin-off of food production for astronauts in space. The five speakers explained what technologies could be expected to become readily available in the next 5 to 10 years. The use of reflectometry of signals from Global Navigation Satellite Systems was presented: it was a way to acquire data on, for example, soil moisture, and, once mature, it would provide information without having to send a dedicated sensor into space. The use of clinostats to simulate conditions that plants would experience in space was an effective way to have them adapt to stress and could

[1] www.un.org/en/food-systems-summit/action-tracks.

increase the yield of crops on Earth. Similarly, closed-loop systems used on space stations showed effective production methods that could be used on Earth. The speakers also discussed the role of food as a culinary experience: they explored how food could be produced directly in space, how to cook it in view of the difference in how it would taste there, and how to ensure that astronauts would not only survive, but actually enjoy their meals.

23. Session 3 addressed legal and regulatory aspects of space applications for food systems. The purpose of the session was to present the legal context in which space solutions are implemented, including regulatory aspects, notably for food products and producers' certification, and to discuss how new policies could be developed that would provide incentives for the use of space applications for food systems. The four speakers in the session looked at how international law in the areas of human rights, peace, environmental protection and space law interacted. They provided an overview of existing instruments within these areas of law and discussed how they related to the right to food. It was considered important to foster international cooperation and mutual assistance, taking particular account of the needs of developing countries, as well as the use of space applications for countries to reach their development goals. As a concrete example of how space applications could help farmers to meet regulatory requirements, for example when growing organic food, a mobile application for food product certification was presented.

24. Action track 3 of the Food Systems Summit addresses how to protect natural ecosystems, manage existing food production systems sustainably and restore degraded ecosystems. A keynote speech on behalf of the Chair of action track 3 explained the preparation process for the Summit and introduced the topic of nature-positive production. The keynote speech highlighted the importance of the involvement of all in the Summit and stressed that independent dialogues were a valuable contribution to the different workstreams in preparing for the Summit, as well as to the ensuing actions.

25. Panel 2 focused on how space applications contribute to nature-positive production. The four speakers presented their respective activities. Precision agriculture was seen as a promising approach, and satellite positioning allowed the precise positioning of machines to function automatically, for example to monitor cattle. Initiatives in Egypt were presented, whose aim was to optimize water use and improve the use of soil, notably by defining optimal crop diversity. Space agriculture and closed-loop systems, where the environment is strictly controlled, could be replicated to grow food in arid and semi-arid areas, improving local practices regarding food sustainability. Some countries were looking at improving yields and the efficiency of agriculture to reduce the land surface required; this was particularly effective when combined with monitoring to allow food producers to act early if conditions such as temperature or the level of dissolved oxygen evolved.

26. In addition to the sessions and panels, two "project pitch" presentations provided a brief introduction to two initiatives. One of them was using space applications for agriculture development of family farms in the Asia-Pacific region; the second looked at how knowledge of vertical farming and of what would be needed for baking on the surface of Mars contributed to sustainable practices on Earth.

27. Attendees were encouraged to use the online communication platform to submit questions to speakers in writing throughout the event, while the moderator used that function to highlight relevant initiatives. Questions to speakers conveyed via the communication platform were read out by the moderator at the end of each session and panel to provide some level of interaction.

28. An independent dialogue was held on the last day of the symposium, bringing together attendees wishing to discuss their experience and experts who had made presentations. Thirty individuals contributed actively to one or more of the five discussion topics:

(a) How can awareness of what space solutions can bring to farming and fishing communities be raised?

(b) How can academia and research institutes better understand the real needs of the user community and translate those needs into technical requirements?

(c) What are the difficulties faced by farmers seeking financing for the adoption of technology to improve agricultural productivity, and what incentives and funding mechanisms could be put in place?

(d) How can technologies used to produce food in space be applied to solve Earth-based problems in food systems?

(e) What actions can young people take to advocate for the use of space technologies in agriculture or to get involved themselves?

Each group discussed what had been presented during the sessions and panel discussions of the symposium during the previous two days, and the participants' own experiences were explored.

29. To add a measure of local culture to the symposium, a virtual visit of the city of Graz was offered on Wednesday evening. Carrying a camera, a tour guide walked the online audience through the old town, providing an overview of the city’s rich history. The audience appreciated the opportunity to learn about Graz and see its main cultural landmarks live on camera.

30. The Office for Outer Space Affairs and the Austrian co-organizers concluded the symposium by providing a summary of what had been presented and an overview of the respective roles of those involved in preparing the event. Participants were encouraged to provide written feedback using a dedicated online form.

V. Recommendations resulting from the dialogue on space applications for food systems

31. The groups on awareness, user requirements and technology transfer made the same four sets of main recommendations for new initiatives to prosper (paras. 32–35).

32. The availability of funding for new initiatives needs to be enhanced. In some countries, aversion to risk and lack of financial support for technical start-ups eager to develop applications of space technologies for food systems hampers their development. There is a role for government agencies in charge of space activities to support the development of their applications with pilot projects of new technologies that directly involve users. Afterwards, the incubation phase towards a sustainable business still needs support. It would be beneficial if, for instance, more space agencies, institutions and private entities had strategy funds for start-ups in the field of space applications, with only low levels of bureaucracy required for obtaining access to such funding. Achieving these conditions would require raising awareness at the government and policy level, as well as the awareness of consumers about how their food is produced so that they can choose more sustainable food and thus have an impact on the way it is produced in a demand-driven process.

33. Understanding of user needs is the key to the success of new initiatives. Participants referred to the need for better communication between end users and those who develop technical solutions, as it is difficult to make information easy to understand for all the different users of every sector of food systems. Technology developers need to understand the environment and the conditions in which their users work. In this context, it is essential to develop prototypes and communicate continually with users throughout the development process, building partnerships with early adopters and champions for adoption of the new techniques. The early adopters are not necessarily young people; they may rather be individuals with a mindset open to change, who can act as a bridge between technical experts and their

own community. It takes time to build knowledge, and local academic institutions need to develop capacity-building opportunities, with support from international organizations if required. Incentives need to be available for farmers to adopt new technology, as adaptation to new techniques will require additional work; in some cases users see a direct, quantifiable and short-term benefit, but in other cases improvements are less straightforward and a subsidy might be required. It is essential to understand users' motivation for new technology to be adopted.

34. Technical limitations of what can be provided need to be clearly understood and communicated. In cases where satellite data is provided free of charge, interpretation of the satellite images into actionable information for food system stakeholders might still require specific expertise that is not readily available locally. In such cases, users do not have ownership of the whole data-processing process and depend on others; they need to be able to rely upon partners in their own country and not only organizations from outside. A local ecosystem around users of a technology needs to be built locally to make the use of that technology sustainable. In some cases, technical limitations remain the main obstacle to broader adoption of new techniques: although information might be provided to farmers at no cost, the data precision (for instance, when assessing nitrogen content in the soil) might still be inadequate, owing to spatial and temporal limitations of the satellite imagery, to be directly applicable to the improvement of agricultural yield.

35. Design of the user interface needs to remain simple to be successful. The device or the information used by actors of food systems need to be as simple and as familiar as possible. It needs to be adapted to where and how a person works (e.g. outside, with a small screen, without access to electrical power). The solution developer needs to adapt this user interface to the needs of the community. Reducing its cost would reduce the financial barrier to adoption of the technology; using mobile phones as a user device is successful in several domains. Young people are very familiar with such devices, and mobile phones are the most pervasive technology in many countries.

36. The group discussing financing considered the constraints facing innovators and farmers in gaining access to financing and concluded that mobilizing both public and private funds was critical for bridging the current financing gap and scaling up the adoption of space-based technologies in agriculture. The group arrived at the following three sets of recommendations (paras. 37–39).

37. Capacity-building is critical for providing the necessary skill transfer to financial institutions in order for them to better understand space technology for agriculture, analyse risks and develop appropriate lending and other financial products. This also involves encouraging a shift in perception, from viewing space start-ups as capital expenditure-intensive "deep space technology" to seeing them as digital firms where value creation lies in data collection and data analytics. Space-based technology is able to optimize the use of resources to increase farm yield, forecast yields and monitor crop growth. Aggregated data and increased transparency would allow credit providers to mitigate the risk of non-repayment of loans and improve lending quantity and interest rates offered to farmers. The data are also useful for other downstream players, such as insurance companies, financial institutions and agricultural companies. Investments in such "one-stop" technology should be boosted. A demand-driven business model for space start-ups that is sustainable and profitable should be promoted, as it will attract private investment naturally.

38. It is necessary to increase collaborations to optimize the use of public and private funds. To reduce transaction costs and risks, blended finance could be encouraged where concessional funds (below market rate) catalyse investments by other private investors. Also, support for first-loss guarantee funds for agriculture focusing on smallholder farmers could be promoted. Private-public partnerships, by which governments could leverage private sector funding and management, should be promoted. Space agencies could cooperate with multilateral development banks to bring space technology to the field. Space agencies would bring in the technical know-how while multilateral development banks could bring in funds and organize

capacity-building activities on the ground. An example is the ESA Global Development Assistance initiative.

39. Investments in an enabling environment are required. The policy and regulatory environment on data collection, analysis and usage (how will the data be used and who can use what data?) should be improved to enable the growth of data-driven space technologies. Last but not least, there is a crucial need for public resources to finance essential public goods and services such as human capital, agricultural research and enabling public infrastructure such as in Internet connectivity.

40. The youth group provided recommendations on actions that young people can take to advocate for the use of space technologies in agriculture. The group discussed education and the need to raise awareness among the general public on how space technologies can benefit farmers. The concrete example of Central Europe was discussed, where the farming industry had undergone major changes in recent years and more technology-savvy young farmers, who were very well educated in agricultural institutes, brought innovations to their daily work. In that region, technology was perceived positively, and the discussion focused on how to incorporate new technology. Participants noted that in Africa many young women worked in agriculture and would need better access to education and capacity-building opportunities to empower them. Most people had mobile phones but no access to higher levels of technology, such as computers or the Internet. Until government support could broaden the accessibility of information and communications technology in the region, people needed easy-to-use and accessible technology. In regions where advanced technology was available, such as autonomous agriculture machines or data-integrated watering systems, food production systems and technical infrastructure needed to be integrated, with a user interface that was easy to use, such as apps on mobile phones. For raising awareness, story-telling was an effective way to convey information from farmers to policymakers, and it would also be important to strengthen scientific networks locally.

41. The youth group discussed how young people could get involved themselves. An effective way of sharing information with and between young persons was to use mobile phones, which were seen as the most convenient and most ubiquitous interface. Beyond accessibility, the content needed to be tailored to farmers or fishers in their local context, for example, by being provided in a local language. Many young people did not have access to land; in order to be in a position to influence the adoption of new space-based technologies, young people would first need to be integrated into decision-making processes about how land is managed. To do so, they needed to integrate themselves into the community and could bridge the gap between people who are familiar with technology and those who are not. Young people were keen to be the interface that engages with local groups and users to understand their real needs and communicate in their language. Young people who studied had been promoting the adoption of new technologies through student organizations and scientific communities focusing on space applications that were supported by professionals such as the Office for Outer Space Affairs acting as advisers. Young people were keen to use digital technologies, but also to direct their energy into hands-on activities locally that did not require technology and might be resource-intensive, for example, conducting field research and having direct conversations with remote farmers to better understand needs.

42. The recommendations above were provided to the United Nations Food Systems Summit through the official feedback form that is available online at https://summitdialogues.org.

VI. Conclusions and lessons learned

43. The symposium provided a wide-ranging overview of how space applications can contribute to improving food systems and considered legal and policy aspects as well as technical initiatives. It presented tools, policies and approaches that could be

adopted according to regional, national or local contexts and raised awareness of successful initiatives. All the presentations of the symposium are available online at unoosa.org.

44. The feedback from participants was overwhelmingly positive. They rated the event 4.71 out of a maximum rating of 5. Words of appreciation were received from speakers and from attendees, especially young people. Several of them intend to attend the technical training opportunities on Earth observation and remote sensing for agriculture that will be provided jointly by the Office of Outer Space Affairs with ESA, ISRO and NASA throughout October 2021.

45. Remote attendance provided the opportunity to have a much larger number of participants than a physical event; it also decoupled the selection of speakers and participants from any financial limitations. As in 2020, online attendance also made it possible to provide younger and less experienced speakers with an opportunity to contribute to the event. Further use of the online platform for future events was recommended by several participants and will be considered.