UNITED NATIONS
OFFICE FOR OUTER SPACE AFFAIRS

Space for Agriculture Development and Food Security

Use of Space Technology within the United Nations System

UNITED NATIONS

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Foreword

Food security and proper nutrition have become pressing global challenges, and the interrelated targets of ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture have been recognized collectively as a core sustainable development goal.

Achieving this goal will require concerted global actions and advanced tools and solutions to eradicate hunger and guarantee food and nutrition security for all, as well as to promote, enhance and support more sustainable agriculture while conserving land, water, plant and animal genetic resources, biodiversity and ecosystems.

Such tools are offered by space science, technology and applications, which help in the monitoring of crops, livestock, forestry, fisheries, aquaculture, and in supporting farmers, fisherfolk, foresters and policymakers in efforts to employ diverse methods of achieving sustainable food production and to respond to related challenges, such as adverse weather conditions, droughts, floods, desertification and land degradation, vegetation fires, and disasters triggered by natural phenomena.

This publication features how space-based technologies are used for supporting decision-making in the fields of agriculture and food security and for overcoming challenges posed to future prosperity, security and the well-being of all humankind. It also features United Nations organizations that use space-based technologies in their efforts to ensure access to sufficient nutritious food for all.

I encourage policymakers to familiarize themselves with the multifaceted applications of these technologies to enhance our ability to advance economically, socially and environmentally.

Simonetta Di Pippo
Director,
United Nations Office for Outer Space Affairs

Background

The United Nations Inter-Agency Meeting on Outer Space Activities (UN-Space), led by the United Nations Office for Outer Space Affairs (UNOOSA), has served as the focal point for inter-agency coordination and cooperation in space-related activities since 1975. This coordination mechanism aims to promote inter-agency cooperation and to prevent duplication of effort related to the use of space applications by United Nations organizations.

At the 32nd session of UN-Space, held in Rome in 2012, representatives of participating organizations agreed to issue a special report outlining the way in which United Nations organizations use space-based technologies for agriculture and food security.

This publication, a synthesis of the longer report (A/AC.105/1042), illustrates a wide variety of activities, including observations, data collection and dissemination, research and development of standards, policy formulation and emergency operations, and presents vivid examples of synergies among different entities, as envisioned under the framework of the United Nations system “Delivering as One” initiative, established by the Secretary-General of the United Nations in 2009.

The present publication features, in alphabetical order, both the thematic areas related to food security and sustainable food production, and United Nations entities that employ space technology in their routine operations in those areas. Organizations of the United Nations system also support Member States in advancing their capacities, promoting policy-science dialogue, developing institutional frameworks and bridging the gaps between knowledge, governance and the capacity to use such technology to enable early detection of threats to agriculture and food security, and informed decision-making in preventing and mitigating the effects of such threats.

United Nations Office for Outer Space Affairs (UNOOSA)

The United Nations Office for Outer Space Affairs (UNOOSA), headquartered in Vienna, Austria, is the United Nations office responsible for promoting international cooperation in the peaceful uses of outer space for all humankind.

UNOOSA serves as the secretariat for the General Assembly's only committee dealing exclusively with international cooperation in the peaceful uses of outer space: the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), established in 1958, and its subsidiary bodies.

The Office is also responsible for discharging the Secretary-General's responsibilities under international space law, and builds, through the United Nations Programme on Space Applications, national capacities on topics that include remote sensing, satellite navigation, satellite meteorology, tele-education and basic space sciences for the benefit of developing countries.

The Office also implements the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) and acts as the executive secretariat of the International Committee on Global Navigation Satellite Systems (ICG).

UNOOSA is the secretariat of UN-Space, a United Nations system-wide coordination mechanism aimed at increasing coordination and cooperation in space-related activities within the system.

THEMATIC AREAS

Agricultural research and development

The space industry has an essential role to play in agricultural research, as a microgravity environment has a particular impact on plant growth and development and affects plant yield. In order to assist Member States in harnessing the benefits of human space technology and its applications, the Office for Outer Space Affairs launched the Zero-Gravity Instrument Project under the framework of the Human Space Technology Initiative of the United Nations Programme on Space Applications.

As part of the project, the Office promotes space education and research in microgravity, particularly for the enhancement of relevant capacity-building activities in developing countries. The project will provide opportunities for students and researchers to study gravitational effects on samples, such as plant seeds and small organisms, in simulated microgravity conditions, with hands-on learning in the classroom or research activities conducted by each institution. It is also expected that a data set of experimental results in gravity responses will be developed and will contribute to the design of future space experiments and to the advancement of microgravity research.

The use of the space environment to uncover hidden potential in crops, commonly described as space breeding, was a focus of a project undertaken by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. Approximately 10 kg of rice of the Pokkali variety was sent into space by a Chinese spacecraft to observe heritable alterations in the genetic blueprint of these seeds and planting materials induced by the effects of cosmic rays, microgravity and magnetic fields in space. Upon return to Earth, the seeds were planted in the greenhouse at the FAO/IAEA Agriculture and Biotechnology Laboratory in Seibersdorf, Austria, with the objective of evaluating progeny for desirable traits such as resistance to stress and improved quality.

Rice fields in Viet Nam.
© UN Photo/Kibae Park

CONVENTION ON BIOLOGICAL DIVERSITY (CBD)

The Convention on Biological Diversity (CBD) was signed at the Earth Summit in Rio de Janeiro, Brazil, in 1992 and entered into force on 29 December 1993. It is the first global agreement to cover all aspects of biological diversity: the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the use of genetic resources.

The Secretariat of the Convention on Biological Diversity (SCBD), based in Montreal, Canada, was established to support the goals of the Convention. Its assists member Governments in mainstreaming biodiversity into broader national policies, facilitates national implementation of the Strategic Plan for biodiversity 2011-2020, compiles national reports on measures taken for the implementation of the Convention and the effectiveness of those measures, coordinates related activities with other international organizations and collects and disseminates information. The Secretariat also acts as an information clearing house.

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CONVENTION TO COMBAT DESERTIFICATION (UNCCD)

Desertification, along with climate change and loss of biodiversity, were identified as the greatest challenges to sustainable development at the 1992 Rio Earth Summit. Established in 1994, the United Nations Convention to Combat Desertification (UNCCD) is the sole legally binding international agreement linking environment and development to sustainable land management.

The Convention specifically addresses arid, semi-arid and dry subhumid areas, known as drylands, where some of the most vulnerable ecosystems and peoples can be found. In Sustainable Development Goal 15, Member States committed themselves to combating desertification and halting and reversing land degradation. The permanent secretariat of the Convention facilitates cooperation among the Convention's 195 parties in improving living conditions for people in drylands, maintaining and restoring land and soil productivity, and mitigating the effects of drought.

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Biodiversity

Biodiversity for food and agriculture includes crops, farm animals, aquatic organisms, forest trees, microorganisms and invertebrates that are directly or indirectly responsible for the production of food for the human population. It is represented by the many thousands of species and their genetic variability, which are at the heart of healthy ecosystems, and is among the Earth's most important resources. Effective and urgent action is needed to halt the loss of biodiversity in order to enhance resilience and functioning of ecosystems to secure the planet's variety of life. To ensure this, it is important to reduce pressures on biodiversity, restore ecosystems, sustainably use biological resources, share benefits arising out of utilization of genetic resources in a fair and equitable manner, mainstream biodiversity issues and values, and base decision-making on sound science and the precautionary approach.

Space technologies, especially in terms of systems for Earth observation and characterization of agroecological zones and ecosystems, could prove an important asset in informing decision makers through assessing the state of conservation of biodiversity for food and agriculture, estimating the health status of ecosystems and predicting threats from climate change and invasive alien species, among other things. Depending on its resolution, space-derived imagery can provide information used in direct approaches (species composition, land cover) and indirect approaches (primary productivity: chlorophyll, ocean colour; climate: rainfall, soil moisture; habitat: digital elevation, biomass structure) for quantifying and modelling biodiversity. Space technologies can also provide additional value by integrating images and mapping abilities into existing information systems on genetic resources for food and agriculture.

Senegalese woman holding home-grown peppers.
© UN Photo/Evan Schneider

Desertification

Sustainable land use is a prerequisite for lifting billions of people out of poverty, enabling food and nutrition security and safeguarding water supplies. Desertification includes land degradation in arid, semi-arid and dry subhumid areas resulting from various factors, including climatic variations and human activities such as overgrazing and overcultivation. Desertification affects as much as one-sixth of the world's population, 70 per cent of all drylands, and one quarter of the total land area of the world.

Building on the recognition by the United Nations Conference on Sustainable Development (Rio+20), in its outcome document, of the need for urgent action to reverse land degradation, Sustainable Development Goal 16 is aimed at combating desertification and restoring degraded land and soil, including land affected by desertification, drought and floods, and strives to achieve a land degradation-neutral world by 2020.

Space technology offers unbeatable advantages in view of homogeneity and spatial and temporal coverage of observations, and allows the monitoring of various elements of desertification processes. These elements include climate-related variables, surface albedo (fraction of reflected radiation), surface temperature, moisture, vegetation indices, as well as changes in vegetation cover, land surface composition, sand transport and wind transportation. Since desertification is a complex, cross-sector environmental problem promoted by multiple drivers, its monitoring requires the integration of human- and environment-based variables. Being essential for early warning and monitoring of desertification development and its extent, remotely sensed information also assists in evaluating the impacts of policies to combat desertification.

Dryland in Timor-Leste.
Image: UN Photo/Martine Perret

ECONOMIC COMMISSION FOR AFRICA (ECA)

Established by the Economic and Social Council of the United Nations in 1958 as one of the five regional commissions of the United Nations, ECA's mandate is to promote the economic and social development of its member States, foster intra-regional integration, and promote international cooperation for Africa's development. Made up of 54 member States, and playing a dual role as a regional arm of the United Nations and as a key component of the African institutional landscape, ECA is well positioned to make unique contributions to address the continent's development challenges.

The ECA report "Status of Food Security in Africa" indicated that food security remains a challenge for the continent and that African countries need to shape their policy responses around increased agricultural productivity and production, development of markets and building the resilience of vulnerable populations. ECA works to build capacities for risk and disaster management systems through the use of information and communication technologies in Africa and to address the lack of both awareness and established systems for prevention, preparedness and monitoring of natural disasters.

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ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN (ECLAC)

The Economic Commission for Latin America and the Caribbean (ECLAC), headquartered in Santiago, Chile, is one of the five regional commissions of the United Nations. It was founded in 1948 with the purpose of contributing to the economic development of Latin America, coordinating actions directed towards that end, and reinforcing economic ties among countries and with other nations of the world. The promotion of the region's social development was later included among its primary objectives.

ECLAC has been engaged in the identification of best practices in the use of satellite remote sensing data to enhance agricultural productivity and sustainability and to mitigate the effects of climate change, and in the regional dissemination of such experiences through publications, seminars, workshops and technical assistance activities. ECLAC has also organized international seminars to discuss, among other subjects, experiences related to the use of spatial imagery, satellite data and satellite Internet access for agricultural purposes, including in areas such as precision agriculture and precision irrigation.

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Drought

Drought forecasting and early detection relies on, among other things, satellite imaging systems, and enables decisions to be taken to prevent and mitigate the effects of drought. Monitoring that is built on knowledge acquired from past events and that uses archived imagery can help profile current trends and events so that the effects of droughts can be mitigated and famine can be avoided.

To mitigate the impact of agricultural drought, it is of great importance to have at one's disposal timely and reliable information on the condition of food crops in all regions and countries. The Global Information and Early Warning System on Food and Agriculture and the Climate, Energy and Tenure Division of FAO have as their aim the development of an agricultural stress index system, based on meteorological operational satellite-advanced very high resolution radiometer (METOP-AVHRR) composite imagery over 10 days and with a resolution of 1 km, for detecting, on a global scale, agricultural areas with a high likelihood of water stress (drought).

The agricultural stress index system is based on the vegetation health index (VHI), which was derived from the normalized difference vegetation index (NDVI) and developed by the Center for Satellite Applications and Research of the National Environmental Satellite, Data and Information Service of the United States. VHI has been successfully applied under many different environmental conditions around the globe, including in Asia, Africa, Europe, and North and South America. It can detect drought conditions at any time of the year. For agriculture, however, only the period that is most sensitive for crop growth (temporal integration) is of interest, so the analysis is performed only between the start and end of the crop season.

Mauritian village affected by drought.
Image: UN Photo/John Isaac

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC (ESCAP)

Established in 1947 with its headquarters in Bangkok, Thailand, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) is made up of 53 member States and 9 associate members and is the regional development arm of the United Nations for the Asia-Pacific region, which is home to 4.1 billion people, or two thirds of the world's population.

Through its Space Applications Section, ESCAP assists its members in the implementation of the Asia-Pacific Years of Action for Applications of Space Technology and Geographic Information System for Disaster Risk Reduction and Sustainable Development, 2012-2017, and the underlying five-year regional Plan of Action. The Regional Cooperative Mechanism on Disaster Monitoring and Early Warning, Particularly Drought, provides substantive technical support to the region for development of national (agricultural) drought disaster monitoring and early warning capacities and services.

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ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA (ESCWA)

The Economic and Social Commission for Western Asia (ESCWA) was established on 9 August 1973 with the objectives of raising the level of economic activity in member countries and strengthening cooperation among them. It was also intended to meet the need of the countries in Western Asia for the services of a regional economic commission to promote the development efforts in the region. Located in Beirut, ESCWA provides a framework for the formulation and harmonization of sectoral policies for member countries, a platform for congress and coordination, a home for expertise and knowledge, and an information observatory.

Under its Regular Programme for Technical Cooperation, ESCWA has advocated for the use of space-based technology in water resource management. To provide policymakers and researchers with greatly improved data in the management of water resources, ESCWA contributes to the development of the Inventory of Shared Water Resources in Western Asia. The inventory compiles and explores information on shared groundwater systems and surface water basins in Western Asia, with an emphasis on hydrology, hydrogeology, water resource development and use, and the status of cooperation.

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Floods

Among disasters caused by natural hazards, floods continue to play a significant role in terms of human and economic impacts. Severe floods threaten food security, cause loss of human life, inflict damage to property and infrastructure, lead to destruction of crops and loss of livestock, and contribute to the deterioration of public health due to spread of waterborne diseases. Space technology and its applications are indispensable not only in addressing the long-term effects of floods resulting from the decrease in agricultural production, but also in facilitating immediate humanitarian emergency situations in flood-affected areas.

Earth observation products are used extensively to forecast storms, floods and cyclones and to monitor their overall impact on the economy. The mapping of floodplains and areas at risk of landslides with high-resolution imagery and detailed elevation models generated from satellite imagery and precise global navigation satellite system (GNSS) services can reduce the vulnerability or exposure of urban and rural populations. Evidence and experience from previous disasters suggest that having substantive capacity enables policymakers to use Earth observation inputs more effectively.

There is a serious need to bridge the gap between the scientific flood forecasting and modelling community and the humanitarian and local support systems in risk-prone areas. In this context, end users are not limited to humanitarian agencies, but rather also include ground-level end users such as smallholder farmers. Critical forecasts will not only allow timely humanitarian planning (pre-positioning), but also enable the most vulnerable members of communities to prepare for and ultimately build resilience to repeated shocks.

Floods of the Zambezi and Chobe Rivers in Namibia.
Image: NASA

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO)

The Food and Agriculture Organization of the United Nations (FAO), established in 1945 and presently headquartered in Rome, Italy, is an agency of the United Nations that leads international efforts to defeat hunger. Serving both developed and developing countries, FAO acts as a neutral forum where all nations meet as equals to negotiate agreements and debate policy.

FAO provides support to countries to promote and enhance sustainable land use and land resources management through, among other things, the development of geo-referenced databases on land cover and global land, water and forest resources, and has created a global fisheries information system. FAO has initiated global inventories of livestock production systems and mapping of generalized farming systems. It provides national land use statistics and maintains an online overview of crop characteristics, ecology and management. FAO holds the ARTEMIS satellite-based environmental and agrometeorological databases and analysis tools and assures the documentation (metadata) and distribution of FAO's spatial information through the GeoNetwork.

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INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

IAEA is the world's centre of cooperation in the nuclear field. It was set up as the world's "Atoms for Peace" organization in 1957 within the United Nations family. The Agency works with its member States and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies. The IAEA secretariat is headquartered in Vienna, Austria, and has its operational liaison and regional offices in Geneva, New York, Tokyo and Toronto. The work of the Agency is as diverse as the landscape of peaceful nuclear technologies, and encompasses experiments conducted in outer space.

The use of the space environment to uncover hidden potential in crops was a focus of a project undertaken by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. As part of the project, a package of rice was sent into space by a Chinese spacecraft to observe heritable alterations in the genetic blueprint of these seeds and planting materials induced by the effects of cosmic rays, microgravity and magnetic fields in space. Upon returning to Earth, the seeds were planted with the objective of evaluating progeny for desirable traits such as resistance to stress and improved quality.

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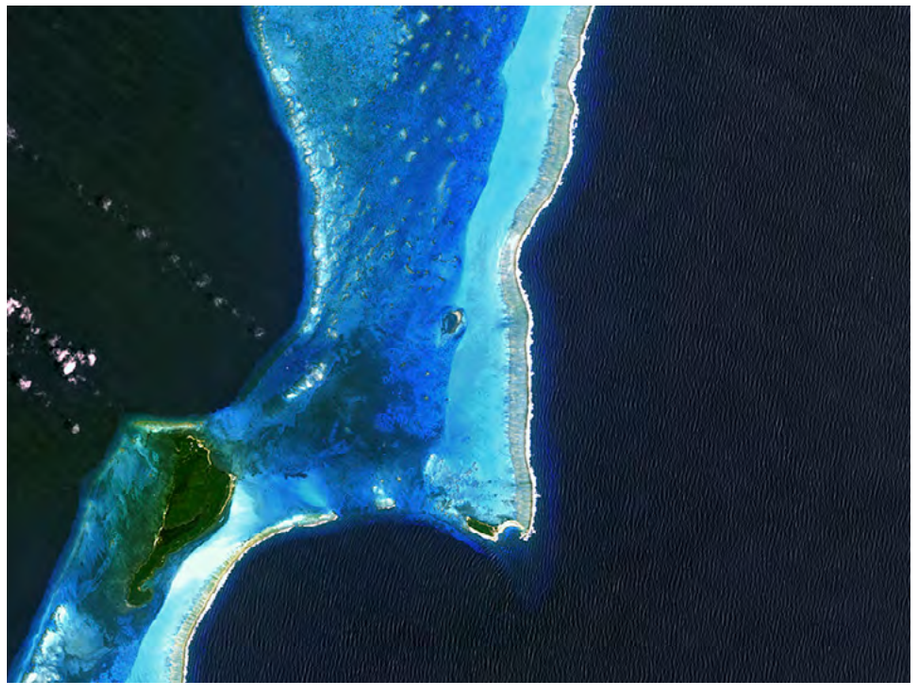
Fisheries and aquaculture

Fish, either produced through fish farming and aquaculture activity or caught from wild marine or freshwater stocks, make an important contribution to global animal protein supplies, and there is a growing recognition of the contribution of fisheries and aquaculture to food security and nutrition. At the same time, marine and freshwater fisheries around the world continue to be seriously threatened as a result of fishing overcapacity and a range of environmental problems, and the rising demand for fish products is largely being supported by increased aquaculture output. Changes in the sourcing of fish will continue to cause significant spatially variable effects on marine and other aquatic environments, effects that are best managed through the application of geographic information systems and remote sensing methods.

Direct detection of fish through the use of space technology is not always feasible, although the latest acoustic techniques allow detection and imaging of fish schools at long distances using the continental shelf as a waveguide. Nevertheless, remote sensing technology is valuable for indirect detection of fish through observation of sea phenomena. These phenomena include bioluminescence (production and emission of light by certain types of plankton when they are disturbed by the movement of fish), changes in ocean colour, chlorophyll distribution and abundance, currents, turbidity, salinity and water temperature.

Space technology is of great value when it comes to characterizing marine and coastal environments. Satellite navigation technology allows authorities to track the position, course and speed of fishing vessels, which is necessary in fighting illegal, unregulated and unreported fishing practices, and contributes to the efficiency of fishing management. Secure satellite communications assist in the transfer of information between ships and shore. Improved weather forecasting through the use of meteorological satellites contributes to safety for fishermen at sea.



Lighthouse Atoll in the Belize Barrier Reef.
Image: ESA

Irrigation and water

Water is a key strategic resource in agriculture, and water scarcity represents both a critical constraint to food production and a major cause of poverty and hunger. At present, 45 per cent of food supplies comes from areas without any water management system (i.e. only rain-fed). Special attention is needed to sustainably manage water sources, including groundwater, non-conventional waters, and stored water.

Space technology provides spatial information regarding water and food production, which is used for assessing water productivity and evapotranspiration and for identifying irrigated areas. Assessing the water productivity of irrigated and rain-fed agriculture, in terms of yield per cubic metre of water transpired, allows the benchmarking of the performance of different agricultural systems and the identification of possibilities for improving such performance. Data on evapotranspiration is useful in water accounting frameworks and in the assessment, under irrigated circumstances, of the amount of water used beneficially for crop growth in comparison with the amount of water withdrawn for irrigation.

Available high-resolution satellite remote sensing data combined with satellite navigation data are also used in precision irrigation and precision farming techniques. Those techniques help in gathering data on factors such as soil condition, humidity, temperature, intensity of planting and other variables in order to precisely identify water, fertilizer and pesticides requirements. Accurate targeting of such areas contributes to an optimal distribution of water and fertilizers, which not only improves crop yields but also reduces costs and the environmental impact of agricultural activities.

Rural areas along Okavango River in northern Namibia and southern Angola.
Image: ESA

UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (UNESCO)

In 1945, UNESCO was created in order to respond to the firm belief of nations that lasting peace must be established through humanity's moral and intellectual solidarity. UNESCO strives to enhance intercultural understanding through protection of heritage and support for cultural diversity, universal access to quality education, and scientific cooperation and protection of freedom of expression as an essential condition for democracy, development and human dignity.

UNESCO's space-related activities are aimed at creating awareness among member States by showing them, with a series of applications, the full potential of space technologies for the well-being of humanity. UNESCO space activities are mainly focused on (1) the Global Ocean Observing System (GOOS), implemented by the International Oceanographic Commission (UNESCO-IOC); (2) Earth observation, through the Global Earth Observation (GEO and GEOOS) forums, in which UNESCO is represented by its Earth Sciences Programme; and (3) support of the activities of the World Heritage Convention with the assistance of a large network of UNESCO space partners.

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UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)

UNEP, established in 1972, is the voice for the environment within the United Nations system. UNEP acts as a catalyst, advocate, educator and facilitator to promote the wise use and sustainable development of the global environment. UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing and enabling nations and peoples to improve their quality of life without compromising that of future generations.

UNEP works to build the ecological foundation of food security through sustainable food systems. It assists its members in strengthening their agricultural, environmental and macroeconomic policies to create the conditions for sustainable agriculture and rural development. Through education initiatives, utilization of economic incentives and the development of appropriate and new technologies, UNEP aspires to ensure stable supplies of nutritionally adequate food, access to those supplies by vulnerable groups, and production for markets; employment and income-generation to alleviate poverty; and natural resource management and environmental protection.

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Land-use mapping

Land-use and land-cover maps are essential tools for decision makers in formulating policies for sustainable rural development. Remote sensing data are a source of information used to map the risk of desertification, soil erosion, oversalinization and acidification. There are over 50 Earth observation satellites, including those of the Landsat and the Sentinel-2 series, that are used for monitoring land cover. Some of these are high-resolution (submetre) imagery platforms that assist in enhancing sustainable land use and land resource management across a range of agroecological zones and production systems, such as rain-fed and irrigated cropping, intensive and extensive livestock production, agroforestry and sustainable forest management.

Satellite images enable direct observation of the land surface at repetitive intervals, making possible the evaluation of the static and dynamic attributes of land cover (types, area and arrangement, and types and rates of change). Soil and fertility analysis and irrigated landscape mapping are examples of some common applications of space technology in land-use mapping. The resulting data and maps of status and trends, combined with best practices and lessons learned, are intended to allow decision makers to identify areas at risk and to better plan, and monitor and assess afterwards, the effectiveness of their implementation and investment strategies and supporting policies in regard to improving sustainable land management.

Promoting a participatory process with land users and service providers at the subnational level improves their inputs and access to information, technical knowledge and know-how, and thereby facilitates the empowerment of farmers, livestock keepers and foresters in implementing sustainable production systems. The combined use of geospatial information and participatory assessments provides an effective decision-making process for enhanced spatial planning (land use/territorial) and sustainable land resource management among the various sectors and actors.

Agricultural crops in Aragon and Catalonia, Spain.
Image: ESA

UNITED NATIONS OFFICE FOR DISASTER REDUCTION (UNISDR)

The secretariat of the International Strategy for Disaster Reduction (UNISDR) was created in December 1999 by General Assembly resolution 54/219 as a successor arrangement of the secretariat of the International Decade for Natural Disaster Reduction (IDNDR) with the purpose of ensuring the implementation of the International Strategy for Disaster Reduction (ISDR). The Strategy reflects a major shift from the traditional emphasis on disaster response to disaster reduction, and in effect seeks to promote a “culture of prevention”.

UNISDR supports the implementation, follow-up and review of the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) adopted by the Third United Nations World Conference on Disaster Risk Reduction on 18 March 2015 in Sendai, Japan. The Sendai Framework is a 15-year voluntary, non-binding agreement that maps out a broad, people-centred approach to disaster risk reduction, succeeding the Hyogo Framework for Action that served as a 2005-2015 roadmap for building resilience to disasters.

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UNITED NATIONS INSTITUTE FOR TRAINING AND RESEARCH/ OPERATIONAL SATELLITE APPLICATIONS PROGRAMME (UNITAR/UNOSAT)

The United Nations Institute for Training and Research (UNITAR) is a training arm of the United Nations system, serving some 36,000 beneficiaries annually by conducting more than 500 capacity development and research activities around the world. The mission of UNITAR is to develop capacities of individuals, organizations and institutions to enhance global decision-making and to support country-level action for shaping a better future.

The Operational Satellite Applications Programme (UNOSAT) of UNITAR is a technology-intensive programme delivering imagery analysis and satellite solutions to relief and development organizations within and outside the United Nations system to help make a difference in critical areas such as humanitarian relief, human security, and strategic territorial and development planning. UNOSAT develops applied research solutions, keeping in sight the needs of the beneficiaries at the end of the process.

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Managing, mitigating and preparing for disasters

Every year disasters take the lives of around 90,000 people and affect close to 160 million people worldwide. In cases of disasters caused by natural hazards, such as earthquakes, tsunamis, volcanic eruptions, landslides, hurricanes, floods, wildfires, heatwaves and droughts, and at each phase of the disaster management cycle—response, recovery, mitigation and preparedness—space technology provides information for emergency planning and response interventions.

In disasters and complex humanitarian emergencies, space technology is crucial to the effectiveness of response and relief operations when it comes to ensuring food security for the affected population. While the role of space technology applications in early warning and monitoring of slow-onset disasters such as drought is clear, it is of no less importance when it comes to rapid-onset disasters. In such cases, space technology facilitates data collection and transmission, as well as the use of crowdsource communities and social networks, through which relevant and validated data can more easily be shared.

Furthermore, as communications capabilities are often limited by emergency-related destruction, satellite communications facilitate smooth and expedient coordination that is critical for prompt understanding of the extent of damage and complex planning with respect to food, water and other necessities, without the need for costly ground-based infrastructure. Satellite navigation and positioning technology is indispensable for tracking and tracing food security efforts during such devastating events, as well as for fleet management related to food delivery. United Nations entities assist Member States by addressing institutional challenges, strengthening policy formulation and building technical capacities to use space technology for disaster management and emergency response.

Flooded streets in Gonaives, Haiti, after a hurricane.
Image: UN Photo/UNICEF/Marco Dormino

UNITED NATIONS PLATFORM FOR SPACE-BASED INFORMATION FOR DISASTER MANAGEMENT AND EMERGENCY RESPONSE (UN-SPIDER)

The United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) was established in 2006 under the aegis of the United Nations Office for Outer Space Affairs (UNOOSA). UN-SPIDER develops solutions to address the limited access developing countries have to specialized technologies that can be essential in the management of disasters and in reducing disaster risks.

Remote sensing for Earth observation, satellite-based telecommunication and global navigation satellite systems contribute to more effective disaster risk management and emergency response. It is UN-SPIDER's mandate to enable developing countries to use all types of space-based information in all phases of the disaster management cycle, including prevention, preparedness, early warning, response and reconstruction.

UN-SPIDER aims at improving actions to reduce disaster risk or support disaster response operations through knowledge sharing and the strengthening of institutions in the use of space technologies. UN-SPIDER also facilitates cooperation between satellite data and information providers and the different groups of users of such data, such as policymakers, disaster risk managers and emergency responders. The objective is a better flow of information on disaster risks or disaster impacts between all stakeholders and affected populations.

UN-SPIDER's Knowledge Portal is a hub for pertinent information, links and resources.

Jointly with its network of international partners, UN-SPIDER builds the capacities of developing countries to access and use space technologies. Through its tailor-made technical advisory support, UN-SPIDER assesses the individual potential of a country, makes specific recommendations and carries out specialized training courses for government staff. Additionally, through its conferences, workshops and expert meetings, UN-SPIDER brings together relevant stakeholders from both the space and the disaster management communities in order to foster an exchange of innovations and experiences.

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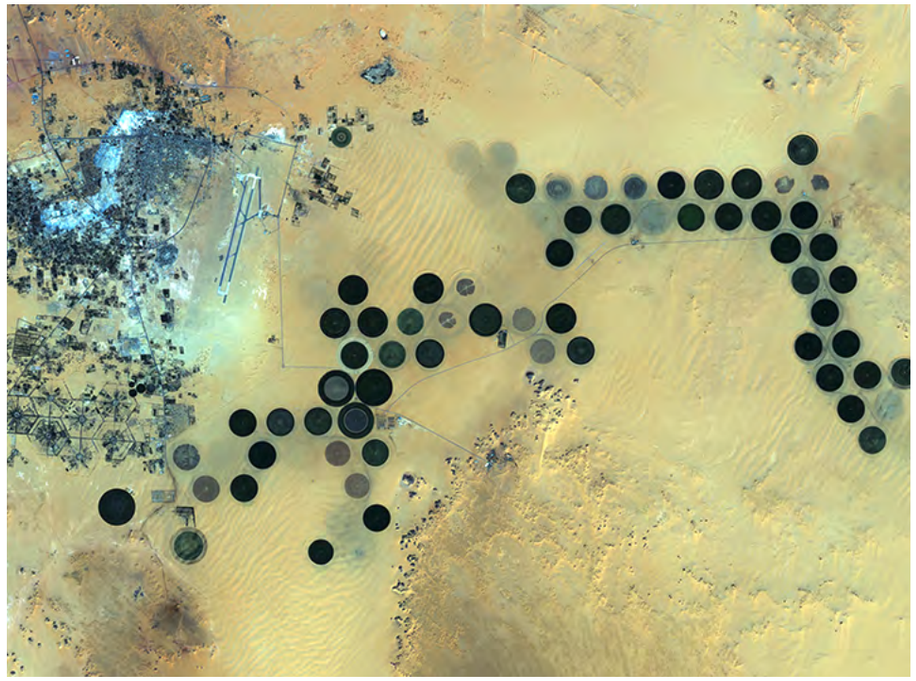
Monitoring agricultural production

Monitoring crop growth and producing early forecasts of planted crops are of immense importance for planners and policymakers at the national level in areas related to food security. Reliable, timely and credible information enables planners and decision makers to handle deficits or surpluses of food crops in a given year in an optimal manner. Timely and reliable national agricultural statistics can be obtained through the establishment of an adequate, periodic national agricultural survey based on probability-sampling methods, image classification and adherence to well-defined and reproducible techniques.

Spectral analysis of high resolution satellite images enables the performance of real-time monitoring of crop vegetation indices for different fields and crops as well as the identification and tracking of positive and negative dynamics of crop development. Such dynamics, revealed by differences in vegetation indices, provide signals about disproportions in single crop development. In addition to crop health and change detection, space-based platforms provide inputs for environmental analysis, irrigated landscape mapping, yield determination and soil analysis. All of these techniques, when integrated in decision-making models, may inform of the necessity of specific agricultural interventions in particular field zones.

The use of a number of ancillary data, including the integral use of remotely sensed data, is a key component in effective monitoring of agricultural production. Earth observation data is now used regularly to monitor the crop season, and satellite imagery coverage integrated with field surveys allows the quantification of areas planted and to be harvested during crop seasons. United Nations entities continue to provide support to Member States in enhancing their national capacities to make improved crop forecasts and production estimates.



Agricultural plots in Libya.
Image: ESA

UNITED NATIONS PROGRAMME ON SPACE APPLICATIONS

The United Nations Programme on Space Applications was established in 1971 on the recommendation of the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE), which took place in Vienna, Austria, in 1968. The Programme's initial mandate was to create awareness among policymakers and government agencies of the benefits of space technology and to assist people from developing countries in acquiring the knowledge, skills and practical experience necessary for its application. A United Nations Expert on Space Applications was also appointed at that time to oversee the Programme.

Since its establishment, the Programme on Space Applications has made substantial progress in furthering knowledge and experience of space applications around the world. Provision of country capacity-building, education, research and development support and technical advisory services by the Programme have all helped to reduce the gap between the industrialized and developing countries. However, much more remains to be accomplished.

The support of Member States and their participation in the Programme on Space Applications are vital. It is only through the commitment of all nations that the Programme can achieve its primary objective of putting space technology to work for sustainable economic and social development, not just in individual countries, but on a global basis.

The Programme on Space Applications is implemented by the United Nations Office for Outer Space Affairs. In fulfilling the Programme's mission, the Office strives to enhance the understanding and subsequent use of space technology for peaceful purposes in general, and for national development in particular, in response to expressed needs in different geographic regions of the world.

Some of the activities organized under the framework of the Programme by the Office for Outer Space Affairs in the area of agriculture and food security include workshops focusing on the use of space technology for sustainable development towards food security (India), integrated space technology applications for monitoring the impact of climate change on agricultural development and food security (Kenya), and integrated use of space technology for food and water security (Pakistan). The workshops are aimed at building capacities in the use of space technology applications, information and services that contribute to sustainable economic and social development programmes supporting agricultural and water security, primarily in developing countries.

PROGRAMME ON SPACE APPLICATIONS, UNOOSA

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Vegetation fires

Globally, vegetation fires affect an estimated 350 million hectares of land each year. The control of such fires has become an issue of high importance, not only because of the increasing number of casualties and the huge areas burned, but also because of the linkages with issues of global interest, such as climate change and food security. The Global Fire Information Management System (GFIMS) addresses these issues by delivering global near-real-time fire information to users to support fire managers around the world.

GFIMS is a web-based integrated tool that uses remote sensing and GIS technologies to deliver global Moderate Resolution Imaging Spectroradiometer (MODIS) hotspot/fire locations (from MOD14/MYD14 standard products) and burned areas (from the MCD45 standard product) to natural-resource managers and other stakeholders around the world. National and regional historical fire statistics, including frequency by major land-cover types (i.e. when, where and what), are produced in support of projects and programmes.

GFIMS is hosted by the Natural Resources Department of FAO and is based on the Fire Information for Resource Management System (FIRMS) developed at the University of Maryland. The system provides information to strategic land managers for policy formulation, including on detection and early warning, deployment of assets for fire suppression, follow-up restoration planning, strategy development for preparedness and prevention, ecological monitoring, modelling of fire emissions, and validation of fire risk maps—all from global to local scale. It is intended to be one of the components of an operational monitoring system of FAO that delivers near-real-time information to ongoing monitoring and emergency projects.

Rim fire in California.
Image: NASA

WORLD FOOD PROGRAMME (WFP)

The World Food Programme is the world's largest humanitarian agency fighting hunger worldwide. Established in 1961, WFP pursues a vision of the world in which every man, woman and child has access at all times to the food needed for an active and healthy life. The core policies and strategies that govern WFP activities are to provide food aid in order to save lives in refugee and other emergency situations; to improve the nutrition and quality of life of the most vulnerable people at critical times in their lives; and to help build assets and promote the self-reliance of poor people and communities, particularly through labour-intensive works programmes.

WFP has been extensively using space applications, in particular Earth observation data, to support emergency response activities and operations. As leader or co-leader of the clusters on global food security, global logistics and emergency telecommunications of the Inter-Agency Standing Committee, WFP coordinates responses to major emergencies.

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WORLD METEOROLOGICAL ORGANIZATION (WMO)

Established in 1950, the World Meteorological Organization (WMO) in 1951 became the specialized agency of the United Nations for meteorology (weather and climate), operational hydrology and related geophysical sciences. It originated from the International Meteorological Organization (IMO), which was founded in 1873. Today, WMO is the United Nations system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources. WMO has a membership of 191 member States and Territories.

The development of the Global Framework for Climate Services became a major milestone in the work of WMO. In that context, space-based observations had an essential role to play in the four priority areas identified among climate application services, namely, health, agriculture and food security, water, and disaster risk reduction.

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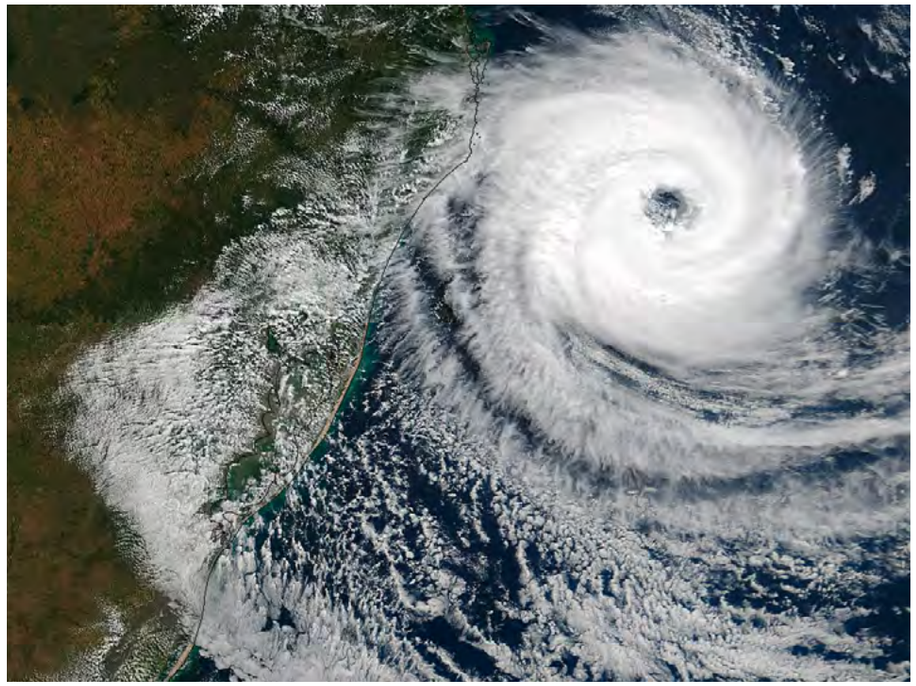
Weather monitoring and forecasting

Global food security, linked to a wide array of agriculture and water supply systems as well as natural ecosystems, is under constant threat from weather and climate extremes, making the monitoring and forecasting of weather of crucial importance to farmers. Such monitoring and forecasting is effectively provided by satellite observations, complemented with ground-based weather stations for predicting storms, flooding and frost.

Space-based weather observations are performed by a constellation of geostationary meteorological satellites for permanent monitoring, as well as by a constellation of low-Earth orbit satellites, which are generally near-polar and sun-synchronous, for global coverage with a comprehensive suite of active or passive instruments. Meteorological satellites provide measurements of atmospheric humidity, temperature and atmospheric winds, concentrations of greenhouse gases and aerosols, cloud-cover density and cloud particle properties; and allow for near-continuous monitoring of global weather conditions and forecasting.

Observations derived from satellites are extensively assimilated in numerical weather prediction models to support short- to medium-range weather forecasts. Rainfall estimations derived from infrared and/or microwave satellite imagery help farmers plan the timing and amount of irrigation for their crops. Land-surface temperature and soil moisture products are starting to be operationally available. At the same time, ground-based measurements of air and soil temperature and soil moisture continue to be used for verification.



Tropical cyclone off the coast of Brazil.
Image: NASA

ACRONYMS AND ABBREVIATIONS

CBD	United Nations Convention on Biological Diversity
ECA	Economic Commission for Africa
ECLAC	Economic Commission for Latin America and the Caribbean
ESCAP	Economic and Social Commission for Asia and the Pacific
ESCWA	Economic and Social Commission for Western Asia
FAO	Food and Agriculture Organization of the United Nations
IAEA	International Atomic Energy Agency
UNCCD	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISDR	United Nations Office for Disaster Risk Reduction
UNITAR/UNOSAT	Operational Satellite Applications Programme (UNOSAT) of the United Nations Institute for Training and Research (UNITAR)
UNOOSA	United Nations Office for Outer Space Affairs
UN-SPIDER	United Nations Platform for Space-based information for Disaster Management and Emergency Response
WFP	World Food Programme
WMO	World Meteorological Organization

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United Nations Environment Programme (UNEP)

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World Food Programme (WFP)

World Meteorological Organization (WMO)

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The United Nations Office for Outer Space Affairs (UNOOSA) is responsible for promoting international cooperation in the peaceful uses of outer space and assisting developing countries in using space science and technology.