Forum:	Commission on Science and Technology for Development (CSTD)
Issue:	Using Satellite Technology to Combat Food Insecurity
Student Officer:	Anastasia Couri
Position:	Deputy President

PERSONAL INTRODUCTION

Dear Delegates,

My name is Anastasia Couri and I am a 9th grader at Platon School. It is my utmost honor and pleasure to be serving as a co-chair in the Commission on Science and Technology for Development in this year's PSMUN conference. During my MUN journey, I have always admired the Student Officers involved throughout all the conferences I've participated in. My goal for this year's conference is to make you all have a great time during these three days and inspire you the way my chairs inspired me during my MUN journey.

Having said that, the Commission on Science and Technology for Development is committed to aiding developing countries to benefit from the use of technology and science, as a means of addressing their challenges. This Study Guide will familiarize you with one of this year's agenda topics, namely "Using Satellite Technology to Combat Food Insecurity," referring to the serious matter of food insecurity all around the world, by utilizing satellite technology. While reading the study guide, you will find information regarding the topic and its historical background while presenting organizations and major countries involved and providing you with possible solutions.

You are all strongly encouraged to conduct your own extensive research regarding the topic and not to rely exclusively on this study guide. In case any delegate has any questions or needs any clarifications, concerning the subject or the procedure, you are more than welcome to contact me by email at anastasia.couri@gmail.com.

I look forward to meeting you all in March!

Yours truly,

Anastasia

INTRODUCTION

Satellite technology constitutes one of the currently developing technologies, in various fields. For context, satellites are devices ubiquitously used, globally, aiming to collect crucial information used in our everyday lives, such as communication via our mobile phone, and navigation, commonly known as GPS, but also predict weather and allow us to explore the universe. They are devices, which depending on their altitude and orbit serve different purposes, yet they all share some common structural aspects.

These include the antenna and the power source. Specifically, these are used to send and receive signals from the stations existing on earth and be powered to complete their services, respectively. Thus, they are connected with a station that transmits radio signals on land, making it the way of communication between Earth and space.

Through this procedure, satellites offer various advantages and aid in addressing issues, such as food insecurity, which a significant amount of the population faces and will be further elaborated on in this study guide. Food insecurity, on the other hand, is the term used when the availability of clean food and water is lacking.[1]

To be specific, the use of satellite technology in food insecurity is contributing to the mitigation of the issue globally, by collecting data, monitoring, and imaging croplands. In further detail, satellites get to use their sensors to fulfill the aforementioned tasks and transmit the data through radio signals to Earth. Afterwards, the data collected includes information and images of croplands, stating their water availability, plant health, the population of pests, product yield, and soil fertility. In addition, they also allow farmers to protect their yields from droughts, floods, and other extreme weather by predicting these phenomena.

However, it goes without saying that although the use of satellite technology offers many advantages, which will be further explained, it also comes with several challenges and concerns. Therefore, while satellites may be a potentially efficient way to tackle issues such as food insecurity, it is not without their drawbacks, which ultimately leads to the paradox of progress. [2]

[1] FAO. "Hunger and Food Insecurity." *Food and Agriculture Organization of the United Nations*, 2022, www.fao.org/hunger/en/.
[2] "Blog." *TS2 SPACE*, ts2.space/en/the-impact-of-satellite-technology-on-the-agriculture-and-food-industries/#google_vignette.

DEFINITION OF KEY TERMS

Satellite

A satellite is essentially a smaller body that rotates around a much bigger one. In the case of satellite technology, we are talking about a machine or a device that rotates around Earth, with the ultimate goal of collecting data.[3]

Satellite Orbit

When talking about the orbit of a satellite, we mean the circular motion it does and the path it follows, around the Earth.[4]

Altitude

In simple terms, altitude is the height of a body, above sea level. For instance, satellites usually have a high altitude, measuring from a few kilometers up to thousands.[5]

Food insecurity

When a person is characterized as "food insecure", they lack access to food and proper nutrition. In extreme cases, such individuals have gone an entire day without food throughout the year.

Satellite technology

Satellites have the ability to communicate by receiving signals from the earth and sending them back with the use of a retransmitter, which utilizes radio signals.[6]

Crop monitoring

This term refers to the variety of technologies used with the ultimate goal of analyzing and assessing the health of crops from a distance, by monitoring the land. [7]

Precision agriculture

Precision agriculture uses information technology (IT) to ensure plants and soil get the necessary nutrients for health and productivity. [8]

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[3] "What Is a Satellite?" *NanoAvionics*, 1 Sept. 2022, nanoavionics.com/blog/what-is-a-satellite/.

[4] European Space Agency. "Types of Orbits." *Esa.int*, 30 Mar. 2020, www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits.

[5] Staff, Astronomy. "What's the Altitude of a Typical Artificial Satellite, and How Can I See One? | Astronomy.com." *Astronomy Magazine*, 1 June 2006, www.astronomy.com/observing/whats-the-altitude-of-a-typical-artificial-satellite-and-how-can-i-see-one/.

[6] Labrador, Virgil. "Satellite Communication - How Satellites Work." *Encyclopædia Britannica*, 2019, www.britannica.com/technology/satellite-communication/How-satellites-work.

[7] Mary. "Remote Crop Monitoring System: How Does It Work?" *Geopard.tech*, 28 Feb. 2022, geopard.tech/blog/smart-crop-monitoring-system-how-does-it-work/.

[8] Wigmore, Ivy. "What Is Precision Agriculture? - Definition from WhatIs.com." *WhatIs.com*, Oct. 2022, www.techtarget.com/whatis/definition/precision-agriculture-precision-farming.

BACKGROUND INFORMATION

An overview of satellite technology

A satellite is, generally speaking, a small object revolving around a bigger body of mass. For instance, the moon could be considered Earth's satellite, as it revolves around it. As aforementioned, the uses of satellites and their capabilities are ubiquitous and have a wide variation of branches they contribute to. However, although it may sound rather simplistic, satellite technology used nowadays in various fields, such as agriculture, is a bit more complex.

Specifically, the satellite's orbit consists of three main dimensions, including the orbit's leaning, or the angle it forms with the equator, as well as its perigee and apogee, which are the closest and farthest distances from Earth, respectively. In further detail, the orbital inclination indicates the angle that the satellite is in when in orbit, compared to the equator of Earth.

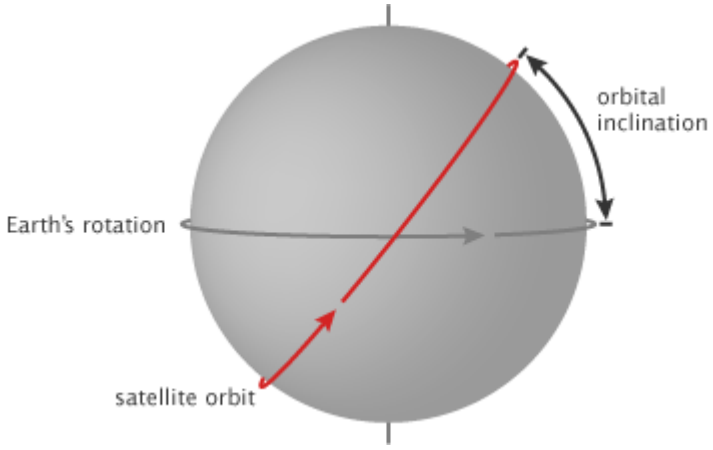

Illustration of orbital inclination, to the Earth's equator

At the same time, both apogee and perigee are measured by the sensors of the satellite which, later on are put into a software program, after it makes it into orbit, either in kilometers, which is more common, or nautical miles. The perigee refers to the point closest to Earth, which the satellite reaches during its rotation. On the other hand, the apogee refers to the farthest point it would reach while it revolves around Earth.

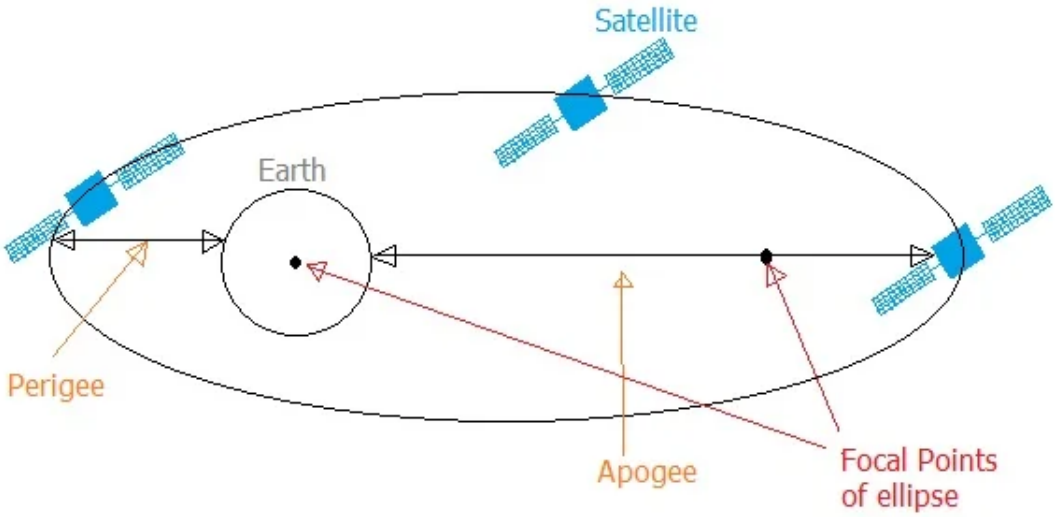

Illustration of the earth and a satellite during its full rotation [9]

Orbits are reached successfully when a satellite manages to accelerate to the desired height and reach its rotation speed of approximately 10 kilometers per second, to maintain its acceleration height. The different rotations they might do, however, depend on the purpose they are to serve. Thus, for that specific reason, satellites are categorized based on their orbit, namely, their altitude.

Types of satellites

Specifically, there are five different types of satellites, including; Low Earth Orbit (LEO), Medium Earth Orbit (MEO), Geostationary orbit (GEO), and lastly, Sun-synchronous orbit (SSO).

Low Earth Orbit Satellites (LEO)

To be specific, the satellites in the LEO category have the ability to reach an altitude between 160 and 1.500 kilometers above Earth. However, due to their short orbital period which only ranges between 90 to 160 minutes, they manage to approximately complete 16 daily orbits around the Earth, which is a relatively small value. LEO satellites, though, are the ones most commonly used for practices such as precision agriculture, which aids in the mitigation of

[9] "Redirect Notice." *Google.com*, 2024, www.google.com/url?sa=i&url=https%3A%2F%2Fwww.rfwireless-world.com%2FTerminology%2FApogee-vs-Perigee.html&psig=AOvVaw3LxgA29qUrcV08UPLhlNcu&ust=1706729403530000&source=images&cd=vfe&opi=89978449&ved=0CBQQjhxqFwoTCJCVtY6ejYQDFQAAAAAdAAAAABAD.

food insecurity. Thus, such satellites perform as tools to address this issue, since they provide society with high-quality, up-close imagery of landscapes.

Medium Earth Orbit Satellites (MEO)

MEO satellites, on the other hand, reach an altitude of around 5.000 to 15.000 kilometers. This allows them to provide further information used for services such as navigation and positioning. Recently, however, the newer ones are being used to provide low-speed communication to other service provider companies and governments or organizations. When it comes to their orbit, they have a bigger one compared to LEO satellites, with it being between 2 to 12 hours, and manage to cover a larger amount of land, leading to the use of fewer of them revolving around Earth. However, their latency is delayed, and they transmit weak radio signals.

Geostationary Orbit Satellites (GEO)

GEO satellites are the ones used to provide society with communication services such as mobile phones and TV. Their altitude reaches values up to approximately 36 thousand kilometers above land, and each has the ability to cover almost the whole surface of the Earth. This can be particularly useful since fewer satellites that serve such purposes are needed, while they also have an orbital period almost equal to the earth's daily rotation. Furthermore, GEO satellites collect data regarding weather conditions, aiding particularly not only in everyday life but also in addressing food insecurity. Specifically, since such satellites are capable of predicting the weather and crop patterns, farmers can take advantage of their use and protect their croplands.

Sun-Synchronous Orbit Satellites (SSO)

Lastly, SSO satellites are used in order to observe the land and monitor the environment. Specifically, their orbit is designed to align with the local solar time, which leads to perfect lighting throughout the satellites' rotation around the Earth. Their altitude ranges between the value of 600 and 800 kilometers, which is lower when compared to GEOs. It is scientifically proven, however, that such satellites have the ability to further detect and predict potential dramatic changes in the climate, including severe droughts and floods, which could ultimately lead to the destruction of crops. Therefore, SSOs serve as satellites that contribute to mitigating food insecurity globally.

Each of these different types serves several purposes and is dependent on its altitude, starting at 160 kilometers and 90 minutes of orbital periods, up to 35.786 km, as previously mentioned. Thus, it can be understood that each satellite, with a different

service it is initially made to provide has a different orbit period, orbital inclination, and altitude, which aid in achieving its purpose. [10]

The Role of Satellite Technology in Eliminating Food Insecurity

When it particularly comes to contributing to the mitigation of food security, satellites can be used as tools to aid significantly. Meaning, satellite technology can play an important role in addressing such issues.

Monitoring of Agricultural Lands

To be specific, monitoring agricultural lands is one of them. As aforementioned, Low Earth Orbit (LEO) satellites help in the careful and detailed observation of croplands. This would not only be used as a means of allowing landowners to have an overview of their crops, regarding their health, nutritional needs, and population of insects but also optimize the use of fertilizers and chemicals with a harmful impact on the environment. In further detail, farmers could use this sensitive data collected by analyzing the imagery provided by satellites in order to predict their yield production. This would allow organizations such as the United Nations World Food Program (WPF) to manage their supplies of grains and develop a proper plan to contribute to the mitigation of food insecurity globally.

Predicting Droughts

In addition, by making drought predictions, satellites could help farmers protect their agricultural fields and avoid potential destruction of yield production by taking the appropriate measurements beforehand. Since satellite technology has the ability to collect accurate data when it comes to weather conditions, farmers can be informed beforehand, regarding weather conditions and manage their crops. This, in fact, goes hand in hand with satellites predicting and monitoring dramatic changes in the climate, which can ultimately lead to crop yield destruction. It goes without saying that yield destruction is a factor that ultimately contributes to food insecurity, thus, being able to protect croplands is equally important, as aforementioned.

Analyzing Cropland

Lastly, farmers are given the opportunity to acquire data such as soil fertility, allowing them to be knowledgeable regarding which area of their field would lead to higher production yield. Satellites, using their sensors, are able to provide data analysis of soil fertility. Therefore, agriculturers gain a better

[10] Sergieieva, Kateryna. “Types of Satellites by Orbits, Functions, and Practical Uses.” *Eos.com*, 22 Mar. 2023, eos.com/blog/types-of-satellites/.

understanding of their cropland and take advantage of such specialized data, to boost yield productivity. [11]

Concerns Raised Regarding the Use of Satellites

On the other hand, however, the increasing use of satellite technology in everyday life has aroused multiple concerns.

Privacy Concerns

One of them, is, without doubt, the privacy concerns of society. Specifically, due to the developing technology and enhancement of satellite capabilities regarding the collection of data, surveillance and privacy questions have been raised. For instance, since newer satellites have the ability to monitor and take high-quality images of the ground, governments or organizations, etc. may use this sensitive information to track people and their activities. What is meant by that is that as technology becomes more advanced, the abilities of satellites and the accuracy of services they provide only become further developed. High-quality images and an excessive amount of sensitive, specialized data are becoming available to governments and organizations with ease. This has ultimately led to the majority of the population, informed about satellite technology, starting to have certain doubts about the surveillance of their private data. Therefore, this makes up for one of the most ubiquitous concerns raised around the use of satellites.

Cybersecurity Attacks

Secondly, it is safe to say that it is becoming a well-known fact that as technology develops, the risk of cybersecurity attacks and hacking the systems of satellites is a concern of many. There have been numerous reports of cybersecurity attacks, while the development of technology works both ways. Meaning, that evolving technology not only contributes to the security and surveillance of information but also gives hackers a wider variety of ways to cyberattack, with even greater ease. The information satellites collect is both sensitive and could also disrupt and create problems in fields such as navigation and communication which are dependent on satellites. As a result, confidential information of governments, citizens, and organizations could cause catastrophic events if fallen into the wrong hands, which reasons why the risk of cybersecurity attacks raises the concerns of individuals.

[11] "How Satellite Data Is Contributing to Global Food Security." *Geoawesomeness*, geoawesomeness.com/eo-hub/how-satellite-data-is-contributing-to-global-food-security/. Accessed 2 Feb. 2024.

Affordability

Thirdly, due to the excessive amount of money acquiring a satellite requires, LEDCs may not have the financial resources needed to use satellite technology. Costs around satellites may vary, depending on the purpose they are to serve and the data they are to provide. Of course, this has a direct connection to the altitude and orbit of each device, analyzed previously. It goes without saying that the more advanced technology satellites use, especially for addressing issues such as mitigation of food insecurity, the more costly they are. Therefore, this could increase the problems that would have been addressed using satellites, making such countries unprivileged, which are the ones most in need, due to lack of information and technology.[12]

Dependence on Technology

In addition, the continuous use of satellite technology in our everyday lives, and more importantly addressing issues specifically like ones related to food insecurity can raise various concerns. To be specific, relying on a single method to mitigate such issues can lead to a dependence on technology. If farmers become too dependent on technology as a means of achieving the desired results in their farming and even sometimes rely completely on it to complete their work, in cases where technical issues occur or various other unforeseen circumstances, such as the ones mentioned above, they would be left in a vulnerable state. As a result, farmers would not be able to cope and take care of their croplands adequately, leading to a worse state of food insecurity than it previously was.

Environmental Impact

Lastly, the environmental impact of using such technology has raised multiple concerns. As most technological advances nowadays do not take into consideration the environmental impact they may have, using satellites could ultimately lead to environmental degradation and further changes in the climate. In further detail, the extraction of resources and manufacturing constitute a factor of concern around that matter. Not only does extracting and processing raw materials for the construction of these devices lead to environmental degradation, but also the extensive use of high energy levels could have a similar, potential impact. [13]

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[12] "Privacy Concerns and Security Measures in Satellite-Based Positioning." *Utilities One*, utilitiesone.com/privacy-concerns-and-security-measures-in-satellite-based-positioning.

[13] *What Problems Do Satellites Encounter in Space? - Darwin Innovation*. darwincav.com/satellite-problems/.

Advantages of satellite technology

It goes without saying that satellite technology offers many benefits in various fields, due to the different purposes they have the ability to serve. Despite being costly, satellites, especially newer ones, manage to cover a great amount of distance. What this essentially means is that a single satellite can collect data in a wide space, and provide the necessary services by receiving and sending back signals via radio transmissions, even at great distances. Ultimately, a single satellite can be used to cover a large amount of land on its own.

Satellites have the ability even to mitigate environmental concerns on Earth. They allow us to have access to a significant amount of crucial information which would otherwise have to be collected by complex infrastructure and large towers on Earth, if possible. This information is afterwards further studied, allowing the scientists to reach conclusions and find ways to address environmental issues.

For instance, satellites aid in addressing issues such as food insecurity. Specifically, by monitoring croplands and imaging the land while at the same time collecting various other useful data to combat the issue, including the prediction of the weather, yield production, soil fertility, and plant health. This would, therefore, give farmers the ability to control and have a better understanding of their crops, ultimately eliminating food insecurity. Also, satellites, using their sensors, help predict and identify early signs of catastrophic climate phenomena such as hurricanes, droughts, and floods. Therefore, it makes it possible for farmers to manage their crops and take the appropriate measures beforehand with the ultimate goal of avoiding the destruction of crop yield and food insecurity.

Furthermore, they play an important role in scientific research. More specifically, by collecting data such as imagery and observations of celestial bodies in space, they contribute to the understanding of the universe and help astronomers study space.

In addition, except for communication and internet services, satellites provide us with the necessary data used for navigation. By sending signals back to earth, and collecting images from the land, we are provided with accurate positions, both on land and overseas. [14]

Challenges of satellite technology

Although satellites are used as a means of tackling food insecurity effectively and other, various issues while providing the world with services, they involve challenges

[14] "Blog." *TS2 SPACE*, ts2.space/en/the-impact-of-satellite-technology-on-the-agriculture-and-food-industries/#google_vignette.

in several fields. In further detail, when talking about such incapabilities of satellites, it is meant that either due to technology limitations, or limited radio frequency, both the data quality and availability decrease. For instance, even in LEDCs which are fortunate enough to have their own satellite, or even share one with neighboring countries, economic implications could be a potential factor that holds back the development of satellite technology, leading to limitation of data available and its quality. Direct connection with this challenge faced when wanting to utilize satellite technology has significant cost these devices require. Meaning, that, LEDCs might face several challenges when wanting to make use of satellites and their various benefits. This could be considered one of the most potential drawbacks of satellite technology, considering that such countries are the ones most in need of satellites, as they have been facing issues such as food insecurity for a period of time.

In addition, it goes without saying that debris in space makes up a challenge for the use of satellite technology. There is always the risk of satellites getting hit and, therefore, destroyed by a piece of debris floating in space, which is difficult to predict, considering the satellites' altitude, orbit, and capabilities. Consequently, not only would this lead to the waste of a significant amount of money that the country provided for the launch and construction of this complex device, but it would also potentially degrade the environment. Specifically, in case a satellite is destroyed while in orbit, its parts would float around space, therefore, raising the issue of space pollution. Additionally, space debris could be formed from the materials of the destructed device, increasing the risk of collision with other spacecraft and satellites in operation.

Response and reaction time, too, are considered a challenge, themselves. What is meant by that is the fact that depending on the altitude of each satellite, especially the ones with higher altitudes, latency may increase or decrease. Higher altitude means that the response and reaction time of the satellite may increase, making it slower. The reason why this is a potential challenge when it comes to utilizing satellite technology is that when it comes to real-time data, high latency is necessary for the effective use of the service, in, for example, communication and navigation. Thus, it constitutes a problem with deeper roots and not an easy solution. Specifically, as aforementioned, different satellites that provide different services need a specific altitude and orbital inclination each, making it impossible to decrease the perigee of the satellite, since that would consequently defeat the purpose of using satellite technology by not using them effectively and not receiving the initial services.

Lastly, it is a well-known fact that extreme climate conditions and dramatic changes in the weather can cause technical problems and even the destruction of satellites at a lower altitude. Specifically, communication and navigational services provided by relatively closer-to-earth satellites could be cut off in case of technical issues caused by weather. Since such satellites have a lower altitude, there is a potential risk of them

facing challenges rooted in climate conditions. Also, as aforementioned, if the satellite is destroyed, further environmental issues would be boosted, consequently leading to an increased frequency of cases similar to those.[15]

MAJOR COUNTRIES AND ORGANISATIONS INVOLVED

India

India is one of the countries that despite being an LEDC, has efficiently adopted satellite technology as a means of addressing food insecurity. For context, the country's agriculture is highly dependent on the monsoons, which depending on the geographical part, vary from two to 4 months. Thus, it goes without saying that in cases of an unforeseen pattern of such heavy rainfall, out of the usual circumstances that farmers are prepared about and depend on their yield production, could have catastrophic effects on the crops. This constitutes the main reason why India implemented the National Agricultural Drought Assessment and Monitoring System (NADAMS). In further detail, NADAMS is a system initially launched with the ultimate purpose of projecting drought conditions in an attempt to tackle food insecurity, during the year 1986. With the use of satellite technology, NADAMS has the capability to analyze both soil index of moisture and predict rainfall indicators, allowing farmers to be pre-informed about any droughts that may occur during the monsoon period and have the potential of negatively impacting their crop yield. [16]

European Union

The European Union has also made efficient attempts to tackle food insecurity with the use of satellite technology. Such an example is "SENTINEL-2", a satellite with high image resolution and multi-spectral vision. It was launched in 2015 by the European Space Agency, aiming to monitor land and climate change, which ultimately contributes to addressing food insecurity in the continent as a whole. It has the ability to also collect data and monitor for the next wave of useful services, such as geophysical components, land-cover maps, and maps showing land-change detection, which was one of its initial purposes before it was launched. With a pathway of 290 km, while making use of an SSO, SENTINEL-2 effectively manages to provide data regarding crop growth, health, and nutritional needs, namely, crop monitoring, but also analyzing factors such as soil fertility, contributing to the mitigation of food insecurity. [17]

[15] "Satellite Communication Infrastructure Challenges and Solutions." *Utilities One*, utilitiesone.com/satellite-communication-infrastructure-challenges-and-solutions.
[16] "NADAMS: Droughts in India and Implementation of a Drought Analysis System." *BYJUS*, byjus.com/free-ias-prep/national-agricultural-drought-assessment-management-system/.

[17] "Sentinel-2 - Missions - Sentinel Online." *Sentinels.copernicus.eu*, sentinels.copernicus.eu/web/sentinel/missions/sentinel-2.

The United States of America

The United States of America has made multiple attempts to eliminate food insecurity by using satellites. One of the most significant and, therefore, successful attempts which contributed to that purpose is The Global Precipitation Measurement (GPM) satellite. This satellite, in fact, was launched by NASA in cooperation with the Japan Aerospace Exploration Agency (JAXA), thus, it is not a device that the state owns on its itself. As far as the uses of GPM are concerned, it is a worldwide satellite network, that provides next-generation universal measurements of snowfall and rain. The GPM's initial goal was to enhance our knowledge of Earth's water and electricity cycles, improve forecasting of extreme events that cause natural hazards and disasters, and expand its present capacity in using accurate and on-time rainfall data to aid society by means of enhanced measurements of rainfall worldwide. [18]

China

China constitutes another one of the countries that has attempted to address food insecurity by utilizing satellite technology. Specifically, the country has launched "ZY-3", by the China Centre for Resources Satellite Data and Application in 2012, with its end-of-life date reaching 2025. This satellite's mission includes environmental monitoring since it was designed as an observational satellite, initially. In detail, it collects and provides data including high-quality Earth imagery, and obtains various multi-spectral sensors, which contribute to further land and agricultural analysis. Thus, ZY-3 is essentially a satellite that significantly contributes to the mitigation of food security in the country by efficiently monitoring any changes in the cropland, evaluating the different land uses on the soil, and lastly, helping in resource management while at the same time giving the farmers the opportunity to appropriately protect their crops in environmental means, through the data it collects, previously mentioned. [19]

TIMELINE OF EVENTS

DATE	DESCRIPTION OF EVENT
July 23, 1972,	On July 23, 1972, the Earth Resources Technology Satellite (ERTS-1) is launched in cooperation with NASA, which focuses on providing the world with real-time land data to achieve food security by collecting data, which was not available before. [20]

[18] NASA. "The Global Precipitation Measurement Mission (GPM) | NASA Global Precipitation Measurement Mission." *Gpm.nasa.gov*, gpm.nasa.gov/missions/GPM.
[19] "ZY-3A (Zi Yuan-3A) - EoPortal." *Www.eoportal.org*, www.eoportal.org/satellite-missions/zy-3a.
[20] USGS. "What Is the Landsat Satellite Program and Why Is It Important? | U.S. Geological Survey." *Www.usgs.gov*, www.usgs.gov/faqs/what-landsat-satellite-program-and-why-it-important.

October 2013	GODAN is established by the G-8 with the aim to "share relevant agricultural data from G-8 countries with African partners" and to "achieve commitment and action from countries and relevant stakeholders to promote policies and investments in projects that expand access for the public" [21].
3 April 2014	Sentinel-1's mission includes monitoring and imaging landscapes, thus providing the necessary data via its sensors to achieve security both in coastal areas and the ocean.[22]
September 2015	The 2030 Agenda for Sustainable Development, which the United Nations is establishing, consists of 17 goals to be achieved by 2030. It emphasizes "Zero Hunger", goal number two, to eliminate food insecurity and hunger worldwide. [23]

PREVIOUS ATTEMPTS TO SOLVE THE ISSUE

India's National Agriculture Insurance Scheme

In the year 1999, and more specifically, on June 22nd, India established the National Agriculture Insurance Scheme (NAIS). This project aims to regain the farmers' reliability for the next season by offering insurance coverage and financial help in case any of the crops fail due to pests, health implications, or natural disasters. In addition, it was also initially established with the purpose of stabilizing agricultural revenues, especially during catastrophe years, but also encouraging farmers to embrace progressive farming techniques, high-value inputs, and better technology in agriculture. It has, indeed, contributed to combating challenges such as inaccurate assessment of crop loss and providing the country with real-time and high-quality imagery of croplands. Ultimately, this attempt efficiently manages to address issues regarding food insecurity in the country, which has been suffering and still does, from a significant amount of life losses due to insecure food and water resources. [24]

[21] Musker, Ruthie, and Ben Schaap. "Global Open Data in Agriculture and Nutrition (GODAN) Initiative Partner Network Analysis." *F1000Research*, vol. 7, 11 Jan. 2018, p. 47, https://doi.org/10.12688/f1000research.13044.1.

[22] "Sentinel-1 - Overview - Sentinel Online - Sentinel Online." *Sentinels.copernicus.eu*, sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/overview.

[23] ---. "About the 2030 Agenda for Sustainable Development." *Www.cepal.org*, 17 Feb. 2017, www.cepal.org/en/topics/2030-agenda-sustainable-development/about-2030-agenda-sustainable-development.

[24] byjus.com/free-ias-prep/national-agricultural-drought-assessment-management-system/.

Brazil's Amazonia-1

"Amazonia-1" is the name of Brazil's first attempt to address the deforestation of the Amazon in 2021, using satellite technology. To be specific, the initiatives of this project, are to monitor the rainforest and provide researchers with real-time data regarding the agricultural activity and deforestation in the world's largest forest. By doing so, the issue of food insecurity in the whole continent of South America would be further addressed, because of the indirect effects of deforestation and dramatic land changes of the forest on agriculture. Essentially, by affecting climate patterns and ecosystems. This project, however, has faced numerous challenges since its launch, which have aroused concerns about the effectiveness of the satellite. Challenges both in controlling the satellite, and preventing cybersecurity attacks but most importantly ones of a socio-economic and political nature have led to a potential increase in questions raised regarding the project. [25]

Russia's GLONASS Navigation System

The GLONASS Navigation System for Precision Agriculture is currently run by the Russian Space Force on behalf of the Russian government. After the fall of the Soviet Union in 1995, however, the already established GLONASS satellite network began to deteriorate due to the unsteady economic climate. This led to a second, and therefore, successful launch of the same satellite network, in the following years. Thus, it is essentially a network that has significantly contributed to addressing food insecurity since it was initially launched to aid in precision agriculture. In further detail, the field of agriculture is undergoing development in satellite-based localization technologies and Global Navigation Satellite Systems (GNSS) receivers, which are similar to the well-known GPS. These receivers are an essential component of precision agricultural technology since site-specific crop management requires position information. As a matter of fact, the specific advantages GLONASS provides to precision agriculture include crop monitoring (nutritional needs, growth, pests, illnesses), crop mapping, and precise management of the chemical used, which goes hand in hand with the obvious effects these might have on the yield production. [26]

POSSIBLE SOLUTIONS

Eliminating Privacy Concerns

Privacy concerns regarding the use of satellites are raised by a significant number of individuals, which were elaborated on earlier. In further detail, though, such concerns

[25] "Brazil's Satellite Monitoring Reduced Amazon Deforestation by 60,000 Sq Km in 5 Years." *Mongabay Environmental News*, 8 May 2013, news.mongabay.com/2013/05/brazils-satellite-monitoring-reduced-amazon-deforestation-by-60000-sq-km-in-5-years/.

[26] Perez-Ruiz, Manuel, and Shrini K. Upadhyaya. *GNSS in Precision Agricultural Operations*. *Www.intechopen.com*, IntechOpen, 10 Oct. 2012, www.intechopen.com/chapters/39780.

can include identity theft, collection of sensitive, personal information, and location tracking. Since satellites have the ability to collect such data with the use of the sensors while in orbit, to provide their initial services, as technology develops and the capabilities of satellites only increase, more and more privacy-related concerns are raised. Thus, eliminating those concerts plays an important role in enjoying the benefits of satellite technology, with no fears at all, which could be achieved in quite a few ways. Specifically, while the transmission of sensitive data rises, so do the risks of unauthorized access to it. In response to that, agencies must develop clear standards and enforceable restrictions, which could potentially monitor the transmissions made and the ones able to access them. In addition, legislators who specialize in satellite technology-related matters, and have a fundamental knowledge of the situation, must address these issues and guarantee that the necessary protections are in place. Also, anonymization techniques could be put into use, which involves removing any personal identification information that the data collected may have. In such ways, minimization of the hazards and full use of the possibilities of satellite-based location technology could be achieved, while finding a balance between innovation and privacy.

Preventing Cyberattacks

As aforementioned, cybersecurity attacks constitute a ubiquitous concern of many individuals globally when it comes to the ones around satellite technology. Thus, finding means of preventing such potential risks, is crucial. This could be done by, for instance, training employees and raising awareness. Specifically, raising the awareness of the employees of satellite-related companies via seminars and training them on how to deal with cyberattacks in satellites' systems, could be a potentially efficient way to prevent them. In simple terms, this essentially means that in such a way, regular, if not daily checks could be done, too, to ensure the security of the communication channels and prevent hackers. In addition, using backup systems could contribute to ensuring that the sensitive data is secure, which when combined with the measures mentioned above, would ultimately prevent the majority of cyberattacks. With the utilization of backup systems, confidential information collected by satellites would still be secure and remain in the possession of the organization/company in cases of such attacks. Lastly, governments could be responsible for implementing regulations to achieve secure communication via private communication channels used back and forth by stations and satellites. More specifically, this refers to the governments of countries currently utilizing satellite technology to introduce protocols when it comes to accessing a specific satellite channel and be in charge of overseeing those frequencies.

Making Satellites Affordable

As mentioned above, satellites are devices with a significant cost that not all countries in need of the utilization of satellite technology might have the capability to allocate

money for this purpose. In such cases, governments collaborating for the launch of a satellite that would provide services in multiple neighboring regions is an equally effective way of making use of satellites and benefiting from their services. This would be done by two, or even more different governments launching a satellite together, with shared costs, in the desired altitude and orbit, which would serve the nations in partnership. By such means, the countries would have the ability to benefit from using satellite technology at minimal cost, compared to the initial one of launching one on their own. Another way of achieving the affordability of this technology, however, can be by using reusable launch devices. In simple terms, satellite devices that were originally planned to be used and have a life span of 10 years, could, in fact, be enhanced, and put reusable rockets which would be responsible for bringing the satellite back to Earth, could be put into use. Lastly, governments could engage in planning and launching multi-mission satellites. Assigning a single mission to each satellite put into a relatively similar orbit and altitude with others, would not be an effective, and most importantly, affordable way of using satellite technology. Thus, combining those missions, however, and assigning them to a single satellite, put into an effective orbit, depending on the services they are to provide, would aid in achieving affordability, since fewer devices would be required.

Mitigating the environmental impact of satellite

As aforementioned, the negative environmental impact of satellites in space constitutes a concern of many individuals globally, making them contemplate whether or not using satellite technology is a wise idea. Thus, mitigating the environmental impact of such would partially encourage more countries to adopt satellite technology. To be specific, a way of achieving this would be by encouraging neighboring states to collaborate and share satellites that serve similar purposes. By doing so, fewer devices will be put into orbit, and ultimately reduce, in a way, the effect of satellites in space. In addition, companies should consider designing satellites with the so-called “end-of-life-disposal”. Essentially, satellites would be designed in such a manner that they would have the ability to de-orbit after the period of their operational life would have ended, in order to avoid them becoming space debris. This, in fact, goes hand in hand with mechanisms and certain technology designs that allow satellites to be put back into orbit, even after their operational life has ended, with the use of little, to no new resources needed to be used. Lastly, by switching to renewable energy sources to power ground infrastructure, satellite companies may drastically cut their carbon impact. Consequently, by considering all of those measures not only when developing but also when putting satellites into orbit, we can minimize the environmental impact of the increasing utilization of satellite technology.

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