IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
IJARSCT
Impact Factor: 6.252
Volume 2, Issue 4, June 2022

Space Technology for Societal benefits with respect to Environment

Smita Survase[1], Geeta Nair[2], Laxman Survase[3]
K J Somaiya College of Science and Commerce, Vidyavihar, Mumbai[1,2]
S H Kelkar College of Arts, Commerce and Science, Devgad, Sindhudurg[3]

Abstract: *Our environment is hugely affected by human actions. Irresponsible human activities, over the years, has resulted in ozone layer depletion and climate change and in general overall degradation of the environment. The need of the hour is sustainable development. Space technologies involves the study and understanding of our planet and the use of technology for the overall benefit of mankind. These studies have improved our understanding of air quality, water cycles, climate change by providing valuable and timely information. The data provided by this technology helps in managing our resources in a sustainable way. Space technology can greatly contribute to sustainable development goals. This paper looks into the various sectors where space technology has helped us in better understanding in the field of agriculture, health, solar power and climate.*

Keywords: Space technology

I. INTRODUCTION

It was on 4th October 1957, Soviet Union successfully launched the world's first artificial satellite Sputnik I. Since then, we've seen humans set foot on the Moon, successfully launched more than 150 Space Shuttle flights, set up several space stations such as Skylab, MIR, created the International Space Station (ISS), and have launched thousands of space objects in almost every corner of the Solar System. Space technology has a significant impact on the planet, particularly in terms of communications, positioning services, and Earth observation. Besides the convenience of knowing exactly where we are on the planet due to GPS satellites, or weather forecasting, or watching television in remote areas due to broadcasting satellites, there are some critical environmental uses of Space technologies. For example in the areas of natural resource management and environmental monitoring.

Food security, disaster risk reduction, natural resource monitoring, and poverty reduction are just a few of the main global development concerns that satellite data, photos, and information can help us to deal with. The Earth exploration-satellite service provides various benefits to society in both the public and private sectors

According to UN World Commission on Environment and Development, "Sustainable development" is defined as "development that meets current needs without jeopardizing future generations' ability to meet their own." Sustainable practices support ecological, human, and economic health and vitality. Sustainability assumes that resources are finite and should be used wisely and cautiously in terms of long-term priorities. The energy intensive industries have resulted in various environmental issues such as water shortages, climate change, and the depletion of essential natural resources is also rapidly increasing. In this scenario, space technology can play a vital role in enabling a digital and green transformation. The aim of this paper is to highlight the possible benefits of space technology for life on Earth from environmental, social, and economic perspective. We also aim to show how space technology and sustainability on Earth are related to each other.

1.1 Space Technology and Climate Change:

Climate change is becoming one the most challenging long term issue. There is a change in the weather pattern mostly due to greenhouse gases, which trap energy in the atmosphere, and make the world warmer. A warming planet causes changes in rainfall patterns, sea level rise, and a variety of other effects on plants, fauna, and human activity. Climate change is posing an increasing hazard to us all. Natural disasters such as hurricanes, earthquakes, storms, floods, and fires have become more common in recent decades. In last 20 years globally, 1.3 million people have lost their lives by climate-related and geophysical disasters whereas 4.4 billion people were displaced, injured or left homeless or in need of emergency assistance [1].

Significant advances in weather predictions have been accomplished over the last decade. This is possible because of large number of upgraded meteorological satellites. This in turn has resulted in significant gains in agriculture and energy management. Climatologists and glaciologists rely on continuous satellite observations of the Arctic and Antarctic more than ever before to investigate climate change processes in near real time.

For example Topex-Poseidon is a satellite designed to measure the topography of the ocean's surface with unparalleled precision. Topex/Poseidon spent more than a decade in orbit, helping scientists better understand ocean circulation and its impact on global climate. It allowed scientists to foresee and better understand the El Nino phenomena of the late 1990s by providing the first worldwide observations of seasonal current variations. During the 2017 Atlantic hurricane season, reliable weather forecasts and enhanced communications helped manage evacuations and save lives [2]. Countries like Bangladesh and India, both prone to cyclones, have been investing in advanced meteorological services and early warning systems [3].

Greenhouse gases and other critical climate indicators are also monitored by Earth observation satellites. Plans for coping with climate change would be less effective if such type of environmental data is not available beforehand. Satellites are the only way to monitor the entire Earth's ecology, including land, sea, and air. Satellites have the ability to observe large areas in a non-intrusive and uniform manner, as well as to instantly target any point on Earth, including distant and hostile locations, and to continue with a series of observations over a long period of time.

1.2 Space Technology and Natural Resources

Earth observation provides data and support for agricultural production, fisheries management, freshwater management, and forestry management, as well as monitoring for destructive activities including illegal logging, animal poaching, fires, and environmentally damaging mining [4,5]. Satellite-based Earth observation data can also be utilized to address issues such as air pollution, forest preservation and water management. Precipitation monitoring is useful in dealing with water-related calamities such floods, typhoons, and landslides.

The Japan Aerospace Exploration Agency (JAXA) has developed a precipitation monitoring system that offers global rainfall maps using satellite data. The RaioSat and the BiomeSat are two separate Nanosatellite missions planned by Brazil's National Institute for Space Research (INPE), as part of its Earth Science and Space Engineering programme. These missions were meant to track natural phenomena such as lightning strikes, which have been linked to extreme occurrences, and Amazon biomass, which has been decreasing recently due to deforestation. [6,7].

Remote sensing can be used to track natural fluctuations in river sand flux, as well as illegal sand mining. Satellite data from NASA's gravity recovery and climate experiment, can reveal sediment discharge rates at river mouths. Earth observation can also be used to track country-specific environmental conditions and issues, such as snow, ice, and glaciers [8].

1.3 Space Technology and Solar Power

Because sunlight is unfiltered by Earth's atmosphere in space, it can shine for more than 99 percent of the year for orbits at sufficiently high altitude [9]. The basic idea behind space solar power (SSP) is to capture sunlight, convert it to microwaves or laser light, and then send it back to the Earth's surface, where it will be converted to electricity. A system like this can provide electricity for the most of the day. Furthermore, because of its vantage point in space, the satellite can beam power to nearly any spot on Earth within line-of-sight, and can be directed to locations thousands of kilometers apart, or even to numerous locations simultaneously using phased array technology. This could help to provide immediate power to remote areas during disaster relief measures. SSP has the potential to become less expensive than wind or solar electricity in the future [10]. Furthermore, with SSP providing baseload power, there will be less need for energy storage via batteries or other environmentally harmful methods.

1.4 Space Technology and Public Health

In recent years, space-based technologies have become increasingly important in achieving global health goals. Remote-sensing data is used to track disease patterns, assess environmental triggers for disease propagation, anticipate risk zones, and identify places where disease control strategy is needed [11]. For example, analysis of geospatial data gave an early warning of malaria, resulted in 500,000 fewer new cases in almost 28 countries [12]. The National Aeronautics and Space Administration (NASA) satellite data was utilized to forecast cholera in Yemen in 2018, with a 92 percent accuracy rate [11]. The World Health Organization (WHO) uses JAXA's digital elevation models to map difficult-to-reach locations and to execute effective measures for infectious diseases, such as polio in Niger.

In addition to monitoring infectious diseases and facilitating access to medical care in remote areas, space technologies can facilitate medical research that would otherwise be difficult to do in a terrestrial setting. For example high-quality protein crystals generated in microgravity can aid in the development of innovative medicine designs for cancer, infectious disorders, and lifestyle-related diseases. Telemedicine, telehealth, disease surveillance systems, and health mapping are some of the key applications of space technology in public health.

1.5 Space Technology and Agriculture

Space technologies can be vital in agricultural innovation, modern agriculture and precision agriculture. The World Meteorological Organization (WMO) provides meteorological and drought forecasting services to farmers, herders, and fishermen through its agricultural meteorology programme in order to promote sustainable agricultural development, boost agricultural production, and contribute to food security. At the national level, applications can help with crop monitoring from space utilizing publicly available satellite data. For crop production estimates, Canada is the first national statistical office to substitute a farm survey with a remote sensing model-based technique [14]. Crop Watch Cloud is a cloud-based crop monitoring technology that enables countries to conduct independent crop monitoring and early warning related to food security without investing in infrastructure [15].

II. CONCLUSION

Space technology has a significant impact on the world today, affecting practically every aspect of human activity. In this article we have only focused on few of them. Due to the limitations of face-to-face interactions, we were relying on space technologies more than ever during the COVID pandemic. Space technology will definitely not provide a solution for all the problems; but, in order to fully realize the potential of space technology, they must be employed in a way that is inclusive, just, and equitable. Apparently, we need to explore space technology in order to benefit from Earth's riches and for the sake of posterity. It is within our power to safeguard and conserve the planet Earth.

REFERENCES

[1]. United Nations Office for Disaster Risk Reduction and Centre for Research on the Epidemiology of Disasters, 2018, Economic Losses, Poverty and Disasters: 1998–2017.
[2]. https://public.wmo.int/en/media/news/extremely-active-2017-atlantic-hurricane-season-finallyends.
[3]. https://blogs.worldbank.org/voices/modernizing-weather-forecasts-and-disaster-planning-savelives.
[4]. https://www.thespacereview.com/article/3768/1
[5]. Anderson K, Ryan B, Sonntag W, Kavvada A and Friedl L, 2017, Earth observation in service of the 2030 Agenda for Sustainable Development, Geospatial Information Science, 20(2):77–96; Wood D and Stober KJ, 2018, Small satellites contribute to the United Nations Sustainable Development Goals, available at https://digitalcommons.usu.edu/smallsat/2018/all2018/437/
[6]. M. Cardoso et al, BiomeSat: A proposal for forest health estimation in Brazil using Nanosats,proceedings in: II IAA Latin American CubeSat Workshop, Ubatuba, SP, Brazil (2018)
[7]. J. Schuch et al, The NanosatC-BR, CubeSat development program a joint CubeSat program developed by UFSM and INPE/MCTIC – space geophysics mission payloads and first results, Brazilian Journal of Geophysics, 37 (1): 95-103, (2019+
[8]. http://www.enveo.at/euprojects/89-cryoland.
[9]. Mankins, JC (2014). The Case for Space Solar Power, Houston, TX: Virginia Edition Publishing, ISBN 978-0-9913370-1-9.
[10]. Mankins, JC (2016). "New Developments in Space Solar Power," 67th International Astronautical Congress, 26-30 September.

[11]. https://unctad.org/system/files/official-document/ecn162020d3_en.pdf

[12]. Juma C, Harris WL and Waswa PB, 2017, Space technology and Africa's development: The strategic role of small satellites, Faculty Research Working Paper Series No. 43, Harvard Kennedy School

[13]. Advances in telemedicine, disease models, psychological stress response systems, nutrition, cell behavior and environmental health are some of the benefits gained from the International Space Station microgravity environment. https://www.nasa.gov/mission_pages/station/research/benefits/human_health.html).

[14]. https://marketplace.officialstatistics.org/earthobservations-for-official-statistics.