

The Role of Space Science and Technology for National Development

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ABSTRACT

Recently it is known that space science and technology play a great role in national development. Having a Space program by itself defines the national economic status of once country. space science and technology have many application areas like space surveillance, aviation's, communication, and earth observation and different economic benefit areas of the society. This research paper deals with the Role of Space Science and Technology for the National Development of Ethiopia. It includes an introductory part that states the socioeconomic status of the country and the value of space science and technology for sustainable development. The second part of the paper is about the country's space program which deals about the country's space program with recently ongoing projects and their main future goals of these projects. The third section mainly discusses the benefits of space science and technology in different areas of application. It also compares and contrasts these areas of applications with the country's standard and the economic and social impact of the technology for national development. The conclusion comes next. This section recommends having a space program in the country that has a great role in national development and modernizing the socio-economic activity of society. And lastly, there are lists of references which are the researcher uses as a source for information for this research paper.

Keywords

Assembly Integration and Test, Cub sat, Ethio-telecom, ETRSS1, GTP program, national development, Satellite, sustainable development goals, space science and technology

1. INTRODUCTION

Ethiopia is blessed with an abundance amount of natural resources such as gold, Potash, plenty of unexploited natural gas or Methane, copper, iron platinum and other unexplored minerals. Since Ethiopia's economy depends mostly on agriculture (about 45 to 50% of GDP), but the agricultural system and land management are traditional subsistence farming systems, grow crops and rear animals just to feed themselves and their families. As a result, the country suffers a lot of natural challenges such as drought and unpredictable flooding due to climate change, poor resource, and land management, Real-time information, un existing of early

warning and prevention system. If space science and technology could assist the mainstream socio-economic activities of the country. The country should have to do more in space science and technology activities for the development of the society. Because space program has a great role in facilitating and assisting the country's development. Therefore, the growth of space science and technology have a great role in the national development of the country and transforming the living standard of the society. Knowledge about space, gained through scientific studies can have enormous economic and social benefits that contribute to fulfill many societal needs, from human security to sustainable development. So, space science and technology have ultimate support of different economic and day to day activities of the people and for the national development of the country. Owing to the rewards and opportunities afforded by space science and technology it is important in promoting social and economic development, and looking at possibilities to enable developing nations to have access to space technology tools by strengthening their indigenous capacities. Space science and technology enables to observe possible threats to life on Earth.

2. SPACE SCIENCE AND TECHNOLOGIES IN ETHIOPIA

Recently the country is ready to launch the first remote sensing satellite which is called 'ETRSS1'in at the end of 2019. Even if it is the first satellite for the country, there will be an increasing needs satellite technology which support for innovative Earth information systems. This means the country should have to do more in the area for the future. This big project is run by the national space institute called Ethiopian space science and technology institute (ESSTI). The institute was established as a national institute level and started its work in October 2016. With the motto 'We explore the universe for the benefit of our people'. The main objective of establishing the space program was to enable the country's multidimensional uses from space science & technology. The establishment of ESSTI is one big step forward for the development of Ethiopian Space activities that will give advantage for Ethiopia to be an effective and extensive use of space science and technology for its sustainable development and also the space program should have to its contribution for the country's sustainable development program. The country

has fifteen years of growth and transformation programs (GTP) in three terms of each five years interval. Within these GTP programs, the country has plan to change its economy from lower-income to a middle-income economy level. So, for this national plan achievement space, science and technology plays a great role contribution by enhancing the society's living standard regarding health care, learning style, broadcasting, telecom, and disaster and risk management so on. From those national space programs launching a satellite and using the product is takes the main part.

2.1. Satellite Technology

Once launched to space satellites are subjected to perform a specific mission. As a result, many satellites have been built and launched frequently to perform a specific mission through sophisticated structural designed and predetermined orbit. Based on the specific task satellites may categorize as remote sensing satellite, communications satellites, navigation satellites, weather satellites, scientific satellite, and Military satellites and so on. On the realization of such function of a satellite, the Ethiopian government established the Ethiopian Space Science and Technology Institute (ESSTI) with a mandate of researching, teaching, producing and providing space-based information and technology. It also strives to perform research work to make the country effective and extensive user of space science and technology in all aspects of socio-economic development of the country and to make the country one of the contributors to the development of space science and technology. In recent, the ESSTI is highly engaged to satellite technology in collaboration with the most experienced countries to achieve its mission and to take the let comer advantage in the field. The demand of satellite data for different key economic sectors of the country is very high and to alleviate problems of high expenses related to satellite rental and data security, organizing and establishing of complete facilities and infrastructures to build once own satellite is the task that should not be held over for tomorrow.

2.1.1. Earth observation microsatellite

Starting from its establishment Ethiopian Space Science and Technology Institute is doing activities in the space program for the country. To forward the country in its economy the institute have many space projects and do researches which considered as sustainable development goals of the country. From these projects, ESSTI is currently working on launching the first-ever Ethiopian satellite into space called ETRSS-I. The satellite is a multi-spectral earth observation satellite that will be operational in low earth sun-synchronous orbits and with an expected service life of more than two years. Since the satellite is a remote sensing earth observation satellite, it mainly used for water resource monitoring, disaster management, vegetation coverage mapping, land management, crop distribution, and other application services. Once having this satellite, the country will solve many problems mainly in agricultural and natural resource management sectors.

2.1.2. Communication satellite

Now a day's sharing of information through electronic media is common throughout the country. For these day to day activities the country is using other satellite through Ethio-telecom which is Ethiopian telecommunication organization. It is known that communication facilities play an important and leading role in the socio-economic development of the

nation and taking that into account, ESSTI is working on developing a communication satellite. The benefit of having a communication satellite is very essential for the use of mobile and fixed telecom service, mobile service, broadcast service, distance education, telemedicine, high throughput data services, internet access, VSAT to reach to the remote area and other communication services. Even if the project is in its infancy stage it brings more benefits for the country.

2.1.3. Cub sat

In this time the world is changing satellite projects from large scale to the smallest one. This is because of highly reduces the cost and weight of the satellite. As the size reduced the cost of the launcher is very low and also the launcher can carry and launch more satellites at a time. So, this modern technology has done wonders to improve the livelihood of society. Various studies point out the miniature of a satellite to develop and operate with a reasonable cost and time that uses the same application of the large one. The benefits of a Cube Sat are that it will be launched in low earth orbit near earth and use full for drought and disaster monitoring to land and forest management is unparalleled. To move forward with this enlightening project, ESSTI has proposed to design a 6U Cube Sat under space engineering research and development directorate (SERDD) which will be used for earth observation. It is known that the project will eventually lead to the development of satellite technology in Ethiopia.

2.1.4. Satellite Assembly Integration and Test (AIT) Center

Assembly Integration and Testing (AIT) is one and the more essential project for one country to have a sustainable space science and technology program. So, by taking this into account, Ethiopia is started launching the project. This project is running by Ethiopian space science and technology institute; ESSTI. The AIT center is capable of up to 500kg satellites for performing different testing facilities. It includes testing facilities like - Assembly and Integration of Satellites and its subsystems, Structural Testing, RF Testing, Thermal Vacuum Testing, Environmental Simulation, Testing of Ground Systems and subsystems for Space Projects, other test Facilities will be performed in the AIT. This is because specialized testing facilities are needed for assuring the success of the program to simulate its operation in space environmental conditions. In parallel with this AIT project the institute also focused the capacity building for the sustainability of the project even for the country's space science and technology program. In addition to these satellite projects the country has many space and technology projects like Aerospace component manufacturing, Space Robotics & Autonomous Systems Development, launching vehicle and rocket development, Development of Application Software's, Launching Propulsion System Development and so on.

3. BENEFITS OF SPACE TECHNOLOGY FOR NATIONAL DEVELOPMENT.

Even if it is difficult and needs high investment costs to have space science and technology, it has great benefits to facilitate the socio-economic activity of the nation for one country. But one thing take into consideration is by overcoming these challenges and working in space programs has led to many

technological and scientific advances that will provide and benefit to the society on their day to day activities. It uses in areas like health and medicine, transportation, public safety, consumer goods, energy and environment, information technology, and industrial productivity, etc. from this technology Satellite technology takes the main part. It has the advantages of large area coverage and enables the country to foster socio-economic development and convenient capability of communication networking, aerial observation, natural resource management, metrological aspect and so on without any influence of geographical constraints. Even if space technology has many application areas, some of these applications are listed as follows.

3.1. Space Technology for Telecommunication purpose

Ethiopian telecommunication ground station service was constructed at a small town called sululta about 20km far from Addis Ababa, capital city of Ethiopia. The first ground station antenna was installed in 1964G.C. (Fig 1). It is about 33m in diameter. And the next antenna which is about 30m is installed after six (6) years which is 1970. Onwards the ground station has many antennas which are used for different stockholder like INSA, schools' nets, telecommunication itself and also private companies. By using these ground station antennas telecommunication uses a satellite transponder from INTELSAT. Ethio Telecom spends lots of money on telecommunication services for the country. It is about 12 million dollars on annual fees for satellite services [3]. Experts said that the fact that national access to satellite communication and information through satellite depends on the goodwill of service providers, makes it essential for the country to launch its satellite. South Africa, Egypt, Algeria, Morocco, and Nigeria are the African countries that have launched their own satellites. It is known that a communication satellite could cost more than USD 100 million but even if the cost is high it is essential and mandatory for the country to have its communication satellite. It has lots of benefits. It can reduce 12 million dollars of foreign currency annual fees for communication satellite services expense and in the reverse, the country can gate and secure lots of foreign exchange. So, having a communication satellite the country can jump its economic status from low income to middle income.



Fig. 1. A 33m Ethiopian telecommunication ground station antenna which found at sululta about 20km from the capital of Addis Ababa.

3.2. Space Science and Technology for Health Care

Most of the population in Ethiopia is located in rural areas. Since there is far from the center, the accessibility of technology is almost less. They do not gate full packages of services like health care education, and other services equally with the other societies located in the center and city area of the country. So to overcome these national problems Space science and technology have a great impact on national health development and facilitating health activities. It helps in many health activities such as addressing basic medical services into remote areas of the country, giving professional training services, data collection, and disease monitoring into areas that are not possible by health professionals. It also uses for Provide video-based health worker training Improve health systems management and governance using an information system application. To achieve and improve national healthcare centers satellite-based infrastructure is necessary; once having a satellite it provides good solutions for the problem regarding health care infrastructure and its distribution throughout the country. This helps for the achievement of national socio-economic activities especially for developing countries like Ethiopia. Therefore once the country has satellite technology, it will benefited from the service in health activity. And it also has a great role for national development by contributing its part to sustainable development goals of the country.

3.3. Space Science and Technology for Broadcasting Service

Satellite broadcasting is the distribution of multimedia content or broadcast signals over or through a satellite network. The broadcast signals usually originate from a station such as a TV or radio station and then are sent via a satellite uplink (uploaded) to a geostationary artificial satellite for redistribution or retransmission to other predetermined geographic locations through an open or a secure channel. Downlinks are then received by base stations such as small home satellite dishes or by base stations owned by the local cable network for redistribution to their customers [11]. In Ethiopia, currently, 19 TV stations broadcast their programs through ground and space satellites, while 65 radio stations currently conduct broadcasting services in the country [7]. All broadcasting media are using satellites from other countries by paying a huge amount of foreign currency. These huge expanses of the broadcasting service for satellites have a great impact on the country's development. On the other side, the country is planning and practicing a 15 years program of changing the country's economy from low income to middle income by using sustainable development goals (SDGs).

3.4. Space Science and Technology for Agriculture Development

The United Nations Office for Outer Space Affairs works to promote international cooperation in the peaceful use and exploration of space, and in the utilization of space science and technology for sustainable economic and social

development. Space technologies have an impact on almost all aspects of development [6]. Here in Ethiopia Agriculture accounts for 46.3 percent of the nation's Gross Domestic Product (GDP), 83.9 percent of exports, and 80% of the labor force. About 80% of the country's income is based on agriculture [8]. The country's aspiration for achieving overall economic growth largely depends on the performance of the agriculture sector. The sector requires a substantial transformation to sustain economic growth, reduce poverty and ensure food security. But this agriculture practice is still in the traditional way of farming. This agricultural activity is not that much increasing within the growth of the country's population. This is due to poor performance and a traditional way of farming. Even if there are changing to modern and technology-based activities still the almost all the activities on the area are practicing a traditional way of farming with low-technological farming techniques like wooden plow by oxen and sickles (fig. 2) with metrological guides. But this tends the sector low performance as a result of poor resource utilization (e.g. regarding the total amount of available natural resources like water irrigation, land for cultivation, and are below their capacity); a poor and traditional way for soil and water conservation techniques. So, the country should have to change this traditional way of agricultural practice to Space-based technology. This space-based technology which spaces science and technology great advantages and values to farmers, agronomists, food manufacturers and agricultural policymakers who wish their profitability and country's development. So, that is why the researcher recommends the country to have satellite technology and should have to do more in space science and technology programs for the country's sustainable development. And also, it has a great role to achieve the country's sustainable development goals. In general, satellites are the best provider of modern data for monitoring soil, snow cover, and drought and crop development. It also helps metrological rainfall assessments in the country throughout the year which helps farmers to plan the timing for crop production by gaining accurate information and analysis to predict the future.



Fig.2. Plowing style by using oxen and traditional tools from Wikipedia, the free encyclopedia of Agriculture in Ethiopia.[8]

In general, by this time-space science and technology have a great roll in addition to the above-listed areas like education services: distance learning, online learning, real-time interaction between teachers and students, live broadcasting of distance learning; Telemedicine: real-time medicine providing with real-time and low cost. Disaster monitoring (earth quack,

landslide management, flooding, volcanic eruption and so on). So once using space science and technology those challenges will be solved.

4. CONCLUSION

Even if the country is blessed with an abundance amount of natural resources such as gold, Potash, unexploited natural gas or Methane, copper, iron platinum, and other unexplored minerals and its economy depends mostly on agriculture, it is necessary to give special care and modernize the sector by using modern technologies like satellite technology-based farming. But the agricultural system and land management are still in traditional subsistence farming systems, grow crops and rear animals just to feed themselves and their families. As a result, the country suffers many natural challenges such as drought and unpredictable flooding due to climate change, poor resource and land management, poor delivery of real-time information, un-existing of early warning and prevention system, less in managing illegal urbanization and land exploration, poor in natural resource management system, also there no modern health care, education and banking system and etc. These and other problems are the main challenges that affect the country's sustainable economic growth. Therefore, to secure its sustainable development, the socio-economic activities of the country should be supported by indigenous space science and technology especially satellite technology and its products. Space science and technology have a great roll in facilitating and assisting the development of the country to increase the socio-economic level of the country from lower-income to middle income. So, what the researcher recommends is that the country has better to do more in space science and technology programs which already started a few years ago.

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