Title: Potential of Space Technology for Improving Food Security in the Horn of Africa

Bancy M. Mati,
Jomo Kenyatta University of Agriculture and Technology, Kenya

Background

The Horn of Africa (HoA), comprising seven countries viz. Djibouti, Ethiopia, Eritrea, Kenya, Somalia, Sudan and Uganda, has a land area of nearly 5 million square kilometres with 150 million inhabitants. It covers much of an area that is described as the eastern arm of the Sahel. As such, about 73% of the region is classified as drylands, composed of dry sub-humid and semiarid ecological zones, where rainfed agriculture is either impossible or highly unreliable, and accommodating about 46 million people, or 32% of the population. The seven countries of the HoA have many similarities in their bio-physical, demographic, socio-economic and political conditions. However, Eritrea, Somalia and Djibouti have all their potential rainfed crop area in semi-arid zones, while, Ethiopia, Kenya and Sudan have 61 to 87% of their area being drought prone (Sanders and McMillan, 2001). Furthermore, the HoA is characterized by limited income opportunities, with per capita income in the region being less than US$ 300 per annum (Africa's average is US$ 500) and that of drylands is even much lower. In essence, over 50% of the people live below the poverty line.

Food insecurity in the Horn of Africa

According to the FAO, *Food Security* exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food for a healthy and active life (SPFS, 2001). This involves four conditions: (i) adequacy of food supply or availability; (ii) stability of supply, without fluctuation or shortages from season to season or year to year; (iii) accessibility to food or affordability; and (iv) quality and safety of food. Going by this definition, most of the people in the Horn of Africa are food insecure, and there are several reasons for this sad situation.

The Horn of Africa is a region that has suffered prolonged and recurrent droughts over the last three decades, and more than 20 million people are chronically food insecure due to aridity of the land, yet agriculture is the mainstay of their economies (IGAD 2001). The HoA is the highest recipient of food aid in the world. This gloomy picture of the region's food insecurity should ideally not exist because there are many untapped opportunities for improving the food situation. For one, the region has vast lands with good potential for irrigation development, as exemplified by the successful Gezira irrigation scheme in Sudan.

Although the HoA is classified as water-scarce (with the exception of Uganda), the region's potential water resources have remained largely underutilized. The HoA sits on a long marine shoreline of over 4,000 km, which remains largely unexploited for fisheries and mining, while the second largest fresh water lake in the world (Lake Victoria) and indeed the longest river in the world (the Nile) are also found in the region. Besides, there are several ephemeral streams and underground basins that can be successfully used for small scale irrigation programmes. Perhaps the greatest water resource that has remained untapped is rainwater. There are few water harvesting and storage activities, yet even the driest areas do receive some rainfall. If this were harnessed, much of the land degradation associated with flooding and surface runoff would be reduced, and water provision for crop production, livestock and fish farming would be made available.

Another major deterrent to development in the Horn of Africa is due to insecurity. The region is prone to many cross-border and internal conflicts, wars and banditry activities. Cattle rustling, within and across borders has continued to impoverish many pastoral communities, and cause much suffering. It is also well known that food security can not be realised unless there is peace and security. However, the problems in the HOA are compounded by poor infrastructure, especially in the dry areas, making the provision of services, such as veterinary, extension, medical and security very difficult. Whereas the rest of the world is enjoying the benefits of the information superhighway, the basic infrastructure that can support communication, such as good roads, telephone services, clean water and electricity are nearly non-existent in much of the dry areas of the HoA. As such, in order to tackle the basic necessities towards development, poverty reduction, human and food security in the HoA, the use of space technology is a must. Space technology is an especially attractive option under the circumstances, given that it is not constrained by political boundaries or conflicts, and it can be used where other forms of physical infrastructure, such as roads, are unavailable or unsafe. It addition, space technology provides relatively unbiased information quickly and repeatedly.

Use of space technology in the Horn of Africa

Despite the limitations listed in the preceding section, the Horn of Africa is experiencing some advances towards to use of space technology. In the major cities and towns, satellite communication facilities such as cellular telephones and the Internet are available, albeit to a small minority of the population. Other than poor infrastructure to support good connectivity, the high prevalence of poverty makes these communication facilities unaffordable to the majority. In addition, few people in the HoA have access to a computer and/or telephone, making it difficult to reap the benefits of the information age. Even audio radio communication is limited, as majority of the rural poor cannot afford a radio and/or the power (batteries) to run them. Other modes of communication do not fare any better. For instance, it is quite normal for postage mail to take up to a month, to reach the recipient within the country and even longer across borders. Apart from communication, the use of space technology for addressing food security issues has been limited by the same problems of poor infrastructure, as well as lack of trained personnel and a clientelle that would be willing or has the resources to invest in the sector. As such, response to food security issues such as early warning systems, implementation of projects and general information flow is severely hampered.

On a more positive note, space technology has been applied in the Horn of Africa for scientific as well as development activities. For instance, Akhtar et al. (1994) used SPOT and Landsat TM satellite imagery to map desertification in the Sudan, in which they did qualitative analysis of small training areas and supervised classification of digital satellite data to get a comparatively quick and efficient assessment of degradation over a vast region. In the Lake Victoria Basin, satellite imagery have been used to develop a methodology for quickly mapping soils, for the integrated measurement of soil quality for plant production (Shepherd and Walsh, 2001). In Kenya, Mati et al (2000) used satellite imagery to assess land use/land cover for the assessment of soil erosion in the Upper Ewaso Ng'iro basin. Elsewhere, remote sensing has been used to assess land use dynamics, desertification and availability of resources in the Arid and Semi-Arid Lands of Kenya (Isavwa 1989).

There are many other examples where space technology has been used for early warning systems, disaster management, land evaluation and food security planning, albeit there have been limitations in the extent of use (Beukema, 1994; Catizzone and Fanta, 1993). At policy level each HoA country has a government ministry or department involved in some aspect of space technology. Within the region, IGAD (2001) is implementing several projects namely Strengthening Remote Sensing Applications for Food Security Early Warning and Environmental Monitoring in IGAD Region, Market Information System and Household Energy, Regional Integrated Information System (RIIS), Regional Livestock Development Programme for Eastern Africa, Promotion of Community Based Natural Resources Management (CBNRM) and Capacity Building in Water Resources Management. In addition, the Hydrological Cycles Observation System (HYCOS) and the Environmental Education and Training, are food security related projects, which have been formulated and are also waiting to be implemented. Many of these projects utilize space technology. Also, the Regional Centre for Surveying and Mapping is situated in Nairobi, and it provides services in remote sensing to member countries in the region.

Types of information that is needed for disaster mitigation

Information is power, and its timely availability, reliability and usability can, not only avert a disaster, but also lead to developments that improve people's livelihoods. In the case of the Horn of Africa region, one persistent disaster is that of food security, as discussed above. Closely associated with food insecurity are the problems of recurrent drought, water scarcity, poor physical and technological infrastructure, political and socio-economic conflicts, poverty and general insecurity. Thus, any information that can address these pertinent issues will be beneficial directly or indirectly towards solving the food security problems of the region. One way of improving information flow is by use of space technology. The main types of information that would be useful include the following:

- Information on early warning systems. These can be captured through satellite data, providing information such as desert locust migration patterns, army worm invasion, expected droughts, floods or other predicted disasters.
- Accurate and reliable weather forecasting (e.g. from Meteosat) is another type of information that is obtained through space technology, which is useful for the planning of agricultural production.
- Estimation of crop production during the growing season (use of NDVI indices) at country and regional levels, can also be used to mitigate against food shortages, by warning governments and farmers early enough, so that safety nets are planned and set in place.
- Space technology can be used as a medium of education, to reach poor land users in places where physical infrastructure is lacking. This can be through broadcasts (e.g. World Space Radio) and use of winding radios (instead of battery powered ones), to improve information flow and provide extension services such as level of inputs, new production technologies, water management, market information etc.
- Space technology can also be used to drastically improve communication in remote areas, by setting up cellular telephone facilities. This way, information on the ground on such disasters as cattle rustling, disease outbreaks, floods or crop failure can be

relayed to the relevant authorities relatively faster, to permit timely mitigation responses.

- Space technology is necessary for resource identification and mapping, which is a prerequisite to good land use planning and management. The types of information such as extent of soil types, water resources, settlements, cropped areas, forests, rangelands, etc can be obtained from remotely sensed data.
- Space technology is also necessary for planning long term programmes on food security such as irrigation schemes, rangeland management, water supplies, settlements etc, as it allows prediction of future scenarios based on observed trends.
- Identification of hot-spots such as land degradation, migration of wildlife and livestock, biodiversity degradation (deforestation), livestock watering problems, effects of war and other disasters can be easily pick up from space, providing information that can be used for planning emergency relief and long term mitigation strategies.

Conclusions

The types of information listed here are by no means exhaustive, and indeed some of this information is already available in the Horn of Africa. The more important issue is how to get this information to the rural poor, where education levels are low and given that the ability to make use of the information, even when available, is hampered by physical and socio-economic constraints. Thus, to reap the benefits of space technology towards improving food security in the HoA, it is necessary to empower the communities with both the physical and technological infrastructure to be able to cope.

One simple step would be to start with institutions of technology, such as universities, government departments and research institutions associated with food security in the region. This will provide the necessary manpower as space technology is a highly specialized science. To go hand in hand with this should be development of tools and techniques that bring the use of space technology to the local communities, in a language and format they can understand. This can be developed through participatory methodologies (Ramasubramanian, 1999). It is also necessary to set up well-equiped disaster management centers, which will provide both the expertise and quick response, required when disaster strikes. These centres should be capable of conducting research, for them to be relevant to the ever-changing local and international conditions. Training of the local people, at both advanced and technical levels, is also required to ensure functionality of any space technologies that are in use. Finally, there is a need for the international community to intervene, and to assist in bridging the gap between the technologically rich and the technologically poor, if space technology is to make a meaningful impact towards improving food security in the Horn of Africa.

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