UNOOSA

New eyes: 'A look from above' on the Post-2015 Development Agenda, and the growing relevance of UNOOSA

Authors:
Boris Brkovic
Marek Kristof

Mentors:
Mr. Niklas Hedman
Mr. Luc St-Pierre
Dr. Werner Balogh

Counsels:
Mr. Marko Novakovic

20.12.2014

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Introduction

When Marcel Proust wrote that "the real voyage of discovery consists, not in seeking new landscapes, but in having new eyes"[1] he could not have imagined how right he would be in regards to the possibilities that today's technology has brought to mankind. Now that we have new sight what seems to be missing is a vision. The United Nations together with its member states and agencies have set out on defining a new vision, a new set of goals for the Post-2015 era. This paper will deal with the role of UNOOSA in the post-2015 development agenda and will analyse the relationship between space technology and certain goals in respect to its original assignment of the topic, which highlighted water, natural resources and disaster management.

The paper will be split into 3 major segments. The first section will begin with a brief introduction to the general benefits of space technology after which we will look at the SDGs as they currently stand following the final proposal of the Open Working Group for Sustainable Development Goals. This will be followed by a description of the role of UNOOSA within the UN system to help us determine the boarders of its mandate.

The second segment of this paper will deal with the application of space technologies in 3 different fields. Firstly we will look at disaster-risk management and UN-SPIDER. Secondly we will analyse the field of precision agriculture, what some authors believe to be the new agricultural revolution, which would not be possible without the significant implications of geospatial technology. The third field we will consider is one that was in the hart of the 1st, 3rd and 7th MDG, this is the area of water management, in particular we will focus on the use of space technology in regards to rainwater harvesting, irrigation and runoff harvesting, and wetland assessment.

This examination of the three field mentioned in the previous paragraph will be done to identify a commonality they all share and at the same time mismanage, and this mismanagement can be answered by UNOOSA's mandate to help achieve the set out goals for the Post-2015 era.

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[1] Marcel Prost (1923): La Prisonniere

1. General introduction to the space topic

The space age begun less then 60 years ago and during this time humans expanded their knowledge of space and its benefits for the people on planet Earth. This definite rapid development raised a need to coordinate efforts of nations in a global and interconnected way, to achieve the full potential and expand the benefits not only to few main players in this industry but to everyone.

We can differentiate between three major groups of space benefits:

- Telecommunication – transmitting data for voice and data communication (phones, internet, television broadcasts, emergency channels, satellite phones, tele-education, tele-medicine...),
- Navigation (positioning systems for civilian, professional and military use, emergency location pin-pointing systems),
- Earth observation (e.g. real-time, short-term, long-term, in different spectrums of different characteristics and observation of land and sea, weather). Images with resolution up to 3 m are usually paid and with resolution up to 10 m are very often available for free.

Except for this direct contribution of space technologies, there are also so called spin-offs, which are technologies originally developed for space exploration purposes, now used in common daily life on Earth. NASA recognizes many space technologies used on Earth, e.g. miniaturized portable sensors monitoring metabolic health, solar refrigerators for life-saving vaccines etc.[2] UNOOSA is not dealing with these space technologies; however it represents significant part of total space benefits, which could also play a significant role towards the achievement of Sustainable Development Goals (portable water purifiers for remote locations etc.).

These benefits and efforts need to be governed in a sustainable way in order to be helpful and not damaging. Just around 500 people were ever able to see the planet from its orbit, to see the curvature of Earth. But every single one of them lists this experience as life changing. As astronaut Michael Collins said: "Earth has to become such, as it looks like: blue and white, not rich, not poor, just blue and white. Because our planet, which we all own, is connecting us together in a more essential way, than colour of our skin, religion or economic importance divide us".[3]

[2] National Aeronautics and Space Administration, *Spinoff* (NASA, Washington 2014)

[3] Jim Lovell and Jeffrey Kluger, *Apollo 13*, (BB art, Praha 1996) 338.

"It was not essential, who likes or dislikes whom, or on which side are you standing, because all people were on the side of world with very clearly defined finite resources, and all of them, without any difference will suffer by terrible consequences, if they will suck to a naked bone world, which conceived life of human race, adopted it and nourished that life, which is now threatening it with contamination and destruction."[4]

The generosity of the Earth is not endless. Her supplies of energy, food, a clean atmosphere and water are finite[5].

2. <u>Sustainable Development Goals</u>

J.F.Kennedy said: "The nation that will conquer space will be the master on Earth, as well".[6]

The post-2015 development agenda, unified in its content and universal in form, will require effective, enhanced and innovative tools to support its implementation. Among those tools are the ones offered by space science and technology, which could act as both an enabler and a catalyst for the efforts of countries with regard to progressing towards internationally agreed development goals and for sustainable development. Advancing international cooperation in the peaceful uses of space science and technology and increasing the use of space-derived data and information are at the core of international efforts for harnessing the benefits of outer space for development in the post-2015 framework.[7]

The Committee on the Peaceful Uses of Outer Space, the primary United Nations body for coordinating and achieving international cooperation in space activities, in its contribution to the United Nations Conference on Sustainable Development, highlighted the value and the importance of space-derived information and recognized that space-derived geospatial data constituted a resource that could be

[4] Alan Shepard and Deke Slayton, Cíl měsíc (ALPRESS, Frýdek-Místek 1996) 319.

[5] Alan Shepard and Deke Slayton, Cíl měsíc (ALPRESS, Frýdek-Místek 1996) 374.

[6] Ján Azoud, Úvod do medzinárodných vzťahov a medzinárodného práva, (UMB FPVaMV, Banská Bystrica 1996) 114.

[7] United Nations, Coordination of space-related activities within the United Nations system: direction and anticipated results for the period 2014-2015 – addressing the post-2015 development agenda (UN doc. A/AC.105/1063, 2014) 1.

used to support sustainable development policies at the local, national, regional and global levels, notably through the establishment of dedicated spatial data infrastructure.[8]

Among the newly formed sustainable development goals, there are several that could be addressed by UNOOSA and space activities. This paper will analyse the relationship between space technology and certain goals in respect to its original assignment of the topic, which highlighted water, natural resources and disaster management:[9]

- Proposed goal 2: End hunger, achieve food security and adequate nutrition, and promote sustainable agriculture.
- Proposed goal 6: Ensure availability and sustainable management of water and sanitation for all.

In the proposed goals we can see a focus on disaster management, which is mentioned in the targets 1.5, 2.4, 11.5, and 13.1. Here space technologies can have a leading role. They enable us to encompass the whole disaster management cycle, which is composed of: preparedness, response, recovery and mitigation. As the International Journal of Applied Earth Observation and Geoinformation pointed out: “The United Nations Office for Outer Space is leading global efforts in standardizing the process of sharing global data during disasters.”[10]

3. UNOOSA

One reason of establishing the United Nations Office for Outer Space Affairs (UNOOSA) in 1962 was the coordination of mankind´s space activities at international level. Its role was to support the work of the Committee on the Peaceful Uses of Outer Space (COPUOS) and to implement a multifaceted programme that covers the legal, scientific and political aspects of space-related activities. The Office works closely with national space agencies, international space organisations, the private sector, non-governmental organisations and media[11].

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[8] United Nations, Coordination of space-related activities within the United Nations system: direction and anticipated results for the period 2014-2015 – addressing the post-2015 development agenda (UN doc. A/AC.105/1063, 2014) 11.

[9] International Institute of Sustainable Development, Earth Negotiations Bulletin (2014).

[10]Editoral (2010): Towards effective application of geospatial technologies for disaster management; International Journal of Applied Earth Observation and Geoinformtion, pp. 405-407

[11] United Nations Office for Outer Space Affairs, Space Matters, (UNOOSA, Vienna 2011) 25.

For over 40 years UNOOSA has provided practical assistance on the use of space technology for peaceful purposes throughout the world, through its workshops, initiatives, fellowships and regional centres[12].

To enhance the understanding and subsequent use of space technology for peaceful purposes in general, the UN Programme on Space Applications promotes greater cooperation and exchange of actual experiences in space science and technology between industrialized and developing countries as well as among developing countries. The Programme also organizes seminars on advanced space applications and disseminates information on new and advanced technologies and applications, with emphasis on their relevance and implications for developing countries.[13].

The United Nations provides a forum for countries, international organisations and non-governmental organisations to discuss issues related to the peaceful uses and exploration of outer space.[14]

UNOOSA is not the biggest consumer of space technology within the UN as some might think. However, several United Nations entities routinely use space-derived geospatial data, which constitute a vital source of essential information for a wide range of mandated activities.[15] During the contract period between 2008 and 2013, the Department of Field Support, the Department of Peacekeeping Operations, the Department of Political Affairs and their field missions collectively spent $12 million on system contracts, while other entities of the United Nations system spent approximately $3 million. A solicitation process to establish a new generation of system contracts with the private sector was initiated in 2013, and is expected to be finalized in 2014. The use of such commercial long-term agreements is expected to continue to increase.[16]

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[12]´Bringing the benefits of space to humankind´, Promotional video 1:14-1:50 (UNOOSA website) <http://www.unoosa.org/>, accessed 18 June 2014,

[13] United Nations Office for Outer Space Affairs, Propagation Bulletin (UNOOSA, Vienna) 3.

[14] United Nations Office for Outer Space Affairs, Space Solutions for the World´s Problems (UNOOSA, Austria 2006) 17.

[15] United Nations, Contribution of the Committee on the Peaceful Uses of Outer Space to the United Nations Conference on Sustainable Development: harnessing space-derived geospatial data for sustainable development (UN doc. A/AC.105/993, Vienna 2011) 8.

[16] United Nations, Coordination of space-related activities within the United Nations system: direction and anticipated results for the period 2014-2015 – addressing the post-2015 development agenda (UN doc. A/AC.105/1063, 2014) 15.

UNOOSA´s role is in fact more in coordination, promotion and enhancing the cooperation among member states and different UN agencies. Therefore one of the goals of UNOOSA is standardisation and better coordination of usage of space data. One such initiative is "UN-Space", which is an inter-agency meeting on Outer Space Activities, with the aim of promoting synergies and preventing duplication of effort related to the use of space technology and applications in the work of United Nations entities.[17] The main concern of UNOOSA is to bring experts together, who will afterwards create networks of their own. Additionally, UNOOSA can offer managerial assistance to help to build a national chain: data gathering – interpretation – decision – reaction - reflexion.

Processed data and information are shared among United Nations entities and made available through websites such as *ReliefWeb*, a global hub for time-critical humanitarian information on complex emergencies and natural disasters, the *Global Disaster Alert and Coordination System*, *UNITAR/UNOSAT*, the Inter-Agency Standing Committee's Common and Fundamental Operational Data sets Registry and the UN-SPIDER operates *Knowledge portal*.

4. UN SPIDER

Most satellites point inwards rather then outwards and they are launched to provide services to people on Earth. They are also important for cost-effective monitoring of remote and dangerous areas.[18] According to the European Space Agency, Earth observation from space is one of the most important sources of information for decision makers that have to react to challenges such as global environment changes and security issues. This information has to be of practical use, they have to be fast and low-cost accessible and be available for their users.[19]

For instance, *Copernicus* (*GMES*) is the most ambitious Earth observation programme to date. It will provide accurate, timely and easily accessible information.

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[17] United Nations, Coordination of space-related activities within the United Nations system: direction and anticipated results for the period 2014-2015 – addressing the post-2015 development agenda (UN doc. A/AC.105/1063, 2014) 2.

[18] United Nations Office for Outer Space Affairs, Space Solutions for the World´s Problems (UNOOSA, Austria 2006) 2

[19] European Space Agency, Die ESA stellt sich vor (2011) 5.

Its services fall into six main categories and one of them is security and climate change.[20]

UN-SPIDER was created based on a Resolution of the General Assembly in 2006 to support the full disaster management cycle, to connect the disaster management and space communities while being a facilitator of capacity-building and institutional strengthening, in particular for developing countries.[21] The General Assembly was seriously concerned about the devastating impact of disasters (natural or technological), causing the loss of lives and property, displacing people from their homes and destroying their livelihoods, and causing tremendous damage to societies around the world.[22]

The General Assembly agrees that the programme should work closely with regional and national centres of expertise and to be offered, by Member States, particularly by developing countries.[23]

Any organisation that wants to make a change on a global level needs a global network to support it, because no single actor possesses the whole set of required skills. Since its establishment in 2006, UN-SPIDER has devoted considerable efforts to building its network of Regional Support Offices (RSOs). The network of RSOs works in close collaboration with UN-SPIDER offices in Beijing, Bonn and Vienna. Joint activities are cross-cutting in UN-SPIDER´s pillar of work: Technical Advisory Missions, training activities and other capacity building measures, ad-hoc emergency support and bridging knowledge gaps in the use of space technologies in disaster risk reduction or emergency response. For example the RSOs use their expertise to develop tailor-made training material and to conduct one-week training courses with the aim of strengthening the skills of staff in government agencies on the use of specific software applications to process satellite imagery.[24]

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[20] About Copernicus, Copericus Masters´ (Copernicus Masters website) <http://www.copernicus-masters.com/index.php?kat=about.html&anzeige=about.html> accessed 9 June 2014

[21] United Nations, Resolution adopted by the General Assembly. United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN doc. A/RES/61/10, 2007) 2.

[22] United Nations, Resolution adopted by the General Assembly. United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN doc. A/RES/61/10, 2007) 1.

[23] United Nations, Resolution adopted by the General Assembly. United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN doc. A/RES/61/10, 2007) 3.

[24] UN-SPIDER, 'Newsletter' (2014) Vol. 2 UN-SPIDER Newsletter, < http://www.un-spider.org/sites/default/files/Newsletter_online_0.pdf> accessed 5 December 2014, 1.

In 2013 the UN-SPIDER programme reached the established target of providing technical advisory support to 28 countries; worked on the further improvement of its knowledge portal; organized or provided support to a number of international and regional workshops, as well as expert meetings; and facilitated the conduct of capacity-building activities in Africa and Asia.[25]

UN-SPIDER aims to bridge the gap between science and practice by promoting useful and operational methodologies on the use of space technologies for disaster risk management. The recommended practices are intuitively accessible in a user-friendly way on the UN-SPIDER *Knowledge Portal*. Since flooding often occurs under cloudy conditions, SRI NASU-SSAU uses radar sensors because of their ability to acquire data through clouds. In this practice, Radarsat-2 data is processed using freely available remote sensing and GIS software packages. Based on a histogram analysis, a threshold is selected to separate water from non-water surfaces. Afterwards the final flood extent map is produced. This methodology was already successfully applied to map the extent of several floods in Australia, Africa and Asia. Flood extent mapping is especially useful in the disaster response phase to quickly provide an overview on the affected areas to relief agencies. Complementary to the recommended practices, some RSOs have elaborated booklets on lessons learnt in using space technologies. A first booklet was published by SUPARCO (Pakistan) focusing on their experience in utilising satellite data for floods.[26]

The Sudan Technical Advisory Mission (TAM) carried out in 2011 is one example that highlights the importance of the participation of RCMRD in the TAMs in the region. One of the recommendations from the mission was to hold a training workshop targeting staff from the Government and from other agencies working in disaster risk reduction in Sudan.[27]

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[25] United Nations, Report on activities carried out in 2013 in the framework of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN doc. A/AC.105/1057, 2013) 1

[26] UN-SPIDER, 'Newsletter' (2014) Vol. 2 UN-SPIDER Newsletter, <http://www.un-spider.org/sites/default/files/Newsletter_online_0.pdf> accessed 5 December 2014, 3.

[27] Denis Macharia, 'RCMRD´s partnership with UN-SPIDER as a Regional SUpport Office' (2014) Vol. 2 UN-SPIDER Newsletter <http://www.un-spider.org/sites/default/files/Newsletter_online_0.pdf> accessed 5 December 2014,5

UN-SPIDER joined forces with its Regional Support Office ICIMOD to provide a training course in Nepal on multi-level flood risk management in June 2014. In a session taught by ICIMOD, participants learned how to apply the indicator-based approach for hazards, vulnerability and risk mapping approaches using ArcGIS. The flood session focused on flood mapping techniques using optical and radar sensors. The aim was to build capacities on the use of satellite data to support post-flooding interventions as such data increases the situational awareness. The session on landslides covered semi-automatic detection of landslides through image processing. This method is useful for inventory development and landslide susceptibility mapping, which provide input for land use policies and plans.[28]

A workshop called *Earth Observation Technologies for Flood Risk Mapping, Modelling and Management* took place in Sri Lanka in November 2014. The objective was to present a broad array of methodologies and tools for flood hazard data collection, analysis and management, flood inundation modelling and rapid flood damage assessment.[29]

UNOOSA, through UN-SPIDER, organised co-organized or attended following capacity-building events:[30]

- United Nations/Germany Expert Meeting on the Use of Space-based Information in Early Warning Systems, Bonn, Germany, 25 and 26 June 2013,
- International training programme on flood risk mapping, modelling and assessment using space technology, 22 to 26 July 2013, India,
- Workshop on advances in using space technology and geospatial information for disaster management, China, 21 and 22 October 2013,
- United Nations/China International Conference on Space-based Technologies for Disaster Management: Disaster Risk Identification and Response, Beijing, 23 to 25 October 2013,
- Training course on space technology for flood and drought risk mapping and assessment, China, 27 to 31 October 2013,

[28] UN-SPIDER, 'Newsletter' (2014) Vol. 2 UN-SPIDER Newsletter, <http://www.un-spider.org/sites/default/files/Newsletter_online_0.pdf> accessed 5 December 2014, 4.

[29] UN-SPIDER, November Updated 2014, <http://www.un-spider.org/sites/default/files/UN-SPIDER_Updates_Nov14.pdf>, accessed 5 Decemebr 2014, 1.

[30] United Nations, Report on activities carried out in 2013 in the framework of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN doc. A/AC.105/1057, 2013) 4

However, those are not all of the events where UN-SPIDER was involved in 2013. It has been represented on many conferences and symposiums. We must also consider the activities following the technical advisory missions as the one that took place in Sudan in May 2013. Furthermore, it has been actively working with specific government agencies as a way to promote the incorporation of specific texts in the post-2015 framework for disaster risk reduction, highlighting the use of Earth observations and space-based technologies.[31] UN-SPIDER also aims to disseminate info for non-specialists. They are often sending out teams for the assessment of a country´s usage of geospatial data and they are helping with implementations of adjustments.

UN-SPIDER´s Bonn office contributed to the update of guidelines on *Tsunami Risk Assessment and Mitigation for the Indian Ocean* in 2014. They will be used to conduct a regional training workshop targeting representatives of institutions from countries exposed to tsunamis in the Indian Ocean. The training is expected to be held in the beginning of 2015. [32]

UN-SPIDER provided support during several emergencies: for activating the International Charter on Space and Major Disasters and coordinating with end users during typhoon Bopha in Palau and the Philippines; providing satellite images through ISRO during typhoon Haiyan in the Philippines; and providing products to the Government of Iraq for flood monitoring in northern Iraq and Baghdad, with the assistance of ISRO and NDRCC.[33]

The web-based Knowledge Portal of UN-SPIDER is now a well-established source of information for many practitioners in disaster risk reduction and emergency response.[34] The portal provides databases on freely available satellite data, derived products and software, as well as compilations of all relevant maps and resources for

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[31] UN-SPIDER, November Updated 2014, <http://www.un-spider.org/sites/default/files/UN-SPIDER_Updates_Nov14.pdf>, accessed 5 Decemebr 2014, 2.

[32] UN-SPIDER, November Updated 2014, <http://www.un-spider.org/sites/default/files/UN-SPIDER_Updates_Nov14.pdf>, accessed 5 Decemebr 2014, 2.

[33]United Nations, Report on activities carried out in 2013 in the framework of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN doc. A/AC.105/1057, 2013) 13

[34] Luc St-Pierre, 'UN-SPIDER and its Regional Support Offices: The way ahead' (2014) Vol. 2 UN-SPIDER Newsletter <http://www.un-spider.org/sites/default/files/Newsletter_online_0.pdf> accessed 5 December 2014, 6

selected major disasters. UN-SPIDER is also strengthening its network of 16 regional support offices.[35] A network is a network if exchanges happen in a multitude of directions[36]

The knowledge portal of UN-SPIDER is a very important tool of communication, knowledge transfer and dissemination of information in cases of increased demand as disasters strike (e.g. in Central Europe in summer 2013). Also management practices are promoted at this portal. They are giving guidance on the use of archived and up-to-date imagery to derive information for disaster risk reduction and emergency response (flood-plain delineation, flood mapping, vegetation monitoring, etc.).[37] Between 1 September 2012 and 31 August 2013, the monthly visits to the knowledge portal experienced a general upward trend, averaging about 10,000 visits per month in the reposting period.[38]

5. Space technology in Precision Agriculture

The World Development Report on "Agriculture for Development" has recognized that agriculture is one of the central factors for achieving the Millennium Development Goals of poverty reduction and environmental sustainability.[39] With this in mind the projections that arable land is to decline from 0.23ha in 2004 to approximant 0.15 ha by 2015, the food grain will increase while the number of people in rural arias will decrease, are much more concerning. New, more productive ways of agriculture needed to contra-weight these changes. The significant role of spatial imagery in improving crop management and the quality of agricultural data dates back

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[35] United Nations, Coordination of space-related activities within the United Nations system: direction and anticipated results for the period 2014-2015 – addressing the post-2015 development agenda (UN doc. A/AC.105/1063, 2014) 17.

[36] Luc St-Pierre, 'UN-SPIDER and its Regional Support Offices: The way ahead' (2014) Vol. 2 UN-SPIDER Newsletter <http://www.un-spider.org/sites/default/files/Newsletter_online_0.pdf> accessed 5 December 2014, 6

[37]United Nations, Report on activities carried out in 2013 in the framework of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN doc. A/AC.105/1057, 2013) 9

[38] United Nations, Report on activities carried out in 2013 in the framework of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN doc. A/AC.105/1057, 2013) 10

[39] Fopal, N et al.(2013): Using geospatial technology to strengthen data systems in developing countries: The case of agricultural statistics in India; Applied Geography, (43), p. 99

to 1929 when Arial photography was used to map soil resources.[40] The first satellite data for agricultural purposes was used in the early 1970`s with the launch of Landsat 1 and its use for remote sensing.[41] In the following paragraphs studies that analyzed the used geospatial technologies for precision agriculture and agriculture statistics will be pointed out with the goal to identify the consensus in the academia as well as the challenges and problem that might arise with the use of these technologies.

When we talk about using geospatial technology in agriculture we are most likely speaking of precision agriculture. The first question that arises is the one about the difference between precision agriculture and the more conventional traditional methods of agriculture. Conventional management methods assume that a field is homogenous and apply a uniform application of fertilizers, irrigation, seed etc. to the field as a whole.[42] On the other hand precision agriculture uses remote-sensing applications that are based on the interaction of electromagnetic radiation with soil or plant material to divide the field into management zones that receive customized inputs (fertilizers, herbicides, seed, fuel) depending on soil types, landscape, management history etc. Through this method better infield management decisions are made, chemical and fertilizer costs are reduced through efficient application, accurate farm records are produced, profit margins are increased and the overall pollution is reduced.[43] Because of these facts academics argue that precision agriculture is one of the top ten revolutions in agriculture.

The technological progress of satellite based remote sensing amplified the scope of their application in precision agriculture. Over the past decade the spatial resolution of imaging has improved, the return visit frequency has been drastically shortened, and the spectral bands have improved from four bands with Landsat to eight or more with WorldView. However farmers, crop consultants, extension agents are not aware of what is available, how to extract information for imagery, nor of its economic value. Projects have been developed and implemented with the goal of change this picture. One of

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[40] Seelan, S. et al. (2003): Remote sensing applications for precision agriculture: A learning community approach; Remote Sensing and Environment, 88, p. 158

[41] Mulla, D. (2013): Twenty five years of remote sensing in precision agriculture: Key Advances and remaining knowledge gaps; Biosystems Engineering, 114, p. 361

[42] Nahry, E. et al. (2011): An approach for precision farming under pivot irrigation system using remote sensing and GIS techniques; Agricultural Water Management, 98, p. 517

[43] Seelan, S. et al. (2003): Remote sensing applications for precision agriculture: A learning community approach; Remote Sensing and Environment, 88, p. 157

these was the Upper Midwest Consortium (UMAC) that used a learning community approach for promoting the use of remote sensing among farmers and ranchers. The researchers provided the farmers with an opportunity to use high-resolution imagery collected at 70 cm ground resolution. After proper training the farmers were able to retrieve information out of these images such as identifying stressed areas caused by wind damage, damage due to inundation, fertilizer skips, cultivator blights, disease etc. and implement this information in their further decision making.[44]

NASA's Synergy program used a similar approach as UMAC. The Synergy program established training classes to ensure a smooth transition of technology from the academia to the user domain. They found that the early involvement of the users was critical for the success of application development and realizing an impact on decision-making. This support of an early user group that could showcase the benefits of remote sensing over conventional methods is essential for a wider adoption.[45] The additional benefit to society would be the creation of highly technical jobs, and currently more than 30 % of the growth in US agribusiness is expected to come from further adoption of precision agriculture by farmers.[46] The scope for funding new hardware, software and consulting industries related to PA is also growing. The market in Japan is estimated at US $ 100 billion for GIS and US $ 50 billion for GPS and RS.[47]

Precision agriculture is hypothesized to re-organize the total system of agriculture towards a low-input, high-efficiency and sustainable agriculture. There is a perception that precision agriculture cannot be applied to small-scale farms of developing countries, either because of arguments referring to the lack of technology, to the costs related to acquiring the needed data, and the lack of training. However, courtiers such as Japan, China, and the Republic of Korea are developing web-based

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[44] *Seelan, S. et al. (2003): Remote sensing applications for precision agriculture: A learning community approach; Remote Sensing and Environment, 88, p. 162*

[45] Kalluri, S. et al (2003): The potential of remote sensing data for decision makers at the state local and tribal level: experiences from NASA's Synergy program; Environmental Science and Policy, (6), p. 495

[46] Mulla, D. (2013): Twenty five years of remote sensing in precision agriculture: Key Advances and remaining knowledge gaps; Biosystems Engineering, 114, p. 359

[47] Basu, M. , Mondal, P. (2009): Adoption of precision agriculture technologies in India and in some developing countries: Scope, present status and strategies; Progress in Natural Science, 19, p. 665

GIS systems which will be adapted for the use of small farms. Agricultural Advanced Technology programs should be started in developing countries as soon as possible.[48]

In their study Fopal et al. extend the existing literature and compere the use of traditional methods for crop aria statistics and modern methods that use geospatial technology. The study has been conducted in the Indian state of Karnataka.

The conventional methods give the task of collecting crop area statistics to a village level government functionary (VA). The VA is expected to manually gather data about each crop in each village and has one month to complete the data collection process in each season. Once the data is collected a private software firm takes approximately 20-30 days to digitalize the data.[49]

Fopal et al. developed an alternative data collection method. They integrated a geographic information system (GIS) with a global positioning system (GPS) to enhance data quality. These parcels were further demarcated into small sub-plots created based on topography to identify single crops, the boundary of each crop grown within a plot were traced using the GPS device.[50]

The final step of the study was to compare the two methods (Table 1). The conventional method made inaccurate crop area statistics, it generally underestimated crop yield thus having direct bearing on the expected prices, leading in flawed policy making and weak procurement processes. It is also not appropriate for capturing changing cropping patterns. With the alternative approach data collection is precise (accuracy above 90%) and instantaneously digitized, reducing the time for collection and dissemination of information for the decision making process. The authors point out that there is surprisingly little research on this topic despite the fact of the significance of agriculture in developing countries and the recognition of the need for improving agriculture and rural statistics in these parts of the World.[51]

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[48] Basu, M. , Mondal, P. (2009): Adoption of precision agriculture technologies in India and in some developing countries: Scope, present status and strategies; Progress in Natural Science, 19, p. 661, 664

[49] Fopal, N et al.(2013): Using geospatial technology to strengthen data systems in developing countries: The case of agricultural statistics in India; Applied Geography, (43), p. 102

[50] Fopal, N et al.(2013): Using geospatial technology to strengthen data systems in developing countries: The case of agricultural statistics in India; Applied Geography, (43), p. 103

[51] Fopal, N et al.(2013): Using geospatial technology to strengthen data systems in developing countries: The case of agricultural statistics in India; Applied Geography, (43), p. 111

The under-recording of cash crop areas using the conventional method limits the availability of credit and insurance coverage because the amount of credit a farmer can obtain depends on the area-estimated cost of cultivation. This is an essential concern for developing countries in which the agricultural sector is in transiting towards commercialization and adaptation of high-value crops.[52]

Through the facts stated in the paragraphs above we can identify the impact of geospatial technology in the agricultural sector. When we look at Proposed goal 2 of the Open Working group for Sustainable Development Goals we can see that the revolutionary contributions of these technologies can provide a basis for meeting the benchmarks set out in this goal. We are talking about a low-input, high-efficiency and sustainable agricultural model that transcends the borders of one country or region. To be able to globally implement this model in the post-2015 era further coordination of cost-benefit analysis is needed, as well as the involvement and education of stakeholders on all levels of the further development and implementation of these technologies.

6. Space Technology and Water Management

The problem of freshwater scarcity is becoming more serious in several parts of the world, especially in developing countries. The achievement of water security is one of the biggest tasks of the 21st century. This is why water is in the core of the 1st, 3rd and 7th MDG, and is interlinked with the achievement of the other MDGs.[53] The same is true for the achievement of the 6th, 12th, 14th and 15th proposed SDGs. Technological advances and their implications may be the crucial factor in fulfilling the task stated above. Garg stresses that: “Satellite remote sensing and GIS have emerge as the most powerful tools for inventorying, monitoring and management of natural resources and environment.”[54] This section of the paper will deal with rainwater harvesting, irrigation, and wetland preservation as only parts of a much broader water management area. We

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[52] ibid p. 108

[53] Madan, K. et al. (2014): Rainwater harvesting planning using geospatial techniques and multicriteria decision analysis; Resources, Conservation and Recycling (83), pp. 96

[54] Garg, J.K. (2013): Wetland assessment, monitoring and management in India using geospatial techniques; Journal of Environmental Management, p. 174

will see how water managers use satellite remote sensing and GIS to improve water security in developing countries.

6.1. Rainwater Harvesting

Water scarcity and climate change call for more resourceful substitutions of water conservation. Rainwater harvesting (RWH) is one of the most promising alternatives. This term is usually used to describe the collection, storage, distribution and use of rainwater. Water managers claim that RWH is an important tool, which can insure safe, accessible and affordable water for drinking and other uses. The benefits of RWH also have positive side effects: no excessive runoff, flood control, soil conservation etc. There are six key factors for determining suitable sites for RWH: climate (rainfall), hydrology (rainfall-runoff relationship and intermittent watercourses), topography (land slope), agronomy (crop characteristics), soil (texture, structure and depth) and socio-economic conditions. To water managers it is clear that with the help of remote sensing and geographic information systems many of these factors can be precisely determined and potential RWH zones and sites for RWH structures can be identified.[55]

In their study Madan et al. identified suitable sites for RWH in West Bengal (India) using specific suitability criteria. They developed a rainwater harvesting potential map (Fig. 1) of the study area and divided it into three zones: good (24 % of the aria), moderate (47 %), and poor (29 %). The researchers have also identified it is suitable for check dams and percolation tanks (Fig. 2).

In Tanzania rainwater harvesting is widely practiced and farmers practice RWH through a number of different technologies and practices. Mbilinyi et al. compared the findings of potential rainwater harvesting sights using RS and GIS technology with the location of existing structures. After developing a suitability map they found that most of the RWH technologies were found within the very high suitable locations (40 %) and highly suitable locations (41.4 %). This evidence shows that GIS and remotely sensed information can reliably be used to predict potential sites for RWH that may be used for development and management rainwater harvesting programs.[56]

[55] Madan, K. et al. (2014): Rainwater harvesting planning using geospatial techniques and multicriteria decision analysis; Resources, Conservation and Recycling (83), pp. 96

[56] Mbilinyi, B. et al. (2007): GIS-based decision support system for identifying potential sites for rainwater harvesting; Physics and Chemistry of the Earth, 2, p. 1080

6.2. Irrigation and runoff harvesting

Irrigation is the largest user of freshwater, it is estimated that approximately 70% of withdrawals are from irrigation. We must point out that irrigation produces 30-40% of the world's food crops. It is clear that to manage the growing demand for food new ways to better manage our water resources need to be found. Bastiaanssen et al. recognize the potential of Remote sensing: "Remote sensing has the possibility of offering important water resource-related information to policy makers, managers, consultants, researchers and to the general public. This information is potentially useful in legislation, planning, water allocation, performance assessment, impact assessment, research, and in health and environment-related fields."[57] Bastiaanssej et al. call attention to the importance of water rights and the problems in determining them. They suggest that remote sensing should be used to determine which individual or group is presently or historically using water. And after the water rights are placed, water use can be checked. Remote sensing offers the possibilities in the collection of fees and enforcement of regulation. This method was applied by Hongjie in his study in El Paso (Texas) where he used remote sensing to help water departments efficiently monitor the water use of each household.[58] Furthermore system managers can modify decisions throughout an irrigation season based on field moisture depletion and evaporation deficit by regularly monitoring field wetness indicators with the help of remote sensing technology.

In water scarce countries milder forms of dry spells can severely reduce yield potentials or even cause crop failures. Here runoff harvesting is a potential solution of providing enough freshwater for irrigation purposes. These water harvesting systems can be grouped into three main types: in-situ moisture conservation (soil and water conservation), concentration of runoff to crops in the field, and collection and storage of runoff water in different structures. Using a similar approach as Madan et al., Winnaar et al. located optimal sites for runoff harvesting in the Thukela River basin, South

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[57] Bastiaanssen, W. et al. (2000): Remote sensing for irrigated agriculture: examples form research and possible applications; Agricultural Water Management, 46, 137-155

[58] Hongjjie, X. (2009): Using remote sensing and GIS technology for an improved decision support: a case study of residential water use in El Paso, Texas; Civil engineering and Environmental Systems, vol 26 (1), p. 53

Africa. After creating a runoff potential map and combining it with socio-economic factors (Fig. 3) they found that 18 % of the Potshini catchment is highly suitable for developing runoff harvesting systems innovations.[59] It is almost needles to emphasize the importance of such data for further investments and decisions by the public or the private sector.

6.3. Wetland assessment

Wetlands are areas that are used both for consumptive (hunting, fishing, agriculture) and non-consumptive purposes. They provide clean water and fuel wood to the surrounding communities. Wetlands are an important sink for carbon, and have a vast potential for agricultural production.[60] Due to filling, farming, grazing, settlement development a large number of wetlands have been lost. Hunger, loss of livelihood options, water scarcity, salinization, and degradation of soil are some of the consequences of the loss of this natural habitat.[61] [62] Remote sensing has been identified as a very useful technique for inventorying, monitoring and management of wetland ecosystems: “Satellite remote sensing allows detection and mapping of sediments changes in color and temperature variations in aquatic ecosystems. Using satellite data it is possible to delineate structural components of the wetlands such as open water, aquatic vegetation zones, raised areas or islets, water pools, tree vegetation etc. using visual and digital analysis techniques.”[63]

Mwita et al. used satellite sensors for wetland detection in East Africa. Their study made efforts to identify small, undocumented wetlands in Kenya and Tanzania. These wetlands have a lot of benefits to the ecosystem and the surrounding communities as pointed out in the paragraph above. The maps that have been generated out of this study may provide water managers with the quantitative basis to guide and predict

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[59] Winnaar, G. et al. (2007): A GIS-based approach for identifying potential runoff harvesting sites in the Thukela River basin, South Africa; Physics and Chemistry of the Earth, 32, p. 1064

[60] Mwita, E. et al. (2013): Mapping small wetlands of Kenya and Tanzania using remote sensing techniques; International Journal of Applied Earth Observation and Geoinformation (21), p. 174

[61] ibid

[62] Garg, J.K. (2013): Wetland assessment, monitoring and management in India using geospatial techniques; Journal of Environmental Management, p. 1

[63] ibid, p. 4

future wetland uses and conservation in recognition of an increasing demand for agricultural land.[64]

7. Conclusion

Although this paper has analysed three fields, which at first do not seem to share many characteristics with each other, we have identified a commonality that resonates throughout the topic of the use of space technology for the benefits of mankind in the respected fields. Disaster risk management, agriculture, water management all face one and the same issue when looking at them on a global scale, and this issue can be adequately addressed within the mandate of the United Nations Office for Outer Space Affairs. In all three instances we see a severe lack of coordination and education. The effective federation and collaboration across states, government agencies, non-government organisations, industries, academia, and the public is yet to be achieved. The development stage of the use of space technologies in the fields analyzed in this paper are still isolated from the end-users who lack both the information and education to comprehend the implications of such technologies in their respected fields.

UNOOSA has recognized these blind spots, and has sought out to address the issue within its powers. The question is how to adapt the already developed approach to best address the Post 2015 Development Goals. Within this journey we must keep in mind that we are talking about a time period of 15 years, and that with every month we are experiencing ground braking achievements in the sphere of space technology, only in the last 6 months of 2014 we were able to witness the successful launch of the most powerful Earth Observation satellite World View-3 (launched by the private sector, Digital Globe), and the first landing of a man made object on a comet (Rosetta Mission, ESA). In the following we will point out certain aspects of the Agencie's work which might be further developed and modified accordingly to best address the 3 fields mentioned in this paper in regards to the stated SDGs.

7.1 Coordination

The Committee on the Peaceful Uses of Outer Space pointed to the need for establishing suitable nation spatial data infrastructure.[65]

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[64]Mwita, E. et al. (2013): Mapping small wetlands of Kenya and Tanzania using remote sensing techniques; International Journal of Applied Earth Observation and Geoinformation (21), p. 182

At its third session, held in July 2013, the Committee also recognized that there would be a need to create a network of global data and information supported by the tools and technology to create maps and detect and monitor change over time in a consistent and standardized manner, and that the sustainable development user community should be more engaged.[66]

Geospatial data is a key decision-making tool for the efficient management of assets, environments and communities, but bottlenecks and gaps exist with respect to access to, as well as interpretation, analysis and usage of, such data, as they are at present provided mainly by the private sector, governments and specialized agencies. Nevertheless, within the United Nations efforts are being made to increase and streamline the use of geospatial data.[67]

Another central element in the work of the Committee is to further strengthen capacity, particularly of developing countries, in the use and applications of space science and technology for sustainable development and increase awareness among decision makers of the benefits of space science and technology and their applications in addressing societal needs for sustainable development through international cooperation among Member States and national and international space-related entities, including the private sector as appropriate.[68]

In its resolution 65/97, the General Assembly emphasized that regional and interregional cooperation in the field of space activities was essential for strengthening the peaceful use of outer space. Furthermore this process would assist States in the development of their space capabilities and through this contribute to the achievement

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[65] United Nations, Coordination of space-related activities within the United Nations system: direction and anticipated results for the period 2014-2015 – addressing the post-2015 development agenda (UN doc. A/AC.105/1063, 2014) 11.

[66] United Nations, Coordination of space-related activities within the United Nations system: direction and anticipated results for the period 2014-2015 – addressing the post-2015 development agenda (UN doc. A/AC.105/1063, 2014) 13.

[67] United Nations, Coordination of space-related activities within the United Nations system: direction and anticipated results for the period 2014-2015 – addressing the post-2015 development agenda (UN doc. A/AC.105/1063, 2014) 15.

[68] United Nations, Contribution of the Committee on the Peaceful Uses of Outer Space to the United Nations Conference on Sustainable Development: harnessing space-derived geospatial data for sustainable development (UN doc. A/AC.105/993, Vienna 2011) 3.

of the goals set out in the United Nations Millennium Declaration and to that end fostered interregional dialogue on space matters between Member States.[69]

By taking advantage of that expert network and close end-user interaction, UN-SPIDER significantly contributes to the harnessing of geospatial data for sustainable development, in particular by supporting resilience to disasters and emergency relief efforts.[70]

7.2 Education

The decisions of the Committee and its subsidiary bodies will continue to be implemented by the Office for Outer Space Affairs. In the biennium 2014-2015, the Office, within the framework of the United Nations Programme on Space Applications, will continue to organize, in close cooperation and coordination with other relevant United Nations entities, a series of conferences, workshops, symposiums and training courses addressing a wide range of topics related to capacity-building in space science, technology and education, including within the frameworks provided by the United Nations Basic Space Technology Initiative and the Human Space Technology Initiative, aimed at supporting relevant indigenous capabilities with regard to small satellites for sustainable development and human space technology spin-offs, respectively. Additionally, the UN-SPIDER programme will contribute to capacity-building in the use of space-derived data and information in disaster-related situations. The study of the Group of Governmental Experts noted that there were many regional and multilateral capacity-building programmes on space science and technology, such as the United Nations Programme on Space Applications and the capacity-building programmes of UNESCO, WMO and ITU.[71]

The Office for Outer Space Affairs of the Secretariat, through its United Nations Programme on Space Applications, organizes meetings to provide unique opportunities

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[69] United Nations, Contribution of the Committee on the Peaceful Uses of Outer Space to the United Nations Conference on Sustainable Development: harnessing space-derived geospatial data for sustainable development (UN doc. A/AC.105/993, Vienna 2011) 4.

[70] United Nations, Contribution of the Committee on the Peaceful Uses of Outer Space to the United Nations Conference on Sustainable Development: harnessing space-derived geospatial data for sustainable development (UN doc. A/AC.105/993, Vienna 2011) 9.

[71] United Nations, Coordination of space-related activities within the United Nations system: direction and anticipated results for the period 2014-2015 – addressing the post-2015 development agenda (UN doc. A/AC.105/1063, 2014) 12.

for bringing together experts in space science and technology, decision makers and practitioners to share their experiences and knowledge with the aim of having geospatial data used for sustainable development as widely as possible. Capacity-building through long-term education is specifically provided by the regional centres for space science and technology education, affiliated to the United Nations, located in Brazil/Mexico, India, Morocco and Nigeria. All regional centres are holding nine-month postgraduate courses in satellite remote sensing and satellite meteorology, utilizing geospatial data for training, education, application and research purposes.[72]

While the benefits of space-derived geospatial data are widely known, there is still a need to enhance capacities in many countries to ensure that such data can be exploited to the fullest extent possible. The increased availability of space-based data at little or no cost is an important factor in that regard.[73]

8. Recommendations

To ensure that the benefits of space technology are implemented, and that the coordinating and educating role of UNOOSA is achieved to the fullest extent possible in regards to the post 2015 development agenda, the following could be considered by Member States and United Nations entities as goals to be pursued at the national, regional and international level:

a) Improve geospatial data modelling and processing capabilities in all parts of the world and overcome the constraints of internet bandwidth.
b) Improve the availability of trained human resource for regions struck by natural disasters.
c) Provide access to geovisual analytics applications, which combine visualization with human factors and provide effective analytical and decision support approaches through near real-world simulations, available to the emergency management community in less developed countries of the World.

[72] United Nations, Contribution of the Committee on the Peaceful Uses of Outer Space to the United Nations Conference on Sustainable Development: harnessing space-derived geospatial data for sustainable development (UN doc. A/AC.105/993, Vienna 2011) 9.

[73] United Nations, Contribution of the Committee on the Peaceful Uses of Outer Space to the United Nations Conference on Sustainable Development: harnessing space-derived geospatial data for sustainable development (UN doc. A/AC.105/993, Vienna 2011) 7.

d) Develop tools to foster interoperability in the integration process and maintain it at the data, information, and knowledge levels to avoid the building non-sharable data systems.
e) Develop a research agenda that addresses the use of geospatial technology in regards to the Post-2015 Development Agenda through effective federation and collaboration across states, government agencies, non-government organisations, industries, academia, and the public.
f) Support a creation of an early user group that could showcase the benefits of remote sensing over conventional methods.
g) Support place-based policy and other national and international initiatives based on a seamless integration of data for the following tasks: Facilitating the sharing of data; maintaining the information processed from raw data; validate the knowledge obtained from the information.
h) Create a dynamic educational model that would support the process of "socialising the pixel".
i) Promote the development of cost-benefit analyses for the implementation of geospatial technologies in various fields.
j) Enhance North-South, South-South and triangular regional and international knowledge sharing in the field of space technology.
k) Assist development countries in attaining trained personnel resources for the transformation of raw data into usable information for the decision making process and promote them actively.
l) Moderate the quality assurance and standardization processes.

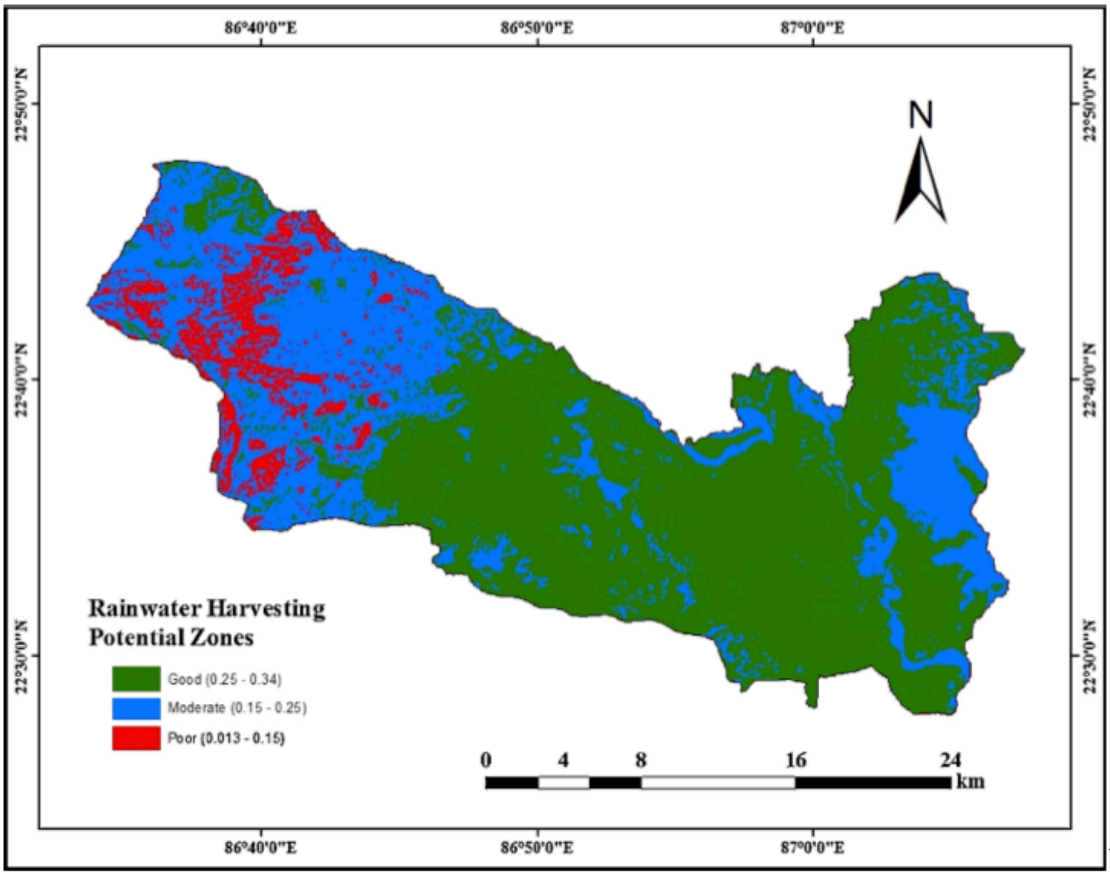
Figures and tables:

Table 1- cost conventional vs. alternative

Parameters	Conventional method	Alternative method
Cost per season for the total area of 4600 acres (assigned to each VA)	Costs 538.88 US$ (1 US$ = Rs. 55.67) Cost breakdown: 2 months VA salary = 2 × 269.44 US$	Costs 485.86 US$ Cost breakdown[a]: cost of updating = 414 US$ (0.09 US$ price paid for traversing per acre × 4600 acres) + 26.94 US$ is the user cost of a hand-held device + 44.92 US$ paid for verification of data The data is directly transferred to the server which can be accessed using GIS application

[74]

Figure 1: Rainwater harvesting potential zone map



[75]

[74] Fopal, N et al.(2013): Using geospatial technology to strengthen data systems in developing countries: The case of agricultural statistics in India; Applied Geography, p. 107

[75] Madan, K. et al. (2014): Rainwater harvesting planning using geospatial techniques and multicriteria decision analysis; Resources, Conservation and Recycling (83), p. 108

Figure 2: Suitable sites for recharge stations

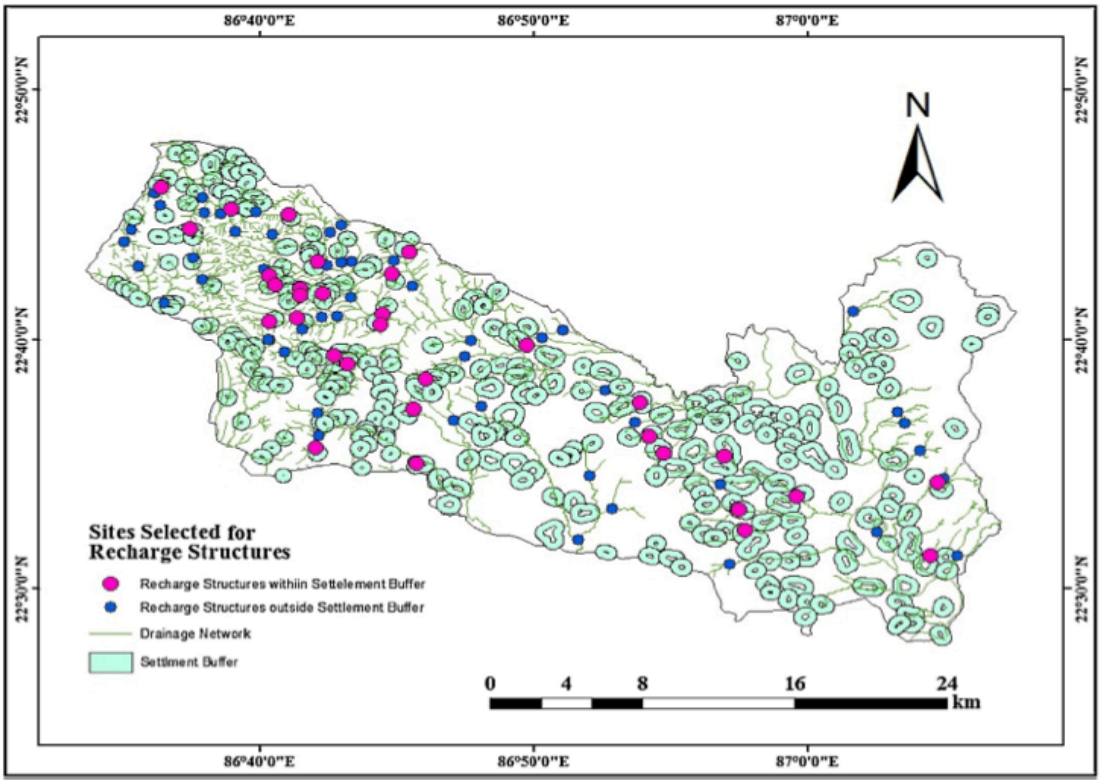


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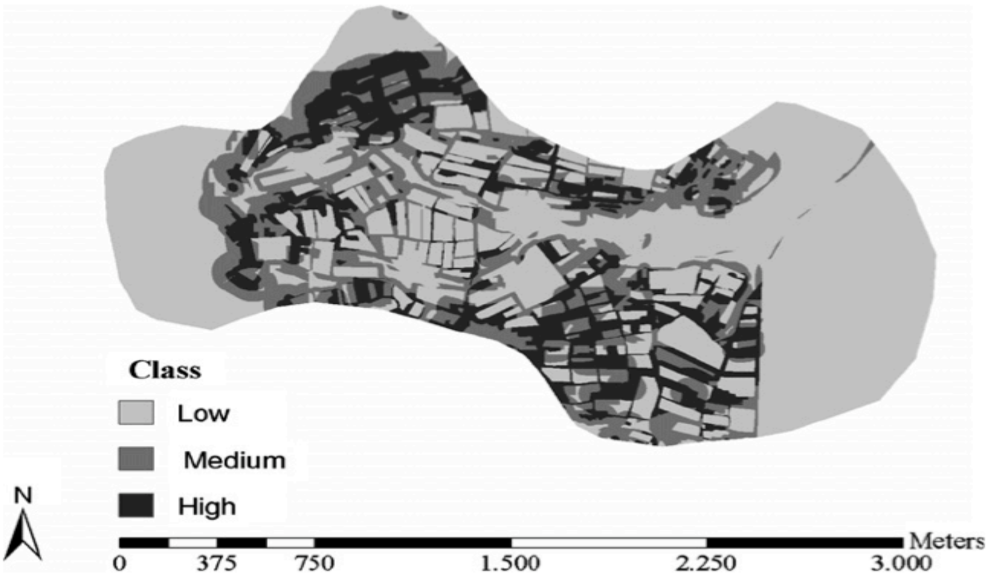
Figure 3: Suitability map ranking of the Potshini catchment



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76 Madan, K. et al. (2014): Rainwater harvesting planning using geospatial techniques and multicriteria decision analysis; Resources, Conservation and Recycling (83), p. 109

77 Winnaar, G. et al. (2007): A GIS-based approach for identifying potential runoff harvesting sites in the Thukela River basin, South Africa; Physics and Chemistry of the Earth, 32, p. 1064

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