THE ENVIRONMENT MANAGEMENT

A Quarterly E- Magazine on Environment and Sustainable Development

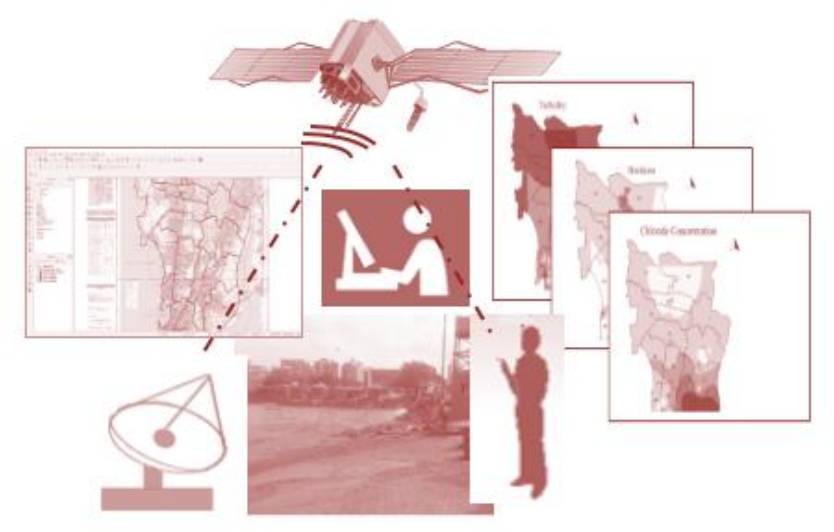
Indian Institute of Environment Management
SIES RISE WITH EDUCATION

पर्यावरणो रक्षति रक्षितः

(for private circulation only)

Vol.: IV | October – December, 2018 | Issue: 4

Current Issue – Geospatial Technologies for Environment Management



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From Director's Desk

Among the environmental resources, perhaps it would be lack of availability of fresh water will create formidable challenge to the human existence and sustenance of economic activities in large part of the world. Urban regions due to high population density in small geographical areas may have more problems in providing fresh drinking water supply. In India, drinking water availability is already grim in urban areas in general and megacities in particular. The limited available resources, high cost of purification and transportation of water from far off places constrain the augmentation of water supply, Further, increasing pollution in surface and underground water bodies, broken pipelines and unauthorized water connections are major hurdles in addressing the problems of accessibility and inequality in water supply. At this juncture, apart from improving the infrastructure, continuous monitoring and mapping of water quality and resources are desirable for policy makers to ensure sustainable water supply and addressing the issues of water governance. GIS and remote sensing have played significant role in monitoring, mapping and modeling of water quality, supply network and improving the efficiency of the system,

Our institute is working in close association with Municipal Corporation of Greater Mumbai in drinking and underground water quality monitoring and mapping by GIS technology in different wards under NRDMS, Department of Science and Technology funded R&D project. We are very happy to release current issue of institute's newsletter on the theme 'Geospatial Technologies for Environment Management'. This volume is also commemorating the National Conference that we are organizing on the application of geoinformatics with sponsorship of Maharashtra Pollution Control Board. We hope that the current issue will provide insight in pertinent areas of GIS applications.

Dr. Seema Mishra

Role of Geospatial Technology in Water Management

Dr. Saumya Singh
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Rapid urbanization, industrialization and increase in population density have caused deterioration of water quality. Sustainable water management is necessary for protecting water resources and environment. Geospatial technologies for sustainable water management are Remote Sensing, Geographic Information Systems (GIS) and Global Positioning System (GPS). Remote sensing helps in obtaining data from airborne and space borne sensor platforms. Geographic Information Systems (GIS) are an effective tool for storing, managing, and displaying georeferenced spatial data. GPS helps in obtaining precise coordinate system of locations. Remote sensing and GPS provides valuable data for GIS mapping required for water management. This integration of GIS, remote sensing and GPS is an important tool for decision making for water management.

Geospatial technology ensures accurate data collection and thereby improves decision making. It provides better data analysis and representation. Water resources are dynamic in nature and affected by various factors like urbanization, industrialization, increase in population density and requires a good understanding of geographical space and related spatial information such as geology, geomorphology, land use pattern, landcover, water source, rainfall pattern, slope, soil type, etc. Monitoring and assessing the quality of water is important to ensure sustainable management of these resources. It is because of this reason that today's water utilities are realizing the benefits of GIS technology in the management of water. GIS database not only brings complete understanding of the drinking water issues but also creates link between the individual level and the community level. Important tool for decision support and management (Fig. 1).

GIS applications in water management includes hydrologic modeling, estimation of run off, pipeline distribution mapping, water quality mapping, storm water and pollution modeling, ground water recharge mapping, ground water potential modeling, identification of recharge sites and other related applications.

Fig. 1: Geospatial technology for decision support and management

The examples below illustrate how GIS has been effectively used for ground water recharge potential mapping and water quality mapping (Fig. 2 and Fig. 3).

For ground water recharge potential mapping, thematic maps such as geology, geomorphology, soil type, slope, land use pattern etc. are prepared.

These maps are integrated together in GIS using its overlay capabilities after feeding weights/ ranks to different thematic maps and final map (recharge potential zone map) is thus prepared. Maps can be classified into various classes such as Very High, High, Moderate, Low, Very Low recharge potential zones.

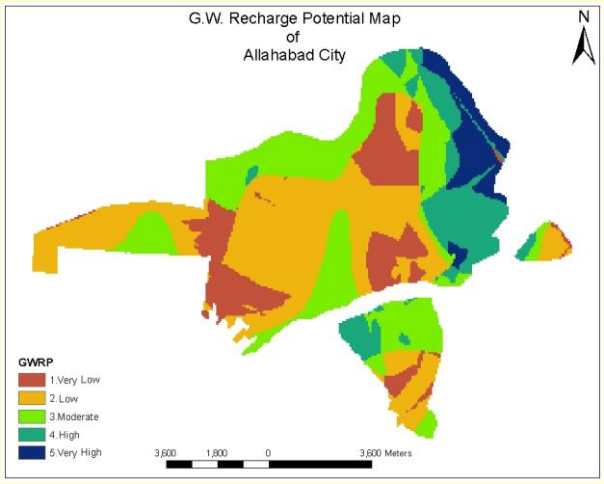

Fig. 2: GIS application in identification of ground recharge potential zones for Allahabad city (U.P.)

Similarly, water quality maps can be prepared using geo spatial technology. Map layers/ thematic maps are generated for different water quality parameters. Final map generated has potential to demarcate actual drinking water problem in a city, poor water quality as well as safe drinking water zones. By layering the information one on top of the other, one can show the relationship and degree of connectivity between various parameters.

Water management requires dealing with huge amount of data. Better maintenance of data and updating is possible by generating a geospatial database. In a topographical map all components are seen on a single sheet. However, in a GIS each of the components are presented in separate layers and therefore information retrieval is easier.

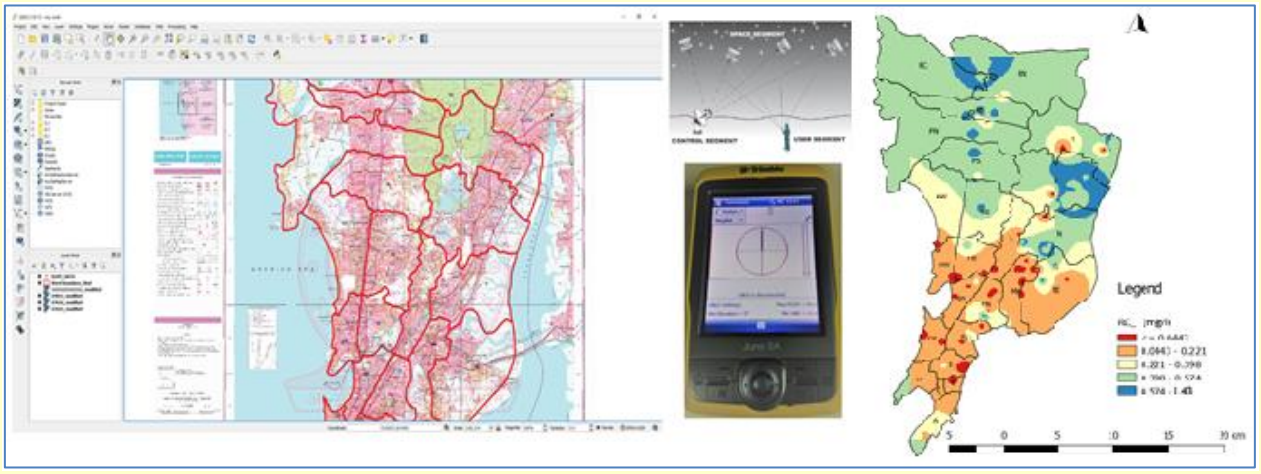

Fig. 3: Use of Geospatial technology for water quality mapping in slums of Greater Mumbai (Maharashtra) under the R & D Project sanctioned by NRDMS, DST, Govt. of India

Geo-spatial Technologies for Prudent Management of Riverine Ecosystems

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Geospatial technology refers to all of the technology used to acquire, analyse, and archive geographically referenced spatial information. Recent advances in remote sensing have empowered the geospatial domain with the availability multi-resolution spatial data at regular interval1,2. Geospatial technologies include Geographic Information System (GIS), Global Positioning System (GPS) and data acquired through space borne sensor at regular intervals (RS: Remote sensing data). Geospatial technologies aid to understand past, present and future status of landscape, impacts environmental policies and management practices, etc. Geospatial technology supports environmental sustainability through a wide range of innovative and cost effective solutions1. Fig. 1 outlines various components for the water sustainability considering resources availability, uses and users' needs, and prudent allocation of resources within the ecosystem's sustainability threshold[1].

This article focuses on the assessment of eco-hydrological footprint in the Kali River of central Western Ghats, Karnataka. Land use dynamics assessment2 using the temporal remote sensing data of four decades reveal decline of evergreen forest cover from 61.8% to 37.5% in Kali river basin during 1973 – 2016. Computation of eco hydrological indices shows that the sub catchments in the Ghats with higher proportion of forest cover with native species has better eco hydrological index as against the plain. This highlights the vital ecological function of a catchment in sustaining the hydrologic regime when covered with the vegetation of native species. The presence of perennial streams in sub-catchment dominated by native vegetation compared to the seasonal streams in the catchment dominated by anthropogenic activities with monoculture plantations.

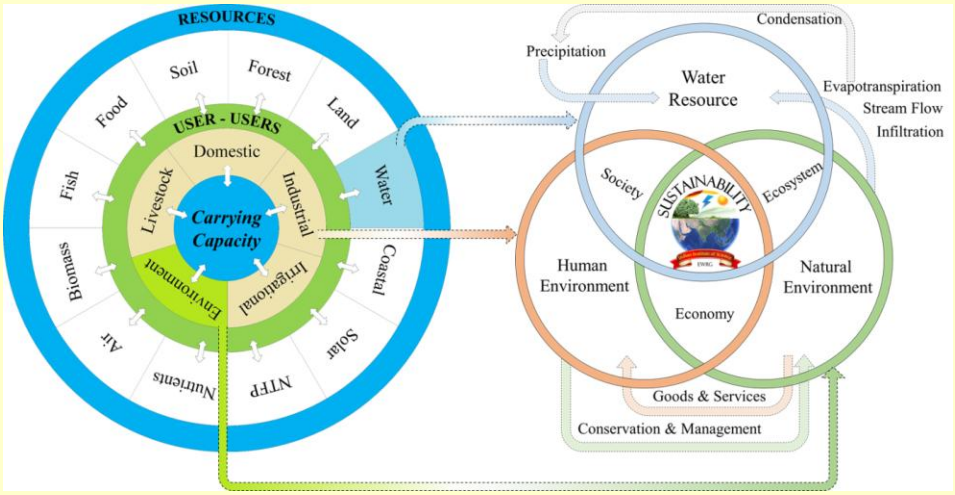

Fig. 1. Resources interaction and footprint (hydro-ecological)

The overall water footprint in a river basin for the sustenance of water resources (given in Fig 2) has been assessed through (i) land use analysis to understand the structure of the river catchment and the dynamics (ii) assessment of hydrological footprint, (iii) assessment of ecological footprint, (iv) quantification of eco-hydrological footprint and (v) assessment of eco-hydrological status.

Kali River catchment physical integrity is altered with the implementation of unplanned developmental projects such as the construction of series of dams, Kaiga nuclear power plant, Dandeli paper mill, etc. leading to large-scale land cover changes3 evident from the decline of forests from 84.6% (1973) to 54.9% (2016) and the reduction of evergreen forests from 61.7% to 38.5%. Now the River Kali has over 58% forest cover. These structural alterations of the landscape in the basin have altered the natural hydrologic regime.

Runoff in the basin is about 2227 million cubic meters and Infiltration of 7696 million cubic meters. Presence of rich evergreen forest cover in the Ghats, has contributed to higher infiltration i.e., about 4035 million cubic meters. Ground water recharge in the catchment ranges between 125 mm to 880 mm in the plains and Ghats, on an average 460 mm in contributed to ground water recharge accounting to 2360 million cubic meters. Water available in the hypomorhpic layer is about 5022 million cubic meters. Sub surface flows as function of pipeflow and baseflow was estimated, considering the soil and geological characteristics of the region. Pipeflow in the basin is about 550 Million cubic meters where as base flow is about 514 million cubic meters both together contributing to a sub surface flow of 1064 million cubic meters.

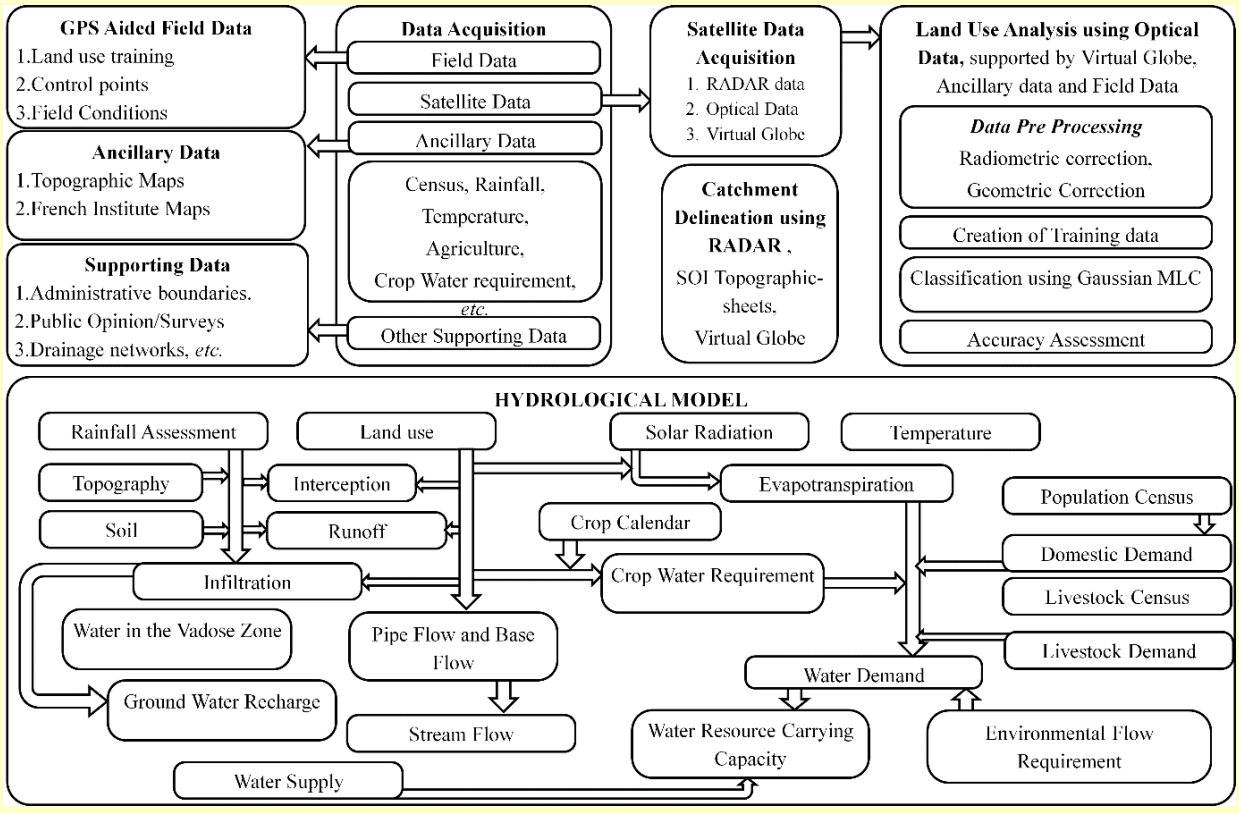

Fig. 2. Method for land use and hydrological footprint assessment

Assessment of water footprint indicates the requirement of 2309 million cubic meters for the societal and livestock demand, 3779 million cubic meters for terrestrial ecosystems and environmental flow of 987 million cubic meters (to sustain aquatic biota). The terrestrial demand is met by percolated water in hypo-morphic zone, supply in the basin would be function of surface and subsurface flows which accounts 3292 million cubic meters. Eco-hydrological footprint emphasizes the role of forests on infiltration and evapotranspiration capabilities. Sub-basins with higher forest cover had higher eco-hydrological index supplementing that the availability of water can satisfactorily maintain the demands, where sub-basins dominated by monoculture had low index indicates water scarcity. Agriculture water demand was found to be higher in Sub basins 1, 2, 3, 4, 5, 6, 11 (Fig. 3) with over 100 million cubic meters as against Ghats, and annual agriculture demand in the basin is about 2272 million cubic meters. Taluk wise livestock census showed of higher population in plains compared to the Ghats or Coasts, with water demand of over 1000 kilo cubic meters. Annual livestock demand in the basin is about 10.2 Million cubic meters. Domestic water requirement in the basin is about 27.1 Million cubic meters across the basin.

Both livestock and human population combined together has a domestic footprint of 37.3 Million cubic meters.

Ecological flow in the basin is about 30% of mean annual flow. Annual average flow in the basin considering runoff and sub surface flows is about 3291 million cubic meters with the environmental flow of about 987 million cubic meters. Ecological footprint of the basin is about 7075 million cubic meters and of this 6088 million cubic meters is the water footprint in agriculture, domestic, livestock and evapotranspiration from forests. Ecohydrological status (Fig.3) assessment confirms the role of native vegetation (native forests) in reatining the water in the catchment. Hydrological footprint (Fig. 3) shows water scarce situation in sub-basins 1, 2, 3, 5 and 6 located in the eastern plains where as sub-basins in the Ghats and Coasts i. e.,4, 7, 8, 9, 10, 11, 12 and 13 show sufficient water availability to cater domestic, irrigation, horticulture, livestock, and ecological needs. Presence of dense forest cover in the Ghats make it more favorable to cater most of the environmental flow demands in each sub-basin and ecological flow demands in the river downstream

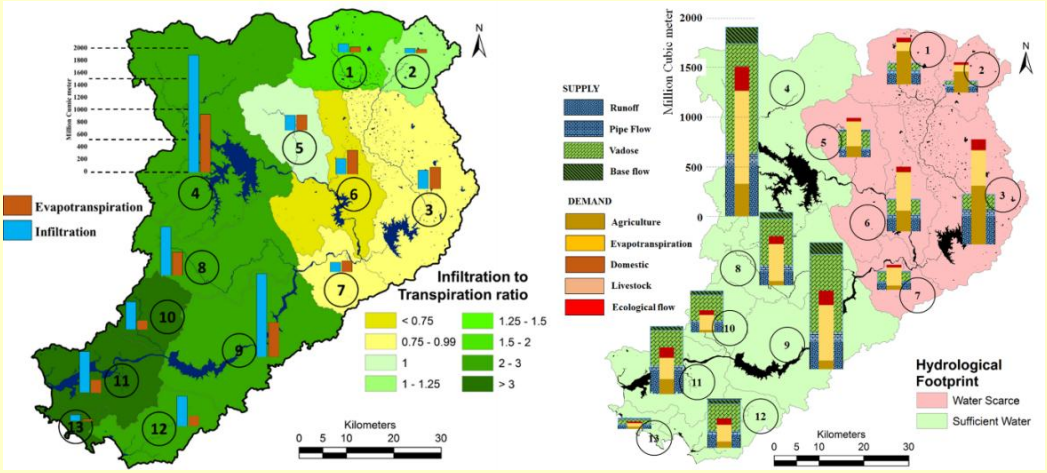

Fig. 3. Eco-Hydrological Status in Kali river basin.

Kali river catchment is a habitat to very rare and endangered wildlife and endemic flora. Ecology of Kali basin is assessed through biodiversity (such as endemic flora and fauna) based on field measurements, and literature studies3,4. The flora includes most threatened and vulnerable species such as Wisneria triandra, Holigarna beddomei, Holigarna grahamii, Garcinia gummi_gutta, Hopea ponga, Diospyros candolleana, Diospyros paniculata, Diospyros saldanhae, Cinnamomum malabatrum, Myristica malabarica and Psydrax umbellate etc. Wild life includes predators such as tiger (Panthera tigris), leopard, wild dog (dhole) and sloth bear. Prey animals are barking deer, spotted deer (Axis axis), wild boar, sambar (Cervus unicolor), gaur (Bos gaurus). The region has an important elephant corridor between Karnataka and Maharashtra for about 47 elephants4. Birds include great hornbill (Buceros bicornis), malabar pied hornbill (Anthracoceros coronatus), blue winged parakeet, Nilgiri thrush, malabar lark, bulbul, thrush, etc. There are about 22 Amphibians and 31 fish species, which are endamic to Western Ghats.

This highlights the occurrence of endemic flora and fauna in catchments with the perennial water resource and sufficient hydrological footprint. The information related to biodiversity and ecology of the region were compiled through literature review and field measurements. Ecological Sensitive Regions (ESR) were delineated based on the geo-climatic, land, ecological, hydrological parameters3. ESR spatial data is integrated with hydrological status of the river (perennial, seasonal) and is presented in Fig. 4. The study confirms the ecological sensitiveness linkages with the hydrologic regime of a region with the occurrence of perennial streams in ESR 1 and 2.

The study confirms the role of native forests (contiguous interior forests) in sustaining the water evident from the occurrence of perennial streams compared to the seasonal streams in the catchment dominated by degraded forest patches. This highlights the linkages of hydrology, biodiversity and ecology with the land use dynamics in a catchment

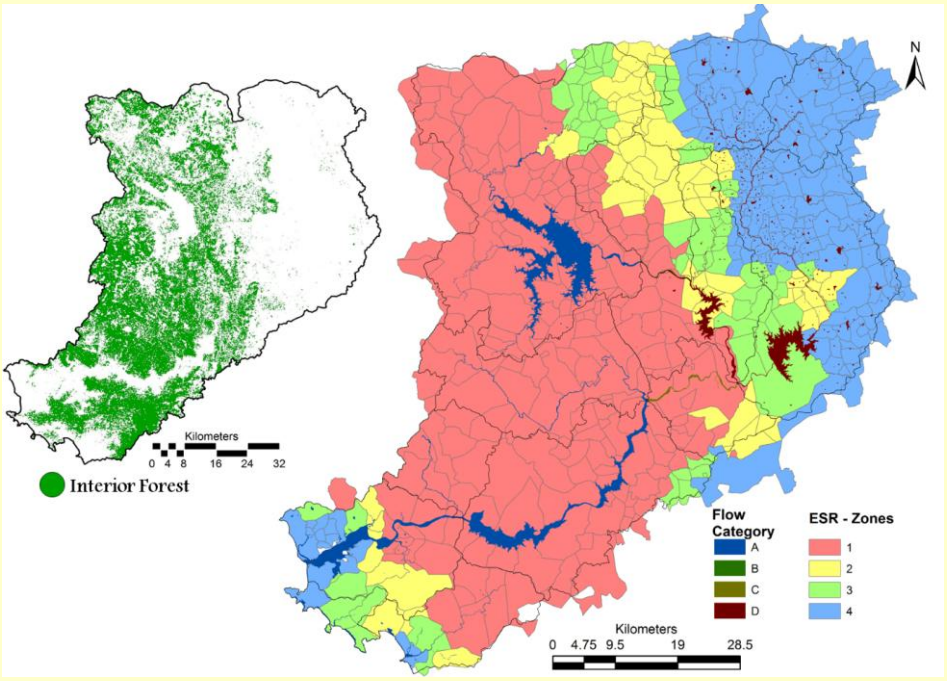

Fig. 4. Ecologically Sensitive Zones (Village wise)

Hydrological footprint shows sustained water supply catering societal and environmental demands in the catchment dominated by native forest cover of endemic flora. Inter annual variability of supply and demand foot prints indicate that the sub basins between coasts and Ghats are with perennial river streams, whereas the transition zones between Ghats and plains towards the eastern portions showed deficit of water for 6 to 10 months with intermittent and seasonal flow. Occurrence of streams with 12 months flow in the ecologically sensitive region (1 and 2) confirms of linkages of hydrologic regime with the ecological sensitiveness of a region. This highlights that streams are perennial in the catchment with forest cover > 70% and with higher endemic plant species confirming the linkage between ecology, hydrology with the land use dynamics in the catchment. This provides invaluable insights to the need for integrated approaches in the river basin management in an era dominated by mismanagement of river catchment with the enhanced deforestation process, inappropriate cropping and poor water efficiency. The premium should be on conservation of the remaining evergreen and semi-evergreen forests, which are vital for the water security (perennial streams) and food security (sustenance of biodiversity). There still exists a chance to restore the lost natural evergreen to semi-evergreen forests through appropriate conservation and management practices.

Current management practices adopted by 20th century civil engineers have been contributing to the erosion of water retention capability in the catchment with severe water scarcity, evident from 279 districts in the country reeling under droughts during the last three consecutive years.

The current study provides insights of the role of forests with native species in maintaining the hydrological regime while sustaining the local demand, which is useful in the watershed (catchment / basin) management by the respective government agencies.

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SIES IIEM DEDICATED TO ENVIRONMENT MANAGEMENT THROUGH R & D AND OUTREACH ACTIVITIES

ABOUT SIES IIEM

- SIES IIEM was established in 1999. It has been contributing in the fields of R&D activities and Academics in the areas of Environment Management and Biotechnology.
- IIEM is recognized by Department of Scientific and Industrial Research for research activities and has successfully completed various research projects with funding from DST, BRNS, DBT, ICMR, MOEFCC, MMREIS and several other agencies.
- IIEM also conducts consultancy services, organizing seminars, workshop and providing community service through research and creating awareness.




INFRASTRUCTURE AND FACILITIES

State of Art Facilities to conduct R & D and consultancy in the areas of Environmental Science and Management. Laboratories are equipped with the equipments like HPLC, AAS, GC, HVS etc.

CONSULTANCY SERVICES

Drinking Water and Waste Water Quality Parameters

- Physical parameters
- Chemical parameters
- Microbial parameters: Total Coliform Test, *E. coli*, Fecal streptococci Manganese
- Heavy Metals: Lead, Copper, Nickel, Iron, Cadmium, Zinc, Aluminum

Soil Quality Index for Agricultural and Landscape Applications

- Physical parameters
- Chemical parameters
- Major Nutrients
- Minor Nutrient
- Secondary Nutrients

Waste Management

- Training programs
- Characterization of Solid Waste for Composting and Vermicomposting
- Compost Quality Index (Physical, Chemical & microbial parameters and seed quality index)
- Testing, characterization and standardization of bio-fertilizers from
  - N fixers
  - P Solubilizers – PSB, AMF

GIS based Environmental Planning and Management

- Natural resource mapping
- Groundwater recharge study
- Site selection
- Database management
- Training Program

Providing CSR Solutions for Environment and Society

Technical Support in CSR	CSR Services
Support in the development of CSR strategies for industries	Linkages with NGO partners
Implementation of CSR strategies in industries and execution of activities in the areas of environment and societal development	Community engagement and mobilization
Stakeholder engagement	Capacity building
Compliance and regulatory affairs in the areas of environment	Training and outreach activities
Impact Assessment of CSR activities by industries	Volunteering
CSR Communications	Promotions

Sustainability Solutions for Mitigation of Climate Change Vulnerability

Biomass Characterization for Physical, Chemical and Biochemical Parameters

- ❖ Moisture content
- ❖ Nitrogen
- ❖ Phosphorus
- ❖ Potassium
- ❖ Crude protein
- ❖ Lignin
- ❖ Cellulose
- ❖ Hemi-cellulose
- ❖ Fibers

- Antimicrobial and Antioxidant Testing Screening and Evaluation of Bioactivity of Synthetic Chemicals and Natural Compounds

Natural Capital Assessment Services

Implementation of Natural Capital and Ecosystem Services Concept

- Integration of business practices and decision making with natural capital and ecosystem services concept.

Assessment of Natural Capital and Ecosystem Services

- Qualitative and quantitative approaches
- GIS mapping
- Foot printing
- Stakeholder engagement

Land Use and Biodiversity Opportunity Mapping Training and Capacity Building

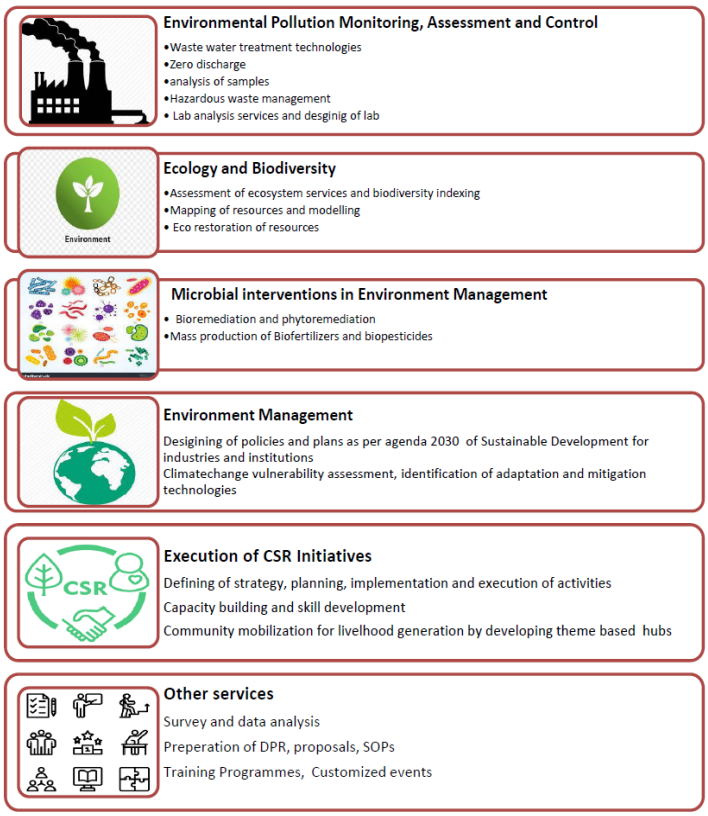
Areas of Research	Specific Areas
1. Total Water Management	1. Purification of drinking water by using low cost techniques. 2. Management of nitrite contaminated wastewater 3. Textile wastewater management. 4. Phytoremediation. 5. Oil spill management by biosurfactants. 6. Management of brine generated from water purification technologies. 7. Assessment and management of marine pollution
2. Solid Waste Management	1. Management of industrial waste. 2. Management of MSW and other solid wastes. 3. Management of agro- residue.
3. Applied Biotechnology	1. Utilization of biofertilizers and biopesticides in soil fertility management and agriculture. 2. Exploitation of beneficial microorganisms in remediation of heavy metals, oil pollution etc.
3. Management of Natural Resources	1. Pollution monitoring and management 2. Ecorestoration. 3. Studies on Climate Change. 4. Biodiversity Studies. 5. GIS

MAJOR FUNDING AGENCIES

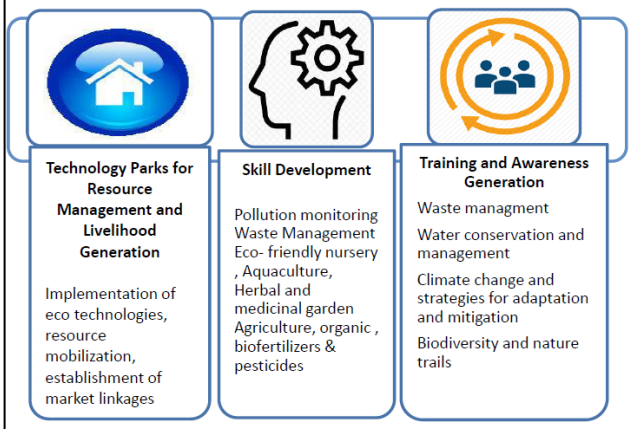
- Ministry of Environment Forest and Climate Change
- Department of Science and Technology
- Department of Biotechnology
- Board of Research in Nuclear Sciences
- Indian Council of Medical Research
- Mumbai- Metropolitan Region- Environment Improvement Society

OUTREACH ACTIVITIES

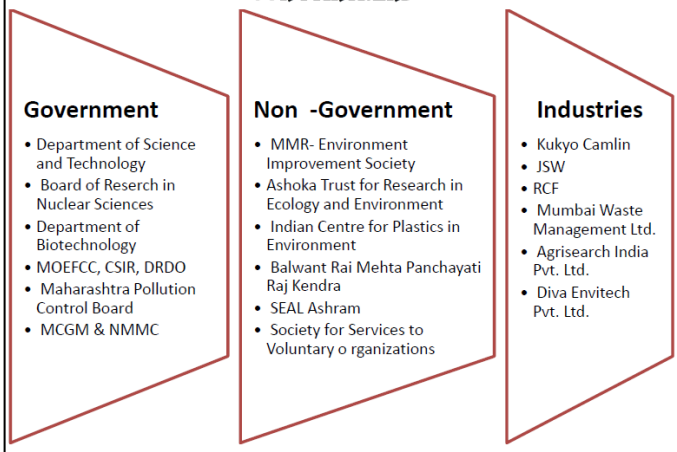
SPECIFIC AREAS OF EXPERTISE IN INDUSTRIAL R&D AND CONSULTANCY

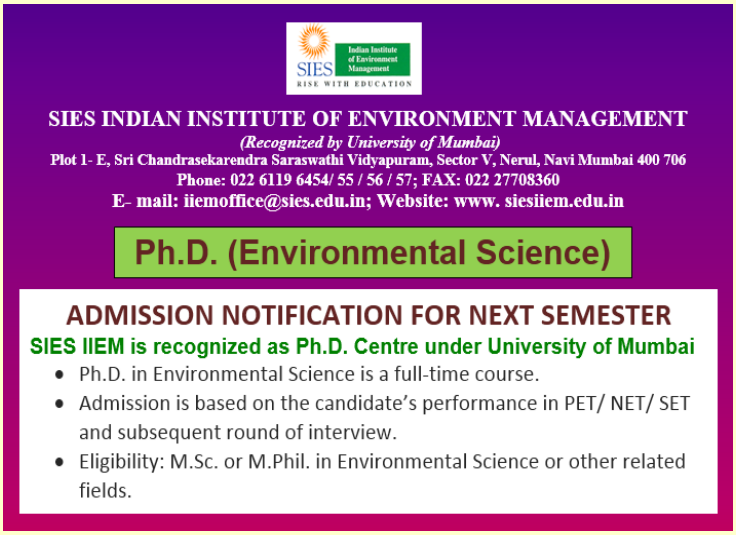


MAJOR AREAS COVERED UNDER OUTREACH ACTIVITIES AND COMMUNITY MOBILIZATION



OUR PARTNERS





Environmentally Sustainable Water Resource Development Using LiDAR Technology – A Case Study

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Geokno India Pvt. Ltd.

The ever-growing needs of our population, the recent KisanLongMarch and various food security schemes initiated by the Government of India, constantly remind us of the need to conserve our resources in a sustainable manner. Being the second most populous nation with agriculture being the major contributor to the GDP, India must be prudent about its water resources. India heavily depends on Monsoons for its water. The water resources of India are unevenly distributed in space and time. While some parts face severe droughts, the other regions are being inundated with floods. This surplus-deficit equation causes widespread socio-economic and political disparities among people.

Construction of Dams and Inter-Linking of rivers have the potential to minimize these disparities. However, such efforts may have a direct or indirect impact on people from several states thus making political leaders wary of adopting these. In addition, water being an environmentally sensitive and scarce resource, any such project must go through stringent scientific scrutiny. A project of this nature includes handling interdisciplinary layers of hydrological, agricultural, and environmental data along with socio-economic and political aspects. The topographic data, also broadly referred to as Geospatial data, are integral and most important part of design and analysis for such projects. Considering the significance of topographic data, it is important that these data be collected accurately, covering entire project site, and at a finer resolution, so that no important details are missed.

Further, the data collection should be fast as delay in data collection results in delay in delivering the benefits of projects to people and loss to government exchequer.

Aerial LiDAR Technology:

Light Detection and Ranging (LiDAR) technology collects high-accuracy elevation data for large areas very quickly and at a lower cost than traditional methods. In LiDAR a Laser transmitter is used to throw a laser pulse, and a receiver is employed to detect the return of the pulse. The 'Time of flight' is then calculated and since the speed of light is known, the distance of the point can be calculated. Normally, based on its requirement, LiDAR can be used on three platforms namely Terrestrial, Mobile, and Airborne.

The aerial LiDAR technology can acquire highly accurate and dense elevation data of terrain surface quickly and accurately with support of high-precision GPS and Inertial Navigation System as shown in figure below. Therefore, a high-precision Digital Terrain Model can be built from it. LiDAR is emerging as a powerful tool for detailed hazard and resource mapping. The Digital Elevation Model (DEM) derived from LiDAR data has the highest spatial resolution amongst other available DEMs.

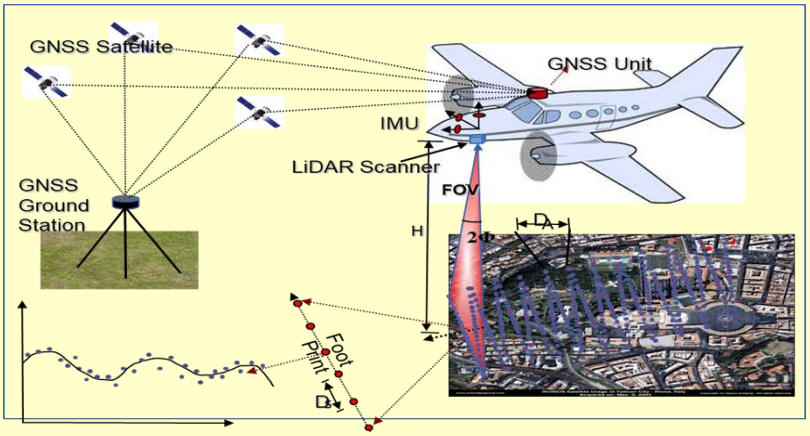


Figure 1: Principle of Light Detection and Ranging

Figure: 2 Sensors used for LiDAR Technology

Aerial LiDAR system uses a combination of LiDAR equipment, GNSS unit for the position, Inertial Measurement Unit (IMU) for orientation and cameras for recording images (for coloring the output) The LiDAR unit is mounted on an aircraft/Helicopter as shown in Figure 1. This is useful for large area surveys such as irrigation, disaster mapping, flood mapping and corridor survey, alignment survey for irrigation canal and high-altitude roads. These data are highly useful in planning and designing greenfield infrastructure projects for mapping large tracts of land, which are otherwise not accessible with conventional technologies.

CASE STUDY: The Tale of two States-Sharing of Godavari Water

The government of Telangana wanted to resolve the decade-old problem of river water sharing with Maharashtra, so that water getting discharged into the sea could be utilized for the benefit of both the states. The Government of Telangana had undertaken a complete re-evaluation of the earlier designed irrigation projects.

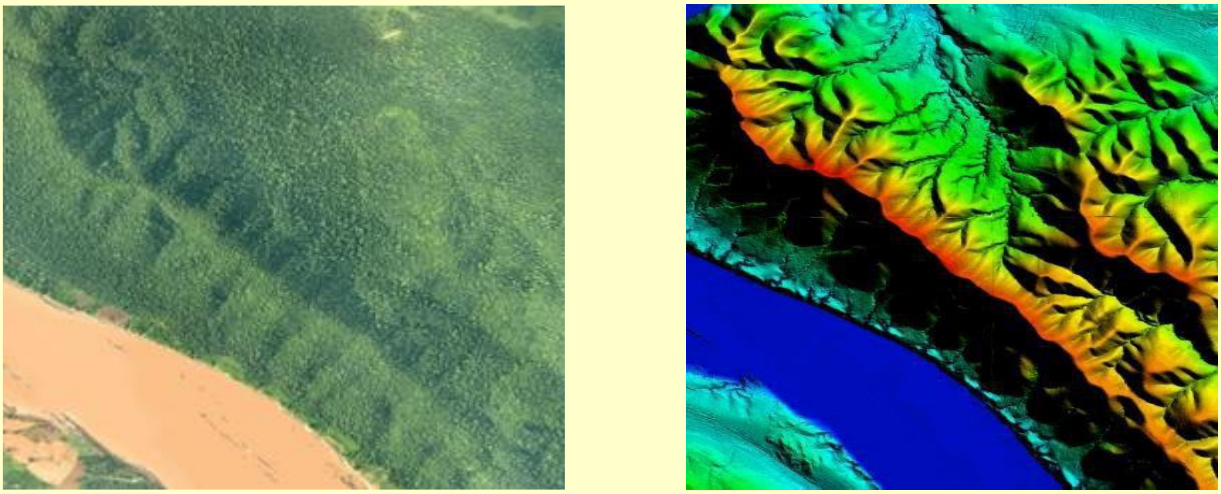


Figure 3: Left : Aerial photograph in which underlying ground details are not visible because of canopy cover; Right : DEM generated from LiDAR data wherein terrain is clearly visible and mapped including the area under forest cover;

Godavari is the second largest river in India after Ganges. The drainage area of Godavari River is 312,812 sq. km of which 48.6% lies in Maharashtra, 19.04% in Telangana, 4.76% in Andhra Pradesh, 18.7% in Chhattisgarh, 5.5% in Orissa, 2% in Madhya Pradesh and 1.4 % in Karnataka. The goal of the project is to identify drought-prone, upland and backward areas of Telangana Region to provide irrigation facilities to several districts in Telangana.

One of the critical inputs needed for resolving the dispute was the Topographic data which would correctly identify the actual submergence in both the states once the dams are constructed. The other two being the generation of Digital Elevation Model (DEM) and Contour Map which give an idea of the basic physical characteristics like drainage networks and drainage flow and a better understanding of the elevation profile of the catchment.

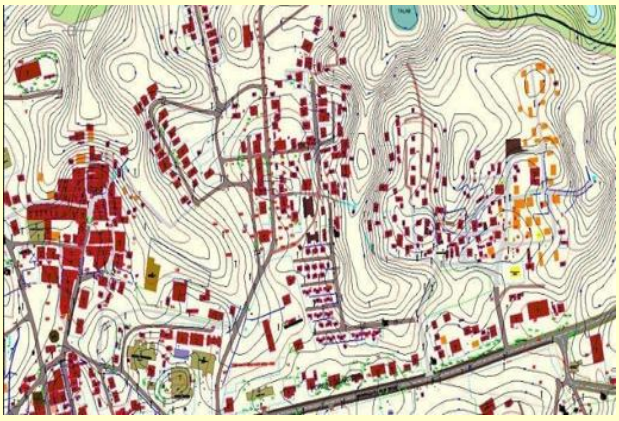


Figure 4: Contour Map generated from LiDAR data which enables better understanding of the catchment area for the administrators

Traditional surveying technology is severely inadequate as the large area of survey would take much longer time besides accuracy issues. Most of the disputes in the past could not be resolved because the levels cross-verified by inter-state departments were never found accurate and mutually acceptable and hence decision making was hampered.

This was caused due to the short-comings of the traditional DGPS/Total Station technologies which are incapable of generating true contours as only a few, and far-spaced points would be available for this purpose. Furthermore, due to extensive manual work involved in DGPS/TS survey, the survey data are prone to human-induced errors. Alternatively, imagery-based technologies like Satellite and Drone-based photogrammetry would also fail as, besides poorer accuracy, it is not possible to measure points under vegetation hence making the resulting data not useful for irrigation projects.

Considering the above, the Government of Telangana and WAPCOS decided that the Aerial LiDAR technology is appropriate for this prestigious project. Using LiDAR technology 100 sq km to 200 sq km area can be mapped per day to high degree of accuracy. Moreover, as LiDAR technology can map below vegetation through small gaps in tree canopies, data below vegetation also becomes available. This results in an accurate 3D mapping of the surface features and bare earth which are required for irrigation design. As the technology is free from human intervention, the captured data are free from manual errors.

WAPCOS identified Geokno India Pvt Ltd which has now 10 years of extensive experience in conducting accurate LiDAR surveys of engineering grade in India for this prestigious project. Geokno was incubated in IIT Kanpur to spread the use of the revolutionary LiDAR technology in India. Heli-Mapper aerial LiDAR system was deployed for surveying the project area. Since the survey started towards the end of the rainy

season, there was an additional benefit of using the Heli-mapper as the helicopter could be flown below the clouds and still capture data. For this multiple flight plans were made so that the survey could be completed at the earliest.

Figure 4: Helicopter ready for surveying with sensors fitted

The survey of over 3700 sq km was completed in a short span of 4 months which would have otherwise taken 3 years using traditional method. The surveyed region is Naxal affected zones making it difficult to map by field based methods. Moreover, the larger portion of the project area is comprised of cultivation land and forest where the LiDAR technology performs best. The Aerial LiDAR survey has also helped to improve the design of multiple irrigation schemes. Telangana Government was extremely satisfied with the project outputs, and the original 700 sq km of the area was extended to more than 3,700 sq km. In Phase 2 further a survey of more than 4,000 sq km of area was carried out. All the issues relating to Aerial LiDAR survey vetting, utilization of water, submergence and project designs were analyzed by the officials of the CDO (Central Design Organizations) of the two states in detail and approved.

The biggest achievement of this survey was that it resulted in an MoU being signed between the Governments of Maharashtra and Telangana within 5 months of the start of the Aerial LiDAR survey. This MoU benefits lakhs of farmers of the two states. The project is expected to irrigate 16.4 lakh acres in Telangana and over 50,000 acres in tribal areas of Maharashtra.

The economic progress of India is not only tied with agricultural development, but also with industrial development for which water resources play major role. As seen in the Kaleshwaram project discussed in this article LiDAR technology has potential to play a key role in the development of nationwide digital elevation dataset. These data provide better understanding of various issues related to water. On one hand water needs can be met by better design of projects while on the other hand a better design also ensures environmental sustainability of the water resources. Better terrain data through LiDAR technology is proving a blessing towards these goals.

Online News Links:
http://www.thehindu.com/news/national/telangana-maharashtra-cms-ink-pact-on-godavari-water-projects/article8327039.ece
http://www.newindianexpress.com/states/telangana/Hope-Springs-as-Telangana-Maharashtra-Set-to-Script-Water-sharing-Treaty/2016/03/03/article3307477.ece

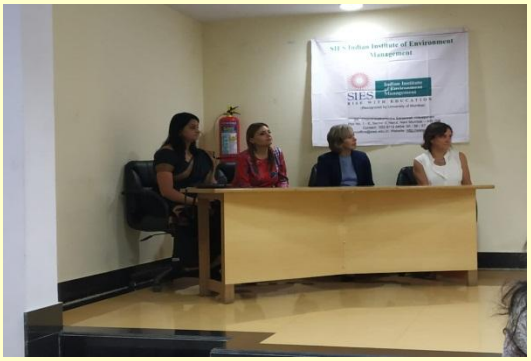
Events organized by SIES IIEM

Seminar in Association with Uni-Italia, Consulate General of Italy, Mumbai 9th October 2018

Seminar was organized on 9th October 2018 at SIES Indian Institute of Environment Management, Nerul, Navi Mumbai on following topics:

1. "Climate Change and Water Resources Management" by Dr. Giovanna Grossi, Asst Professor, University of Brescia, Italy
2. "Academic Programmes at University of Brescia" by Ms. Monica Bonfardini, University of Brescia, Italy

The seminar was organized in association with Uni-Italia, Consulate General of Italy, Mumbai.



Glimpses of Seminar in association with Uni-Italia, Consulate General of Italy, Mumbai

Graduation Ceremony of PGDSEM (Post Graduate Diploma in Sustainable Environment Management) 2017-18 21st October 2018

Graduation Ceremony of PGDSEM (Post Graduate Diploma in Sustainable Environment Management) 2017-18 Batch was organized on 21st October 2018. Mr. Vinod Sant, Ex. DG, National Safety Council was invited as the Chief Guest for the event. All the students of PGDSEM 2017-18 batch were felicitated during the event and diploma certificates were distributed. Glimpses of Graduation Ceremony is shown below:

Felicitation of Chief Guest and Lighting of lamp

Certificate Distribution

Events organized by SIES IIEM

Workshop cum Training Programme on "Management of Drinking Water Quality"
20th October 2018
Under the project "Addressing Drinking Water Issues in Slums in Greater Mumbai and its mapping using GIS sponsored by NRDMS, DST

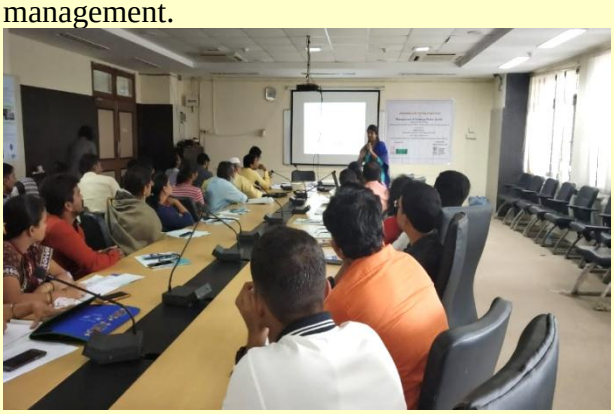
Workshop cum training programme on "Management of Drinking Water Quality" was organized on 20th October 2018. This workshop cum training program is a part of NRDMS, DST sponsored project entitled "Addressing Drinking Water Issues in Slums in Greater Mumbai and its mapping using GIS". It was organized to sensitize people and disseminate knowledge on the need for better management of drinking water at the conference room of ward M East, Greater Mumbai.

Project Team

Audience included MCGM officials, local slum people, NGO representatives

The training program provided an interactive forum to MCGM officials, local slum people, NGOs, scientists and academicians to understand various complex problems associated with drinking water management.

New ideas, recommendations raised in the training program will support in opening new avenues in the areas of drinking water management.



Dr. Saumya Singh (Principal Investigator of the Project) delivering a talk on "Management of Drinking Water Quality"

Ms. Farha Nadiadwala (Project Assistant) presenting on low cost water purification technologies

Pre and post knowledge assessment

Events organized by SIES IIEM

Students Eco-Fest on Sustainability...
On Friday, 26th October, 2018

Prakkathan, student Eco fest on Sustainability was organized on 26th October 2018. The event was sponsored by SGS, JSW, Steel Age and Novvo. Media partner was NMTV. Chief Guest for the event was Dr. Shirish Sangle, NITIE, Mumbai. In the event, 2nd Prof. Purushottam Khanna Memorial Talk was deliverd by Dr. Shirish Sangle on the topic "Environment Management and Circular Economy: Directing and accelerating Sustainable Development". Prakkathan included following programs: CSR Conclave on the theme "Towards Sustainable Future", Debate competition, Quiz competition, Poster presentation and Valedictory session.

In CSR conclave, CSR and sustainability heads from Tata Power, Siemens and SGS Liminted, NPCIL, Unityed Waste Mumbai have presented their views on different perspectives of environment management

Student Volunteer

AIR-O2-THON MUMBAI EDITION, 14th DECEMBER 2018

The 3rd AIR-O2-THON 2018 series, an International Conference & awards, addressing the air pollution and indoor air pollution challenges for clean and healthy air quality was inaugurated on 14th December 2018. The event was organized by Prospurs Events & Promotions Pvt. Ltd (V prospurs Group) in association with Indian Pollution Control Association (IPCA) and SIES (IIEM) Indian Institute of Environment Management as the associate partner. In addition, the conference was supported by NEERI National Environmental Engineering Research Institute, Asian Paints as Purification Partner, APT technologies as Associate Partner, Green Ubuntu as Digital Media Partner, Green Dream Foundation as Supporting Partner, Technix as Digital Marketing Partner & Communication India as PR partner. AIR-O-THON was in association with the Maharashtra State Pollution Control Board (MPCB), Indian Institute of Technology, Mumbai. Many renowned delegates participated from various industries, research, academia, government and Non- governmental organization.

Glimpses of AIR-O2-THON, Mumbai Edition

Esri Geo-Spatial Technology for Green Infrastructure Planning

Chandra Mohan Singh Adhikari
Group Manager, ESRI India Technologies Limited

Green Infrastructure provides a comprehensive view of air, land, and water systems, empowering us to protect and connect landscapes that support biodiversity, ecosystems, and sustainable communities.

Green infrastructure is a strategically planned and managed network of open spaces, natural lands, wildlife habitats, parks, and other assets that provide communities with the vital services that enrich and sustain their quality of life.

Green infrastructure planning seeks to leverage natural environmental patterns to better inform land development. This starts with identifying and connecting an area's most valuable assets before growth and development begin, so that costly conflicts, mistakes, and losses can be avoided.

An area's green infrastructure typically encompasses an interconnected mosaic of land that combines several key components:

- Sites that support relevant ecological, cultural, agricultural, and scenic values
- Hazard areas that pose environmental risks
- Networks of corridors that structurally and functionally connect these areas

Geo spatial technology help planners, city officials, community leaders and others see green infrastructure assets around them. It provides a computational, quantitative, and rational way to help everyone understand what's important, from a Green Infrastructure perspective; by combining data from many sources on one map, to visualize the natural and man-made assets.

Figure 1. Green infrastructure fits easily into the ArcGIS platform, where multiple data layers can be analysed in ArcGIS through apps and models

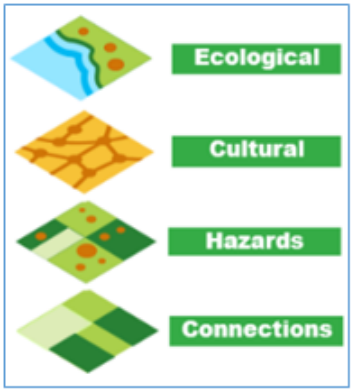


Figure 2. Many different layers used to create comprehensive inventory of green infrastructure

Figure 3. Creation of Green Infrastructure cores after using multiple overlay analysis

In ArcGIS, green infrastructure planning is supported through the availability of online data, models, web apps, and ArcMap, a data authorization desktop application. Thus, created datasets can serve as the foundation for identifying green infrastructure in the community.

Green Infrastructure Geo Design Workflow

To preserve the environmental quality of a particular area, our plans should incorporate environmental information from the very beginning, before any action is taken. The geo-design process is a systematic methodology, or a framework, for investigating the impact of design and planning decisions. Green infrastructure planning contributes to intelligent development by letting identify valuable landscapes, such as hazard areas and ecological, cultural, or scenic assets. Green infrastructure planning is easily accommodated within a typical geo-design workflow.

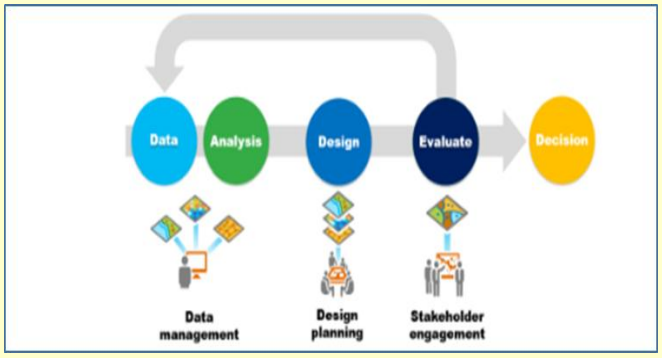


Figure 4. Green Infrastructure Geo Design Workflow

For beginning the process of developing a plan for an area, Green infrastructure planning seeks to work with the natural environment first. This process starts by first identifying an area's natural assets so that they can be protected. Esri technology can be used for creation of natural assets database using data model and schema.

The field level data can be collected and shared using various Mobile apps.

The data from the sensors and other IoT devices can be ingested using stream services on Real time basis using ArcGIS Geo Event.


Figure 5. Assemble and review all existing data and create data model and schema to store the natural assets

By means of various available set of tools available under different extensions, overlay analysis or cost matrix analysis can be done for identification of suitable landscape core area. Esri has created a series of online apps that provides references for identifying and filtering the cores based on several characteristics and scores according to organization's goals. Also, organization can design their own models for the process of identification and analysis using ArcGIS Model Builder and Arc Toolbox tools & scripts.


Figure 6. Creation of Natural Assets map using the assembled existing and additional collected data.

After identification of the cores, esri provided web builder like tools can be used to build a web application for the identified area and can be shared to different planner/consultants to develop a plan to protect those areas.

Esri Geo Planner tool help the different planners/consultants to mark their inputs and the most suitable plan for preserving the green infrastructure areas or at least minimizing the threat to them can be selected by the stakeholders.

Figure 7. https://green-infrastructure.esri.com/ScoreCores/index.html

Figure 8. Web Application shared between different Planners/consultants for inputs

Figure 9. Assessment of most risk areas zoned for development by ranking the key natural assets.

Thus, GIS based maps and models can be used to create strategic regional & local maps and plans to help communities determine where to conserve and where to grow. Green infrastructure can be added to the typical design decision-making process, providing a method to identify ways to prioritize and connect open spaces, watersheds, wildlife habitats, parks, and other natural areas that enrich and sustain a community's quality of life and sense of place.

References:

http://solutions.arcgis.com/utilities/water/help/green-infrastructure/get-started/setup-map/

https://www.esri.com/training/courses

https://green-infrastructure.esri.com/ScoreCores/index.html

https://nation.maps.arcgis.com/apps/MapJournal/index.html?appid=bf6f482b49c84f8c8d6f53f26a247c2a#

https://www.esri.com/en-us/industries/green-infrastructure/plan

http://umich.maps.arcgis.com/apps/MapSeries/index.html?appid=4b257ce673ed4a178d11b4a267a9967e#map

Observation of Flood Hazard using Geospatial Technology

Surya Deb Chakraborty, Mayuri Bhattacharya, Chandan Bhadra

Environmental System Research Institute (ESRI, India)

Abstract: Flood is considered one of important natural disaster which affects many parts of human civilization. Present age geographical information system (GIS) can be used to observe the extent of flood to consider the risk of disaster. The objective of the study to observed before and after flood condition created by titli cyclone using geospatial technology. Here we use sentinel data to estimate flood condition. NDWI (Normalized differential Water Indices) was calculated before and after images of sentinel data using Arcpro software then we did unsupervised classification to estimate flooded area. The study area is chooses Asika town situated in between 2 river Rushikulya River and Badanadi river. This town was flooded during Titli cyclone on 18th oct 2018. To monitor the effects of flood was used the unsupervised classification of two sentinel images acquired on 2018 when a severe flood was affected the above mentioned area. This research offerings a very fast and affordable method of flood monitoring that could be very useful for the emergency management plan of the local authorities.

Keywords: Sentinel, NDWI, Unsupervised classification, Flood map, flood monitoring

Introduction:

The physical cover of the earth including Vegetation and non-vegetation parts are known as land cover. To get solution for planning in context of agriculture, urban and natural conservation a detail knowledge of land cover can give solution (Huth et al., 2012).

Using satellite imagery observing land cover is widely-used tool for large area environmental monitoring to understand the changes (Cihlar, 2000).

Flood is measured to be the most common natural disaster worldwide during the past years, creating many environmental and socio-economic significances within the affected flood plain. The impact of flood hugely affected on human life as well as economic dimensions. Floods directly caused 9500 fatalities and losses assessed at 70 billion euro 20th century in the Europe (Dysarz et al., 2015). For the planning to monitor the future growth of the city and identifying the flood effected area flood hazards maps are very useful. Geospatial technology mainly remote sensing and GIS contribute significantly for flood hazard monitoring.

A severe cyclonic storm named Titly packing heavy winds and widespread rains hit the eastern part of the India 12th Oct on Thursday, in Andhra Pradesh and in Odisha. Aska town in Ganjam district resembled a water world 13th Oct on Friday. The whole town was flooded under 11 feet water as Badanadi and Rushikulya rivers wreaked havoc in the region in the aftermath of cyclone Titli. I was stuck in that flood for 2 days in Asika town. This study is mainly to understand the situation after flood condition as well as my experience sharing using geospatial technology.

Study Area

The study area is taken as Aska town in Ganjam district which is mainly in between of Badanadi and Rushikulya. Asika is located at 19.6°N 84.65°E. It has an average elevation of 30 meters (98 feet). It is situated at a distance of 40 km from Brahmapur on South, 35 km from Bhanjanagar on the North at the confluence of Rivers Rushikulya and Badanadi(Bara River). NH-59 (Gopalpur-Ahmedabad) passes through this city. Aska falling in Ganjum district which is characterized by an equitable temperature all through the year, particularly in the coastal regions.

The average annual rain fall of the district is 129.60cms (source IMD). The rainfall generally increases from the coast towards the interior hilly tracks of the district. The relative humidity is high throughout the year specifically in coastal areas. Winds are fairly strong particularly in coastal regions in summer and monsoon months.

The geographical area in Ganjum district founds cultivated lands. Paddy is the Principal crop in Kharif, while pulses are the main crops in Rabi. Red sandy soils, red loamy soils, lateritic soils, coastal alluvial soils and coastal sandy soils, are the main soil types occurring in the district

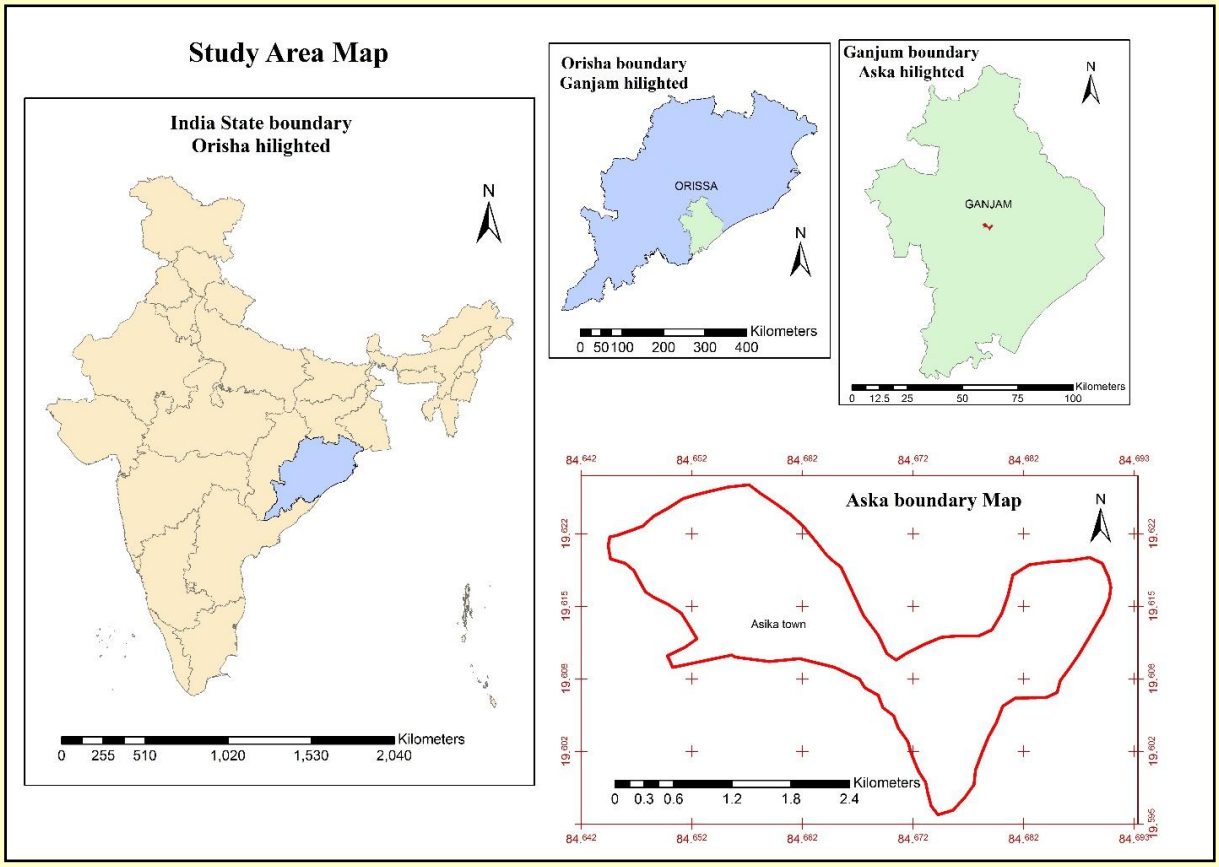


Figure 1. Study area map

Table 1: The following datasets were used to compute Flood change analysis

Data Used	**5th Oct 2018**	**10th Oct 2018**
	Sentinel 2B	Sentinel 2B

Methodology

The Normalized Difference water Index (NDWI) was estimated using over Granjum district. Sentinel datasets of before and after flood are used for preparation Flood change maps.

Water Indices: $NDWI = \frac{\text{Green}-\text{NIR}}{\text{Green}+\text{NIR}}$

In this part using green and NIR bands of sentinel images we estimated NDWI for both dates. Then using unsupervised isodata method we classified it in 4 classes. After that we reclassified that unsupervised image in 2 classes one should be water another should be non-waterbody. Then we convert reclassified image in shape file. Once it's converted in shape file we just extract the waterbody from that shape file. In this way we easily differentiate before and after flood river condition.

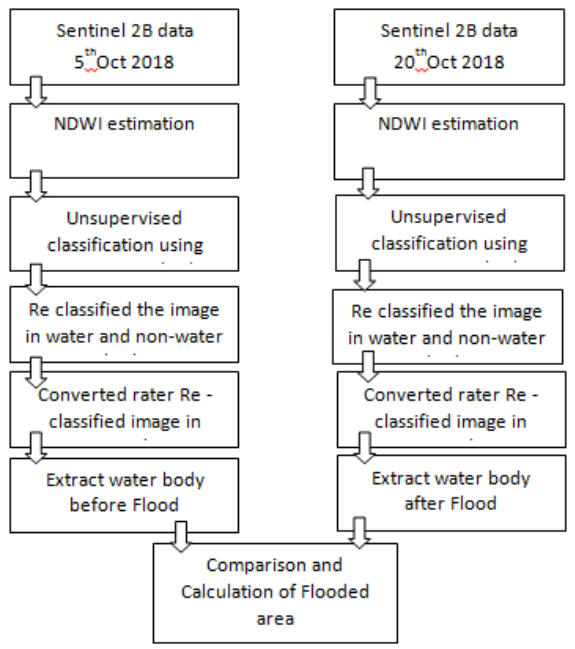


Figure 2. Workflow of the main phases of Flood analysis

Results and discussions

Unsupervised Classification- ISOdata method over Sentinel 2b NDWI Datasets for 5th and 20th Oct 2018 was carried out by taking four classes. Then datasets was re-classifying using the classes and created in 2 classes, one is waterbody another one is non-waterbody. An overall accuracy of 88.74% (Kappa Coefficient: 0.8480) for 5th Oct 2018 datasets and 87.15% (Kappa Coefficient: 0.8275) for 20th Oct 2018 datasets was obtained during the accuracy assessment of the LU/LC classification. Before and after flood water bodies are extracted from classified images of Gunjam district.

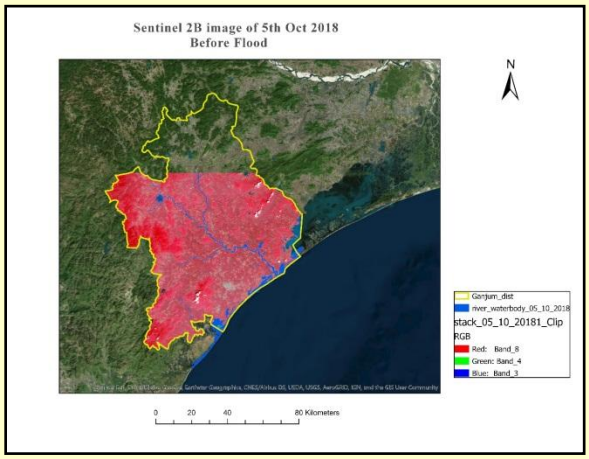


Figure 3. Before Flood condition of Ganjum district

Here in figure 3 we observed the image of 5th Oct 2018 before flood sentinel image. We extracted the total water covered area in Ganjum district which approximately 17839.93 hector. This water body mainly shows rivers, dams and few waterlogged area due to agriculture. But after Flood there is huge change in water covered area which can easily marked on after Flood 20th Oct images.

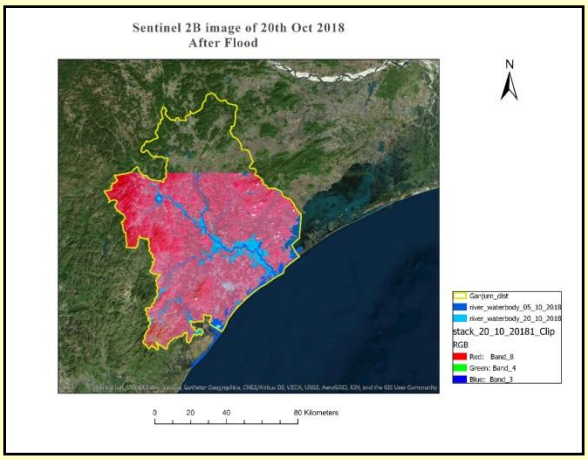


Figure 4. Before Flood condition of Ganjum district

Here in figure 4 we observed the image of 20th Oct 2018 after flood sentinel image. It was observed that a huge increased in water covered area in Gunjum district after flood scenario. It almost 40113.65 hector area. If we subtract before and after flooded water area then we can get a approximately the area under water due to flood which is almost 22273.72 hector area.

Here in figure 4 we observed the image of 20th Oct 2018 after flood sentinel image. It was observed that a huge increased in water covered area in Gunjum district after flood scenario. It almost 40113.65 hector area. If we subtract before and after flooded water area then we can get an approximately the area under water due to flood which is almost 22273.72 hector area.

In this study we try to focus on Aska town, where I (author S D Chakraborty) stuck in the time of flood. Aska town is in Ganjam district which is mainly in between of 2 river Badanadi and Rushikulya. That town was flooded on 13th Oct due to the effect of cyclone Titly. The rain was started from evening 3.30 pm on 13th Oct at 14th Oct night 2.30 am water was started entering to the town and by morning the water level also reached 12th feet. Below we try to focus on Asika town before and after flood condition.

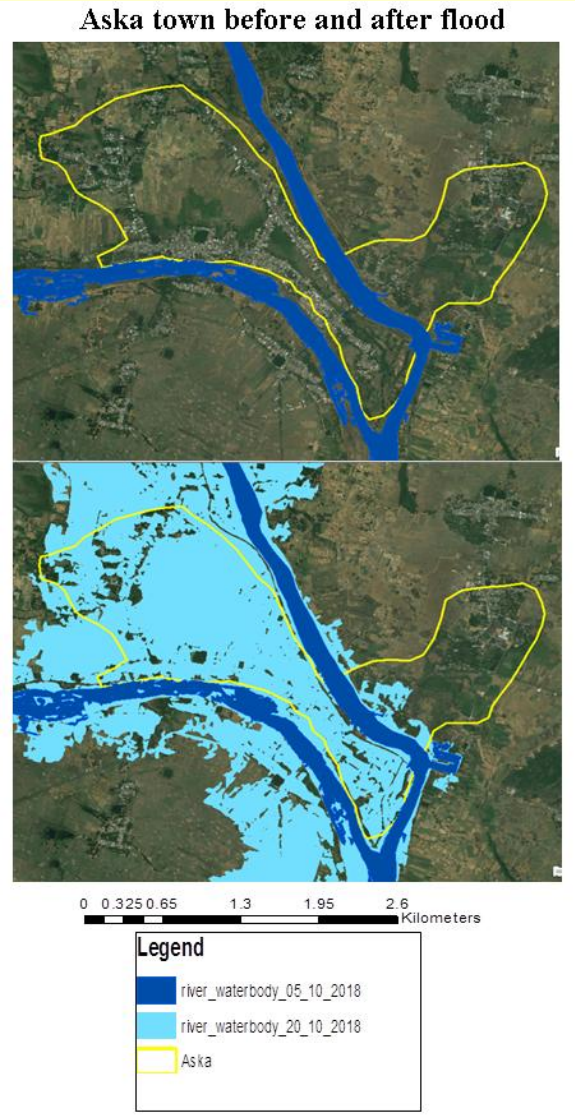


Figure 5. Before and after Flood condition of Aska town

We observed that total area of Aska town is 571.88 Hector approximately, but just after flood on 20th Oct 2018 images we observed 350.80 Hector approximately area of Aska town was under water. Almost 62% of total town area was under water. The land in between badanadi and Rushikulya totally under water only the eastern part which is opposite side of Badanadi was not flooded. Few pictures was collected during flood was given below.

Figure 6. Few pictures of flooded Aska town on Oct 13th, 2018

Flood monitoring and damage assessment remote sensing and GIS area very useful technologies. Remote sensing is capable to study recent and past event as well as its help to predict hazards due to flood and landslide events. Remote sensing provide us real time data of flood situation where it was impossible to reach during flood hazards.

Here we presented a flood extent scenario in very efficient and simple way. Here we mapped flooded and non-flooded area which also verified with the data collected during flooded area. Here we compared the reflectance feature of water versus non water surface on a pair of Sentinel 2 B images (data acquired before and after during the flood event).

The total flooded area derived from the satellite images, on 20th Oct 2018 for Aska town was 350.80 hector or approximately 62% of total city area covered with water. inundation maps for disaster monitoring and relief efforts. Here we can suggest more integration of data like elevation data, river network data etc. are required for more develop algorithms for flood assessment.

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SIES IIEM's Participation in Various Events

International Conference on Interdisciplinary Approaches towards Environmental Sustainability
15th, 16th, 17th November 2018

International Conference on Interdisciplinary Approaches towards Environmental Sustainability was organized by Chhatrapati Shivaji Maharaj University, Navi Mumbai on 15th, 16th, 17th November 2018. Research staff and students from IIEM participated, attended and presented their technical papers during the conference. Dr. Seema Mishra, Director, IIEM has chaired one of the technical session of the conference. Total 4 technical papers were presented as given below:

1. Noise level monitoring and mapping in ward M East of Greater Mumbai using GIS (authored by Anirban Sengupta and Saumya Singh)
2. Studying the urban groundwater quality and salt water intrusion in Greater Mumbai using GIS (authored by Farha Nadiadwala, Saumya Singh, Seema Mishra). This paper was presented under the R & D project sanctioned by NRDMS, DST, Govt. of India.
3. Assessment of potential of AMF Fungi from different types of soils in crop production (authored by Mitesh Grewal, Ashwini Sonawane, S.R Bhonde, Seema Mishra). This paper was presented under Industrial consultancy project supported by Agrisearch India Pvt. Ltd., Nashik
4. Exploration of dark septate endophyte in agricultural soil: the unique organism associated with Arbuscular mycorrhizal fungi (authored by Mitesh Grewal, Anshit Singh, S.R Bhonde, Seema Mishra). This paper was presented under Industrial consultancy project supported by Agrisearch India Pvt. Ltd., Nashik.

IIEM was awarded 3rd rank for best oral presentation for one of the technical paper (Noise level monitoring and mapping in ward M East of Greater Mumbai using GIS (authored by Anirban Sengupta and Dr. Saumya Singh).

Dr. Seema Mishra, with research staff and student in the Conference

Ms. Farha Nadiadwala, Mr. Mitesh Grewal and Ms. Ashwini Sonawane presenting technical papers

Geo-spatial technologies used to evolve Institutes into "Smart Campus".

Prof. Ajit Seshadri
Sr. Faculty-Marine Engg., School of Maritime Studies,
Vels University, Chennai 603103

Background and Introduction:

In this present age, Appropriate Technologies have been applied for carrying out most functions taking care of services in an Educational Institute. As the technology gets modernized in passing of time, it is known to bring in more intricate innovations. Thus making the progress in an Institute to provide smarter living enhancing the quality of life at campus. Smarter people prefer to do smarter things, which can understand their needs and perform better progressively. Also to meet the expectations of the new Gen-next ie generation of youth, Educational institutes are always rejuvenating themselves. Most inmates prefer campuses where almost every system is automated and a campus which is so well connected that things happen seamlessly. This is the vision, the entire world is following. With use of Smart Campus Initiatives, many campuses are taking concrete steps towards creating happier and smarter communities for better future . Thus a smart campus is evolved which has a well ordained digital revolution where different domains of the campus is inter- connected. They are also correlated with each other, using different technology modules to provide best services to all within and outside the Institute premises.

All systems in the campuses of Smart Institutes are connected with each other and is fairly depended on technologies. Gradually when the institutes become aware of the benefits, they aspire and become more smart- literate.

Objectives to Achieve at Smart Campus :

Technological literacy and its apt application is a key to turn an average edu-campus into smart- campus. All elements at a smart campus is well connected, sustained and resilient, where all information is not just available but also findable by most people. The prolonged usage of in- campus services saves their time, eases their tasks and elevates quality of living in the campus. Using appropriate technology, the officials of the Institute Management are able to integrate with the operations all systems, make the campus function smarter, efficient and with bettered performance. It is also about providing the Institute, apt governance where they can give their feedback to the management and administration. Also assess as to how they would adapt and function for their tasks assigned. They would want their campus to excel, and be a role model.

Natural process applied for conservation of natural resources and remediation of wastes:

The objective of conservation of natural resources and remediation of wastes is achieved in reality using principles and practices of geo-spatial technologies. It is also about providing them apt governance where the inmates can give their feedback to the management and administration, in order to adapt and function desired for the tasks are carried out as per Fig 1.

No.	Natural Resource	Green Initiative	Conserved Resource/ "Smart Campus"- Asset
Input + Process = Output			
1.	Rain/ storm water	RWH – Rain Water Harvesting	Recharge in well/ pond
2.	Waste water/ sewage	STP- Sewage Treatment Plant	Co-composting / Manure
3.	Waste water/ sullage	STP- Sewage Treatment Plant	Re-use water for Use
4.	Solid waste – bio origin	Composting & Soil Treatment	Co-composting process
5.	Solid waste – non-bio	Recyclers mode & safe -disposal	Revenue realized/ re-use
6.	Air Quality - CO_2 / SPM	Campus greens & landscapes	Lawn/ green cover
7.	Festival - celebrations	Eco-conduct eg safe practices	Smart campus evolved
8.	Electricity supplied	Energy audit with conservation	Revenue saved
Heat Islands & others remedied /audited/ assets realized at SMART Campus.			

Fig 1 : Table of Green Initiatives carried out using Geo-spatial Technologies in evolving Smart Campus and assessed on Audit Account of Environmental Assets.

Approach to problem and Smart Methods used:

8 Nos. Smart-technologies used for Smart Campus creation as explained - (Fig Nos.1& 2)

1. Information and Communication Technology-ICT:

Creating a two-way communication channel using ICT, is very important for a campus to be smart. ICT helps them to analyze the demand pattern of the elements and thus create a pool of resources to address the same online. The electronic medium of communication in a community helps in creating a collated intelligence which can be deployed for resource optimization with the help of analytics and deep e-learning.

2. Internet of things- IoT

Internet of things- IoT is like veins of the campus spread all across and connecting each and every element. Every device that is part of a smart campus systems needs to be connected with each other so that they can connect and take decisions amongst themselves, which in return allows apt managing of resources. This is where the IoT comes in, providing the perfect template of a body of communicating devices and providing smart solutions.

3.Sensors

Sensors are hidden but ubiquitous components of the system in the campuscape. Sensors are a crucial component of any intelligent control system. A process is improved based on its environment and it is typically fitted with an array of sensors, from which it collects the required data. It then uses the appropriate variables to characterize its environment and

adjusts its operations accordingly. The availability of a multitude of different sensors and continuously evolving technology controls applications. In the past due to high costs and limited availability, it was not feasible. Sensors are like converters which convert parameters of a physical nature to an electronic signal. This signal is interpreted by humans or fed into an autonomous system. These signals for conventional sensors, include required monitoring parameters such as light, pressure, temperature, flow, humidity, moisture, electric measurements, colour etc.

4. Geospatial Technology- GT
Whatever is built in a smart campus system has to be right, in order to maintain a desired plan. The need is sustainable and this requires accurate, concise and detail data. For each function, the role of Geospatial technologies are utilized. GTs provide the underlying foundation and ultimately the very fabric upon which solutions are formed. GTs provide location which allows pinpointing the location of the problem exactly, so that better solution can be made in future. GTs provide a necessary framework for collecting data and transforming observation in these collections to facilitate software-based solution for desired function in a process.

5. Artificial Intelligence- AI
Smart city is in a way a digital revolution generating a huge amount of data. The data evolved when observed are kept note off and processed. All data results in information which in turn needs to be assessed. This massive amount of data generation and its assessment brings the role of AI. AI allows machine to machine interaction by processing and comparing data making an assessment for desired action. AI plays a role in intelligent traffic, transport management, healthcare facilitation and establishment of Control Room with total surveillance.

6.Blockchain- -
Blockchain technology secures data flow of parameters. Its integration could connect all campus services while boosting security and transparency. Blockchain is expected to influence campuses through smart contracts, which help in prompt billing, processing transactions and handling facilities management. Smart contracts are encouraged. These are self-executing contracts with the terms of the agreement between buyer and seller directly written into lines of code. They permit trusted transactions and agreements to be carried out among disparate parties without the need for a mediating third party, making the process safer, cheaper and faster. Blockchain can also be used in smart grids to facilitate energy sharing, a concept which is trending these in different sections or departments at the campus.

7. Robotic Operating Systems- ROS :
Enabling technologies give rise to novel robotics, who can do most tasks as done by humans. At present, there are key hardware and software enabling technologies that are making the emerging new robotics commercially viable for institutes. ROS is used in computing, memory technologies, energy storage, electric motors, cameras, Micro-Electro-Mechanical Systems- MEMS, GPS etc. ROS helps in lowering development costs, and is proficient in deep learning in facial recognition, text recognition and reading, translation, speech, grasping and so on.

8. Drones- Stationary and mobile :
Drones in past were used for military Unmanned Air Vehicles- UAVs. Drones are large gasoline or battery powered entities capable of running surveillance missions and for defense.

At present drones are used as flying cameras, surveillance, remote sensing, motion picture filmmaking, Oil, gas, mineral exploration, providing disaster relief, real estate and constructions, recreational use. Drones are remotely operated in the hands of operator/s. There could be drones piloted by Robots at educational campuses .

Principal Results realized at Smart Campus : The objectives are realized in the evolving of network with sufficient speed and scalability of most functions. In order to have speed and accuracy it would be needed to have feasible networks of 5G Networks or combination of advanced network and enhanced level of signals. The latest refinements in AI allows easy analysis and assessment of large collection of data regimes. At campuscapes all connectivity are either linked by fibre-cables or in wireless network using Router.. The infrastructure is able to aid in providing flexibility and able to function indoors and outdoors at all levels including basements and at floor rises.

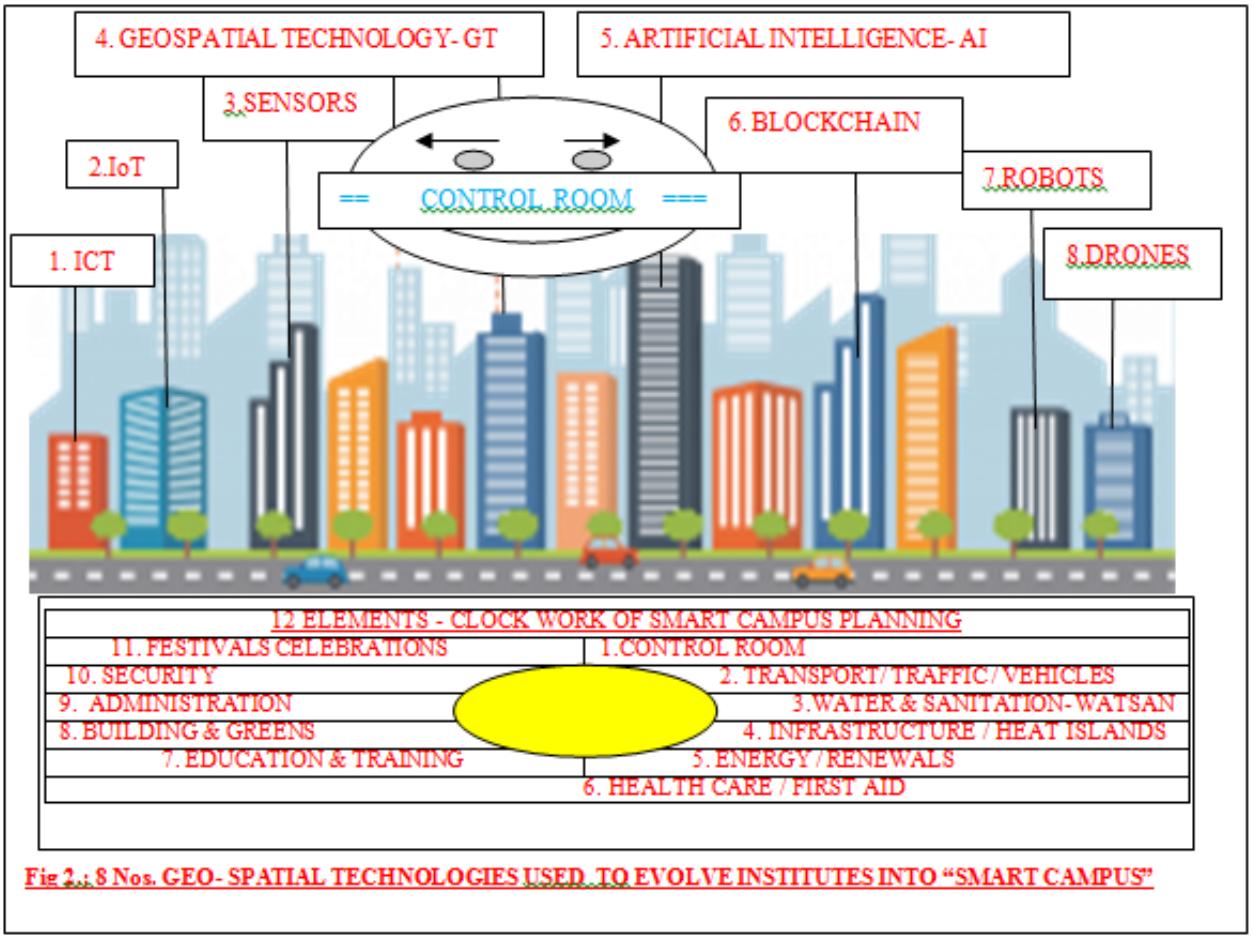

Fig 2.: 8 Nos. GEO- SPATIAL TECHNOLOGIES USED TO EVOLVE INSTITUTES INTO "SMART CAMPUS"

With advanced water and sanitation- watsan management, the campus remains cleaner and optimized. Environmental sensors for specific parameters on water, soil, air and greens are able to monitor campus pollution and provide remedial.

As extension, environmental parameters are applied for analysis and correction using campus- laboratories existent at all departments. Control room is established to monitor, control and measure consumptions of all resources. Upon carrying out Audit, conservation practices are followed for reduction of climate change and green-house gases.

Conclusion/ Way Forward :

In conclusion, a Smart Campus is evolved to sustain its green initiatives with progressive gains and benefits accrued on natural resources. Faculty, youngsters, students and support staffs are evolved as a team to assist and plan out the specifics on the campus. Implementation is done on project mode with an aim of making a Smart Campus.

With evolution of Smart Campus Initiatives, many educational institute campuses are taking concrete and elaborative steps towards creating happier and smarter communities for better future for youth . Therefore when a smart campus is evolved, the campus has a well ordained digital revolution in place. The different domains of the varied Departments in the college campus are inter- connected. Each of the departments are also correlated with each other, using different technology modules to provide best services to all within and outside the Institute.

As a Way forward, Academic Institutions with Smart Campus deal directly with the public and deliver the services of providing education and professional learning to communities for employment etc. While the Institutions have the moral obligation to impart education, they also groom the community and inculcate good culture and custom for better jobs for employment, upgrade living standards. It would be in order to have all academic institutions to aspire and become "Smart Campus" exerting efforts for conserving usage of natural resources viz. water, wastes, electric-power for energy usage. The expenses are economized and resources at lesser costs is created. More availability of resources is ensured and sustained at all times.

This also enhances the sustainability level of each of the institution. Regular Sustainability (SDGs Centric) Audits are carried out with targeted improvements year by year on 12 Nos. Elements of Smart Campus maintained, as in Fig No.1.

Premier educational institutions are exerting efforts to become conscious on Environmental assets, energy and water consumption etc. Environment friendly measures are practiced so that pollution effects are also reduced in campuses.

Visits organized by SIES IIEM

Sewage Treatment Plant, Nerul, Navi Mumbai
17th November 2018

A visit to Sewage Treatment Plant, Nerul, Navi Mumbai was organized by SIES IIEM for M.Sc. students and PGDSEM students on 17th November 2018. The purpose of visit was to learn and understand about the current wastewater treatment & disposal methods adopted by Navi Mumbai Municipal cooperation at the Nerul STP and to learn the function and the techniques used in Sequential batch reactor process.

Group Photo: IIEM Faculty Members Dr. Devayani Savant and Dr. Saumya Singh along with M.Sc. students and PGDSEM students during the visit.

Coastal and Mangrove Biodiversity Centre, Airoli and Thane Creek Flamingo Sanctuary
5th December 2018

A visit to Coastal and Mangrove Biodiversity Centre, Airoli and Thane Creek Flamingo Sanctuary was organized by SIES IIEM for M.Sc. students on 5th December 2018. Creeks are coastal aquatic ecosystems which have connection with the open sea. Due to this reason they are influenced by the oceanic high and low tides. The tidal incursion of marine water produces brackish water conditions due to mixing of fresh and saline waters. This leads to formation of salinity gradient with high salinity on the seaward side and low salinity on the riverine end. Even at a station in the creeks and estuaries, the salinity varies with the tides, which is in fact the unique feature of these ecosystems. Many organisms that have physiological ability to tolerate the varying salinities take shelter in different zones and establish themselves. As there are many salinity zones, there are diverse faunal types in the creeks. The Maharashtra Government has declared the area along the western bank of the Thane Creek as the "Thane Creek Flamingo Sanctuary". It will be Maharashtra's second marine sanctuary after Malvan sanctuary. The sanctuary was notified in Govt. Gazette on 6th August 2015.

Glimpses of the visit

Environment in News Headlines

Remote Sensing to detect vehicular pollution in Delhi

A new sensor-based technology could be used to find out the amount of pollution each vehicle causes as it enters Delhi. The remote-sensing technology is in the testing phase at present with the International Centre for Automotive Technology (ICAT) conducting a study. Sensor-based technology can detect pollution levels of vehicles passing by and indicates which vehicle is polluting more than normal — allowing enforcement agencies to take action immediately.
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Source: Times of India, January 16, 2019

In a first, Elephants to be geo-mapped

In a first of its kind initiative in India, forest officials will soon complete a geographic information system (GIS) based elephant distribution map to track the movement of pachyderms across the country. The project, under the aegis of the environment ministry, is being carried out by teams from the Indian Institute of Science, Bangalore. According to sources, the GIS based system will facilitate easy access to data on elephants and their movement for officials.

Source: Times of India, December 18, 2018

Service lines to be mapped using GIS

Vadodara Smart City Development Ltd, the special purpose vehicle floated for implementation of the Smart City projects in the city, gave its nod to a proposal for a Geographic Information System (GIS) of underground service lines. GIS mapping of underground service lines like drainage, sewage and gas pipelines as well as other cables will ensure that these are not damaged during development works or work to lay new underground service lines.
Source: Times of India, December 14, 2018

NCCR develops system to estimate, predict flooding within Chennai

In 2015, unprecedented and sudden floods paralysed Chennai with over 18 lakh people being displaced. Following this, at the behest of the office of the Principal Scientific Advisor to government of India, research institutions, chief among them the National Centre for Coastal Research (NCCR), Chennai, and IITs, got together to build a flood warning system customised for use in Chennai. Carrying the acronym C-FLOWS, which stands for Chennai FLOod Warning System, the six-module ensemble can predict flooding due to heavy rainfall, sea-level rise and increase in water levels of the three rivers — Cooum, Adyar and Kosasthalaiyar — that traverse the city..

Source: The Hindu, October 20, 2018

Forthcoming Events

- Two Day Internal Auditor Training Programme on ISO 14001 & ISO 45001 on 30th and 31st Jan. 2019
- Alumni Meet, 16th Feb 2019

Articles, photos etc. are invited for next issue (January - March 2019) of 'The Environment Management' on the theme 'Environmental Management Systems for Pollution Prevention'.

Published by-
SIES - Indian Institute of Environment Management,
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