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ENABLING USE OF GEOSPATIAL TOOLS AND TECHNIQUES FOR ASSISTING RURAL EMPLOYMENT GENERATION IN INDIA-CHALLENGES AND OPPORTUNITIES

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ABSTRACT

With the impetus placed on MGNREGA to make it natural resource management based process under the PMKSY umbrella, need to implement geospatial technologies is felt strongly across majority of stakeholders. Convergence possible by the use of geospatial tools and techniques is certainly of a higher degree than perceived till now, especially from the inception of the plan till implementation monitoring. Efforts of ISRO in this regard span various national initiatives addressing rural employment, roads, housing, agriculture infrastructure, watershed development and many more on respective geospatial modules through Bhuvan. At national level, a comprehensive online, open source GIS environment based planning system is envisaged involving spectrum of functionaries and beneficiaries using geotagged asset datasets, legacy information as well as high resolution image series. However,applying Bhuvan based planning tools for rural development to achieve NRM based solutions can be a challenge since concerned functionaries or participating stakeholders may exhibit genuine or feigned aversion for the solution. On the other hand, skill upgradation being witnessed often, by efforts of government institutions as well as self-learning due to the inherent strength of technology, will certainly present opportunities to harness and upscale. Experiences at national level in infusing technology paradigms related to internet connectivity, mobile telephony indicate situations of varied potential. Since remote sensing based visualisation provides higher scope in understanding, analysing and collaboration for realising good NRM plan than conventional trial and error approach, a discussion regarding the challenges and opportunities in this direction is presented. Higher spatial and temporal frequency of imaging coupled with easy to handle interface can certainly appeal to the imagination of the motivated citizens for building a state of the art village development planning and lasting rural development.

Keywords: Resource management, Geospatial, Planning, Rural Community.

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Introduction

Need for employing geospatial technologies for rural development is increasing at an unprecedented proportion, following impetus at highest governance echelons as well as the operational implementation through Bhuvan based solutions. Specific instances of geospatial services GeoMGNREGA, Integrated Watershed Management Programme, Bhuvan Panchayat, Soil Health Card portal, Rashtriya Krishi Vikas Yojana interface as well as PMKSY have delivered the potential at their best to bring in efficient monitoring and transparency into the governance. Confidence at the grassroot by cross-discipline field functionaries regarding the quantum jump in the accountability and rule compliance itself can be an empirical indicator in this direction. Energy with which State apparatus has responded is exemplary, especially in case of Geo MGNREGA to geotag the completed assets and set benchmarks for such field based inventory for rural development initiatives. However, as envisaged now, need for the governance is to adapt space based inputs to support complete planning, implementation and monitoring for Mission Water Conservation (MWC) conceived under PMKSY. This helps to ensure a complete mechanism of scientific input based execution of policy. Mission Water Conservation is the programmatic reshaping of MGNREGA under PMKSY for rural employment generation rooted in ridge to valley principle oriented natural resource management. This has scope to ensure the sustained rural development in terms of infrastructure creation as well as self-reliant enterprises, weaned away from erstwhile relief oriented and central fund based approach.

In view of such emerging requirement, it is apt to explore the strengths of the geospatial technology for the intended paradigmatic shift, as well as consider the extant limitations posed by the characteristic frailties of Indian village communities critically so as to counter them effectively. Planning capacity proposed to be built through Bhuvan is aimed to address requirements of the planning process at grassroots level. At the same time it is important that information generated is policy-compliant, transparent, accurate as well as easy to understand for all stakeholders.

Rural Employment Generation and Natural Resource Management

Villagers need creative engagement to earn livelihood and income from the resources available in their vicinity. Rural landless need higher attention, since no meaningful employment is available to them in lean agricultural season, which causes severe distress leading to migratory labour, unsupported households in critical situations and possible criminal manifestations. Mahatma Gandhi NREGA addressing rural landless poor, has created 235 crore mandays across 2,50,000 Gram Panchayats of the nation during 2015-16 by focusing on creation of assets under 155 sub-categories. As the paradigm evolves, need for bringing in self-reliance into rural job sector is being felt increasingly. Conservation of natural resources, harnessing of the ecosystem services emanating thereof as well as continued upkeep and

stewardship of sustainable solutions created has vast potential in generating rural employment in years to come. While technologically driven demand-supply scenario was not prevalent in rural economies, exploitation of the resources was within the respective recuperative capacity of land, water and trees.

However, the onset of skewed of resource exploitation and climate vulnerability, have pushed condition of rural ecosystems to a brink. So it is essential to engage in amelioration of natural resources so that village communities actively participate in restoring the ecological balance so that agricultural productivity is revived. Realisation that rural employment generation paradigm should move away from relief based approach to natural resource management approach to achieve a sustained job creation is timely and can propagate scientific management of resources (Figure 1).

Figure 1: Employment Generation in Rural Areas through NRM Activity Based Approach

Geospatial Tools and Techniques for Ridge to Valley Approach Based Planning

Maps can transcend language barrier in conveying the information, since principles of adjacency, topology and association deliver intuitive, non-semantic appeal, even to the least literate. When oriented with minimum effort, familiarity of a village citizen, with the landscape in terms of man-made and natural features, can get translated into information and finally a useful inference. Contextualised information thus catalogued on to geospatial framework can add locally specific yet valuable information to the already existing datasets created by professional organisations involved. Such a synergy alone can bring in the much needed involvement of rural communities.

Geospatial datasets created by various thematic experts across organisations are key to

a holistic approach to the sub-continental scale problems at hand in the context of Indian villages. Unless available range of information on various themes, for each given target area is made available through an easy to use, web enabled visualisation tool, planning may not be full-fledged. Wide ranging thematic contents addressing land, terrain, atmosphere, hydrology, disasters and climate change as well as wealth of time series imagery along with historic datasets (Corona imageries) are currently realised as web services through Bhuvan, which offers unprecedented scope of earth observation, analysis, planning and evaluation over Indian region, that too through a policy enabled mechanism.

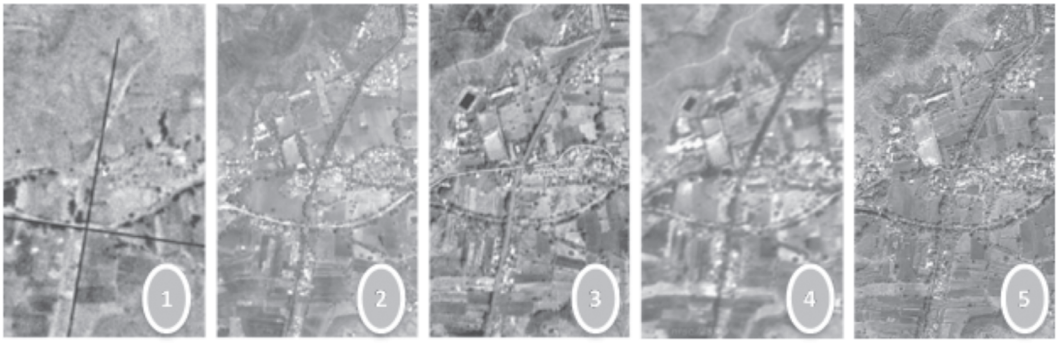

Figure 2: Image Sequence of High Resolution Satellite Data Available in Bhuvan 2d Interface for Ralegaon Sidhi Village, Ahmednagar, Maharashtra. (1- Corona Image (1960s) 2. 2010 3. 2015 4. 2017 5. 1m Image) Corona Image is Historical Data Giving Earliest Status of Rural Setting, while 5th Image Shows High Detail Content Required for Planning and Monitoring

Earliest instances of rural development initiatives under ISRO, in the form of Bhuvan Srishti and Drishti addressing Monitoring of Watershed Development Component of PMKSY (earlier IWMP) started in 2014, and has collated as on date 6370 satellite scenes on Bhuvan. Dominant State-wise natural colour satellite image rendered on Bhuvan for three year period from 2013-16, is illustrated in Figure 2, which indicates the opportunity of earth observation, available to geospatial user community. Madhya Pradesh and Rajasthan currently depict highest acquisition beyond 1000 scenes per State. Bhuvan also renders wall to wall imaging using 1 mtr natural colour high resolution ortho rectified images for recent period (2015-16). Apart from this, historic images acquired from Corona imaging system during 1960s are also placed on Bhuvan (Figure1), which adds a special dimension of building true perspectives of long-term land cover changes and erstwhile natural resource status clearly.

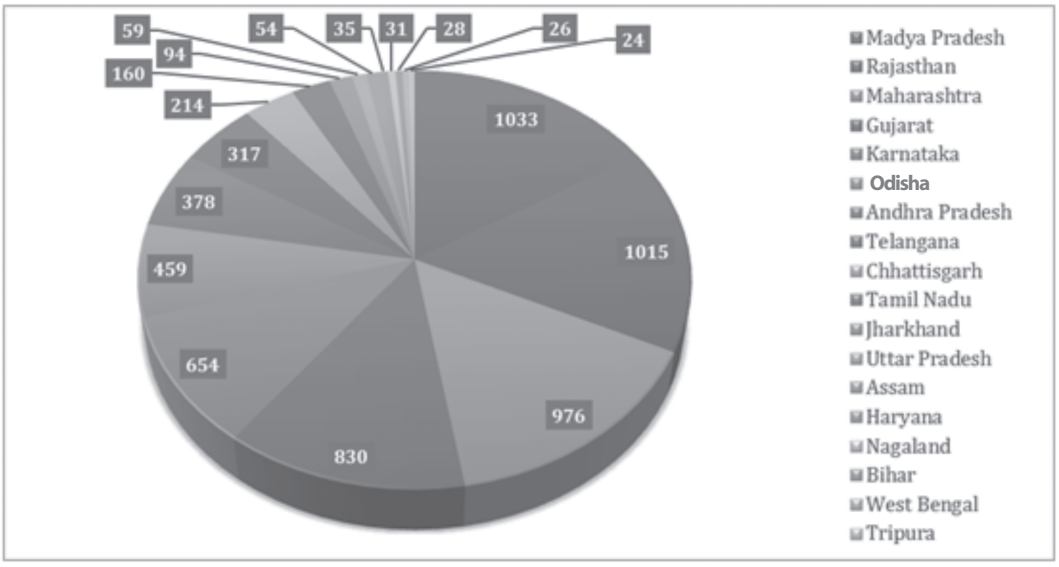

Figure 3: Satellite Images Acquired, Prepared and Placed for Monitoring Watershed Development Component in Srishti Interface of Bhuvan

Tools for planning NRM Activities Using Geospatial Technology

Planning optimal number of natural resource management interventions at appropriate locations with due considerations to requirements of rural society, ecosystem as well as rural economy ensures a desired solution for achieving sustainable rural development. Bhuvan based planning solution is being implemented for delivering support in terms of planning, implementation and monitoring to teams handling field realisation of Mission Water Conservation. Web GIS based tools addressing typical analytical requirements of a micro level planning are available on Bhuvan and will be incorporated into a planning portal. High resolution image based datasets on land use land cover, digital terrain model, stream database as well as the geotag information collected by Geo-MGNREGA for each village will be available to the village level planning unit

Figure 4: Major Components in Structure of the Proposed Planning Portal Under Bhuvan for Taking up the NRM Planning Under Mission Water Conservation

Planning is a multiscale process involving field based inputs and geospatial content from various decision levels. In case of Mission Water Conservation context, regional level plans may be developed as draft shelf of plans by generic expertise available at State level or district level GIS units either offline or using online tools of Bhuvan . At sub-district level, block level official or technical person preferably along with Bare Foot Technician can apply local knowledge to place the recommended envelopes (spatial parcels or locations as polygons/lines/point topology) as per the local context and preferences. Iterative session of optimal period (16-40 hours) may be required to tune the inputs as per desired objectives. Following preparation of such maps, village communities can verify the suggested elements or revise them as per site suitability, which in turn need to be updated in database for final approval by designated authority, for allocation requirements. Alternatively, if association of rural community with BFTs is capable enough to use Bhuvan based solution to plan online and use it for complete approval process, optimal intervention by block level office may be enough. Illustration of one such instance can actually enable cascading effect of much desired involvement of rural communities in applying GIS tools on their own, which in turn can spawn new ethos as well as confidence. Smartphone application is already made available to functionaries to track the creation of new assets.

Technological Penetration in Indian Rural Contexts

Penetration of technology in rural areas is a challenge in general, as long as it involves a process of adaptation whereas tools get absorbed very fast. Mobile telephony, solar lamps, pesticides, affordable farm machinery, etc., are instances of massive penetration. About 25 per cent of rural expenditure is on mobiles and telephone services as per NSSO Survey and is an indicator of the awareness about technological adaptation across the nation and about 68 per cent of the rural households have mobile connections. Total number of mobile users as estimated by SIM holding is estimated to be 37.1 crore as of 2016. Mobiles have clearly changed the way rural enterprise is handling markets, as exemplified by transactions by farmers, artisans and practitioners of various livelihood options who depend on concentrated and diffuse clientele in and around their habitations. Astonishing examples of rural telephony entrepreneurs with surging turnover and employment generation are available in many hinterlands.

Farmers' ability and willingness to adopt new technologies is considered a key to productivity growth and structural transformation, which will in turn determine the poverty reduction rate in settings where most of the poor still live in rural areas (Ali et al, 2017). However, adoption of a new technology must be preceded by technology diffusion e.g. the act of making new technology known to the potential adopters. Diffusion is therefore, the link between R&D and adoption, effective diffusion is an essential but

not sufficient condition for adoption (Arnon 1989). The farmers of a given 'target category' must not only be made aware of an available technology, they must also be convinced that adoption is in their best interests (Pinstrup-Andersen, 1982), and above all, they must be able to adopt the proposed technology. Information and communication technologies (ICT) are indeed generating new possibilities to attack problems of rural poverty, inequality, and environmental degradation (Bhatnagar and Schware, 2000). The paradox is that rural communities that are most in need of improved digital connectivity to compensate for their remoteness, are least connected and included. This is due to persistent and growing differences in data infrastructure quality between urban and rural areas. The hampered diffusion of technologies and the lower average levels of education and skills in rural areas have a negative impact on adoption and use (Salemink et al, 2017).

Ease of Learning Technological Products

Perception in policy making level about technology outreach points to fact that much of the content rendered on Government portals fails to communicate to the citizen, since the language seems complex and convoluted. Efforts to overcome such constraint, may invariably have to focus on professional pedagogical approaches, so that a verified learning happens whenever dissemination of technological content is involved. Effective literacy, required to achieve diffusion of technology, in Indian village context is extremely worrisome, especially in remote parts of low ranking States. Ability of the village community to perceive, assimilate and practise the technical aspects of the newer developmental initiatives may be minimal and hence sustained efforts of repeated communication and verification of learning achieved is must. In such contexts, technical information required for practising new tools and steps must be presented in simple, modular as well as attractive way, preferably as a reward oriented goal seeking exercise. Element of discovering the newer aspects of the intended learning, should be part of the entire outreach approach so that monotony of single sided communication does not set in. Most of the technical content may be replete with specific terminologies in sync with non-rural contexts and hence may repel most inclined community members gradually. This in turn demands effort to add flavour of curiosity and story-telling to such new concepts, so that audience dwells on the concept of term to adapt in the entire outreach sequence. It is an acknowledged fact that most of non-cognitive skill building happens (Mackay, 2013) when knowledge engagement is done in informal way considering variety of knowledge transfer techniques.

Serious Games, a new field of digital learning, relying on game based learning, has immense potential (Christie et al, 2017) in building information literacy in village communities. Since human mind has higher inclination to associate with a sequence of simple events leading to higher order complexity , hence solutions, converting a planning process, intended under Mission Water Conservation, into plugin objects and modules that can lead to desired results. Though currently planning portal is

oriented with conventional GIS tools and techniques, flexibility exists with regard to geographic information to evolve into a game based interface. Objects and modules that can be conceived in realising a plan to achieve best soil and water conservation as well as sufficient mandays can be designed and implemented on line gradually.Essentially micro plan preparation has focused on putting all the ideas of villagers in to a participatory mapping exercise and derive the plan. Similar logic will certainly hold good if massive multiplayer online role-playing games (MMORPGs) can be deployed for communities for realising plan done in participation using dynamic artifacts or objects from the available digital repositories. A low-fidelity prototype may be initiated as done elsewhere (Stigall and Sharma, 2017) involving available geospatial layers for conducting pilots followed by a high-fidelity prototypes for operational tests.

Conclusion

Information and Communication Technology coupled with Geospatial information derived from space-borne, air-borne and hand-held sensors will play a major role in transforming rural livelihoods and natural resource management at a much higher ebb. It is essential to harness the advantages of state of the art geospatial information, tools for their manipulation and creation of participatory information at local level so as to build much needed synergy in rural development. Emerging fields of information technology based learning approaches and devices coupled with strength of already existing technology penetration can provide a fertile ground for connecting to rural masses and realise their involvement in ridge to valley principle based activity plan preparation, for Mission Water Conservation.This will go a long way in strengthening the implementation of water positive paradigm envisioned.

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