ICAR-INDIAN INSTITUTE OF SOIL AND WATER CONSERVATION, RESEARCH CENTRE,
BALLARI - 583 104, KARNATAKA

WORKSHOP PROCEEDINGS

A WORLD BANK FUNDED
KWDP-II (SUJALA-III) PROJECT

Science Based Watershed Planning and Implementation: Learning Experiences and Way Forward

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WORKSHOP SUMMARY

The views emerged from the stakeholders of the Project concludes that Karnataka Watershed Development Project-II (KWDP-II or Sujala-III) provided a platform for convergence of efforts from various Institutes, Organizations, Departments and Agencies working for conservation of natural resource by harnessing collective synergies and breaking down functional silos. Cost effective mapping scale (1: 8000) and resolution of 15 minutes rainfall interval used in the assessment of water balance components for accurate prediction of rate and quantity of runoff were greatly appreciated. LRI database integrated with hydrology information and it availability in digital form are found handy in future planning of all developmental projects. LRI trainings are found effective in imbibing scientific farming approaches in the farmers as it helps in effective utilization of farm resources by providing land management information along with nutrient status of soil to the farmers and it remains valid for at least next 25-30 years.

Updation of LRI database using high resolution spatial information, widening choice of crop selection and generation of atlases for sub-watersheds, correction of shape files database for proper nomenclature of villages and hamlets, inclusion of DEM and aquifer monitoring information and maps into the atlas, use of high temporal resolution infiltration-study information in hydrology estimates of runoff, proper time frame for planning, training, implementation and impact assessment of the watershed works and a call for effective awareness and rapport building among the local beneficiaries were emanated as key points of way forward. Views expressed also long for real time information generation and dissemination, a structured decision support model involving all direct and indirect variables and processes for deriving hydrological planning and crop selection, inclusion of untouched stakeholders and follow up schemes for absorbing human resource and infrastructure developed and interventions implemented. Overall expressions yearn for development of an integrated database of LRI and hydrology for entire State and the Country.

BACKGROUND

Sujala-III Project was designed to integrate watershed development with agricultural and other programmes by harnessing synergies of science-based Land Resource Inventory (LRI) and hydrological dynamics of the watershed through involvement of local governments and communities. Lessons learnt under Sujala-I have lent their relevance to the Sujala-III in course of project planning. KWDP-II opened for the first-time new vistas in planning and implementation of watershed programmes in the country by developing and providing scientific basis for designing watershed development interventions. Learning is a continuous process and it is never ending one. In the path of present project LRI partners built LRI database, which has later been integrated with hydrology atlas of watershed, provided strong scientific foundation for planning and implementation of watershed treatment interventions by the project implementation agencies (PIAs) of various districts. The work progress was constantly monitored and evaluated by teams of Monitoring and Evaluation (M&E) agencies. This was represented by a word of farmer in the watershed that “given thirty plants and visited three hundred times”. The workshop had an object to set the stage for LRI partners, PIAs and M&E agencies to share their experiences, lessons learnt, constraints and conflicts encountered and a way forward for the future. The output of the workshop identifies and enlists key lessons learnt in the course of Project and remains as a record for future reference while designing and planning of new watershed and other development projects.

OBJECTIVES OF THE WORKSHOP

The main objective of the workshop was to pool the experts' views and their field level learning experiences from partners of the project such as Watershed Development Department (WDD), Karnataka State Department of Agriculture (KSDA), LRI partners (ICAR-National Bureau of Soil Survey and Land Use Planning (ICAR-NBSS & LUP) and State Agricultural Universities), PIAs, and other line department and M&E Agencies (TERI, Bengaluru and ICAR-Indian Institute of Soil and Water Conservation, Ballari (ICAR-IISWC)). The workshop aims to find organizational silos, constraints and a way forward for future.

PROCEDURE OF THE WORKSHOP

The workshop followed a procedure which contained welcome address, an overview, Chief Guest address and sharing of experiences on science-based watershed planning and implementation by LRI partners, PIAs and M&E agencies. Presentations and interactive discussions among the Professors, Scientists and Administrative Heads of the KSDA and NGOs were set to derive key outcome of the workshop. The general outline covers learning experiences, difficulties, constraints and possible future modifications and expedition strategies needed for more effective planning and implementation of the scientific watershed management.

PARTICIPANTS

KWDP-II (Sujala-III) planners, Implementing Agencies and Monitoring and Evaluation Teams were participated in the workshop. In total of forty-one participants representing different organizations and agencies were attended the workshop. Officials from WDD, Government of Karnataka, Coordinators of Sujala-III from NBSS&LUP, Regional Centre, Bengaluru, University of Agricultural Sciences, Bengaluru, University of Agricultural Sciences, Raichur, University of Horticultural Sciences Bagalkot and KSNDMC, Bengaluru were participated. Further, DDAs, ADAs, AOs and AAOs of KSDA, Government of Karnataka were shared their experiences and the way forward for better implementation of future watershed projects. Finally, Heads of M&E team of the Sujala-III were participated and expressed their learning experiences.

WELCOME ADDRESS

In welcome address, Dr. Rajendra Hedge, Head, NBSS & LUP, Bengaluru formally invited the Chief Guest Dr. Padmaya Naik, Director, WDD, Government of Karnataka, Bengaluru, Dr. S.L. Patil, Head, ICAR-IISWC, Research Centre, Ballari and other dignitaries in the workshop. Extending his welcome address he invited all the Professors of State Agriculture Universities and Scientists of NBSS&LUP, Bengaluru, functionaries involved in the LRI data generation, M&E agencies, PIAs from different districts of the state and representative from the KSNMDC, Bengaluru.

OVERVIEW OF THE WORKSHOP

In opening remarks to the State Level Workshop Dr. S.L. Patil, Head, ICAR-IISWC, RC, Ballari explained the overview of the workshop. He stressed the importance of the workshop “Science Based Watershed Planning and Implementation: Learning Experience and Way Forward”. He thanked the World Bank for funding science based Sujala-III Project, designed and implemented by WDD, Government of Karnataka. Appreciating various Institutes involved in the Project, he underscored the development of LRI database and its integration with hydrology atlas of watershed as first of its kind in the country. Dr. Patil enlisted up and downs of the Sujala-III Project with respect to generation of LRI database to its dissemination. He said that LRI card was the useful product of the project; however, cards distribution at the middle or towards end of the project to the farmers draws flak. Thus, he emphasized efforts needed for reaching all the farmers of the watershed well in advance. He also made a comparison of earlier crop management system with LRI based crop systems and appreciated the LRI Partners and PIAs for bringing innovation into the watershed planning and implementation. He mentioned about demonstrations of various technologies on farmers' field by KSDA and ICRISAT, Hyderabad, trainings offered to all field functionaries and beneficiaries by NBSS & LUP, Regional Centre, Bengaluru, District Agricultural Training Centers (DATCs), Krishi Vigyan Kendras (KVKs) and Raitha Samparka Kendras (RSKs). Saying this project was a bundle of innovation as it launched Digital Library and DSS for farm level data documentation and support in decision process. Besides that, he highlighted the M&E activities of ICAR-IISWC, Research Centre, Ballari on scientific and technical aspects of interventions implemented in the watershed. At the end, he appealed to the participants to express their views in free and open mind for improvement of LRI based watershed planning in future.

EXPERIENCES OF WDD AND FUTURE PLAN

The chief guest of the workshop Dr. Padmaya Naik, Director, WDD, Government of Karnataka appealed to the participants for thorough discuss of the LRI database and its dissemination to the end user. He expressed his desire to know what would be course of action needed for modification and updation of LRI database and means of its dissemination. He expressed his concern over water scarcity for irrigation due to variability in duration and intensity of rainfall events as a part of climate change and mitigation strategy with effective water conservation and utilization. Further, he said that farming community arising slowly but steadily and searching for quick solutions to the aberrations occurring due to climate change and global warming. So he called all developmental agencies to work in this direction in a well coordinated and scientific manner for better adoption of climate mitigation measures. Appreciating the LRI data generation for agriculture lands, he expressed his desire to extend LRI activities to forest and degraded lands in the State. He concluded his speech by asking the scientific community to study the LRI impacts on watershed development and fine tuning LRI and Hydrology database for serving the farming community in a best way possible. In his final words he remarked that “This is not the end, but it is beginning of the new arena for future Watershed Projects” and he called upon everyone to share their experiences and way forward.

EXPERIENCES OF LRI PARTNERS

Dr. T. Chikkaramappa, Coordinator of Sujala-III Project at University of Agricultural Sciences (UAS), Bengaluru shared his team experiences and brought out few constraints and solutions in the form of way forward. First constraint was lack of awareness and misconception among the farmers about LRI, as few of them denied collection of soil samples and profile study in their farm. To overcome this, he stressed requirement of rapport building measures through village level stakeholder meetings for educating farmers about Project and to curb misconceptions. The second constraint revolves around LRI crop recommendations with respect to horticulture, forestry and field crops as farmers were not readily convinced with it, thus he called for more and more result demonstration on farmers' fields. The third one was requirement of proper hydrology atlas of the watersheds and preparation of sub-watershed level hydrology integrated LRI

atlases, similar to the micro-watershed atlases prepared in the Project. Further, he listed training of the farmers on LRI at the early stage of project implementation for better acceptance and adoption of LRI fertiliser recommendations, use of updated cadastral maps for generation LRI atlas to avoid discrepancies in land registration details, sub-division of LRI crop recommendations into further different categories like millets, cereals, horticulture/plantation crops to widen choice of selection and life risk of personnel involved in the LRI. Finally, he shared photo documentation of problematic soils in the sampling areas which ignited audience for further thinking.

Dr. Satish Kumar, Coordinator of Sujala-III Project, UAS, Raichur, shared his experiences on Hydrology planning, its effective execution and constraints associated faced during the project period further he suggested ways for better implementation of hydrology component in the project. He appreciated cost effective mapping scale (1:8000) used in the Project and resolution of 15 minutes rainfall interval used in assessment of water balance components for accurate prediction of rate and quantity of runoff in tillage zone of soil (A horizon). Further, he called for inclusion of infiltration studies to enhance accuracy in estimation of rate and quantity (mm) of runoff. Dr. Kumar highlighted that the hydrology model designed under the Project provides a management tool which differentiate between runoff available for conservation and water harvesting and environmental flow within the watershed. He further added that methods were developed to measure soil moisture both at surface and across profile which help analyzing moisture variability in time and space and also between two rainfall events which in turn help determining adequacy of soil moisture in the crop growth period and length of growing days in the watershed. Additionally, he said characterization of evapotranspiration in relation to rainfall, PET and AET is a unique feature of the project and it helps in deciding aridity status of watershed and water usage from different sources. Regarding assessment of ground water status based on fluctuation and recharge size due to antecedent rainfall and its quality for its usage for agriculture, he said it is helpful in deciding extent of draft that can be depend upon. He suggested recommendation of hydrologically suitability of crop by combing LRI atlas with hydrology maps and emphasised collection of primary data and its management along with convergence among stakeholders to address the watershed planning and implementation in tandem as it is followed in the Project. He suggested for mapping and monitoring aquifer status as part of hydrology atlas. He called for organizing trainings and workshops at appropriate levels for percolation of database information in the form of atlas, LRI cards, DSS and digital library. He also called for convergence among the scientific community in undertaking research initiatives including artificial intelligence and data mining in natural resource management by integrated related database and development of electronic devices and sensors for measurement of runoff and soil moisture at affordable costs by curbing organizational silos and harnessing synergies of all sectors like credit providing Banks to energy supplying agencies. Finally, he expressed existence of gaps in mapping and implementation, besides understanding of maps *per se.*

Dr. Praveenkumar B. Naikodi, Coordinator of Sujala-III Project, UHS, Bagalkot appreciated Sujala-III project as it was a multi-Institutional project and effectively coordinated to break down institutional and organizational silos. He appreciated LRI works accomplished by agriculture diploma students, which he said that was on par with expert survey. He highlighted the inventory of soil, land and hydrology, application of tools, preparation LRI atlas and LRI cards, preparation of net- planning and DPR, inclusion of B:C ratio in crop selection, system for monitoring of Budget Expenditure and Auditing,

human resource developed in the project and its future utilization and finally institutional and individual learning from the Project.

He suggested structural equation model to accommodate various factors to derive decision on crop selection and hydrological planning, like inclusion of evapotranspiration, rainfall and runoff characters in one equation for estimation of runoff, moisture availability and ground water recharge. He also mentioned possibilities of higher spatial resolution atlases in future by using 0.25m resolution CARTOSAT images against 1:50000 scale Toposheets which help specific survey and recommendations. He argued for involving untouched stakeholders in project planning, like bank manager, power supply agencies, pump-set manufacturers etc for understanding LRI based recommendations and thereby either accepting or rejecting the crop loan or power supply. He found that this project established relationship between landscape, physiography and potentials and limitations of the soils. Project set a platform in understanding role of various stake holders such as farmers, women, labourers and Institutions in watershed. It provides procedure for identification of priority areas and suitable sustainable interventions for degraded lands, soil fertility and soil and water conservation measures for crop production based on site specific characterizations of resources. The main constraints he mentioned was time frame given for inventory and planning, implementation and impact assessment as it provides no room for percolation of LRI information to the end users and incubation period for Assessment of treatments impact. His way forward suggestions argues for developmental planning on micro watershed as a unit involving both macro land micro level hydrological assessment for conservation of natural resource in the country. He also suggests including watershed management tools in natural calamities rehabilitation projects such as drought, floods, hailstorms etc.

Dr. Rajendra Hedge, Head, NBSS & LUP, Bengaluru has highlighted that LRI is not for solving all agricultural problems but it is a assisting tool for agricultural planning. There is difference between LRI and soil health card: LRI cards provides land management information along with nutrient status of the soil and it will remain valid for at least next 25 to 30 years. He stated that Karnataka is leading State in watershed planning and many States in the country are following the watershed guidelines framed by State. Digital maps were made available through web portal using high spatial resolution Quick Bird images, was note worthy contribution of this project. He said that the guidelines followed in the project were science based and it was appreciated by Commissioner, WDD, Government of Karnataka, Bengaluru. Further, he asserted that project was planned in such way that LRI, hydrology and horticulture were the prime components of the project as desired by World Bank team. Sujala-III project involves interactions between State Agricultural universities, WDD, KSDA and World Bank and it was a learning lesson for building a database of natural resource conservation. He said that State Agricultural Universities involved in soil surveying and generation of LRI cards, KSDA, Department of Horticulture and others involved in preparation of DPRs and LRI data base. He hinted that by observing the success of this project, World Bank is foreseeing to replicate similar model of climate smart agriculture in African countries. Besides sharing the cost of each soil profile, he said that the Commissioner, WDD has taken a note of areas which are very deficient in soil organic carbon and micronutrients and had a plan for proposing a future project to address such issues in particularly Koppal and Yadgir districts of the State.

EXPERIENCES OF PROJECT IMPLEMENTING AGENCIES

Dr. Mohandas, Deputy Director of Agriculture, Rona sub-division, Gadag district highlighted that the Sujala-III Project is a diversion from the conventional watershed implementation adopted earlier. It will provide PIAs a scientific guidance and exposure to various academic and scientific Institutions. Further, introduction of LRI and Hydrology atlas will help the implementing work in a more effective way with available limited time. He said that convergence with other projects with Sujala-III helps them to overcome difficulties of non-acceptance by farming community while implementing the scientific watershed planned activities. Defending Sujala-III was better than IWMP and NWDPRA in his own words he explained that LRI based farming practices reduced many hurdles faced by project implementing agencies from farmers and political organisations in the villages. Giving explanations for his words he said that due to availability of scientific data (LRI and Hydrology Atlas) in the hands of the implementers reduced the burden and supports decision making easy and reliable. Now, convenience of the farmers to adopt the scientific watershed practices and structures is less difficult. Comparing the Project implementation activities in the IWMP he said that political interferences were drastically reduced in influencing the PIAs to get the benefits as per their desire because LRI recommendations and Atlas hydrology atlas does not permit for the same. He said that LRI Maps and Hydrology Atlas is a defence tool against many misconceptions faced by PIAs in the earlier projects like IWMP. Emphasising the Socio-economic development aspects chalked under Sujala-III Project, it is a new kind of exposure to PIAs to collaborate with the Skill Development Institutes like RUSETI. This helps create employable and entrepreneurial skill sets in youths of weaker section, women in SHGs and also ensure gender mainstreaming. He further said that along with Hydrology atlas there should be a need for technical guidance on materials used for construction of cost-effective structures along with new soil and water conservation technologies, which can be adopted in the watersheds. Regarding watershed activities under Sujala-III he shared some of the success stories of improvement in ground water and bore well yields. Also suggested thinking for provision of borewell recharging filters in Sujala-III for effective improvement of borewell yields. Finally, he said that more time should be given for planning (planning phase), that will helps ease the process of implementation.

Mr. Kariyappa, Assistant Agricultural Officer, Chikkamagaluru highlighted that Trench Cum Bunding (TCB) technology is a boon for the farmers as it helps the farmers to conserve rainwater and simultaneously farmers utilise bunds for taking alternate crops which generate additional income. He ascertained that, fodder development and animal husbandry practices were not emphasized in the Projects, which needs be given priority in upcoming projects. He also mentioned that staggered trenches were not recommended in LRI atlas for coffee growing slope landscapes. Further, he suggested for changing of LRI recommendation of cricket ball variety of sapota which was not suitable to the location. In discussion, it is informed that Chikkamangalore and Raichur were lately included in the project thus suitable upadation is required in LRI crop recommendation.

Mrs. B. Manjula, Assistant Director of Agriculture, Lingasur, said that positive aspect of the Sujala-III is that it provides opportunity to reach a diversity of stakeholders like land-owned farmers, landless, women, weaker and backward sections and simultaneously work with scientific community. Expressing her concern about the LRI training to the watershed field functionaries, trainings to be simplified and thorough trainings must be provided to understand the process and its effective execution in the field. Furthers she expressed her concern about the need for effective trainings to create the awareness among the farmers for its better utilisation, which is tedious task in the project. As most of the farmers were illiterate, understanding the LRI Cards were solely depend on the training provided by the LRI managers. She said that the project focus as of now confined to rainwater harvesting but provision should be given to channelize the village waste water/rainwater to the common outlet, by having a convergence with the PWD departments is essential. Regarding Forestry component more forestry plantations should have been taken in the common property lands, which are missing in the project as per her experience. Simultaneously, she stressed the fellow line departments to expedite the development of forestry interventions on community lands. Survival of plantation and forestry crops is also another major concern as per the present situation, she said. She also advocated that there is a need for more awareness to farmers to maintain and ensure survival of plants for more success of the project.

EXPERIENCES OF MONITORING AND EVALUATION AGENCIES

Dr. Lasya Gopal, Area Convenor, TERI, Regional Centre, Bengaluru, highlighted that for effectiveness of project there should be real time information. In this project experts from various Department and Universities were also involved. She said that, TERI was not participated in base line survey but included later for monitoring and evaluations. To figure out how work was done, there was no repeating the work in the time period of evaluation, thus it remains as a constraint, she said. Collection of data from farmers was difficult and at few points there was clash in data collected by two monitoring agencies.

She argued that, qualitative aspects should be included in the project evaluation but World Bank focused on quantitative monitoring. She said there room for enhancing better involvement of local communities through results demonstrations in the project. She proposed for launching follow up schemes to ensure sustainability of projects interventions, as way forward.

Dr. S. L. Patil, Head, ICAR-IISWC, RC, Ballari shared his learning experiences and highlighted that Karnataka is a pioneering State in planning and implementation of watershed projects. The State has largest dry land area after Rajasthan in the country and suffers with frequent droughts. Cadastral level LRI atlas and LRI cards generated in the project differentiated it from the rest. The LRI based recommendations on crops and cropping system matches with existing cropping system in Koppal watershed with highest B:C ratio. He said, LRI recommendations for forest and horticulture species based on soil depth are appreciable. He shared his experience with planting of Melia dubia in watershed and advised to plant where mean annual rainfall is >750 mm at with spacing of 15 x 15 feet. He counted few lacunas in the projects, like construction of few check in the first order stream in close horizontal interval with inadequate catchment area, priority given to farmers' preference in site selection and construction of farm ponds, breach of waste weirs in black soils and no scope for promoting efficient irrigation systems. He proposed for proper and strict site selection for check dams and farm ponds, piped waste weirs for black soils, provisions for promotion of drip and sprinkler irrigation systems. Further, he said LRI training were beneficial to farmers, which imbibed scientific farming approaches in the farmers, however called for training before implementation for greater acceptance of LRI based recommendations. Livelihood trainings such as dairy farming, tailoring and value addition trainings to women were also beneficial. In his way forward suggestions includes LRI database for entire country along with digital library and DSS. He called for discussion of pre and post planning of LRI especially among LRI partners and among PIAs and farmers during pre and post watershed planning and implementation. For ensuring protective irrigation from farm ponds, he proposed for Silpoulin lining in red soil regions. He also proposed for increasing duration of training for different functionaries from three to seven days with importance on practical teaching and such training must be conducted within first six months of project implementation.

He recommends that LRI card preparation and distribution should be done within first six months of the project implementation. He also called for continuous runoff measurement for estimation of soil and nutrient loss.

SAILENT OUTCOMES OF THE WORKSHOP

Experiences

1. Discussion with the watershed beneficiaries during Pre and Post planning of LRI through village level meetings and similar discussions of PIAs' with the watershed beneficiaries during Pre and Post watershed planning are essential for understanding watershed project and to eliminate misconceptions and wrong notions and to ensure active participation. Further it helps the farmers for understanding LRI and adopt suitable agricultural, horticultural and forestry crops and fertilizer recommendations.
2. Conducting watershed and LRI trainings to the field functionaries and LRI trainings to the farmers while distributing LRI cards during the early stage of the project help farmers in adopting science based farming.
3. LRI based crop recommendation considered soil, water, climate and economics but market and biotic interference needs to be given attentions for location specific crop selections.
4. Limitation in shape files provided by KSRSAC, anomalies in village name and locations needs to be rectified along with generation of sub-watershed LRI and hydrology atlases. DEM data may be added to the atlas, which was useful for hydrology studies.
5. Check-dams (CDs) were constructed with proper hydrological design; however, few CDs were constructed in the first order stream in close horizontal interval with inadequate catchment area.

Lessons learnt

1. Sujala-III project developed LRI database and it recommends suitable crops and cropping system, horticulture and forestry based on B:C ratio and soil depth including application of fertilizer application well LRI cards developed and distributed is first of its kind in the country.
2. LRI trainings were found useful to the farmers in selection and adoption of field crops, horticulture and forest crops and effective utilization of farm resources which promotes scientific farming approaches.
3. Hydrology atlas integrated with LRI will help the planners to develop a holistic plan for the whole micro/sub-watershed, right from crop (field/horticultural/forestry) selection to optimize soil conservation options.
4. Convergence among scientific institutes, implementation agencies and allied stakeholders played a key role in breaking down functional silos of organizations and institutes and it exposed PIAs and even LRI partners to the new paradigm of tools and applications.
5. Project provides provisions for gender mainstreaming through training of SHG women and building employable and entrepreneurial skill sets.
6. Mapping scale (1:8000) and resolution of 15 minutes rainfall interval used for accurate prediction of rate and quantity of runoff was appreciable. The runoff model developed differentiates runoff available for conservation, harvesting and environmental flow.
7. The methods have been devised to measure soil moisture both at surface and profile which help analyze the variability both in terms of time and space, length of growing days and also within the two rainfall events.
8. The ground water availability status has been assessed based on water level fluctuations in selected observation wells/bore wells and recharge due to antecedent rainfall and its quality for irrigation which helps to decide the extent of draft that can be dependable. Hydrological suitability for crop planning with respect to soil moisture availability under normal and drought situation for given sub-watershed has been suggested.
9. Piped waste weirs are found efficient and cost effective in black soils for drainage of excess runoff from fields compared to loose-boulder waste weirs. Site selection for construction of SWC structures have been done scientifically, however at some place's farmers preference was given priority.
10. In comparison to IWMP, NWDPRA and other watershed projects, scientific justifications provided in the form of LRI database and hydrology atlas in Sujala-III were handy for convincing farmers, for selection of suitable sites SWC structures and to thwart local political pressures. In addition it helps in reducing time for science based planning, DPR preparation and implantation of watershed activities.

Way forward

1. LRI database, digital library and DSS developed in the Project will serve as an effective tool in planning and implementation of future watershed projects. Therefore, it needs to be extended to cover entire State/Country. Further, fine tuning of database in terms of customization by query and analysis may be done in future.
2. Mobilization of farmers in the pre-planning and planning phase of the watershed will ensure more acceptance and sustenance of watershed project impact. Therefore, before commencement of the LRI work, concerned department officials along with the LRI partners should discuss and convince the farmers about LRI and watershed-hydrology for building rapport and to avoid conflicts with farmers.
3. For greater acceptance of LRI-based recommendations, early LRI training and LRI card distribution is essential along with result demonstration on farmers' fields and refinement to blanket horticulture crops recommendations.
4. Mapping scale 1:8000 used in the Project was cost effective and higher scale maps needs to be developed for future watershed projects. Preparation of sub-watershed atlases, updation of cadastral maps with correct village names, inclusion of DEM, land use land cover maps, aquifer monitoring and mapping information in the atlas needs to be accomplished in future for creating scientific awareness in farming community.
5. There is a need for convergence among the scientific community in undertaking research initiatives including artificial intelligence and data mining in natural resource management for building integrated database, as it happened in the Project. Participation of untouched stakeholders (Zilla, Taluk and Gram Panchayats, banking system, power suppliers, pump set manufactures, etc) at the planning phase is very important for planning inclusive growth and sustainability. Micro-watershed should be recommended for considering as a planning unit rather than Panchayat boundaries.
6. Tools need to be developed to overcome the dilemma of how much of rain water to be conserved and harvested in water harvesting structures and how much runoff to be allowed as environmental flow. With proper water budgeting, drip and sprinkler irrigation should be promoted for judicious use of harvested rainwater and enhancing crop water productivity. Documentation of ITKs on soil and water conservation.

7. Specific time frame for LRI inventory, planning and implementation of the watershed and impact assessment, as it seems overlapped with limited incubation period in this project.
8. Intensity assessment rainfall events and infiltration studies results in accurate estimation of rate and quantity of runoff. Information soil moisture in the profile estimated and provided for proper crop planning.
9. For runoff measurement, gauging devices to be installed at the initial stage of project implementation for measuring pre- and post-project runoff and sediment yield. Thus, impact of watershed treatment in terms of reduction in soil and nutrients loss can be quantified.
10. The Evapo-transpiration characterised in relation to rainfall, PET and AET was a unique feature of the project and such data helps in deciding status of watershed in terms of aridity and extent usage of water from different sources. There is a need for development of electronic instruments for measurement of runoff and soil moisture at affordable costs.
11. The duration of trainings on watershed management and capacity building conducted at District Agricultural Training Centres (DATCs) needs to be increased from four to seven days for ADAs, AOs, AAOs, NGOs and Executive committee members with more emphasis on practical teaching for effective learning and implementing various watershed activities. Such trainings may be conducted within first six months of project. Trainees were evaluated for knowledge gained at post trainings appraisal. However, pre and post appraisal is essential for assessment.
12. Percolation tanks should also be constructed in red soil areas for augmentation of ground water recharge. Silpoulin lining of farm ponds is essential in red soils to avoid seepage loss, where harvested water has been used for irrigation.

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We acknowledge Mr. Prabhash Chandra Ray, Commissioner, Watershed Development Department, Government of Karnataka, Bengaluru for his constant cooperation and guidance for successful organization of the workshop, which set a stage for pooling intellectual and pragmatic experiences necessitated for correction and modification of future LRI based scientific watershed Planning and Implementation.

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