ITKs on Soil & Water Conservation for Strengthening Alternate Land Use Systems

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Indigenous knowledge represents the accumulated experience, wisdom and know-how unique to a given culture, society, and/or community (http://www.nuffic.nl/ik-pages/index.html). It stands apart as a distinctive body of knowledge, which has evolved over many generations in a particular ecosystem. It defines the social and natural environments, is based within its own philosophic and cognitive system, and includes first-hand working knowledge in such fields as: agronomy (polyculture, including natural pest control, microclimate management, and soil regeneration); taxonomy; natural resource management (including wildlife and agroforestry systems); aquaculture (including certain water purification technologies); animal husbandry; meteorology; human and veterinary medicine; plant, animal and human nutrition; mathematics; architecture; communications; social and consensus management systems; childhood development and education; and integrated ecology. Early research often presented indigenous knowledge systems as static paradigms, but more recent studies have revealed them to be dynamic and highly adaptive, with change driven by circumstantial demand for sharp observation, creativity and experimentation. When holders encounter new types of knowledge and skills — from the dominant or other indigenous systems — they always seek to test it and incorporate whatever is useful into their own knowledge and practice base. Local systems vary in response to different roles, age and status within a given group, and provide the basis for local decision-making. They are thus useful for total systems management. The role of indigenous knowledge in strengthening the development process was not discussed seriously until the early '80s, first by academics, then by development and development research agencies. Field investigations have since shown that local knowledge systems are by nature efficient, effective, and intensely practical, and field testing has further demonstrated that they are a valid form of science – though user-derived, rather than scientist-derived. Awareness is growing that the use of indigenous knowledge in development initiatives could bring long-term benefits, richly complementing and enhancing the contributions of modern inventions and development efforts.

Soil and water are the basic resources and these must be conserved as carefully as possible. The pressure of increasing population neutralizes all efforts to raise the standard of living, while loss of fertility in the soil itself nullifies the value of any improvements made. This calls for more systematic resource conservation efforts. It is well known to every farmer that it is the top soil layer, which sustains agricultural production. Once this layer is lost or eroded, nothing can be done to replace it within a short period of time. Climate and hydrology, soil topography, soil surface conditions and their interactions are major factors affecting erosion-sedimentation processes.

The semi–arid regions with few intense rainfall events and poor soil cover condition produce more sediment per unit area. But the man's intervention has disturbed the natural equilibrium and intensive and extensive agriculture has become a dominant factor in accelerating land degradation. The ever-increasing population pressure has brought intensive cultivation of land to the forefront through irrigated agriculture. No doubt these practices have resulted in a great increase in productivity, but they have resulted in large-scale water logging. Cultivable wastelands are increasing in the agricultural fields due to improper land management. The obvious remedy for this is to follow soil and moisture conservation practices along with integrated nutrient supply system for

improvement of soil fertility as well as crop productivity on sustained basis. Soil conservation in any form is the only known way to protect the productive lands. In a predominantly agricultural country like India, where droughts and floods cause chronic food scarcity, adequate soil conservation programme, not only increases crop yield, it also prevents further deterioration of land. Methods to control surface runoff and soil associated erosion have been practiced in India from times immemorial in form of different ITKs.

Fortunately, we have many indigenous techniques for conserving natural resources (Agarwal and narain, 1999). These have been in practice for number of years as presented in the write up. Therefore there is a need to enmesh these practices along with conventional soil and water conservation measures for promoting sustainable development of agriculture. It may not be out of place to mention that some of these ITKs may need minor modifications in different watershed situations as well as socio-economic fabrics across the country. Inclusion of these ITKs would ensure sustainability of different eco-systems, befitting the man-animal-plant-land-water complex in each watershed. The documentation of ITKs on soil and water conservation will form a basis for formulating coordinated research programme for validation and refinement of the ITKs on soil and water conservation. In recent years the idea of taking ITK into consideration in developing projects and locating research thrust areas has been gaining momentum. This knowledge is not possessed by only one sector of society, for example, in many cultures; women and elders have passive insights into certain aspects of culture. Sometimes researchers have been unaware of such perceptiveness among rural people due to their biased focus on land-owning male farmers, neglecting other members of society. Traditional knowledge and practices have their own importance as they have stood the test of time and have proved to be efficacious to the local people. Some of these traditional practices are in the fields of agriculture such as crop production, mixed farming, water harvesting, conservation of forage, combined production system, biodiversity conservation, forestry and domestic energy etc. India is unique having a rich history of traditional systems of soil conservation and water harvesting in almost all the states. Conservation of both surface and ground water has been an integral part of our country for many centuries. In fact, different types of ponds and tanks represent important community resources for drinking water and allied uses in rural India. Even today, the main attributes to their success are the sound scientific knowledge and methods on which they have been built. Moisture conservation begins right from seedbed preparation. Although farmers practice many indigenous technologies relating to soil and water conservation, there is a lack of documentation for identifying the constraints for possible refinements. There exists a need to evaluate the potential indigenous practices in the regions for their improvement and dissemination to new areas. There is also a need for scientist-farmer interaction for large-scale adoption. The outcome of a study on ITKs relating to soil and water conservation is presented here for addressing the researchable issues for refinement and up-scaling the technologies.

Methodology

In order to obtain the feedback of the farmers regarding soil and water conservation measures the survey using developed proforma was initiated in treated and untreated villages in different agro-ecological regions through the project centers. Farmers' awareness and adoption of soil and water conservation practices was attempted in the study. The study was carried out in 18 centers of All India Coordinated Research Project on Dryland Agriculture (AICRPDA) including Hyderabad, which was the nodal center of the project. These centers cut across various states and various rainfall zones but all represent rainfed zones of the country. The process followed during documentation was as follows:

1. The ITK proformae consisting of general information of village, views and observations on soil & water conservation measures, in-situ moisture conservation practices, technical information on run-off management practices and Indigenous technical knowledge was developed.

2. The proformae for documenting ITKs on soil & water conservation and run-off management was finalized duly after getting the feed back from participants.

For the purpose of documentation and analysis of ITK, a simple ITK proforma was developed. This proforma contains Title, Purpose, Location, Ago ecological setting, Description, Advantages, Constraints, Replicability / Feasibility and Researchable issues. The researchable issues opens up new vistas for furthering the technologies towards development of farmer-friendly doable technologies. This is just an honest beginning of a validation process made by NATP, ICAR. Of the many available, a few ITKs could be documented in the limited time frame through the project centers located in various SAUs. There is a lot more to be done in this direction by the R&D and implementing agencies involved in the community development.

Documented ITKs

Some of the ITKs were documented under following specific categories as listed below.

a) Agronomic Measures

- Intercropping
- Cultivation and sowing across the slope
- Wider row spacing and deep interculturing
- Mixed cropping
- Cover cropping
- Criss –cross ploughing
- Hoeing with local hoes
- Set furrow cultivation
- Application of manure (FYM)
- Strip cropping
- Green capping
- Green manuring
- Pre-emergence soil stirring
- Ridge and furrow planting

b) Tillage

- Conservation furrows with traditional plough
- Deep pluoghing
- Summer ploughing/ Off-season tillage
- Repeated tillage during monsoon season

c) Bunding & Terracing (Mech. & Vegetative barrier)

- Vegetative barrier
- Stone bunding

- Nala check with soil filled in cement bags
- Compartmental bunding
- Peripheral bunding/ Field bunding
- Ipomea as vegetative barrier
- Cosnervation bench terrace
- Loose stone surplus
- Stabilization of field boundary bund with *Vitex negundo*
- Strengthening bunds by growing grasses
- Bund farming of pulse crops in *kharif* under rainfed situation
- Earthen bunds
- Stone-cum-earthen bunding
- Live bunding by raising Cactus
- Grass Plantation on field boundaries (filter strip)
- Growing of Saccharum munja as vegetative barrier on field boundaries

d) Land Configuration

- Use of indigenous plough for formation of broad bed & furrows
- Furrow opening in standing crops local implement hoe (Dawara) for moisture conservation
- Levelling the plots by local leveler
- Opening up set furrow
- Conservation furrow : *Gurr*

e) Soil Amendment / Mulching

- Application of tank silt
- Application of ground nut shells
- Sand mulching
- Gravel sand mulching
- Retention of pebbles on the soil surface
- Retention of sunflower stalks
- Mulching of *Sal leaf* in turmeric
- Crop residue application in the field

f) Erosion Control & Runoff Diversion Structures

- Sand bags as gully check
- Loose boulder checks
- Stone waste weir
- Waste weir (stone / sorghum stubbles) at the outlet of the field
- Brushwood structure across the bund
- Grassed waterways
- Spur structure
- Nala plugging

g) Water Harvesting, Seepage Control & Ground Water Recharge

- Seepage control by lining farm ponds with white soil
- Harvesting of seepage water
- Wells as runoff storage structures

- Rain water management using indigenous rain gauge (*Role*)
- Farm pond
- Percolation pond / tank
- Ground water recharging through ditches and percolation pits
- Well recharging through runoff collection pits
- Dug wells
- Haveli / Bharel system
- Bandh system of cultivation
- Earthen check dams
- Field water harvesting
- Nadi farming system
- Collection of sub-surface runoff water and recycling in Diara land
- Rain water harvesting from roof top and road surfaces
- Rain water harvesting in *Kund / Tanka*

Refinement of ITKs for Up-scaling the Technologies

Some potential ITKs identified for further study, research and development of new projects is presented in table 1.0. A scientific study may change this Indigenous Technical Knowledge to Modern Technical Knowledge (MTK). Prevailing ITKs should invariably be given priority. All the on going projects on resource conservation and management should focus on the viable and appropriate ITKs relating to soil & water for sustainable development and dissemination of the local technology.

As an initiative, the ITKs on S&WC for other agro climatic regions may be documented and later validated and refined at local level. This will form a programme by itself to popularize indigenous knowledge with the developmental agencies. Exposure visit and farmer-to-farmer interaction on the subject may be encouraged for better adoption. The ongoing watershed programme should adopt the ITKs on S&WC in their project activities. During the first phase planning the local technologies should be documented.

The stakeholders in the conservation programme who can be partners for promoting the ITKs are Farmers,NGOs,Government Agencies,Research Institutes / Scientists, Administrators, Policy makers / people's representatives.

The research findings may be disseminated through the extension agencies. The research results will benefit both farming community as well as the promoting agencies i.e. the Govt. or non-government organizations. Some of the researchable issues pertaining to some ITKs have been identified and presented in Table 1.

Conclusions

Many ITKs on in-situ soil and moisture conservation are not adopted everywhere throughout India because of constraints in adoption and unawareness of the effectiveness of such practices. The present documentation process has definite bearing on the future course of action in framing new projects. This short-term documentation project may lead to the following future activities:

- Similar exercise can be undertaken to document the ITKs from all the Agro-ecological regions of the country.
- The potential ITKs may be tested for their suitability and adoption in other Agro-ecological regions as a dissemination strategy.
- The documented ITKs may be published/translated in all regional languages for the benefit of the farming communities.
- Validation of the ITKs is a logical step to qualify and quantify the effectiveness of these practices. Suitable modifications of the traditional practices through on-farm research would help in developing appropriate and acceptable technologies for different local environments.
- The effect of conservation measures on resource losses can be studied in detail through experimentation and use of stimulation model.
- As a policy matter the local ITKs should be in built in the resource conservation programme.

To conclude, the documentation, refinement and promotion of ITKs should form the basis for implementing natural resource conservation technologies on watershed basis.

Table 1. Identification of researchable Issues of some selected ITKs

Name of ITK	Purpose	Researchable Issues
Furrow opening in standing crops	Rainwater conservation	▪ Modification of implement with different serrated blades and introducing additional tines ▪ Effectiveness in conserving soil moisture
Nadi farming system	To collect runoff during *kharif* for life saving irrigation during drought spell or pre sowing irrigation (*Palewa*) for *rabi* crops	▪ Documentation and analysis of socio-economic aspect of present *nadi* system for its sustainability ▪ Evaluation of present *nadi* farming system
Mixed pulses as vegetative barrier	Resource Conservation	▪ Proportion of pulses as vegetative barrier ▪ Cost effectiveness of the system
Stabilization of gullies using sand bags	Gully control and runoff management	▪ Soil conservation efficiency ▪ Strengthening of sand bags structure with different vegetative barriers
Application of white soil as lining material in farm pond	To work as a sealant material for lining dugout farm pond	▪ Standardization of application technique and economic feasibility for wider application ▪ Study on the seepage losses at different hydraulic heads
Wider row spacing in pearl millet	Rainwater conservation and weed control	▪ Plant geometry and population research in different rainfall situations
Rainwater harvesting in *kund/tanka*	The harvested water in kund / tanka is used for drinking and establishment of tree	▪ Research should be done on the use of stored water for arid horticulture ▪ Design of *tankas* for different geo hydrologic conditions
Crop stubbles and residue management	Improve the organic matter and water holding capacity of soil	▪ Quantification of soil and water conserved and yield advantage ▪ Better or improved implements for crop residue

Name of ITK	Purpose	Researchable Issues
		incorporation ▪ Alternate ways of composting and application
Brush wood waste weir	Safe disposal of excess runoff	▪ Design and stabilization of structure
Mulching in turmeric	To conserve rainwater	▪ Quantification of soil loss, improvement of soil quality and water availability ▪ Use of alternative organic material to *Sal* leaves as mulch
Indigenous stone / brush wood structure across the slope	To check soil loss	▪ Shape and size of brush wood structure depending on the runoff and site conditions
Agave sp. as vegetative barrier	To reduce runoff velocity and to increase infiltration opportunity time	▪ Different species of Agave can be evaluated ▪ Cost benefit analysis
Broad bed and furrow practice	To harvest rain water and dispose of runoff	▪ Width of broad bed needs to be evaluated for different crops and rainfall situations ▪ Identification of suitable low cost tractor/bullock drawn implement for layout of BBF
Water harvesting and recycling	Rain water harvesting	▪ Recharging of water table ▪ Cost effectiveness
Standardization of recharging technique	Augmentation of ground water	▪ Design of filter and improvement in filtering efficiency with better filtering material. ▪ Effect of geology/soil formation on recharge
Set-row cultivation	For harvesting rain water and maintaining soil structure	▪ Quantification of rainwater conservation and water use efficiency (WUE) of the crops ▪ Improvement in soil health and crop yield over years
Summer / pre monsoon tillage	Conservation tillage-to harvest early showers, facilitate timely seeding and weed control	▪ Identification of appropriate tillage implements for soil and water conservation ▪ Evaluation of root: shoot ratio and quantification of WUE of crops
Ridge & furrow planting for modulation of overland flow	Conservation of rain water, modulating excess water, control soil loss and boosting productivity	▪ Fabrication and development of ridge former accommodating required row spacings and ridge cross- section
Formation of *Gurr*	Reduction of runoff and soil moisture conservation	▪ Effect of bullock and tractor made *Gurr* on runoff reduction, soil water conservation and crop productivity
Green manuring practice	To conserve soil water and improve soil health	▪ Growing of green manure crop and its management in improving soil health and crop productivity ▪ Economic evaluation of the system by addressing sustainability issues

Name of ITK	Purpose	Researchable Issues
Application of tank silt	To increase the fertility and water holding capacity of soil	▪ Method and quantity of tank silt application in different soils ▪ Improvement in soil water and fertility with tank silt application and its effect on crop productivity ▪ Cost effectiveness of silt application especially with Government programme of tank desiltation.

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