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Research Article

A STUDY ON INDIGENOUS TECHNICAL KNOWLEDGE ABOUT SOIL AND WATER CONSERVATION IN NORTHERN HILL REGION OF CHHATTISGARH

Sinha B.L., *Jitendra Sinha and Kerketta A.K.
Department of Agricultural Engineering, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) - 492 012
**Author for Correspondence*

ABSTRACT
A study was conducted to survey and identify indigenous soil and water conservation practices prevalent at ambikapur block of sarguja district in northern hill region of chhattisgarh during 2012-13. Study revealed that with the help of long historical knowledge, traditions and experiences farmers have been developed indigenous practices for soil and water conservation. The most common practices followed by farmers are farm pond, well, fencing trench as recharging trench, brush wood structure, peripheral stone bunding, sand bag structure, borrow pit, dhodhi, fym pit, field earthen bund, tank silt application, deep ploughing, vegetative barrier, biasi and utera. These indigenous techniques of soil and water conservation are mostly individually managed. Presently the adoption percentages of these itk are low i.e. 20-30% except 60% in summer ploughing and field boundary bunding due to unawareness, non availability of suitable implement and financial difficulty. By the improvement in existing technology, these practices may be more adoptable among the farmers.

Keywords: *Indigenous Technical Knowledge, Soil Water Conservation, Farm Pond, Trench, Bunding, Chhattisgarh*

INTRODUCTION
Over a millennium indigenous people of Chhattisgarh have evolved a large number of practices locally called Indigenous Technical Knowledge (ITK) relating to soil and water conservation suitable for different agro-climatic conditions of the state. Rainfed areas of the state have high rural population with a high concentration of poverty stricken community. In this context, precision agriculture is needed to boost the agricultural production in a more scientific way with farmer's participation on watershed basis constitutes the key to agricultural development of rainfed areas. Conservation of land and water not only controls land degradation but also can lead to sustain productivity. Rainfed areas are mostly characterized with high intensity, short duration and erratic rainfall causing unpredictable droughts and floods. Conservation of this scares resources through improved soil and water conservation technology therefore hardly needs emphasis. Before considering the improved system of soil and water conservation, there is need to document indigenous methods of moisture conservation, water harvesting, storage and seepage control techniques vis-à-vis the land productivity because of its equally effective, locally available, relatively cheap and less destructive to local environments. Understanding the strength and weakness of the indigenous conservation practices which have stood the test of time could perhaps give useful clues in evolving land and water management strategies for sustainable agricultural development of a region. Mishra *et al.*, (2002 & 2007) and Nema et *al.*, (2005) conducted study on rainwater management for dryland areas .Considering the above facts, a study was under taken to survey and identify indigenous soil and water conservation practices prevalent in different agro-climatic zones of Chhattisgarh during 2012-13. The study was conducted at Ambikapur block of Sarguja District in Northern hill region of Chhattisgarh.

MATERIALS AND METHODS
Methodology
The study was conducted in the year 2012. All the field work was completed from July 2012 to October, 2012. For collecting information on indigenous technical knowledge (ITK) based technologies, the field

surveys were conducted in the rural areas of Surguja district belonging to the northern hill region of Chhattisgarh state. For the survey, the Panchayat Pradhan and farmers were contacted and information about the ITKs, which are being adopted, was collected. A pre-designed proforma was used for documentation and analysis of different indigenous practices on soil and water conservation. Field survey was done for verification. The whole information was subsequently compiled and is presented.

RESULTS AND DISCUSSION

Results

ITKs differ widely from one country to another, from one region to another, and even from one place to another in the same region due to their uniqueness to a particular culture and agro ecosystem. Some common important ITKs in field of soil and water conservation being used by the farmers of the study area are presented in Table 1 and details are described as under.

Farm Pond

Medium category farmers on individual basis practice this ITK. This has been evolved by experience of farmers and is an age-old practice (Plate 1). About 10 % of the farmers are adopting this practice in the village. In this ITK, farm pond is constructed at lower gradient of the field in order to catch the runoff water from the higher gradient. No special implement is needed to dig the farm pond. Usually low land of farm or depressed portion is used for construction of farm pond to avoid expenses on depth. This practice helps to increase the ground water level, further downstream. The yield of bore well has increased during summer season for growing crops. This practice is technically feasible and socially acceptable. This practice can be adopted in a big way to get additional income during rabi season.

Well

This is practiced by all categories of farmers on individual basis. It is an age-old practice and about 10 - 20 % of the farmers of the Village follow this (Plate 2). In this system 2 - 5 m diameter well is dug manually. The depth of the well varies from 5 - 12 m depending on the availability of groundwater in the shallow aquifer. The wall of the well is pitched 'by setting foundation stone up to a height of 1 m above the ground level. The water lifting system is installed in the well. This practice requires improvement as the adoptability is very good and the users take water from the wells either manually, mechanically or by electric pumps or motors for domestic use and irrigation. This is socially acceptable.

Fencing Trench as Recharging Trench

This is an age-old practice usually adopted at those areas where forests are very close (Plate 3). This ITK practiced individually as well as by forest department according to their purpose. These trenches are constructed as that the commonly cattle's as well as wild animals cannot jump the distance and field may keep protected from intruders.

Brushwood Structure

The district of Surguja comes under the Northern Hills zone where the land slope varies from 2 to 20 %. The cultivated areas in the hill base end with abrupt fall. Heavy showers with high intensity occur sometime causing high runoff. Runoff water flows downward with a high velocity. It is a usual practice with the farmers to control the movement and quantity of runoff water by constructing low cost brush wood structures in series along the drainage lines or in their field bunds to remove excess rainwater (Plate 4). The structure consists of locally available wood logs. The loose boulders are packed in between two rows of wooden barrier and runoff water flows through the structure with non erosive velocity. The family labors are utilized to construct these structures. Locally available boulders are collected from the nearby stream beds for use in the structure. These are temporary structures and last for 2 - 3 years depending on the quality of logs.

Peripheral Stone Bunding

This ITK is practiced by small and medium farmers on individual basis (Plate 5). It has been evolved out of the experience of the farmers and has been in practice for the last 80 years. It is practiced in 5 -10 % of the area. In this, stones are piled up to 1 m height. The bunds can be made by the farmers themselves or by engaging skilled labour during the off-season. These bunds are maintained by replacing the damaged

layers with available stones. This ITK can be adopted in a big way if stones are available nearby in plenty.

Sand Bag Structure

In this ITK, sand bag structures are constructed when field buds are broken/damaged during peak flow across the drainage line of field with cement bags filled with soil/sand to check the flow of water and to strengthen the bund (Plate 6). The runoff water is stored or checks without much seepage loss and stored water is utilized for growing of paddy. This is practiced on individual basis. It was evolved from the creativity and experience of the farmers of the village. It is easy to construct.

Borrow Pit

This ITK is by product of farmers. This has been evolved by experience of farmers and is being practiced for last several years. About 100 % of the farmers are adopting this practice in the village where mud house exists. In this ITK, pit is dug to excavate the soil or earth for making mud house and pit is abandon (Plate 7). There is no specific size of pit. Therefore this practice helps to increase the ground water level as it work as percolation pit. This practice can be technically feasible and socially acceptable.

Dhodhi

Farmers of Lalmati village in Ambikapur block harvest seepage water of canal by constructing dhodhi (well like structure) which is used for daily purpose. This structure is found in low land area. The farmer made square / circular shaped ditch at lower level part of the land to harvest seepage water to the ditch. Dhodhi is made very similar to the well, internal wall is made by stone/boulder/wood and upper portion by cement lining as well as woods are placed around the Dhodhi wall (Plate 8). Size of Dhodhi usually kept 1.5x1.5x2 meter. This practice is usually individual as well as by gram panchayat level constructed.

FYM Pit

Generally farmers of the area apply the FYM to the field in summer season and pits remain empty (Plate 9) .The pits are filled with runoff water in pre monsoon season. The water from the pits percolates down through soil and augmented the ground water. This is an old age practice. This practice can be extended to all categories of farmers by providing technical guidelines and financial support.

Field Bund

This ITK is adopted by all types of farmer on individual basis. This is an old age practice and has been evolved from experience of storing the water for paddy crops in *kharif* season. The practice consists of earthen bunds which are constructed manually by spade and kudali to impound runoff water in rainy season. The impounding of water during growing of paddy crops help in augmentation of ground water (Plate 10). These bunds are covered with local grasses. These grasses regenerate naturally. The pigeon pea and sesame are also grown in bund to gain extra income as well as strengthen the bund. This practice is cost effective and technically feasible as well as socially acceptable.

Tank Silt Application

This ITK is practiced by small and medium category farmers on individual basis. This concept is carried from generation to generation (Plate 11).

In this practiced, tank silt is transported by desilting the tank. The silt is applied over the filled to a depth of 10 cm and then thoroughly mixed with soil manually.

After 10-15 days ploughing is done before sowing seed. This practice helps in increasing the moisture holding capacity as well as crop yield. This ITK can be widely adopted if the tank silt is available nearer to fields that reduces the transports cost. This practice is cost effective, technically feasible and socially acceptable.

Deep Ploughing

This is practiced by all categories of farmers on individual basis (Plate 12). This practice has been evolved by observation and is followed for last 100 years. This is practiced after harvesting of kharif crop with the help of bullock drawn or tractor drawn plough (Deshi and M.B plough). Presently, government and other development elegancies are also recommending M.B. plough for deep ploughing as it pulverizes soil to a greater extent and helps in water conservation. It is also socially acceptable but it increases the cost of cultivation. Deep ploughing should be done once in 2-3 years.

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Vegetative Barrier

This ITK is practiced by all categories of farmers on individual basis (Plate 13). This is evolved by experience and is in place for last 50 years. About 5 % of the area is covered under this practice. In this practice, *Ipomea* (Beshram), Sindhwar and Bamboo are planted thickly in two rows on bund costing about Rs. 1000 ha^{-1}. This practice helps in reducing fertile soil loss. It also stabilizes bunds. Beshram, Sindhwar and Bamboo are freely available and requires regular cutting as a part of maintenance.

Biasi

This ITK is practiced by all categories of farmers on individual basis. This is an age old practice. The area covered under this practice is 90 to 95%. In this method, furrows of depth ranging from 15 to 20cm are opened (when the crop is 30-40 days old) with animal drawn indigenous (desi) plough (Plate 14). This operation helps to maintain plant population, to reduce weed infestation by uprooting and buried into the soil, this will also help in increase to prevent leaching, to induce tillering and to increase organic content. The area of coverage is about 0.5 ha/day. The cost of ploughing operation is Rs. 400 to 500/ha.

Utera

Utera cropping literally refers to "sowing of the next crop seeds before harvesting 15 days of standing paddy crop in order to utilize residual moisture efficiently" under rainfed agro-ecosystem. Utera cropping is only adopted in Rabi season (Plate 15). This system helps farmers to use the available moisture in rainfed areas and diversify the next cropping system by incorporating two or three pulse and cereal crops to reduce crop failure risks. For a successful Utera cropping system, seeds of the local pea, linseed, local variety of black gram, and lathyrus (lentil, *Lathyrus sativus*) are sown. In the paddy crop field, most of the paddy cropping area is done in a micro-environment by conserving water from natural resources. Just before the 15 days of harvesting of the paddy crop, the seeds of the above-mentioned crops are broadcasted. The environmental and economic sustainability of the Utera cropping system is assured by compatible ecological conditions and harvesting more than one crop at a time, without applying additional external inputs.

Discussion

Farm Pond

Replicability/Feasibility: Scientific study is required for accessing the runoff and the recharge potential of the area for designing of the farm pond.

Researchable/issues*:* The recharge through pond and water use through wells should be scientifically integrated Social research is needed for equitable distribution of water in watershed perspective.

Constraints: (1) Siltation of tank (2) Repair of bund around the pond.

Well

Replicability/Feasibility: Feasible to adopt throughout the country in areas where water table is available up to 15 m.

Researchable/issues*:* (1) sustainable use of stored water. (2) Reducing the cost of construction

Constraints: Feasible to adopt throughout the country in areas where water table is available up to 15 m.

Fencing Trench as Recharging Trench

Replicability/Feasibility: It can be replicated in all location.

Researchable/issues*:* Size and location of trench can be considered according to topographic condition of particular area.

Constraints: Care is needed to don't let to fill the trench.

Brushwood Structure

Replicability/Feasibility: In sloping hilly areas with good forest.

Researchable/issues*:* Shape and size of brushwood structure depending on the runoff and site condition.

Constraints: Availability of brushwood in large quantity as trees are cut for this purpose.

Peripheral Stone Bunding

Replicability/Feasibility: Wherever the land is undulating and having slope more than 2%.

Researchable/issues*:* Soil and water conservation efficiency in terms of reduction of soil and water loss.

Constraints: Availability of stones in large quantity.

Sand Bag Structure
Replicability/Feasibility: All location having similar situation
Researchable/issues*:* (1) Further research needed to develop proper structural design for construction of embankment with known runoff yield from the catchment.
Constraints: **(**1) Non-availability of raw material. (2) Location specific.
Borrow Pit
Replicability/Feasibility: Scientific study is required for accessing the runoff and the recharge potential of the area for randomly formed pit.
Researchable/issues*:* (1) The recharge through pit and water use through pit should be scientifically integrated. (2) Social research is needed for equitable distribution of water in watershed.
Constraints: Siltation
Dhodhi
Replicability/Feasibility: It can be adopted anywhere where seepage is excessive and the geological formation is favorable for local harvesting of seepage water.
Researchable/issues*:* (1) Design of suitable filter. (2) Study on cost and benefit ratio of this system. (3) To study the type of formation for this type of structure.
Constraints: Usually far away from residential location for daily use purpose.
FYM Pit
Replicability/Feasibility: Generally all categories of farmers are adopted.
Researchable/issues*:* Estimation of groundwater augmentation.
Constraints: Encroachment of land

Table 1: Details of commonly used ITKs in different Agro ecology region of Chhattisgarh

S.N.	Name of ITK	Purpose
1.	Farm pond	To store water in the pond for ground water recharge and / or supplemental irrigation
2.	Well	Domestic and agricultural uses, and ground water recharging
3.	Fencing trench as recharging trench	To protect field from intruders. To hold rain water which conserve soil and water.
4.	Brush wood structure	To check soil loss
5.	Peripheral stone bunding	Soil conservation and runoff management
6.	Sand bag structure as waste weir	Soil and water conservation Safe disposal of runoff and strengthen bund
7.	Borrow pit	To store rain water and To recharge ground water.
8.	*Dhodhi*	Harvesting of seepage water.
9.	FYM Pit	To increase the ground water level
10.	Field bund	To harvest rainwater and conserve soil
11.	Tank silt application	To increase the fertility and moisture holding capacity of soil
12.	Deep ploughing	To break down the hard pan and improve water infiltration and conserve soil and water
13.	Vegetative barrier	To check soil loss, as well as protection against animals
14.	Biasi	To maintain plant population •To reduce leaching To reduce weed infestation
15.	*Utera*	To utilize the residual moisture of kharif season

1. Pond **2. Well** **3. Fencing trench**

4. Brush wood structure **5. Peripheral stone bunding** **6. Sandy bag structure**

7. Borrow pit **8. Dhodi** **9. FYM pit**

10. Field bund **11. Tank silt application** **12. Deep ploughing**

13. Vegetative fencing **14. Biasi** **15. Utera**

Plate 1-15: Various ITKs in the study area

Field Bund

Replicability/Feasibility: This is a most feasible technique of effective use of rain water for paddy based cropping system in the region. This can be adopted in other places.

Researchable/issues*:* Identifying economical cross section of bund commensurating with catchment area. Quantify the augmentation of ground water.
Constraints: Wastage of land in bunding, needs regular maintenance

Tank Silt Application

Replicability/Feasibility: This can be followed in the area where soil is infertile and tank is available nearby.
Researchable/issues*:* Quantification of improvement in soil quality over years and its effect
Constraints: (1) Lack of awareness and community effort. (2) High cost of transportation.

Deep Ploughing

Replicability/Feasibility: This can be replicated in areas specified as above. In case of non-availability of MB plough, Chisel plough can be used.
Researchable/issues*:* Quantification of water infiltration Schedule of deep ploughing should be worked out to reduce the recurring cost.
Constraints: Higher cost of operation.

Vegetative Barrier

Replicability/Feasibility: This can be practiced irrespective of soil types and place with proper management.
Researchable/issues*:* (1) Quantification of soil loss and moisture conservation. (2) Suitability of Sindhwar as a green manure cum vegetative barrier and Comparison with other Vegetative barrier.
Constraints: Regular pruning of Beshram, Sindhwar are required to control spreading to other fields as weed.

Biasi

Replicability/Feasibility: This can be replicated in other places.

Researchable/issues*:* (1) Implements can be devised to improve the area of coverage per day.

Constraints: Availability of animal power is scarce.

Utera

Replicability/Feasibility: This technology can be extended throughout the country.

Researchable/issues*:* Suitability of other crop except Leguminous.

Constraints: (1) During broadcasting shattering of kernels is serious problems due to walking of farmers on field. (2) Weed density increases in rabi seasons. (3) Not suitable for water logging area and bhataland

Conclusion

Overall it was noted that the all ITK method exists in the study area for moisture conservation and rainwater management and soil conservation were found to be excellent method. Many ITKs on *in-situ* soil and water conservation are not adopted everywhere throughout Chhattisgarh because of constraints in unawareness of the effectiveness of such practices, and difficulty in finance the adoption percentage of these ITKs are comparatively less. Integration of modern scientific knowledge, proven eco-friendly techniques of moisture conservation utilization of naturally available material and implements can made existing ITK economically viable. The present documentation process has definite bearing on the future course of action in farming new projects. The added advantages will include reduction in soil erosion and increase in ground water level.

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

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REFERENCES

Mishra PK (2002). *Indigeneous Technical Knowledge on Soil and Water Conservation in Semiarid India,* edited by Mishra PK, Sastry G, Osman M, Maruthi Sankar GR and Babjee Rao N. NATP, CRIDA, Hyderabad 151.

Mishra PK, Sastry G, Osman M, BabjeeRao N and Maruthi Sankar GR (2002). Dividends from Soil and Water Conservation Practices (A Brief Review of Work done in Rainfed Eco-Regions), NATP, CRIDA, Hyderabad 40.

Mishra PK (2007). Indigenous Technical Knowledge (ITK) on Soil and Water Conservation in Rainfed Areas. *Ecology, Environment and Conservation* **13**(4) 207-215.

Nema AK, Sinha BL, Singh SP and Chauhan SPS (2005). Indigenous Technology of in-situ moisture conservation and runoff management in South- Western part of Uttar Pradesh, *National Conference on WAMSP, G.B.P.U.A. & T. Pantnagar* 19-21.