

TRADITIONAL KNOWLEDGE FOR SOIL MANAGEMENT INDIA

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ABSTRACT

Ever since agriculture started, the agricultural practices started evolving as per the requirements faced by the communities. Many traditional farmers in the developing world are still practicing farming methods that are sustainable and highly efficient. When local knowledge and practices developed over centuries are shared in farmers' groups who work on the land together, it clearly supports sustainable agro-ecosystem management in the region. In India, farmers have developed traditional calendars to control the scheduling of agricultural activities. Some ancient farmers developed sustainable agriculture practices that allowed them to produce food and fiber for thousands of years with few outside inputs. These practices need to be understood particularly for those practices, which are beneficial for their integration in the modern day agriculture.

KEYWORDS: Soil Management, Traditional Knowledge

INTRODUCTION

Agriculture is a dominant mode of support for human societies. Those who adopted it, have survived and increased, and passed their techniques of production to the next generation. This transformation of knowledge was the base of further development in agriculture. No aspects of agro-ecosystem management are more important to long term agro-ecosystem sustainability than those involving the soil. It is significant that traditional soil management does not depend on manufactured fertilizer inputs. Krishi Parashara (C.400 BC), Parashara stressed Soil Management "Farms yield gold if properly managed but lead to poverty if neglected". He also emphasized "Crop grown without manure will not give yield". Krishi Gita (C 1500 AD), Parasharama recommended deep summer ploughing this has been in practice in Kerala for several centuries and green manuring was recommended for rice[3], India has twenty eight states wherein more than 60 per cent of population depends on agriculture. India has immense traditional knowledge which is being practiced in farming particularly for soil management. Since traditional knowledge is getting obsolete with introduction of modern agricultural practices, this is an attempt to bring all indigenous practices prevailing in different states of India under one roof.

OBJECTIVE

To study most of the indigenous practices prevailing for soil management in different states of India which have scientific rationale from the point of view of agricultural productivity and sustainability.

METHODS

India being seventh-largest country in the world and is endowed with abundant sunshine, water resources, climatic, physiographic and a wide variety of soil types to support diverse agricultural crops. The Indian Council of Agricultural Research (ICAR) has made an authentic and standardized classification of soils and divided the soils of India into the following 8 groups: Alluvial soils, Black soils, Red and Yellow soils, Laterite soils, Arid soils, Saline soils, Peaty and Organic soils, and Forest soils. Different kinds of soils in India indicate that the soil diversity is quite large because of

variability of several factors of soil formation. Farmers need to protect the soil from a number of possible threats - such as erosion, organic matter decline, compaction and contamination. Local people, including farmers, landless labourers, women, and rural are the custodians of rich indigenous knowledge systems. Over centuries, indigenous people have learnt to utilise land and soil for agriculture in a sustainable manner through traditional knowledge. The paper enlists and discusses group held knowledge, as collected through a survey undertaken among indigenous farmers from different part of the country as well as research publications.

SOIL MANAGEMENT PRACTICES FOLLOWED IN DIFFERENT PART OF INDIA

Traditional Knowledge of Soil Management in North Eastern States of India

Some of the techniques developed traditionally in the region are the zabo system of terrace farming (figure 1) in Nagaland [2], [4], bench terracing cultivation in sikkim and Panikheti in Nagaland: bamboo drip irrigation system of jowai in Meghalaya [6]; and the sustainable land and water management system practiced by Apatanis in Arunachal Pradesh [1]. The terraces are quite broad, perfectly leveled and provide with strong bunds (risers). These risers are made of soil and supported by flattened wooden clips fixed at the base. Bamboo or boulder support is provided if the riser is tall or if there are chances of erosion due to runoff. All terraces are provided with inlet and outlet pipes for proper water management.

The risers are used for finger millet cultivation. Although the yield of finger millet on risers is low to average, it checks weed growth and act as a binding material for Soil on risers. Apatanis do not use any chemical fertilizer in their wet terraces. Nutrient and fertility management of the terraces is done mainly by recycling agricultural wastes. All types of biomass from the rice field, cattle yards, poultry houses, domestic waste, and leaves collected from the adjoining jungles are recycled in order to replenish humus and nutrient in the soil.

The paddy straw, approximately 4-5 t ha⁻¹, is allowed to decompose in the wet terraces and finally incorporated at the times of land preparation. After the rice crop is harvested, cattle are allowed free grazing in the fields from December to February and thus the cow dung is also recycled. Thus, the entire hills, surrounding valleys, and uplands around the villages are conserved as forests even today. Soil erosion, silting of rivers, drying of the water sources, and loss of nutrients, loss of flora, fauna, and forest resources are negligible in this plateau.

Traditional Knowledge of Soil Management in Andhra Pradesh

In earlier days, problem of insect pests and diseases were less pronounced. Fertilizer is being used in the past few years only. Earlier, farm-yard manure (FYM), and green manure from plants such as kanuga (*Pongamia pinnate* (L) Merr.), vempali (*Tephrosia purpurea* Pers.), and jilledu (*Calotropis gigantea* (L) R.Br.) were used in paddy fields. Nevertheless, the same are being used even now by a majority of farmers. There is considerable reduction in the application of FYM on Dryland [5] which is affecting soil health adversely.

Traditional Knowledge in Sorghum Cultivation in Madhya Pradesh for Soil Management

- Application of bone powder (bone meal) Supplements phosphorus % calcium to soil (The animal bones are buried in the basin area of the plants to improve 'P' availability.)

- Mixings of urea and neem powder to increase the effacing of urea
- Application of Neem cake during ploughing to kill insects.
- Use of bukhar for moisture conservation
- Application of pond mud in the field. (It brings silt along with nutrients brought from the catchments area.)

Soil Conservation and Management in Jharkhand

- For direct seeded rice, cow dung is powdered and mineral thoroughly with the soil after broadcasting of rice seeds & then planking with wooden log is done. This helps in faster mineralization of nitrogen and improves WHC.
- Small rain water harvesting structure (< .2 ha) called Doba with 4.5m³ capacity has been used for conservation and harvesting the rain water before the onset of monsoon, lined with black polythene Sheet. Finally in October it is thatched by Hogla (Types elephantine). At fortnightly neem/karanj oil is poured to check evaporation. At one place Doba stands for 3-years.
- Grass waterways to check Soil erosion (1m width .5-.7m depth.).
- Planking in standing wheat crop at CRI stage with desi plough for soil compaction in increase the capacity rice in rainfed wheat.

Bun Cultivation Meghalaya (North East)

- Bench terraces are constructed on hill slopes running across the slopes. The vertical b/w the terraces is not usually more than a metre. It prevents soil erosion and retain maximum rain water within the slopes and safely disposing off the excess runoff from the slopes to foothills
- In Agriculture fields soil erosion is minimized through traditional methods such as using bamboo, stones and gunny bags filled with soils.

Lanual Spriti & Kinnaur of Himachal Pradesh

Mixing of ash with household waste and cattle/ human excreta helps in weed control, surface soil crust breaking rain water conservation. It is also used for nutrient availability & recycling.

Table 1: Indigenous Practices followed for Soil Conservation and Management in Different States of India

| S No. | Indigenous Practices | Purpose/Benefit | Crops/Plants Grown | State Where Followed |
|-------|---|---|--|-------------------------------------|
| 1 | Spur structure | Protection of crop land from erosion by diverting the run off. | | Jharkhand |
| 2 | Mixed intercropping as vegetative barrier | Run off management. | Groundnut, pigeonpea and pulses | Andhra Pradesh |
| 3 | Relay cropping | Reduction in runoff and better utilization of soil moisture. | Onion-rabi sorghum or chick pea | Karnataka |
| 4 | Vegetative fencing/barrier | Reduce water runoff and velocity and to increase in infiltration opportunity time | Kiluvai (Blasmo Dendron verii) and Agave | Karnataka |
| 5 | Mixed cropping (Mishrabele paddati) | Reduction in runoff and better utilization of soil moisture. | Onion+chilli+cotton | Karnataka |
| 6 | Pre-emergence soil stirring | Removal of weeds, loosen the soil for conserving moistures. | | Uttar Pradesh |
| 7 | Compartmental bunding; Loose boulder checks; Peripheral stone bunding; Strengthening bunds by growing local grasses and Field bunding | Soil conservation and runoff management. | | Andhra Pradesh, Orissa, Maharashtra |

Table 1: Contd.,

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|----|--|--|---|---|
| 8 | Bunds protected with vegetal cover | Protection and Strengthening of earthen bunds and to reduce soil erosion and runoff losses | | Gujarat |
| 9 | Bandh system of cultivation | Harvest runoff for assured rabi crops in rainfed areas; | | Madhya Pradesh |
| 10 | Live bunding | Reduce runoff and check soil erosion. | By raising cactus | Uttar Pradesh |
| 11 | Cross ploughing | Check run off and soil loss. | | Uttar Pradesh |
| 12 | Mixed cropping | Run off management and better utilization of soil moisture | | Uttar Pradesh |
| 13 | Green capping | Reduce soil erosion and velocity of runoff and to increase time of concentration. | | Madhya Pradesh |
| 14 | Stabilization of field boundary bund; plantation of grasses on field bound; stabilization of field boundary bund | Reduce runoff and soil loss. | With Vitex negundo (Nirgundi) With Agave spp. | Maharashtra |
| 15 | Peripheral bunding; Use of stone and bags; Vegetative barrier across gullies | Gully control and runoff management | Agave spp, Ipomea | Andhra Pradesh, Karnataka |
| 16 | Nala plugging | Control of flow of water in nalas (gullies area, carrying water) to minimize further development of gully and lateral recharge of water. | | Uttar Pradesh |
| 17 | Conservation furrows with traditional plough (Oodu ulavu); Intercropping Wider row spacing, deep interculturing; Tank silt application | In situ moisture Conservation. | Groudnut+ pigeon pea | Karnataka, Andhra Pradesh, Orrisa |
| 18 | Wider row spacing | Sustain crop production during deficit rainfall by moisture conservation, weed control and increase aeration. | | Gujarat |
| 19 | Repeated tillage during monsoon season | Soil moisture conservation for sowing of winter crops. | | Haryana |
| 20 | Crop residue in the field | Prevent sheet erosion and increase in-situ conservation. | | Gujarat |
| 21 | Application of groundnut shells by mulching and incorporation; Ploughing across the slopes; Planting of potato across the slopes; Strengthening of bund; Levelling the plot by local leveler; Furrow opening in standing crops with local implement hoe (Dawara); Haveli/ Bharel system by impounding rain water in Kharif and taking Rabi crops on conserved moisture; Mulching during Rabi in sugar cane fields; Off season tillage; Mulching with sal leaf in turmeric; Collecting the silt from the foot hills and reusing in the fields, lands preparation with harrow (Kullav) to loosen hoes in Kharif and Rabi crops, Inter culturing operation (Aantar khed) | Moisture conservation. | | Andhra Pradesh, Orrisa, Maharashtra ,Karnataka ,Gujarat, Haryana, Uttar Pradesh |
| 22 | Ploughing/ deep ploughing | Harvest early showers. | | Maharashtra |
| 23 | Field boundry bund | Harvest rainwater and conserve soil. | | Uttar Pradesh |
| 24 | Inter culturing (Hoeing) and earthening in standing crop | Harvesting rain water and to provide soil mulch and for easy penetration of pegs of groundnut in the soil. | | Gujarat |
| 25 | Sand mulching, cultivation; Stone bunding; Murrum bunding and conservation of bench terrace; Deep ploughing and gravel sand mulching; Retention of pebbles on the soil surface and retention of sun flower stalks; Planting of sweet potato along the ridges; Bunding/ Bandhan making/pal making and strip cropping; Stone cum earthen bunding; Stone cum vegetative bunding and stone bunding; Grass plantation on field boundaries; Strengthening bunds by growing local grasses; cover cropping; surplus waste weir at the outlet of the field; Kris cross ploughing; Earthen bunds (Kuchha pala) | Soil and moisture conservation. | | Andhra Pradesh, Orrisa, Maharashtra ,Karnataka ,Gujarat, Jharkhand, Uttar Pradesh |
| 26 | Stabilized grassed waterways | Soil, plant nutrients, and water conservation and land degradation control. | | Jharkhand |

Table 1: Contd.,

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|----|--|---|--|----------------|
| 27 | Line sowing behind the plough | Soil and water conservation and better utilization of soil moisture and reduction in cost of inter cultural operation. | | Orissa |
| 28 | Vegetative barrier supported with small section bund | Soil moisture conservation and to avoid encroachment by wild animals. | | Uttar Pradesh |
| 29 | Small cross sections earthen bund across slope | Reducing slope length and to increase of infiltration opportunity time for in-situ moisture conservation and minimizing erosion. | | Uttar Pradesh |
| 30 | Summer ploughing | Conservation of early showers from tillage to harvest, facilitating timely seeding | | Uttar Pradesh |
| 31 | Contour cultivation (operation across slope) | Elimination slope length, creating barriers for water flow, enhancing soil moisture status. | | Uttar Pradesh |
| 32 | Ridge and furrow planting | Conservation of rain water, modulating excess water, control soil loss and boosting productivity. | | Uttar Pradesh |
| 33 | Negative barriers (Munj and Khus) on field boundaries | Soil moisture conservation and save the crop from wild animals. | | Uttar Pradesh |
| 34 | Conservation furrow (Gurr) | Reduction of runoff and soil moisture conservation. | | Uttar Pradesh |
| 35 | Mixed cropping | Soil moisture conservation, increase of productivity of soil and ensure the production of at least one crop. | Pearl millet +green gram(4 kg/ha +5 kg/ha), pigeon pea+black gram(3 to 9 kg/ha +5-6 kg/ha); Pigeon pea +cluster bean (4 kg/ha+6 kg/ha) and chick pea + mustard (60-65 kg/ha+ 3 to 3.5 kg/ha) | Uttar Pradesh |
| 36 | Loose stone surplus bund | Prevent loss of fertile soil and riling of cultivated land | | Andhra Pradesh |
| 37 | Brush wood structures across the bund | Check soil loss | | Orrisa |
| 38 | Application of tank silt | Improvement of nutrient, status of soil, improvement in soil moisture holding capacity of amended soil and enhancement in water storage capacity of tank. | | Madhya Pradesh |
| 39 | Green manuring with sun hemp; sesbania and cowpea | Improve organic matter for soil fertility improvement, weed control, soil and water conservation. | | Madhya Pradesh |
| 40 | Growing of vegetative barrier on field boundaries | Check soil loss by wind erosion | Saccharum munja | Haryana |
| 41 | Green manuring | Increase soil fertility. | | Uttar Pradesh |
| 42 | Bund farming of pulse crops in kharif under rain fed situation | Enhancement of income per unit area. | Pigeon pea,(Black gram) | Orrisa |
| 43 | Crop stubbles/residue management | Improve organic matter in soil and to improve water holding capacity of soil. | | Madhya Pradesh |
| 44 | Inter row cropping | Increase the moisture use efficiency, risk coverage due to failure of any of the moisture availability period especially on medium deep soil. | | Madhya Pradesh |
| 45 | Mixed cropping | Better utilization of soil moisture and reducing the risk of crop failure. | Pearl/ millet, guar and green gram | Haryana |
| 46 | Deep ploughing | Break down the hard pan and improve water infiltration. | | Gujarat |
| 47 | Planting trees | Reduce salinity of soil. | Acacia sp. | Uttar Pradesh |

Source: As in [7]

CONCLUSIONS

Traditional knowledge of a community in a particular region is derived from the local people's farming experience and is handed down from generation to generation. Traditional agricultural practices have scientific rationale from the point of view of agricultural productivity and sustainability.

These practices need to be understood particularly for those practices, which are beneficial for their integration in the modern day agriculture.

REFERENCES

1. Chaudhary, R. G., Dwivedi, R.N., Prasad, R.N., and Dutta,K.K. Research needs for land and water management for enhancing agriculture production in Arunachal Pradesh. In: proceeding of the workshop on Research Needs on land and water Management for enhancing Agriculture production in Eastern Region. Water Technology center for eastern region, bhubaneshwar, Orissa, India, 93-120. 1990.
2. Gokhle,A.M., Zeliang, D.K., Kevichusa, R.,Angami, T., and Bendangnungsang, S.The use of Alder Trees. State council of Education Research & training, Education Department Government of Nagaland, Kohima, Nagaland, Indian,20. 1985.
3. Nene, Y. L., Indegenous knowledge in conservation Agriculture. Asia Agri-History, 3 (4), 321-326. 2009.
4. Prasad,R.N. and Sharma,U.C. Potential indigenous Farming system of North Eastern Hill Region. ICAR Research Complex for NEH Region. Barapani, Meghalaya, India.56.1994.
5. Padmaiah, M. Past and present Experiences of an Elderly Farmer in Andhra Pradesh. Asia Agri-History, 5 (1), 211. 2001.
6. Singh, A., Bamboo Drip Irrigation system, ICAR Research complex for NEH Region. Barapani, Meghalaya, India. 20.1989.
7. S.K Srivastava and Hema Pandey Traditional Knowledge for Agro-ecosystem Management, Indian Journal of Traditional Knowledge, 5 (1), 122-131. Jan 2006.

APPENDICES



Figure 1: Zabo System of Terrace Farming, Nagaland