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Review of indigenous technology knowledge on soil and water conservation

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Abstract
Indigenous Technological Knowledge (ITK) is an integral part of the culture and history of a local community. It is knowledge handed down from one generation to next generation through oral communication which suggests a way of common or communal ownership. It's the systematic body of data acquired by local people through the experience, informal experiment and intimate understanding of local conditions and provides a productive context for activities designed to assist the communities. The present paper focuses on the collection and review of the ITKs in the field of soil and water conservation in Bagalkote district. The dry belt of Bagalkote district receives lesser rainfall when compared to other parts of the district and also there is lesser area under irrigation in the study area when compared to other parts of the district. Hence the ITKs are more prominently adopted in the area. An effort was made to document the soil and water conservation related ITKs in study area, and the results are supported with the similar type of studies conducted elsewhere. This paper is an effort to collect and document the literature regarding the structures to conserve soil and water constructed by farming community and being practiced since generations, and is a part of the thesis submitted to the Janapada University, Shiggaon, Haveri, and Karnataka.

Keywords: Indigenous Technical knowledge, soil conservation and water conservation

Introduction
Indigenous Technological Knowledge (ITK) is an integral part of the culture and history of a local community. It is knowledge handed down from one generation to next generation through oral communication which suggests a way of common or communal ownership. It's the systematic body of data acquired by local people through the experience, informal experiment and intimate understanding of local conditions and provides a productive context for activities designed to assist the communities. Indigenous Technical Knowledge (ITK) is that the product of centuries of trial and error, survival and keen observation that can form the knowledge domain based on which researchers and extension workers can plan their research strategies and proper experimental procedures. 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. There exists a need to evaluate the potential indigenous practices in the regions for their improvement and dissemination to new areas. Specific characteristics of indigenous technical knowledge Scope of the study Indigenous knowledge practices are at danger and becoming extinct due to rapidly changing environment and fast pacing economic, political, and cultural changes on a global scale. Thus major area dealt within the present research project is indigenous technical knowledge related to agriculture. Besides documenting the ITK related to agriculture efforts will be made to the rationale of ITK as viewed by the scientist and by referring the available literature. To spearhead the movement for our coming generation, timely preservation of such wisdom and documentation will be necessary. Therefore, it is necessary to protect indigenous agricultural knowledge.

It is therefore needed to tap or identify from them and keep in a proper record in the form of indigenous knowledge inventory so that the same can be used further by the other farmers. There is also a need for scientist-farmer interaction for large scale adoption. With the above background a study on documentation of ITKs in soil and water conservation was carried out in Bagalkote district of Karntaka. This paper is part of theses submitted to the Janapada University, Gotagodi, and Shiggaon taluka of Haveri district by the researcher. The ITKs documented are classified into two groups for the convenience namely ITKs in soil conservation and ITKs for Water conservation.

Reviews on ITKs related to soil conservation

Eshwarappa and Doddamani (2013) [11] in a study on impact of irrigation tanks rehabilitation on livelihood of farmers reported that majority (82.55%) of the farmers expressed tank silt applied had doubled the crop yield, de-siltation had impact on escalating storage capacity (75%) and after de-siltation of tanks and spreading the silt on the field has enhanced the profit in the crops (54.72%).

Ingle *et al.* (2000) [17] reported that ploughing and harrowing across the slopes is an indigenous land preparation practices among the tribal farmers of Dharnipanchyath samiti of Amravathi district of Maharastara State.

Kharumnuid *et al*. (2018) [21] conducted study on 12 major adaption practices by potato growers. All 30 farmers fully adopted nursynki method of land preparation for autumn crop, use of organic manure, planting pit method and traditional way of earthing up were ranked first among all. There were subsequently fallowed by nur bun method of land preparation (m=2.94), crop diversification (m=2.17), minimum use of chemicals (m=2.02), mixed farming (m=1.93) early planting (m=1.8), off-farm diversification (m=1.75) and terrace cultivation (m=1.37).

Singh (2013) [35] documented specific land management practices of tribal farmers of Sidhi district of Madhya Pradesh, these farmers keep their land filled with rain water for 4 to 5 days after the first rain and cultivation start after draining the water. To ensure good ploughing condition farmers walk around the field and press the soil with foot and dig the field at different points with Kudli. They incorporate differing oil cakes like mustered, neem cake to the soil to maintain soil fertility, they also apply decomposed leaves, crop residues forest waste materials and forest soil to the field to increase the soil fertility.

Dolli *et al.* (2013) [10] in a study on community ownership building through participation and contribution in natural resource management noticed that the immediate benefits observed were improved ground water table (80.00%), reduction in soil erosion (72.65%), water conservation (57.50%), increase in yield(36%) and good crop stand during dry spell (5%) due to moisture retention.

Prasad (2009) [32] in their study documented the maize cultivation practices i.e. burning of crop residues, application of sheep or goat or poultry manure (FYM), storage bins made of bamboo sticks, pasted with clay and cow dung. Furthermore keeping neem leaves/dried chillies in maize storage bins/bags. Erecting bamboo sticks tied with bird feathers in the field. Hanging cobs were drying above the fire place, sun drying the seeds before sowing. Tying 4 to 5 matured maize plants together at flag leaf juncture. Cut the tassel of the maize plant after silking stage. Keeping seed maize cobs without removing husk. Using shelled maize cobs as fuel.

Sumathi and Rathakrishnan (2008) [36] in their study observed that farmers in dry farming areas followed the indigenous practices like summer ploughing, sorghum seeds are presoaked in water, sorghum seeds are presoaked with cow urine, pelletized with copper sulphate at 1:1 ratio and dried under shade. Sorghum seeds are well dried and stored in under -ground pits, relay cropping, inter cropping, sequence cropping, green leaf manuring, fallowing, cattle penning during summer, storing of seeds mixed with ash, for seed purpose in sorghum harvested ear heads were threshed and stored in gunny bags along with the husk to protect from storage pests.

Patil *et al.* (2007) in a study on documentation of ITKs and their use pattern in plantation crops in Davanagere District reported that ITKs most popularly used were incorporation of neem, arka, pongamia, glyrcidia leaves in soils before planting, beejamrutha for seed treatment, jeevamrutha for disease resistance.

Hulagur (2006) [16] in his study on watershed development – NABARD initiatives revealed that IGWDP made efforts to create basic potential like conservation of soil fertility, recharge of ground water, increase in fodder availability etc. through effective soil and moisture – conservation measures. There was remarkable improvement in groundwater table and vegetative treatments and also proved that comprehensive watershed development with people's participation is a feasible proposition.

Joshi and Singh (2006) [18] found following indigenous technologies in their study were application of farm yard manure, use of mixture of ash and manure, crop rotation and fallow land, grazing of farm animals in fallow land, burning the residue of crops, village purohit announced some dates for ploughing of the lands, seed treated with the mixture of ash of cow dung and cow urine, application of wood ash on cut surface of potato, use of mustard oil for storage of pulses, use of ash for storage, use of table salt, storage of food grains in airtight container, application of cow urine on mustard plant when infested by aphids.

Lal and Verma (2006) [23] conducted a study on indigenous technological knowledge on soil and water management reported that villagers often harvest rain water by small water storage ponds, spring water is broadcasted for weed control. Soil crust breaking and making soil more porous by conserving the rainwater.

Singh and Bag (2002) [34] documented different indigenous soil fertility management methods of tribal farmers of North Sikkim. They apply rotten forest litter or organic matter rich top soil in to the groves over potato seeds and use forest litter on bedding material in order to generate a large quantity of compost for crop production

Ranganath (2002) in a study on identification of indigenous farm practices followed by Soliga tribals reported that great majority (80-90%) of the tribals expressed the erection of small section bunds and digging against slope was relatively advantageous and compatible while 25 percent of them had expressed that it was complex process.

Kalaskar (2002) [19] documented that the tribal farmers of Marathawada region of Maharashtra, cattle penning is ia indigenous approach to increase soil fertility. During summer cattle were allowed to in the fields or nearby forests foe grazing and tied to pegs in the field during the night hours. They shift the location of the cattle as periodical intervals within the same field. The practice spread cow dung and urine

directly to the field without much difficulty. But, where livestock's possession of tribal farmers declaimed to one or two practices of the cattle and goat penning become a co-operative effort of the community.

Sundaramari (2002) [37] stated that 85.49 per cent of the total 356 indigenous agriculture practices were judged rational while 14.51 per cent were rated irrational by the scientist.

Ganesamoorthi (2000) [12] in his study on indigenous post-harvest practices observed that, the scientists rated more than 80.00 per cent of the indigenous postharvest practices are rational. Lakshmana (2000) [22] reported that, out of 96 indigenous farm practices (IFP) in his study 80.21 per cent of indigenous farm practices were related rational by the scientist.

Samanta and Hegde (2000) observed that, farmers were placed handful of compost over the cotton seeds after placing the seeds in soil; scientific reason was prevents erosion of cotton seeds when it rains and it serve as source of nutrient. Border sowing of 2 to 3 rows of Niger around sorghum crop; border crop act as trap crops for insect and pests and serve as wind barrier. Coating red gram seeds with red earth will guard the seed against moisture attack. Feeding banana mixed with rice gruel to cattle suffering for foot and mouth disease; banana and rice gruel will help in providing energy, banana is rich in starch and easy to digest.

Ingle *et al.* (2000) [17] stated that the tribal farmers of Dharani District of Amaravathi conserve soil and water by digging diversion trenches, by constructing stick and stones bunds and by sowing the crops across the land slope, they further recorded that these methods over a long period also helped the tribal to level the fields and increase the productivity.

Shinde *et al.* (2000) in their study documented indigenous agricultural practices by dry land farmers are ploughing the field immediately after harvesting of crops, spreading manures in the field in the morning, keeping the field for sun heating after ploughing during summer, construction of bunds before onset of monsoon, collecting and burning the stubbles of previous crops, treating the seeds with cow urine, avoiding repetition of jowar crops in the same field, spraying brine solution on parthenium grass, spraying the pest of garlic and green chilli mixed with soap solution, dusting ash on tur crop, pelting stone with help of traditional rope, storing pulses in earthen pot, placing neem or Nirgudi leaves in storage bins.

Gaur (1998) found that farm women broadcast farm manure (made of animal wastes) in the field to make land fertile. Manjunath *et al*. (1998) revealed that most of the farmers (94.44%) under the study were using FYM as per the recommendation, as they perceived this practice as cheap, not risky, triable, useful and with the conviction that it improves the soil fertility.

Padaria and Singh (1996) reported that farmers in Nagoria village Ranchi District (Bihar) carryout ploughing during April May for maximum retention of rain water and enhancing fertility status of the soil.

Talwar and Singh (1994) stated that the cattle penning was indigenous manuring practices prevalent among farmers of Badami in Northern Karnataka, the authors further reported that practice was followed on community basis to avoid constraints of herd size.

Nandini *et al*. (1999-1996) have recorded on adoption of indigenous soil and water conservation practices by the farmers of NGO and Govt. organization in Dharmapuri District oh Tamil Nadu. Majority of the farmers were following different indigenous soil and water conservation practices like summer ploughing (100%), manuring(70%) construction of earthen embarkments bunds (25%) and stone walls (40%) growing cover crops (41.67%) intercropping (87.50%), growing bushy shrubs like lantana camera (12.50%) agave planting(8,33%) and digging of trenches around tree crops (12.50%)

Warjau *et al.* (1997) [40] stated that under favourable condition leguminous green manure crops can provide a particular way of securing nitrogen supply via biological nitrogen fixation and are therefore genuine supplies on farm. There is however, evidence that several non-leguminous plants accumulates as much nitrogen in their leaves or legumes and that they also have very high levels of phosporous. This is most probably become these, after indigenous species are better adopted to the area have greater root volume and a special ability to recover scares nutrients from the soil. When their biomass is transferred from where it has been produced to where it can be used it provide extra nutrients input of great benefit to crop producers

Balasubramanian *et al.* (1995) he identified some of the indigenous practices followed by dry land farmers in Palladom Block of Coimbatore district in Tamil Nadu, under preparatory tillage cultivation, the summer ploughing practice was known to all respondents, eighty four percent of small farmers and all the big farmers were aware of cattle penning to improve soil fertility.

Dialla (1994) [9] reported that indigenous soil conservation practices followed by messi farmers at Renewa and Aoreme villages of Yatenga provience in Barkina Faso, he stated that stone lining either around or across the slope of field was proven practices in vogue to slow down in water runoff and to increase infiltration

Oliver (1994) [27] in his study on traditional agriculture of Tamilnadu found that deep ploughing was adopted by the farmers rather than shallow ploughing. Big clods were broken to form small clods by ploughing and allowed for drying some time and then sown with crop. The spacing for short duration paddy crop should allow the crate to move freely (15x10 cm). The spacing for long duration paddy crop should allow the fox to run freely (20x10 cm). The spacing for sugarcane should allow the milch cow to pass through (3 feet). The spacing for banana plantation should allow the bullock cart to drive (6 feet). The spacing for coconut plantation should allow the Thiruvarur temple car to move (27feet) in between, he also reported in the study that after harvest of paddy, farmers immediately ploughed and left the field fallow. This is being recommended as summer ploughing after harvest of second paddy crop so as to control weeds, early preparation of land and for moisture retention. In certain cases, they stagnated water in the field and allowed paddy cut ends to rot.

Kanagasabapathi (1993) [20] in Tamil Nadu he reported, the following are used as green manures, calattropis- Calotropis gigantea; ' nuna' –moringa tinctoria, etc these are quick green manuring leaves.

Chittiraichelvan and Raman (1992) [5] Reported that summer ploughing was proven ITK which controls insect pest and diseases on one hand and decreases soil compaction, increases aeration and infiltration rate on the soil

Dekel and Fairs (1992) [7] stated the practices of crisscross ploughing practiced among farmers in rainfed area of Northern Iraq The authors reported that this practice was followed with dual objectives of water conservation and weeding.

Dey (1992) [8] stated that "ploughing across the slope' was an ITKs and low cost technology practiced among the maize growers Bangalore district of Karnataka state.

Gupta and Patel (1992) [15] in Gujrath region, Kavada (*Cassia tora*) seeds are broken on the field at the beginning of monsoon season and month later it is incorporated to soil will improve

Gupta and Patel (1991) [14] in dry region of Gujarath, well decomposed cattle dung and urine were mixed with water in water channel with the help of hand at the time of first irrigation, it will help in uniform tillering and growth of the lucerne crop.

Padaria and Singh (1990) [29] reported that plot to plot bunding and terracing of sloppy land was an indigenous practices prevalent in northern Karnataka dry zone

Millington (1987) reported that the indigenous soil conservation techniques followed by shifting cultivators and stated that stick and stone bunds were constructed by shifting cultivators to check soil and water erosion. It was further observed that the structures were erected across the slope of land by using locally available stones and wooden sticks and least costly.

Reviews on ITKs related to water conservation

Rain water harvesting structures can store the runoff water and there by water is percolated down to the soil profile this increasing ground water recharge

Ranade *et al.* (1999) [33] infers that various soil conservation measures in the watershed enhance ground water recharge and ultimate increased crop intensity and crop productivity

Anonymous (1996) [2] revealed that the profile soil moisture was increased by 15-30 percent under contour tillage as compared to along the slope tillage in the fields with 7.3% slope.

Alermelu (1996) [1] reported following ITKs that are commonly many regions of agriculture and followed by farmers in different cropping system. With regard to cultural practices followed he reported that, shallow ploughing of pearl millet is a common practice followed by rainfed farmers on 45th day after sowing to improve soil condition. Rajasthan farmers adopt the practices of covering the curds of cauliflower with the top leaves to avoid direct sunlight and to provide good quality of curds of cauliflower, mixing sand with seeds of tobacco, ragi, onion sesamum while sowing ensures uniform crop stand Mallikarjunappa Gowda (1992) [24] reported that the water table in the wells located on the down-stream side of nala bunds increased considerably due to increased rate of underground recharge making more water available for irrigation in the open wells.

Biradar (1991) [4] showed that soil and water conservation structures reduce soil erosion considerably in Muchkalla Nala watershed and the ground water recharge increased with three years of construction.

Conclusion

The above studies reveal that, ITKs are being followed since ages and are passed on from generation to generation. Summer ploughing, manuring, construction of stone bunds, construction of earthen embarkments bunds, and stone walls, growing cover crops, intercropping, growing bushy shrubs like lantana camera, agave planting, and digging of trenches around tree crops. Among the ITKs related to water conservation watershed activities, contour storage along slope, mulching with crop, shallow ploughing, recharging open wells.

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