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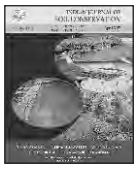

Adoption behaviour of different soil and water conservation measures among tribal farmers of Gajapati, Odisha

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ABSTRACT

A number of indigenous Soil and Water Conservation (SWC) techniques, those passed on to them by their forefathers and few indigenous technologies modified scientifically over time have been practiced by tribal farmers in Gajapati district of Odisha. The adoption behaviour of these techniques with their strengths and weaknesses have been analyzed based on the primary information collected through a structural interview of 120 farmers from five blocks of the district and focused group discussions among key informants held during September to December, 2013. The results of the analysis revealed three SWC measures namely, application of Farm Yard Manure, Agro-forestry and Crop rotation are adopted in order of preference among most of the farmers. These practices generally need little technical skills and show positive short-term benefits resulting in increased productivity quite quickly. Practices like summer ploughing, Inter-cropping, Farm pond and Legume crop were moderately adopted as these are labour intensive practices and farmers are not willing to do due to unavailability of labour. Due to lack of resources, more than 67% farmers do not practice SWC measures like Cultivation across the slope, Earthen bund, Waste weir, Bench terracing, Bunding+grass, Stone bund *etc.* More than 95% farmers do not practice SWC measures like Vegetative barrier, Mulching, Ridge and Furrow and Trenching due to lack of interest and understanding of their long run benefits. These practices require financial support and creation of awareness among farmers by different line departments.

1. INTRODUCTION

The resources conditions in rainfed areas show a grim picture of water scarcity, fragile environments, drought and land degradation due to soil erosion, low rainwater use efficiency (35-45%), poverty, low investments in Water Use Efficiency (WUE) measures, poor infrastructure and inappropriate policies (Wani *et al.,* 2003b; Rockström *et al.,* 2007). Agricultural land degradation alone can be expected to depress world food production by approximately 30% during next 50 years period (Kendall and Pimentel, 1994). Reduction in crop yields up to 60% (Sehgal and Abrol, 1994; Sharda *et al*., 2010) due to removal of top soil through erosion processes under various soil types in India. A loss of productivity and shortfall are the immediate impacts of soil and water erosion (Mishra and Rai, 2013). Though the problem of runoff, soil loss and land degradation has been existing from past, the pace has greatly increased in recent times due to the burgeoning population and the increased exploitation of natural resources. As a preventative measure, SWC measures have been developed over the years under unfavourable land conditions with steep slope, excess runoff and soil loss, inadequate available nutrients and soil moisture that limit the crop production. These conservation practices are often not only used to reduce soil loss or manage runoff, but are often introduced to improve productivity and the suitability of the land to cultivation (Krugger *et al.,* 1996). Many small and marginal farmers in dry areas use SWC techniques, which have evolved over time, without any known outside Institutional intervention and have some conservation effect (Krugger *et al.,* 1996). They are mostly developed in response to prevailing environmental and socio-economic constraints (Martin *et al.,* 1998) of the poor small holder farmers. The predominantly small farmers usually

lack the necessary socioeconomic influence to attract research policy support.

In the Gajapati district of Odisha, where 98% people's source of livelihood is agriculture, sustainable food production through proper soil conservation practice has been the major challenge. With small land holding, farmers practice shifting cultivation, an age-old traditional method of farming. Both Government and many NGOs are involved in making farmers aware of soil conservation and land management practices. Different types of soil conservation and land management practices adopted by farmers. Despite efforts made to manage their farmlands, in many instances farmers have not been able to control soil erosion and manage runoff effectively leading to loss in productivity. In view of this, the study was carried out to find out different types of SWC practices and their relative extent of adoption by farmers and their constraints.

2. MATERIALS AND METHODS

Study Area

The Gajapati district is lying between $18^0$46' to $19^0$39' N and $83^0$48' to $84^0$08' E at an altitude of 1035m above msl. The major part of the district with hilly terrain and undulated topography is inhabited by the tribal farmers. The soils are red soil, clay and sandy loam. The average annual rainfall is 1400 mm received mainly from south west monsoon with occasional rains during the remaining period.

Data Collection

The study is based on the primary data collected through a questionnaire survey and focused group discussion. A list of SWC technologies was prepared and stratified proportionate random sampling plan was adopted to select 120 respondents from different tribal villages in five blocks of Gajapati districts practicing these soil and water conservation technologies. The survey using a detailed structural interview schedule in local language was conducted among respondents. The questionnaire comprised both closed and open-ended questions. Through survey, information collected on farmers' socio-economic conditions, different soil conservation measures practiced and opinions on the advantages and disadvantages of different soil conservation practices. Prior to the survey, discussions were held with key informants, such as watershed management trainees (secretaries, community level workers) with the aim of obtaining information and their views about soil conservation practices. Focus group discussions were made about different soil conservation practices to verify the information collected through questionnaire survey. The discussion focused on soil conservation practices including methods of tillage and crop cultivation, land management practices with their preference, land-use patterns and soil erosion indications like rills, gullies and stoniness. Adoption behavior of the SWC measures are classified based on the percentage of respondents (assuming high adoption for more than 67% , medium adoption for 34-67% and low adoption for less than 34% of respondents practicing the particular SWC measure).

3. RESULTS AND DISCUSSION

Crops and Erosion Status

The most dominant crops in the selected blocks of the district are paddy, ragi, maize, cashew with paddy and *ragi*. Beside they also grow vegetable crops like potato, cabbage, tomato, brinjal for their own consumption. Farmers interviewed are having field at 250 different locations with these crops cultivated. Most of the farmers practice intercropping of maize with ragi. From the discussion, it was found that all the farmers are facing the problem of sheet erosion, whereas rill erosion and serious problem of gully erosion were found in case of 16 and 18% of farmers, respectively. Therefore, either one or another SWC measures were practiced by the farmers for controlling the problem of soil erosion and land degradation.

Soil and Water Conservation Measures

Farmers in the district have used several biological and mechanical measures of SWC to control land degradation. They also apply both organic and inorganic fertilizers to improve soil fertility. The major mechanical measures used by the farmers are earthen bunds, stone bunds and brushwood check dams for gully control. Besides these mechanical measures and soil fertility improvement, some of the practices like agroforestry and intercropping are practiced by the farmers directly contributing to their economies by providing fodder for livestock and increasing the overall crop production. The list of the SWC measures with details of practices is presented in Table 1.

Highly adopted SWC Measures

While there are several types of SWC measures practiced in the district, some are highly adopted (>67 %) by farmers, while the others are either moderately (34-67%) or least (<34%) adopted. As analyzed, application of Farm Yard Manure (FYM), agro-forestry and crop rotation are highly adopted SWC measures practiced in the districts (Fig. 1).

Application of FYM is the most adopted (75.8%) practice of the farmers. Farmers recognized that the application of FYM, the oldest method of soil conservation, contributes to the improvement of soil fertility by increasing the availability of organic matters. They expressed its acceptance as they have livestock and apply the waste materials of livestock in the farm as FYM. Remaining farmers expressed their difficulty due to transportation to distant

Table: 1
List of soil and water conservation measures

S.No.	Conservation practices	Description
1	Application of farm yard manure	Prepared using cow dung, cow urine, waste straw and other dairy wastes
2	Agro forestry	Combining trees and shrubs with crops
3	Crop rotation	Changing the crops sequence on a particular land from season to season
4	Summer ploughing	Ploughing done in summer
5	Intercropping	Planting two or more crops in the same field at the same time
6	Farm pond/any other water harvesting	Water storage structure for irrigation
7	Legume crops	Crops that added fertility to the soil through nitrogen fixation
8	Cultivation across slope	Cultivation done opposite to the direction of slope
9	Earthen bund	Earthen bund constructed along contour line
10	Waste weir	Constructed mainly with stones for disposal of excess runoff
11	Bench terracing	Making terraces in steep slopes and cultivating
12	Bunding +Grass	Bunds planted with grass and are spaced at suitable intervals to retard runoff velocity and to retain eroded soil
13	Stone bund	Stone bund are made to control surface runoff and soil erosion
14	Vegetative barrier	Grasses of suitable species are planted across mild sloped land
15	Mulching	Dry vegetation used to cover the soil for reducing evaporation and retain moisture, reduce soil erosion, and provide plant nutrients as the material decomposes
16	Ridge and furrow	Making of alternate ridges and furrow for soil and water conservation
17	Trenching	Staggered and continuous trenches made for runoff harvesting and increased soil moisture

fields. Agroforestry is the second most adopted (75.2%) SWC measure. Some economically beneficial trees like cashew, mahula, jack fruit and mango have been planted on homesteads and other farm plots, whereas many of these have grown naturally. These products became additional source of income, although majority of the farmers recognized the role of agroforestry in reducing soil erosion and in diversifying farm products. They also reported that their forefathers had planted those cashew trees and they do not need any extra maintenance. Crop rotation is also one of the highly adopted (71.7%) SWC measures practiced without any particular pattern as the farmers have the choice of particular crops to be cultivated based on their specific field condition such as soil type, available soil moisture and slope. Hence, many farmers grow green gram, black gram after cultivating paddy and *ragi*. As a result, fertility of the soil improved and soil erosion is reduced. Although this practice creates some pressure on available resources such as labour and fertilizer, still farmers consider crop rotation to be beneficial from several perspectives like controlling pest infestations in the crops (Table 2).

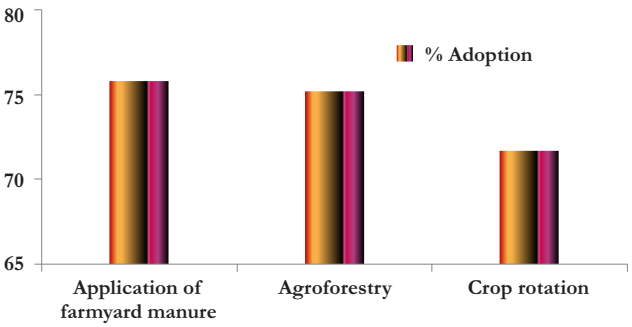

Fig.1. Highly adopted SWC measures

Moderately adopted SWC Measures

Summer ploughing, inter-cropping, construction of farm pond and cultivation of legume crops are the SWC measures practiced by 63.3, 51.7, 50.0 and 48.3% of the farmers, respectively and are grouped under moderately adoption (Fig. 2). Summer ploughing, as kill weeds, hibernating insects and disease-causing organisms by exposing them to the summer heat is adopted by maximum farmers under the particular class. Inter-cropping, the practice of growing two or

Table: 2
Advantages and disadvantages highly adopted SWC measures

SWC measure	Advantage	Disadvantage
Farmyard Manure	• Increased crop yield • Cheaply available • Reduced erosion due to improved soil condition	• Labour intensive • Susceptible to pest and diseases
Agro forestry	• Increased in income • Diversification of farm products • Provides fodder for livestock	• Takes long time to get return • Competition with field crop
Crop Rotation	• Soil fertility maintained • Prevents soil erosion	• Increased production cost and labour

more different crops together is the second moderately adopted SWC measure. The crops being intercropped include a combination of grain cereals and legumes such as maize and *ragi,* maize and groundnuts, maize and ladies finger, maize and groundnut, cotton and black gram. In some instances, maize is also intercropped with potato. An overwhelming majority of farmers have expressed their awareness on the fact of competition between the crops for sunlight, water and nutrients and that it requires higher amounts of labour. They are also aware of the fact of weed control, erosion control and quick return to their investments.

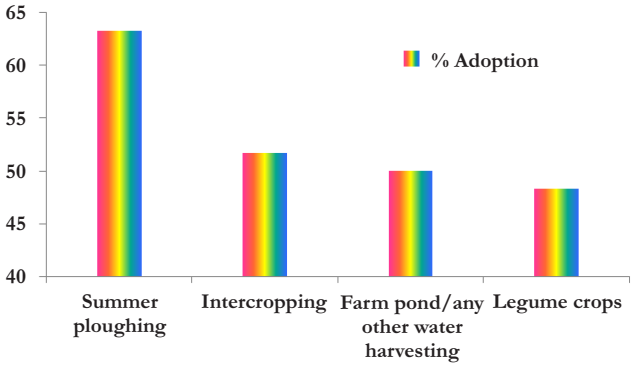

Fig. 2. Moderately adopted SWC measures

Farm pond is a moderately adopted measure by the farmers. Remaining farmers don't adopt due to high cost of initial investment in spite of knowing its advantage and mostly do crops in rainy season. They don't find it to be economical; the water many times dries up and couldn't be used in summer. Although many farmers mentioned that legumes are in great demand as feeds for livestock, only few farmers expressed their awareness of the fact that legume crops could also enhance the presence of nitrogen in the soil and moderately adopted. Farmers also considered legume crops as source of protein for their household consumption, even though expressed some disadvantages in cultivation (Table 3).

Least adopted SWC measures

Among the least adopted SWC measures, cultivation across the slope was practiced by only 33% farmers and remaining 67% farmers were cultivating crops along the slope, thereby accelerating the process of runoff and soil loss (Fig. 3). Earthen bunds to reduce runoff and prevent

Table: 3
Advantages and disadvantages of moderately adopted SWC measures

SWC measure	Advantage	Disadvantage
Summer ploughing	• Increased crop yield • Weed control • Better soil and water conservation	• Requires additional labour
Inter-cropping	• More income from same land • Reduced risk • Availability of different crops	• Competition between crops
Farm Pond	• Storage of extra water • Provides water for supplemental irrigation	• High initial investment • Getting dry during summer
Legume crops	• Fertility maintained. • Nitrogen content in soil improved	• High labour requirement at the time of harvesting

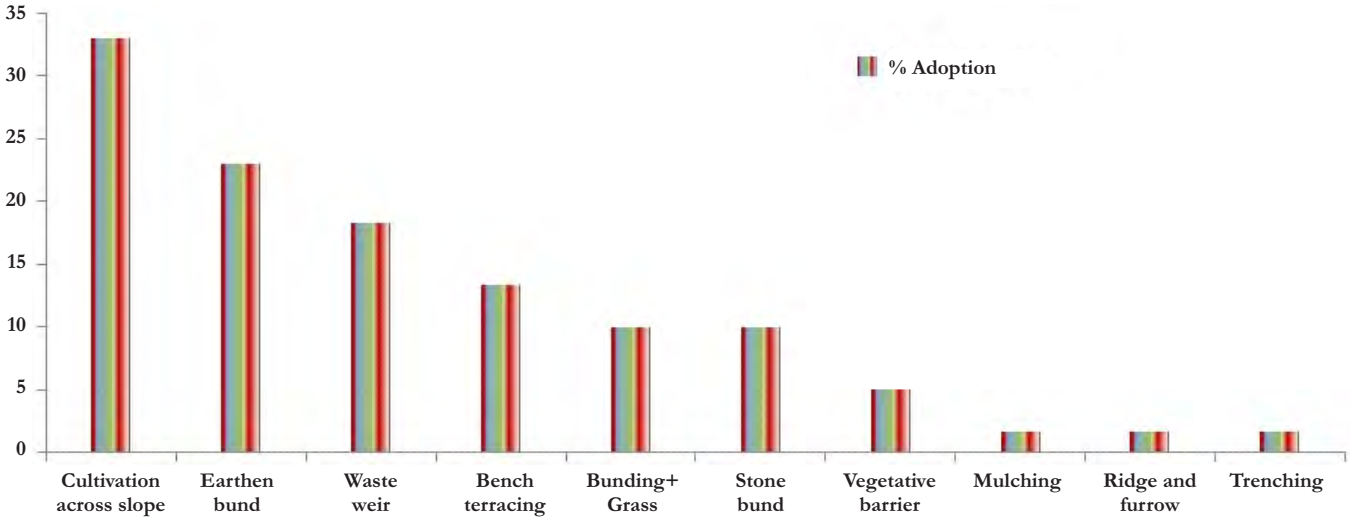

Fig. 3. Least adopted SWC measures

soil erosion in sloppy areas are practiced by 23% farmers. They raise earthen bund particularly to demarcate their field; as a result, it serves the purpose of runoff reduction and erosion control also. They reported that several governments as well as research organisations trained them on construction of earthen bund; however, it is beyond their capability to pay for labour for the construction of the same. Waste weir for safe disposal of excess water is practiced by 18.3% farmers. The use of waste weir, terracing, bunding + grass, stone bund are the least adopted (<20%) SWC measures in the district. Farmers are not very much interested in doing these practices because of inadequate material availability, no immediate return *etc.* Vegetative barrier, mulching, ridge and furrow, trenching are also the least adopted SWC measures (<5%) due to lack of interest and understanding of their long run benefits.

4. CONCLUSIONS

From the study, it is revealed that application of FYM, agro-forestry, crop rotation and summer ploughing are the most adopted SWC measures practiced in the region. Summer ploughing, inter-cropping, legume crops and farm pond construction are moderately adopted while cultivation across the slope, earthen bunding, stone bunding, waste weir, bench terracing, vegetative barrier, Bunding+grass, trenching, ridge and furrow, mulching are least adopted SWC measures. Adoption of these practices requires financial support and creation of awareness among farmers by different line departments.

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REFERENCES

Kendall, H.W. and Pimentel, D. 1994. Constraints on the expansion of global food supply. *Ambio,* 23: 198-205.

Krugger, H.J., Fantaw, B., Michael, Y.G. and Kajela, K. 1996. Creating an inventory of indigenous SWC measures in Ethiopia. In: Reij, C., Scoones, I. and Toulmin, C. (Eds), *Sustaining the soil: Indigenous soil and water conservation in Africa,* Earthscan Ltd, London.

Martin, L., Kayombo, B., Dihenga, H., Nyenza, E., Twomlow, S. and Willcocks, T. 1998. Traditional soil and water conservation systems in Southwest Tanzania. In: *Modern methods from traditional soil and water conservation technologies,* The White Horse Inn, Kabale, Uganda.

Mishra, P.K. and Rai, S.C. 2013. Use of indigenous soil and water conservation practices among the farmers in Sikkim Himalaya. *Indian J. Traditional Knowledge,* 12(3):454-464.

Rockström, J., Hatibu, N., Oweis, T.Y. and Wani, S.P. 2007. Managing water in agriculture. In: Molden D. (Ed) *Water for Food, Water for Life: a Comprehensive Assessment of Water Management in Agriculture,* International Water Management Institute (IWMI) Colombo, Sri Lanka.

Sharda, V.N., Dogra, P. and Prakash, C. 2010. Assessment of production losses due to water erosion in rainfed areas of India. *J. Soil Water Cons.,* 65(2): 79-91.

Sehgal, J. and Abrol, I.P. 1994. *Soil Degradation in India: Status and Impact.* Oxford and IBH, New Delhi, 80 p.

Wani, S.P., Pathak P., Sreedevi, T.K., Singh, H.P. and Singh, P. 2003b. Efficient management of rainwater for increased crop productivity and ground water recharge in Asia. In: Kijne J.W., Barker R. & Molden D. (Eds). *Water Productivity in Agriculture: Limits and Opportunities for Improvement*, International Water Management Institute (IWMI), Colombo, Sri Lanka). CAB International, Wallingford, UK.