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Mini Review

Soil Loss Setbacks to Indian Agriculture

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Abstract

Indian farmers reasonably require the best suite of practices for natural resource conservation to improve water and soil quality and maintain crop yield. In fact, the country has been suffering from land conversion from forest to horizontally expanding infrastructure and residential tract leading to phenomenon of soil loss. In this paper an attempt is made to judge soil loss setbacks to Indian agriculture and discuss land use-based farming practices.

Keywords: Bare Soil; Forestation; Land Misuse; Land Use Based Farming Practices; Organic Matter Dynamics; Soil Loss Setbacks; Soil Organic Matter

Introduction

Today's burning question is whether India would technologically and industrially advance in the direction of horizontal expansion of housing and infrastructure at the cost of forest and pasture land resource or by means of limiting mining-housing tract expanding it vertically. However, the practices of 'sustainable conservation agriculture' too demand proper land use so that bare soil conditions are minimized, and soil might often remain under forest and vegetation cover to prevent soil erosion and enhance fertility. The world average cropland is 12.5 percent [1] while Indian cropland is large enough, 55% of total country landscape [1]. Consequently, Indian agriculture is perhaps running in the phase of land misuse and soil erosive farming practices. In this context it would be appropriate to ponder upon the best suite of practices for natural resource conservation to improve water and soil quality and maintain crop yield. Truly the practices concerned with soil organic matter enrichment demand cover crops [2]. It is difficult to maintain vegetation canopy, all the time, in farms. But in forests and pastures, groundcover maintenance is partly spontaneous and partly dependent on limitations on human extractive activities. India occupies large share of cropland, 4.5 times of world average, and is suffering from land conversion from forest to horizontally expanding housing and infrastructure tract, leading to phenomenon of soil loss. In this paper an attempt has been made to understand how Indian agriculture is facing soil loss setbacks and discuss how demanding land use-based farming practices are.

Indian Agriculture facing Soil Loss Setbacks

Inorganic versus organic farming has been the major issue in perhaps all types of discussions pertaining to agricultural planning in India since the last decade of 20th century. The farming planners have been considering soil fertility reduction as the major setback to Indian agriculture and presuming that inorganic farming or excessive use of chemicals - synthetic fertilizers and insecticides - is responsible for soil degradation and decreasing crop yield. For example, the Estimates Committee on Organic Farming [3], under chairmanship of Dr Murli Manohar Joshi, suggested a changeover from agro-chemical farming to bio-fertilizer organic farming to solve soil infertility problem and considerably reduce subsidy burden (INR Eight hundred million per annum) to a third [3].

The decreasing fertility and increasing subsidy burden, is of course, a measure of setbacks to Indian agriculture but the scenario of problems is much more serious. The Indian farmer, day by day, is losing his or her land or soil which is perhaps among the actual variables that impact soil fertility. This leads to land degradation and affects crop yield of the country [4]. The soil loss setbacks are seldom discussed in India, although India is losing 5334 million tons of or 16.4 tons per hectare of soil every year due to soil erosion (KV Thomas, Minister of State, Rajya Sabha session, 2010). However, soil loss setbacks were considered to take place on account of indiscreet and excessive use of fertilizers and pesticides over the years [5]. But truly India's share in worldwide pesticide consumption is 3.75% only while EU countries and USA shares are 45% and 25% respectively [6]. Therefore, in order to address the fertility decline, Indian agriculture needs to focus on another generalized parameter.

Needless to say, synthetic fertilizers and insecticides application in farms, in the name of green revolution, has seriously affected the soil health, crop health and public health. But soil fertility decline might be better addressed, if Indian agriculture now focuses on soil loss. Soil loss phenomenon can explain the entire spectrum of setbacks to Indian agriculture: soil erosion, soil demineralization, soil desertification, monsoon disturbances or floods and famines, intense rainfall and landslides [7]. It seems more appropriate to consider soil loss setbacks, in general, rather than the synthetic fertilizer-insecticide application to farms when fertility decline problem is likely to be addressed.

Land Conversion leading to soil loss

Bare soil appears to be the core issue that is the matter of fertility decline affecting crop yield in India. Greater the bare soil area, the greater is the bare soil factor related to phenomenon of soil loss. In 2006, the relationship between bare soil factor BS and percent bare soil area A_{BS} was presented as some quadratic equations as follows $8.0 \times 10^{-5} A^2_{BS} + 0.0021 A_{BS} = BS$ [8]. The highlight of this equation is that it leads to results: if A_{BS} = 100%, BS = 1 (maximum soil loss); if A_{BS} = 0%, BS = 0 (no soil loss). In other words, soil loss is the maximum if soil is left 100% bare with no forest, no pasture, or no vegetation cover. On the other hand, soil loss does not occur if soil is not left bare or 100% area is under groundcover.

The groundcover is the special contribution of the nature to planet earth. Forests and pastures are the naturally available groundcover forms. Agriculture is the human attempt to partially cover the ground as cropland. The compact infrastructure with vertical housing expansion is also helpful in covering the ground. On the other hand, loose infrastructure with horizontal housing expansion and mining industry horribly lead to bare soil conditions. In India, mining industry runs to a limited extent with gross domestic product (GDP) contribution 2.2% to 2.5% only and job opportunities to around 700,000 individuals [9]. But the phenomenon of land conversion from forest-pasture tract to lose infrastructure with horizontally expanding housing tract has been leading to rupee depreciation, price hike and loss of jobs for cattle keepers and foresters since 1880s (British rule). This has further accelerated since 1947 (post-colonial independence) [10]. Indian agriculture has been facing soil loss setbacks as crop loss, perhaps not recoverable in future by fertilizer and insecticide applications in farms and the use of genetically modified (GM) seeds.

In this way land conversion leads to soil loss in India for which agriculture has been facing serious setbacks.

Discussion

Land Use based Farming Practices

In the context of soil loss setbacks to Indian agriculture, it would be relevant to discuss land use-based farming practices. There are two data regarding land misuse phenomena taking place in the country which have been mentioned above and now are stated again for discussion purpose:

1. Excessive Agriculture with large cropland share, 4.5 times the world average.
2. Prolonged (1880s onward) land conversion from forest-pasture tract to horizontally expanding housing infrastructure.

Both the phenomena lead to bare soil conditions in India. In this context it would also be appropriate to mention current agriculture and forestry human resource data to evaluate how critically Indian people are now affected by accelerated deforestation.

1. Critical state of agriculture sector human resource - Agriculture sector is critical to India's development for it contributes 14.1 percent to nation's GDP (gross domestic product) and employs 52 percent of the total workforce [11].

2. Critical state of forestry sector human resource- 300 million people, one quarter of India's population, are dependent on forestland, which occupies about 20 percent of the country's total territory [12]. However, it would also be worth mentioning that very dense and moderately dense forests account for around 3.0 and 9.4 percent respectively or aggregate 12.4 percent of total country landscape [13], which should be 33.33 percent as per forest policy.

A possible solution lies ahead of us in the form of land use-based farming practices. If lesser productive cropland (around 20% of total landscape of India) is converted to dense pasture land and concerned farmers diversify to cattle keeping profession, the land under permanent vegetation cover might be around 32 percent (dense forest 12% + dense pasture 20%). Livestock rearing is one of the major occupations in India and is making significant contribution to the country's GDP [14]. But dense pasture land has nominal existence in India.

However, the soil organic matter dynamics is worth considering. And farming techniques that enhance soil organic matter - diverse and high biomass crop rotations, cover crops, reduced tillage and rotational or prescribed grazing - are worth practicing for control over soil loss and appreciable soil conservation [1]. In this way land use-based farming practices seem to initiate from the activity of cropland reduction in India.

Conclusion

The discussion leads to the conclusion:

1. India has been losing groundcover. Therefore, Indian agriculture has been facing soil loss setbacks.

2. Excessive farming, as in India is, harms itself due to soil erosion and subsequent crop loss.

3. Indian farmers may adopt the best suit of practices like cover crops, reduced tillage and rotational grazing to minimize bare soil condition.

4. For effective soil loss control, the cropland reduction and forest-pasture expansion are essential. The working strategy might be diversification of farming profession to cattle keeping profession.

5. It is suggested that Indian farmers might adapt cattle keeping profession and establish dense pastures in low yield farms. In this way, their attempts in establishment of permanent pastures along with rotational or prescribed grazing shall add to groundcover enrichment and soil loss reduction leading to crop yield enhancement.

6. Soil organic matter dynamics in farms is of prime importance for soil loss reduction and effective organic farming.

7. Nowadays agrosilvopastoral systems are recommended for sustainable agriculture that features crops, forestry and pasturage. However more focus on forestation is suggested in particular context of India.

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Volume 2 Issue 6 June 2018

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