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Conceptual

Sustainable Soil Fertility Management Practices in Nepal

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Soil is one of the most important natural resources for agriculture production. Different workers and organizations have defined soil fertility in different ways. For example, soil Science Society of America (SSSA)defines soil fertility as "quality of a soil that enables it to provide nutrients in adequate amounts and in proper balance for the growth of specified plants or crops. Farmers in Nepal have different criteria and classify soil fertility as 'fertile' and 'infertile' soils based on the indicators such as soil colour, crop yield, quantity of Farm Yard Manure (FYM) applied over years, water holding capacity of soil, soil hardness, response to applied manure, crop growth and height and so on.

Sustainable soil fertility management

Sustainable soil fertility management is the practice of maintaining soil conditions in a way to increase crop productivity while improving or maintaining soil's physical, chemical biological properties.

Factors contributing to soil fertility decline

Nutrient depletion in soils adversely affects soil quality and reduces crop yield and consequently poses a potential threat to world food security and sustainable agriculture. Similar to several other countries, soil fertility decline has been widely recognized as a limitation of crop production in Nepal. It has also become a major challenge for sustaining agricultural production. Conditions are experienced in Nepal, where several natural and man-made factors are responsible for declining soil fertility. Four major causes responsible for the overall decline of soil fertility in Nepal are: soil erosion, reduced organic matter or organic sources, nutrients mining and indiscriminate or imbalanced use of agro-chemicals. The contributing factors for each of these causes are discussed as follows:

Soil Erosion

Soil erosion refers to the loss or removal of soil from one place to another by water, wind or any other means. Erosion of top soil os one of the major causes of soil fertility decline in Nepal. The adverse effects of soil erosion are the loss of fertile top soil including Soil Organic Matter (SOM) and plant nutrients at the source and flooding and sedimentation/siltation, damage of fertile land and physical infrastructures and water sources at the destination. Various estimates of soil erosion and nutrient loss have been reported. Soil loss through erosion from agricultural land in Nepalese hills varied from 2 to 105 t/ha/year. In terms of nutrients loss, a 5 t/ha soil loss is equivalent to a loss of 75 kg/ha of Organic Matter (OM), 3.8 kg/ha of Nitrogen (N), 10 kg/ha of potassium (K) and 5 kg/ha of phosphorus (P) in the mid hills of Nepal. Nutrients depletion and soil loss due to soil erosion are worrying especially in the mountains of Nepal.

The factors responsible for soil erosion are both natural and induced by human activities. The natural factors enhancing soil erosion include the fragile geographical formation with steep slopes and high rainfall. Human activities induced soil erosion include encroachment of fragile lands for agriculture, road or other physical infrastructures, expansion of cultivation in marginal and steep lands, crop intensification with intensive tillage practices, deforestation, animal grazing in the sloppy lands, forest fire, inappropriate and unsuitable method and techniques used in infrastructure development such as road constructions.

Nutrient Mining

Nutrient mining is the depletion of plant nutrients from soil through harvested crop yields and/or crop residues. Soil fertility problems associated with human-induced nutrient depletion are widespread world-wide. Depletion of nutrients occurs when the nutrients removal exceeds the total nutrients available in the soil. Agricultural lands in Nepal are highly intensified with double or triple crops in a year. In the foot-hills and Terai region for example, growing upto three crops in a year (e.g. rice-rice-wheat, rice-wheat-maize or rice-vegetables-maize) is common. Similarly, where there is assured irrigation and access to market, intensive

cropping of high yielding crops and their varieties are practiced. In these intensive cropping patterns, removal of nutrients exceeds the available nutrients.

Depletion of soil organic matter

Decreased SOM levels results in poor biological, chemical and physical properties of soil. Reduced SOM as a result of limited OM input into soil has been realized as one of the greatest challenges for sustainable soil management in Nepal. Loss of SOM occurs due to various reasons. Because crop residues are extensively used for animal feed, very little or no crop residues are returned to the soil. As a result, there is negative balance in SOM after each crop cycle. There are also long-term losses of SOM attributed to multiple cropping with intensive tillage practices. Burning of organic residues and using dung as a fuel have also contributed to the negative effects of SOM.

Imbalance Use of Agro-Chemical

Increased cropping intensity and introduction of improved crops and their varieties demand more nutrients in the cropping system. For example, with the increased interest in vegetables and potatoes near urban centres and cultivation of high yield crop varieties of cereals (rice, wheat and maize), chemical fertilizers and pesticides use has increased significantly in recent years. The incidences of soil pollution due to excessive and indiscriminate use of agro-chemicals have been reported in Nepal. Chemical fertilizers are used as an alternative source of plant nutrients, without taking into consideration of right types and/or appropriate application rates. The majority of farmers have low technical know-how and they apply excessive or imbalanced amounts of chemical fertilizers sn pesticides without proper soil test recommendations or considering the actual nutrients requirements of the crop. In the absence of adequate organic manure, continuous and imbalanced use of agro-chemicals has resulted into soil degradation including reduced SOM, hardness (difficult to cultivate), acidification, micronutrients deficiencies, and deterioration of soil and water qualities, and loss of agro-biodiversity.

Sustainable soil management

Sustainable soil management refers to the agronomic and soil management practices that optimize crop yield while maintaining soil health and environment in a long-run. The sustainable approach of soil fertility management emphasizes the best use of renewable resources, such as organic manures, nutrient cycling, increased nitrogen fixation, conservation tillage and irrigation practices so as to minimize soil and nutrient losses, use of crop varieties and crop production practices that are based on local knowledge of sustainable soil management.

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