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Assessment and management of soil sustainability of calcareous soils in different landforms in a transect over basaltic trap

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ABSTRACT

An attempt is being made to assess the sustainability of calcareous soils in a transect over different basaltic trap landforms of southern Saurashtra of Gujarat. Comparing different indicators of soil sustainability with criteria and scoring, it is inferred that cumulative rating index (weighting factors) varied from 24.0 to 29.3 in the soils over different landforms. The soil sustainability of different landforms is in order of hill slope > piedmont plain > lower piedmont > upper piedmont > coastal plain. In general, the soils of southern Saurashtra are sustainable with high input class S_3 (weight factors 27.1) on account of major limitations like poor soil fertility (low O.C.), high pH as well as bulk density, low saturated hydraulic conductivity as well as soil depth and fine texture. The soil management strategies in different landforms are also discussed in the text.

Key words : Assessment, Basaltic trap, Calcareous soils and indicators, Landforms, Soil sustainability.

For sustainable agriculture production, the optimum use of soil resources in prevailing climatic condition is highly essential. Therefore, the basic information on the characteristics of soil is necessary. Periodic evaluation processes and monitoring indicators of soil quality can assess soil sustainability. (USDA, 1992; Acton, 1993; and Lal, 1994). Indicators of soil quality provide baseline information for future planning and also determine the response to the management practices adopted. Keeping this in view, the present investigation was undertaken with the objective to evaluate soil sustainability based on soil indicators in calcareous soils over different landforms of basaltic trap of Southern Saurashtra of Gujarat (India) and come out with specific management strategies to sustain productivity in these soils..

MATERIALS AND METHODS

The majority of the soils in Southern Saurashtra in Gujarat is calcareous, medium black in colour and derived from basaltic trap in semi-arid climate (Gundalia and Savalia, 2000). The study area comprises major part of Junagadh and some part of Amreli district of Southern Saurashtra in Gujarat.

It lies between $20^0$44' to $21^0$10' N latitude and $70^0$25' to $71^0$26'E longitude at an elevation between 4 to 162 meters above mean sea level. The area falls under semi-arid (dry) climate, which is characterized by hot summer, mild winter and dry non rainy days with mean annual, summer and winter temperature of 27.6^0C, 30.6^0C and 22.4^0C, respectively. The mean annual rainfall of the area is 732 mm.

IRS 1A LISS II FCC imagery on 1:50,000 scale in conjunction with survey of India topographical (SOI) map referred above on 1:50,000 scales were used to identify various land forms units. Sixteen representative soils of five landforms *viz.*, hill slope (LS-1), upper piedmont (LS-2), lower piedmont (LS-3), piedmont plain (LS-4) and coastal plain (LS-5) were selected for present study (Fig. 1). The physico-chemical characteristics of horizon samples were determined by standard methods.

Indicators of soil sustainability, such as effective root depth, bulk density, texture, structure, AWC, saturated hydraulic conductivity, pH, EC, organic carbon and ESP were compared with the limits as proposed by Lal (1994).

Evaluation of soil sustainability based on the constraints of soils is accomplished by using scoring method, as outlined by Lal (1994), *viz.*, S_1=highly sustainable (<20), S_2=sustainable (20-25), S_3 = sustainable with high input (25-30) and S_4 = sustainable with alternate land use (30-40).

RESULTS AND DISCUSSION

Soil indicators:

The following soil indicators used in the present investigation are based on morphological and laboratory studies. Elimination levels and soil sustainability classes of individual soils of different landforms are given in Table 1 with weighting score factors.

Effective rooting depth:

Extreme limitation of effective rooting depth was observed in pedon- P_2 of hill slope as a result of high erosion on the side slopes. The severe limitation of effective rooting depth was found in pedons P_3 to P_5 of upper piedmont and P_7 and P_{10} of lower piedmont, while moderate limitation was observed in pedons P_6 of upper