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Short Note

Potential of varied agro-ecoregions and some soils of Shivalik hills of Himachal Pradesh for sustainable crop productivity

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Abstract

A Reconnaissance soil survey of agricultural land in Mandh watershed using topographical sheets (1:50,000) as base maps was conducted during the year 2003. Four soil mapping units comprising of two soil consociations (Patti and Kotlu) and two soil associations (Majhenu–Tikkar and Sun-Daramman-Kotlu) involving six soil series viz., Patti, Majhenu, Tikkar, Sun, Daramman and Kotlu were identified. The soils were slightly acid to strongly acid in reaction, non-calcareous in nature, sandy loam to clay loam in texture having mixed mineralogy (illite, muscovite, biotite and feldspar minerals). Taxanomically, the soils on gently undulating hill side slopes of Shivalik hills and on gently rolling fluvio-glacial terraces belong to *Typic Dystrudepts, Typic Paleudalfs* & *Typic Hapludalfs* and those on extremely steep side slopes of Shivalik hills belong to *Typic Udorthents* subgroups. Based on diagnostic characteristics soils were classified into *Entisols, Inceptisols* and *Alfisols*. A preliminary socio-economic survey was done to collect information on crop and soil management practices, locally preferred crops, crop varieties and other factors affecting agricultural productivity. Socio-economic survey and soil survey data interpretation indicated that there is a considerable scope of enhancing crop production in the area by adopting soil and water conservation measures as per the land capability, using recommended crop varieties and following recommended package of practices.

Key words: Reconnaissance soil survey, Mandh watershed and Shivalik hills.

Soil is a vital natural resource and its fertility is one of the important factors controlling the yield of crops. Soil and landscape ecology holds tremendous capacity to support a finite number of human and animal population under a set of management practices. Proper use of soil determines the life supporting of the nation and socio-economic status of the people. Soils in Shivalik hills of Himachal Pradesh make a significant contribution in total agricultural production of the state. They exhibit differences in their characteristics and profile development with the change of physiography and altitudes (Gupta and Chera 1996).

Greater scope for agricultural growth lies only in hill agro systems. But hill agro system of Himachal Pradesh, is however, characterized by unique problems of low productivity, high male outmigration, a high reliance on women in agriculture, pressure to expand cultivated land at the cost of forest land, undulating terrains, small and scattered holdings, limited irrigation facilities, severe erosion due to deforestation and high intensity rainfall. The problems are of serious concern particularly in hilly terrains. Keeping in view these facts, present study was undertaken following reconnaissance soil survey and socio-economic survey to make recommendations for sustaining agricultural productivity in Mandh watershed.

A reconnaissance soil survey of the Mandh watershed was carried out using topographical sheets (1:50,000) as base maps as per the standard method outlined by Anonymous (1970). Mandh watershed (110 Km^2) lies between 31°52'17" to 32°06'37"N latitude and 76°30'33" to 76°35'17"E longitude. On the basis of ninety auger-bore/mini-pit observations, six representative soil profiles were exposed at Patti, Majhenu, Tikkar, Daramman, Sun and Kotlu area of Mandh watershed. The catchment area is represented by wet temperate climate with average annual precipitation of about 2500mm. The mean maximum and minimum temperature of the area are 24.7 and 9.3 °C, respectively. The main natural vegetation of the study area consists of Ohi (*Albizia chinensis*), Khirk (*Celt. australis*), Simbal (*Bombax ceiba*), Biul (*Grewia optiva*), Akha (*Rubus paniculatus*).Major crops grown are Maize, Wheat, Rice, Soyabean and Potato. It is characterized by dendritic drainage system. The soil moisture and temperature regimes of the Mandh watershed are udic and thermic, respectively. The land use/land cover maps were prepared by adopting visual interpretation techniques in conjunction with collaterial data and through ground checking for correction

Anonymous(1995) Almost all the agricultural land is irrigated through gravity channels (kuhls) except in dissected hills where there is rainfed farming.

A reconnaissance soil survey of Mandh khad catchment (10,825ha) in Kangra district of Himachal Pradesh was conducted (Fig.1).



Fig. 1. Geomorphological and slope map of Mandh watershed

Geomorphological and land use/land cover maps assisted in soil mapping and revealed that majority of the Mandh Khad catchment area comprised of dissected Shivalik hills. On the basis of field observations during soil survey, the agricultural land was found to be located on gently undulating (B) to gently rolling (D) fluvioglacial terraces, gently undulating (B) river terraces, gently undulating (B) to undulating (C) valley fills, undulating (C) hill tops and hilly (F) to extremely steep (I) hill slopes. Systematic auger-bore/mini-pit observations were taken at regular intervals (0.5-1.0 km) depending upon soil heterogenity. The soils are mainly derived from fluvio-glacial deposits and Shivalik formations. The area observed under different geomorphological units in Mandh watershed is presented in table 1.

Table 1. Area of different geomorphological units in Mandh watershed

Geomorphological unit	Total area (ha)	% of watershed area
Fluvio-glacial terraces	3066	28.3
River terraces	633	5.9
Valley fills	737	6.8
Dissected Shivalik hills	6389	59.0
Mandh watershed	**10,825**	100.0

In Himachal Pradesh, most land is non arable and has scattered agricultural pockets, the soil mapping at a large scale/state level as done by Anonymous (1997).It provides limited information about arable soils. Reconnaissance soil survey identifies the kind of soils and their extent of distribution. The agricultural land was noted to be located on gently undulating to extremely steep hill slopes. The scientific management in the study area was almost non-existent. The area under the field crops, tea gardens, forests, scrub lands, water bodies and built-up was 42.9, 4.6, 4.0, 39.9, 5.4 and 3.2 per cent, respectively. Out of the arable area of different geomorphological units in Mandh watershed the cultivated area in Shivalik hills was only 47.5 per cent of the total watershed area. (Table 2).

Table 2. Arable area of different geomorphological units in Mandh watershed

Sr No.	Geomorphological unit	Cultivated area (ha)	% of unit area
1.	Fluvio-glacial terraces	2690	87.7
2.	River terraces	633	100.0
3.	Valley fills	737	100.0
4.	Dissected Shivalik hills	1082	17.0
	Mandh watershed	5142	47.5

Auger-bore and mini-pit observations taken during reconnaissance soil survey of Mandh watershed (10,825 ha) revealed four soil mapping units comprising of two soil consociations (Patti and Kotlu) and two soil associations (Majhenu-Tikkar and Sun-Daramman-Kotlu) involving six tentative soil series viz., Patti, Majhenu, Tikkar, Sun, Daramman and Kotlu. Following six soil series were identified to represent the cultivated soils of the Mandh watershed.

1. Patti : Fine-silty, mixed, *Typic Paleudalfs*
2. Majhenu : Sandy clay loam, mixed, *Typic Hapludalfs*
3. Tikkar : Medium loam, mixed, *Typic Dystrudepts*
4. Sun : Medium loam, mixed, *Typic Dystrudepts*
5. Daramman : Medium loam, mixed, *Typic Udorthents*
6. Kotlu : Medium loam, mixed, *Typic Dystrudepts*

Specifically, 41.9, 42.3 and 15.8 per cent of the agricultural area belongs to *Entisols, Inceptisols* and *Alfisols*, respectively. In surface soils, the clay content, silt, sand, soil pH (1:2.5), organic carbon content, CEC and base saturation varied from 14.6 to 36.0, 31.4 to 48.4, 18.6 to 53.4, 5.2 to 6.4, 0.16 to 1.48, 7.6 to 12.2 and 48.0 to 62.0, respectively (Table 3). Available N, P and K content in cultivated soils of Mandh watershed ranged from 188 to 840 kg/ha, 3.4 to 21.2 kg/ha and 110 to 358 kg/ha. In general, status of available nitrogen was medium, phosphorus was low and potassium was medium in Mandh watershed. Soil series differed considerably in their nutrient supplying capacity to plants. Available N, P and K status in different soil series varied from medium to high, low to medium and medium to high, respectively.

Table 3. Soil–site characteristics of the study area

Clay (%)	14.6 - 36.0
Silt (%)	31.4 - 48.4
Sand (%)	18.6 - 53.4
Soil pH (1:2.5)	5.2 - 6.4
Organic carbon (g/kg)	0.16 - 1.48
CEC(cmol(p^+)/kg)	7.6 - 12.2
Base saturation	48.0 - 62.0

It may be concluded from the Reconnaissance soil survey and socio-economic survey (table 4) that there is a considerable scope of enhancing crop production in the area by adopting soil and water conservation measures as per the land capability, using recommended package of practices. Besides, construction of water harvesting structures and introduction of remunerative crop sequence maize-wheat, paddy-wheat with due consideration to vegetable and fruit production in the area was suggested.

There is a considerable increase in transportation network, population, livestock no. and built-up which led to overall exploitation of natural resources and calls for optimum land use planning. Clubbing of small land holdings for farm mechanization, banning sale of agricultural lands, conducting frequent farmers training camps, on-farm trials and by providing incentives to farmers for land improvement and allied agricultural activities will help not only for its sustained soil productivity but also in effective agro-technology transfer to similar adjoining areas. Thus, sustainable agricultural planning should focus on the development of all components of farming system besides crop production.

Table 4. Socio-economic parameters of the study area

Sr. No.	Parameters	Number
1.	Human population	
	Male	121
	Female	90
	Children	132
	Total	343
2.	Illiteracy (%)	
	Male	10
	Female	24
3.	Occupation (% families dependent on)	
	Agriculture	2
	Agriculture + Daily wages	14
	Agriculture + Govt. services/Pension	40
	Agriculture + Private Service/business	10
4.	Household goods and farm tools (% families having)	
	Katcha house	50
	Semi-pucca house	42
	Pucca house	20
	Television set	96
	Motorcycle/Scooter	16
	Desi plough	68
	Chaff-cutter	16
5.	Livestock number	
	Buffaloes	18
	Bullocks	40
	Heifer	06
	Cow	58
	Calves	26
	Goat	16
	Sheep	12
	Others	06
	Total	182

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