CHAPTER 6: SUMMARY AND CONCLUSIONS

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6.1 Critical and Priority Area Demarcation for making Detailed Soil Resource Inventory

The resource appraisal for developmental planning begins with the preparation of its inventory to identify the problems and potentials of the concerned area. By knowing the critical patches derived from GIS based thematic mapping, one can easily identify the highly prioritized area that requires urgent land treatment.

A reconnaissance soil survey (1:50,000 scale) was carried out in *Upper Kasai* Watershed (154209.8 ha), Puruliya district, West Bengal based on satellite imagery (F.C.C., IRS IC LISS III database), Survey of India toposheets and ground truth checking. Based on 3-tier approach viz. landform analysis, field survey & correlations and laboratory investigations the soil resource map was prepared on 1:50,000 scale with 25 soil series and 32 soil mapping units at the level of soil series association. Critical areas in the watershed were identified based on six most important parameters i.e., slope, soil depth, drainage, surface texture, erosion and soil acidity and the derived critical patches of *Upper Kasai* Watershed were grouped under seven classes (Fig.3).

In this watershed, 43.5% area (maximum coverage) was under poorly drained class; followed by normal soil zone 29.2% and only 2.8 % area was having extreme limitations (Very shallow, steeply sloping, excessively drained, severely eroded, gravelly sandy loam surface, strongly acidic). Other Critical units having spatial; coverage range between 4.2 to 6.4 % of TGA.

Based on the severity of the problems, the identified critical classes were again grouped under various priority zones i.e., high (severe limitations), medium (moderate limitations) and low (minimum limitations/normal soils). High and moderate zones require immediate attention regarding suitable soil / landform protection / amelioration. The high, medium and low priority zones in the *Upper Kasai* Watershed were 14.5, 10.6 and 72.7 % respectively (**Fig. 4**).

The micro-watershed {*Patloi Nala* (a well known tributary of *Upper Kasai*)} was selected from high to moderate priority area so that the moderately prioritized area could also get some preference with highly prioritized area in terms of remedial measures to compensate the recoverable problems keeping in view the favourable socio-economy and geo-hydrological structure. The *Patloi Nala* micro-watershed (684.2 ha) located in between 23°21' to 23°23'23" N latitude and 86°29'47" to 86°31'35" E longitude, in Hura Block, Puruliya District, West Bengal. The micro-watershed was having hyperthermic temperature regime and ustic moisture regime with average rainfall of 1364 mm, average temperature 25.9°C and average relative humidity of 61.3 %, with Length of Growing Period (LGP) of 150 to 180 days. Only 32.3 % people were literate, in which crude female literacy was only 16.6%, which was alarming. More than 50% people (including children) were within non-working groups. The area was having neither any market facility, nor any hospital.

Detailed (1:4000) soil survey and mapping were performed by which, 11 soil series with 23 soil mapping units (considering changes at phase level) were identified from 4 major physiographic units viz. Upland (*tanr*, 5-10 % slope), medium land (*baid*, 3-5 % slope), medium low land (*kanali*, 1-3 % slope) and low land (*bahal*, 0-1 % slope). From soil map slope, depth, drainage, surface texture, erosion, ground water depth etc. maps were prepared. It was revealed that maximum area was covered with 5-10 % slope (50.6% of TGA), very deep (80.06 % of TGA), well drained (50.6 % of TGA), sandy loam surface texture (60.62 % of TGA) and severely eroded (44.39 % of TGA) soil. Considerable area (37.57 % of TGA) was covered with rainfed rice, irrigated rice and wheat, although the ground water depth was >10 m (poor) in most of the area (50.98 % of TGA).

Morphological data revealed that soil colour varied from (10YR 5/6) yellowish brown to dark gray (2.5Y 4/1) with sub-angular blocky structure. Soils of lower landform showed massive structure on surface.

From morphological and physico-chemical database it was revealed that most of the soils (85.1 % of TGA) were Alfisols and for that reason a clay jump was observed from surface to sub-surface of those soils. Surface soil showed lower pH value than the sub-surface both in case of water (pH 4.5-6.92) and KCl (pH 3.4-6.75) taken as solvent. The later indicated the presence of considerable amount of reserve acidity in the soils. The total potential acidity {2.82 to 18.2 cmol (p+) kg^{-1}} was mainly contributed by pH-dependent acidity {2.82 to 18.0 cmol (p+) kg^{-1}} rather than exchange acidity {0.10 to 1.50 cmol (p+) kg^{-1}}.

Soil fertility status revealed that very strongly to strongly acidic soils (pH <5.5) covered 85.2 % of TGA (where, the total potential acidity was mainly contributed by pH dependent acidity), low organic carbon (<5 g kg^{-1}) covered 39.52 % of TGA, while N, P_2O_5 and K_2O covered 47.8 %, 76.1 % and 83.3 % of TGA respectively. Zn concentration in that area varied from 0.24 to 0.96 mg kg^{-1}. More than 50 % area was below the critical level of Zn. Due to overgrazing and simultaneous disruption of soil structure, the surface soil showed greater bulk density than that of lower horizons. All the moisture retention parameters viz. field capacity (r =**0.973), available moisture content (r =**0.900) etc. were significantly and positively correlated with clay content. The Xray diffractograms showed the dominance of kaolinite clay minerals (42-72 %, with an average of 55.8%) in the study area than mica (28-51 %, with an average of 41.0%). Total analysis of nutrients showed that N content was greater in the surface (0.012-0.062 %) than in the lower horizons (0.007-0.026 %), probably due to greater accumulation of organic matter in the topsoil. The total P_2O_5 (0.04-0.08 %) and K_2O (3.10-3.86 %) content were very stable. The total K_2O range indicated the probable development of the soils on potash feldspars or mica rich parent material. Total oxide analysis on the other hand showed that SiO_2: R_2O_3 (silica: sesquioxide) varied from 3.47 to 6.48 indicating the process of silication was operative and patches having SiO_2: R_2O_3 >4 ensured the existence higher amount of crystalline clay.

6.2 Action Plan at a Glance

On the basis of available soil resources four fold action plan was prescribed as suggested landuse. Making of nutrient (N, P_2O_5, K_2O) schedule, lime ($CaCO_3$) requirement schedule, suggesting soil-site suitability of six locally dominant crops (viz. rainfed rice, irrigated rice, maize, wheat, groundnut and potato) and an overall action plan (considering critical patches) were done. It was found that requirement of N was minimum for groundnut. In the same way, P_2O_5 as well as K_2O were minimum for irrigated rice; whereas, N, P_2O_5 and K_2O requirement were maximum for potato. Therefore, potato cultivation was the costliest among 6 chosen crops regarding similar type of fertilizer application. Majority of the area of the micro-watershed (33.96 % of TGA) required 2.5 to 6.25 Mt / ha lime and Mr2 soil series of the upland required 18.3 to 24.7 Mt/ha of lime, which was the maximum. Soil site suitability of six selected crops suggested that rainfed rice was marginally suitable (S3) in major areas and covered

Pic.6: People at Work in Building Water Harvesting Structure in *Patloi Nala* Micro-Watershed

59.8% of TGA. Suitability index of wheat, maize, groundnut and potato were bearing N1 suitability classes (presently unsuitable) in most of the areas, due to marginally low soil pH. But suitability of these classes might be reclaimed from N1 (presently unsuitable) to S3 (marginally suitable) by raising soil pH with proper liming. Cultivation of irrigated rice (where a large amount of water was required) showed unsuitability (N2) in the upland soil series due to greater respective slope (causing greater moisture runoff). So, as per suitability criteria, rainfed rice was the crop of choice for the micro-watershed and indeed rainfed rice was cultivated there as the most dominating crop of the micro-watershed. Land capability study revealed that nearly 40 % area was capable for agriculture (possessing capability units III and IV). The overall action plan derived on the basis of nature and extent of limitations suggested that 39.52% of TGA (maximum coverage) required soil conservation by plantation / bunding + water-harvesting structure **(Pic.6)** + grazing practices + liming + fertility management as suitable action plan, where as, 28.84 % of TGA should be kept with existing management practices.

6.3 Salient Achievements

1) Soil survey (1:50,000) in a watershed was carried out to identify critical and priority area based on the limitations of soil / landform attributes.
2) From critical and priority area map, logically a micro-watershed was identified and detailed (1: 4000) soil resource mapping were undertaken.
3) 'Problems and Potentials' were identified in the selected micro-watershed.
4) Four-fold action plan was suggested in the form of nutrient scheduling, liming, soil site suitability study (of six locally dominant crops) and overall ameliorative measure against different soil limitations.

6.3 Future Projection

The present study might be further extrapolated into various paths. Some of those future projected work related to the present study is explained here as a glimpse of future initiative.

The land use in terms of ameliorative measure or suggestion of crops might be validated during further 3 to 5 years field trials, with proper statistical testing models.

The present project might be treated as a pilot one and the concept of "Soil Resource Mapping and Suggested Land Use" may be further extended to other micro-watersheds facing similar soil / landform limitations.

The information collected and derived specially in the form of mapping may be stored in soft copy as 'Soil Resource Information System' on micro-watershed (or any target area specific) basis, with the aid of any GIS tools or any customized software capable of dealing standard 'Relational Database Management System' (RDBMS). The resource information can be published in large scale for the use of common people through web site.

It is my hope that in near future a new area of study will develop where core soil science in the form of soil resource information (or mapping) may amalgamate with the information technology which will certainly develop a new subject; "SOIL INFORMATICS".