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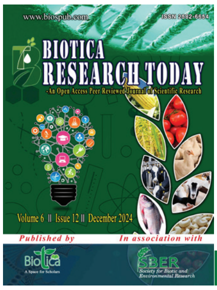

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Popular Article

Land Resource Inventory at 1:10000 Scale for North Eastern Region

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Abstract

A detailed land resource inventory (1:10000 scale) was carried out using remote sensing data in the Jirang block of Ri-Bhoi district. Typical pedons that reflect the main landforms in the study area are the plateau, inter-hill valley plain and denudational hills. Granite and gneiss from various land uses formed these pedons. The soils ranged in hue from dark greyish brown to red, had a high level of organic carbon (which declined with depth) and were high to moderately acidic in response. Ultisols are soils found on hills with high denudation, higher and lower plateaus that are strongly dissected and lower plateaus with low dissection. Their base saturation is less than 35%, making them extremely weathered (kandic horizons). Alfisols are highly weathered soils on low-denudational hills and are found in the lower plateau areas with moderate dissection and the upper valley; however, the latter has a lower base saturation. The lower valley soils are made up of alfisols (aquic moisture regime).

Keywords: Land resource inventory, Landscape ecological unit, Remote sensing, Soil properties

Introduction

The primary issues facing Indian agriculture include rising food needs, diminishing water supplies, expanding aridity, dwindling land resources and ecosystem services. Using a consistent set of techniques to produce crops outside of the suitable zone is one of the challenges. Nonetheless, the nation wants to double farmers' income and achieve an annual growth rate of 4% in agriculture. These require advice tailored based on site-specific data. The Land Resource Inventory (LRI) provides historical and contemporary data on variables and soil formation processes on a 1:10K scale. Various topographical and agro-climatic conditions characterize India's Northeastern Region (NER). However, the pattern of agricultural growth has remained uneven across the region owing to the limited amount of agricultural land. The region has just 3.4% of land used for agriculture, although making up over 8% of the nation's total land area. Despite the region's high biodiversity, diverse climate and extensively varied physiography, it contributes only a small amount (1.5%) to the nation's food grain production. One of the main reasons for the region's diminishing agricultural productivity and output is the ongoing degradation of the soil's health. Due to the significant loss of rich topsoil brought on by deforestation, soil fertility is gradually declining. Soil erosion and environmental deterioration, especially in this area, are equally caused by unscientific and inappropriate usage of the land resources that are now available. The NER states can achieve faster agricultural growth by recognizing and prioritizing site-specific restrictions, fixing crop production challenges and transferring relevant agro-technologies. The agricultural situation in the NER would improve significantly with adequate and appropriate land use planning for the best use of the resources available at the farm level, along with scientific farm mechanization techniques and sufficient extension services. Hence, managing the region's existing

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land resources through adopting appropriate land use plans is of tremendous significance regarding farm sustainability and food security. To evaluate land and determine if a soil site is suitable for crops, it is necessary to generate information on soil and land resources. Particularly in India's NER, several researchers have used data from land resource inventories to evaluate soil erosion, pinpoint erosion-prone locations and create erosion-control plans for agricultural land use planning (Ramachandran *et al*., 2023; Vanlalchhuanga *et al*., 2022; Jena *et al*., 2022). Using land resource inventory approaches, Ray *et al.* (2021) proposed appropriate alternative scientific land use planning for jhum lands after studying the pedological manifestations impacted by shifting agriculture (a practice known as jhum) in northeastern India. In the NER's undulating, severely eroded and degraded terrain, adopting suitable land use plans based on land resource data and other socioeconomic circumstances is essential for the sustainable use and protection of soil and land resources.

The study was conducted in the Jirang block of the Ri-Bhoi district, Meghalaya, which lies between latitude 25°47′17.16′′ N to 26°05′22.56′′ N and longitude 91°20′40.56′′ E to 91°51′41.4′′ E and covers an area of about 714 km^2. There are two agro-ecological sub-regions (AESRs), namely, Middle Brahmaputra plain, hot humid eco-sub region (15.2) and Meghalaya plateau and Nagaland hill, warm to hot moist, humid to perhumid eco-sub region (17.1). A detailed soil survey (at 1:10000 scale) was undertaken to characterize the soils of the Ri-Bhoi district. Before the soil survey field work, a base map or landscape ecological unit (LEU) map was prepared, considering land use/ land cover, landform and slope map. The soils were studied using a transect technique covering all defined landscape ecological units (LEUs) from higher to lower elevations. At least one soil profile or one auger observation, whichever was deemed required, was done in each LEU. Soil description criteria have been used to define the morphological characteristics of the horizons (depth, colour, structure, texture, graveliness, consistency, occurrence of nodules, *etc*.) (Soil Survey Staff, 2014). Using standard procedures, soil samples were collected horizon-wise, let to air dry and then processed through a 2 mm sieve for various analyses.

The digital elevation model (10 m) of the Jirang block indicated that the elevation varied from 60 to 980 m. This is remarkable due to the highly dissected and irregular terrain, in contrast to the regular and steep fall of the southern face of the Meghalaya plateau down to the Barak-Surma plain through a faulted face. The elevation was lower in the north direction of the block bordering towards Assam, whereas it was higher in the southern direction.

A landscape ecological unit map was created using the derived landform and slope map from the CARTOSAT 1 DEM and land use and land cover map from RESOURCESAT 2 LISS IV. This map served as the foundation for the soil survey. The Jirang block had forty-three landscape ecological units (Figure 1).

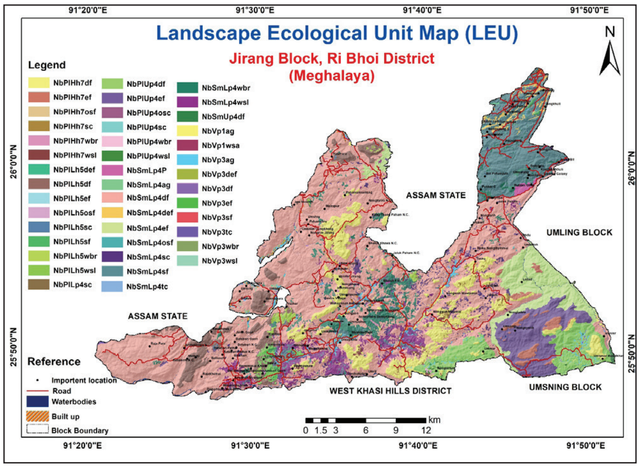

Figure 1: Landscape ecological unit map of Jirang block

[*Physiographic region:* North Eastern Ranges (N), Eastern Himalayas; *Physiographic sub-region:* Meghalaya Plateau (b); *Broad landform:* Upper Plateau (Pl), Hills of the middle and lower plateau (Sub montane) (Sm), Valley (V); *Landform:* Denudational High hills & Low hills (Hh & Lh), Upper plateau & Lower plateau (Up & Lp), Valley plain (Vp); *Slope class:* 0-1%-1, 3-5%-3, 5-10%-4, 10-25%-5, 25-33%-7; *Land Use:* Forest Evergreen & Scrub Forest (ef, sf), Forest, Dense Evergreen forest & Dense Scrub Forest (def, dsf), Forest, Deciduous & Land with Open Scrub (df, osf), Barren/ Unculturable/ Wastelands-Barren rocky, (wbr), Sandy area (wsa), Scrubland (wsl), Agriculture- Plantation (P), Terrace cultivation (tc), Current Shifting Cultivation (sc), Cropland (ag)]

Figure 2 presents the soil-landform relationship developed from the present study. Because the mean annual soil temperature is 22 °C or higher and the difference between the mean summer and mean winter soil temperatures is > 6 °C, the study area qualifies for hyperthermic soil temperature regimes and udic soil moisture because the soil control section is not dried in any part for up to 90 cumulative days in average years. Hence, all the soils were classified under *udic* and *hyperthermic* at the suborder and family level. The moderately dissected upper plateau with forest cover and the denudational high hills (500–900 m) are the sites of the Umtyngar soil series. Yellowish red, dark reddish brown and red are the colours of the Umtyngar (Kandihumults) soils. The soils have a clayey surface and subsurface texture and drain rather well. These soils have low activity of clays with high organic matter due to forest vegetation. The horizon sequence is of the A1-Bw1-Bt1-Bt2 type. The Umtang soil series (*Kandiudults*) are found majorly on the denudational low hills (220-480 m) and highly dissected lower plateau (340-480 m) with scrubland. This soil has low activity of clays with moderate organic matter. The horizon sequence is of A1-Bt1-2Bt2-2Bt3-2Bt4 type. The Umsophanon soil series (*Kandiudults*) are found mainly on the highly dissected lower plateau (220-480 m), with forest vegetation and under shifting cultivation. The horizon sequence of the Umsophanon soil series is Ap-Bw1-

Bw2-2Bt1-3Bt2. The Umkynsier soil series (*Hapludults*) are found on the lowly dissected lower plateau (340-480 m) and the horizon sequence is Ap1-2Ap2-3Bt1-3Bt2-4BC1-5BC2. The Umsong soil series (*Hapludalfs*) is found mainly on a 5 to 15% slope and is developed from the acidic granite-gneiss parent material. The Umsong (*Hapludalfs*) soils are brownish yellow (10YR 6/6 M) in surface horizons and dark yellowish brown to strong brown in sub-surface horizons and the horizon sequence is A1-2Bt1-2Bt2...2Bt6. The New Jirang soil series (*Dystrudepts*) is found mainly on the valley plains, scrub forests and agriculture. The horizon sequence of the New Jirang soil series is Ap1-2AC1-3AC2-4Bw1-5Bw2. The Sukurbaria (*Endoaquepts*) and Nongladew soil series (*Endoaqualfs*) are primarily found on the valley plains, where agriculture is practiced. The horizon sequence of the Sukurbaria series is Ap-Bwg1-2Bwg2-3BC-4Bwg3 type. Similarly, the horizon sequence of the Nongladew series is Apg1-Apg2-2Bwg1-2Btg1-2Bwg2-2Bwg3.

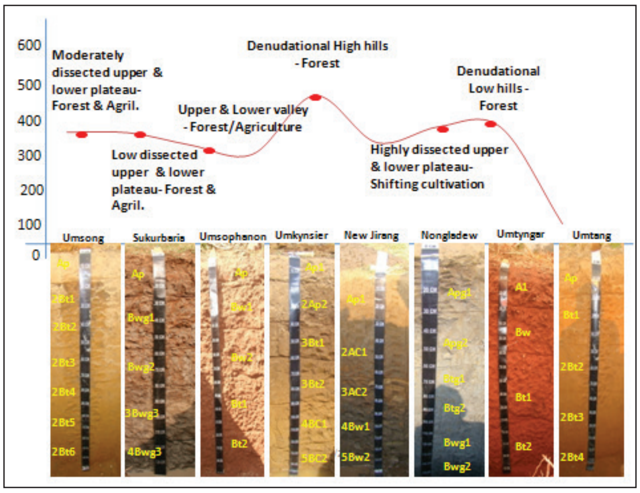

Figure 2: Soil-landform relationship in Jirang block

Of the eight-soil series, the Umtyngar series occupied 33.5% of the block (Figure 3). This series occupies the south eastern and central part of the block and is found mainly on the denudational high hills. Surface textures identified in the soil series are clay loam and clay. The second largest in terms of extent was the Umsong series, which occupied 29.35% of the area of the block. The surface textures identified in

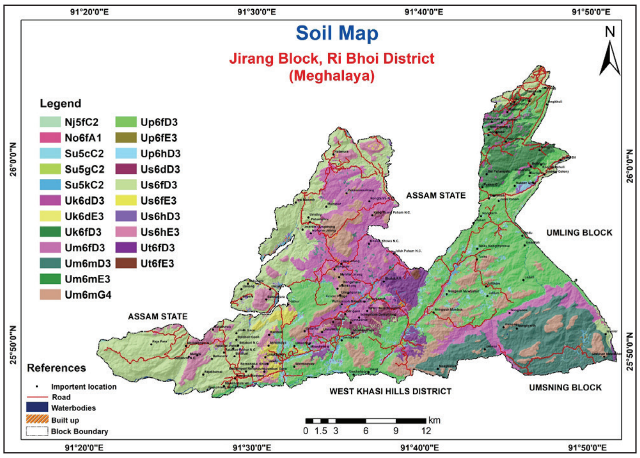

Figure 3: Soil map of Jirang block

the Umsong soil series were loam, clay loam and sandy clay loam. About 25.85% of TGA was under the Umsophanon soil series. The surface textures of these soils were clay loam and sandy clay loam. Umkynsier and Umtang soil series occupied 5.37% and 2.46% of the area, respectively and the surface textures identified in the Umkynsier series were loam and clay loam. In contrast, the dominant surface texture for the Umtang soil series was clay loam - the other three soil series, which were located in valley plains *viz.* Nongladew, Sukurbaria and New Jirang occupied only 0.52%, 1.10% and 0.27% of the area, respectively. The surface texture in the valley plain varied from sandy loam to silty clay.

Conclusion

The Jirang block is located in the western direction of the district. It has a very complex topography as a part of the Meghalaya plateau. The landforms in the block were denudational high and low hills, a highly and moderately dissected upper plateau, a lower plateau that is highly, moderately and lowly dissected and valley plains. The dominant landform of the block was highly dissected lower plateau. The primary area of the block was under forest cover and deciduous forest was the dominant land use land cover class. Agricultural practices were mainly confined to the valley plain. The major concern of the block was the area under shifting cultivation, which was 1781.81 ha (2.59% of TGA). The soils were developed from granite-gneiss acidic parent material. As a result, soil reactions ranged from extremely to strongly acidic. The soils on stable and high-altitude landforms were highly weathered with low base status, whereas soils on valley plains were developed through colluvium deposition from the surrounding landforms. The extent of the Umtyngar series (*Kandihumults*) was highest in the block. To improve livelihoods in the Ri-Bhoi district of Meghalaya in particular and the country in general with comparable circumstances, the results of this study will assist farmers, researchers, planners and policymakers in better understanding the characteristics of soil, including crop suitability, nutrient management, irrigation and water management, alternative land use planning, climate change adaptation, policy and research.

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