Annex 2

Classification of Nepal's Soil

Once a soil has been described, the next step is to classify it so that specific information regarding the soil can be communicated locally, nationally, and internationally. Nepalese farmers have long used a traditional system of soil classification based on soil colour, texture, and water regime and, within their own village, can communicate soil management information effectively (Tamang 1991)

The Government, being primarily concerned with taxation, has developed a system of classification based on the availability of irrigation water (the longer the availability of water, the greater the cropping intensity, and so the higher the taxes).

These two classification systems have not been used extensively by soil scientists in Nepal. Indigenous systems, while very useful on a local level, have different meanings for different areas and among different ethnic groups. The soil classification for taxes provides important information on how the soil is managed, but it is of little use in predicting important soil properties that influence fertility.

The dominant international soil classification system used in Nepal is **Soil Taxonomy**. The system permits identification in the field rather than in a laboratory, it is universal in that it encompasses all of the soils found in the world, and it is easy to translate into other national and international soil classification systems. The Soil Taxonomy classification is based on diagnostic horizons and their significance to soil pedogenesis. The system has been particularly useful in assessing landscape stability - an important feature of Himalayan landscapes.

When the Land Resource Mapping Project (LRMP) carried out their country-wide soil survey, they based the soil classification on Soil Taxonomy. The following summary of the major soil types of Nepal has been based largely on the work carried out by LRMP between 1980 and 1985.

Entisols

While some topsoil development is usually apparent, subsoils are unmodified. Lack of clear soil horizons is the distinguishing feature of these soils. They occur along active river ways and on steeper, less stable slopes throughout the mountain regions. Two major groups of Entisols are common in Nepal.

Fluvents

Fluvents are Entisols that have recently been deposited by river sedimentation. They tend to show little or no pedogenetic development and often exhibit strong evidence of recent sedimentation. Textures of these soils are generally coarse sandy with considerable inclusions of gravel within most of the mountain regions. The risk of flooding precludes intensive cropping on these soils and grazing and firewood collection are the dominant uses. Where irrigation water is readily available, such as in the Kathmandu Valley, along the lower terraces of the Bagmati and its tributaries, Fluvents are occasionally cultivated - although the risk of crop damage or destruction is a constant threat during the monsoon.

Orthents

Orthents are common throughout the mountainous regions of Nepal and occur in areas where slopes have recently failed. They also describe those surfaces where older soils have been seriously eroded by surface erosion and original diagnostic horizons are absent. Generally, Orthents are found on steep slopes (over 30 degrees) or where landslide runouts have been deposited. Areas on gentle slopes can quickly be reclaimed for agriculture, while steeper slopes are rapidly reinvaded by pioneer vegetation. In general, the

Himalayan landscapes have a much higher proportion of Orthents than other mountain regions of the world. This is because of the exceptionally dynamic hill slope processes that occur in the Himalayas.

Inceptisols

Inceptisols are by far the most important soil order in Nepal. Positioned on more stable landscapes than the Entisols, both agricultural and forestry uses are common on these soils. The relative stability of these landscapes permits some leaching of the topsoil and weathering of the subsoil. Three major soil groups occur in the Inceptisol Order.

Aquepts

Aquepts are relatively stable soils that are strongly affected by a high water table - at least during the monsoon season. Subsoils are under anaerobic conditions for long periods, and this inhibits most plant growth but is conducive to rice production. Depending on the depth and variation of the water table over the year, different cropping systems are possible. Those areas of the *Terai* that still have high water tables late in the fall cannot take advantage of some of the cash-cropping opportunities. Farmers tend to grow two rice crops in these areas. Aquepts are common in the lower *Terai*, in stable, low relief areas and are commonly associated with infilled back-water channels.

Ochrepts

Ochrepts include all light-coloured Inceptisols found on the well-drained, deeper parent materials both in the mountains below 1,500m (higher on south-facing slopes) and in the *Terai*. They are the single-most common soil found in the country and are extensively used for agricultural production. *Ustochrepts* with high base saturation are most prevalent in the Far-Western and Mid-Western Development regions of Nepal, where the climate is considered to be sub-humid. *Dystrochrepts* and *Udochrepts* have a lower base saturation percentage and are more acidic. They are more commonly found in Central and Eastern Nepal, where more humid conditions create stronger leaching conditions. It is in the Dystrochrepts and Udochrepts that the problems of soil acidification are most severe. *Cryochrepts* are common at elevations above 3,500 metres, on moderately sloping lands throughout the country.

Umbrepts

Umbrepts are the dark-coloured Inceptisols that usually occur above 2,000 m. (1,500 m on northern aspects). They have low base saturation and high organic matter levels in the surface soil. If organic matter is oxidised off, their natural acidity becomes limiting to the growth of many agricultural crops. *Haplumbrepts* are Umbrepts found below 3,500 m in elevation, while *Cryumbrepts* occur above 3,500 m.

Spodosols

Spodosols are rare, but are important to pedologists as they indicate a stable but strongly leaching environment. Spodosols have a strong reddish or black subsoil in which iron and organic matter have been deposited after initial leaching from the surface soil layers. They occur on stable landscapes at elevations above 3,000 metres where conifers dominate the forest. The best developed Spodosols in the country were sampled 1 km north of the old Tengboche monastery in the Khumbu area. These were *Cryorthods*.

Mollisols

Mollisols have a thick, dark, base rich, high organic matter topsoil. Mollisols have been found sporadically in the *Sal* forests of the upper *Terai* and southern exposed grassland sites in Western Nepal at higher elevations. They are formed on calcium-rich parent materials and, through rapid base recycling and/or low leaching, have maintained their high base saturation. Vegetation removal for cultivation results in the rapid oxidation of the organic matter in the surface of these soils and they are, over time, converted to Ustochrepts.

Alfisols

Alfisols are those soils with significant pedogenetic development, with obvious translocated clay in the subsoil, and a high base saturation percentage. Alfisols are common but do not make up a large percentage of the soils. They represent the most mature landscape positions throughout the sloping lands of the mountain regions and also on older alluvium. *Rhodustalfs*, the strong red soils common on ancient alluvial terraces, are among the oldest soils found in Western Nepal. They are well known to resource managers

because of their tendency to crust on the surface after tillage, have problems with phosphorous fixation, and are occasionally subject to severe gullying. The extensive gullying found in Jajarkhot on the Bheri River in the Mid-Western Development Region shows the extent to which gullying and land degradation can proceed. Strong local relief, low infiltration rates, slow permeability of subsoils due to the clay accumulation, and occurrence in areas of high intensity rainfall are the dominant characteristics that result in the gullying of these soils.

Where soils do not meet the colour criteria for *Rhodic*, soils are classed as *Haplustalfs* and *Hapludalfs*. Hapludalfs are found in the area just north of Godavari on the southern edge of the ancient lake basin that once covered Kathmandu Valley.

Ultisols

Only one Ultisol of any significance occurs in Nepal - the *Rhodudult*. Its properties are identical to those of the *Rhodudalf*, except that it has a low pH and a low base saturation. These soils are restricted to the old *Tars* in Central and Eastern Nepal, and they represent the oldest, most weathered soils found in Nepal. The Jhikhu Khola, just east of Kathmandu, is set between major terrace systems of Rhodudults. These soils are important to distinguish because soil acidification rapidly occurs through use of chemical fertilizers. There is also considerable evidence that phosphorous management will be a serious problem as cropping intensity increases.

Aridisols

These are soils that are dry for more than nine months of the year. They exhibit very little in the way of weathering and usually have free calcium carbonate and other salts at, or near, the surface. Aridisols are restricted to the rain shadow areas of the main Himalayan Massive, where precipitation is less than 300 mm. The areas north of Jomosom in the Mustang area are dominated by Aridisols. With irrigation, in special microclimatic pockets, they can be productive; although the vast majority of Aridisols are covered with extensive grazing pastures at this time. Considering the extreme variability of the landscape, and the variability of land management within that landscape, broad-scale soil maps, representing regional, district,or even *ilaka* areas, have very limited application. Given the seriousness of the fertility problems and the lack of resources, Nepalese soil scientists should be encouraged to investigate the soil fertility dynamics of indigenous farming systems and develop innovations building on the present system.