

3. DATABASE DESIGN AND DEVELOPMENT

The information system established in Lamjung District is based on primary as well as secondary data (Table 5). There are two principal divisions in the group of primary information layers, (1) information on natural resources and land use which was retrieved from maps published by the Land Resource Mapping Project (LRMP 1986), the ONE INCH topographical maps of the Indian Survey (IS), and two sets of satellite imagery taken in February 1984 (Landsat MSS) and May 1994 (Landsat TM), and (2) information on population figures and other socioeconomic data which were compiled from the National Census 1991 and from a settlement level baseline survey, conducted by RDSP-Lamjung in 1995 in collaboration with the DDC Lamjung and the VDC secretaries, covering 1,110 settlements (Table 6).

Table 5: Lamjung District Information System: Baseline Data Layers

Data Layer	Map scale/Resolution	Source
• Lamjung District boundary	1:50,000	LRMP 1986
• Drainage system (rivers)	1:63,360	ONE INCH (IS 1960)
• Elevation contours in 500 foot intervals and spot heights	1:63,360	ONE INCH (IS 1960)
• Land utilisation in 1979	1:50,000	LRMP 1986
• Land utilisation in 1960	1:63,360	ONE INCH (IS 1960)
• Satellite imagery	80m	Landsat MSS, February 3, 1984
• Satellite imagery	30m	Landsat TM, May 13, 1994
• Land capability in 1979	1:50,000	LRMP 1986
• Land systems	1:50,000	LRMP 1986
• Ecology and ecological zones	1:250,000	after Dobremez et al. 1970-81
• Meteorological data of stations in Central and Western Nepal		HMG Nepal 1966-86
• Road and trail network	1:125,000	Central Service Map, SBD 1989
• Bridges and fords	1:125,000	Central Service Map, SBD 1989
• VDC boundaries	1:20,000 - 1:50,000	HMG Nepal 1989 ONE INCH (IS 1958-62)
• Settlement locations	1:63,360	ONE INCH (IS 1960); field survey

This information was then applied to attain more knowledge by creating secondary layers, e.g., on the topography (aspect, slope gradient), elevation zones, climate (temperature and moisture regimes) and agroclimatic zones, and land cover. Primary and secondary information layers were used to build on models using raster GIS (100m resolution) in order to arrive at an approximation of (i) land-use changes over the last three decades, focussing on forest cover; (ii) changes in accessibility to road infrastructure, which has been heavily developed over the last five years; and (iii) potentials in horticultural/potato development considering the marketing aspect to some extent, i.e., access to roads (Table 7).

The Geographical Information System software Arc/Info was used to establish the database. The software used was based on an IBM compatible PC platform for data input and digitising. Similar ILWIS software was applied for image processing on a PC platform. Geographic analysis was con-

Table 6: Lamjung District Information System: Settlement Database

Items	Parameters
<ul style="list-style-type: none"> • Households and population • Food sufficiency • Employment • Education/schools • Services • Distance to services • People trained • Livestock • Land use • Community forestry • Grazing area of sheep • Nurseries • Landslides • Drinking water facilities • Irrigation facilities • Cottage industries • Development agencies 	<p>men/women, caste/ethnicity, landholding, age number of months number of months and where boys/girls attending school: school type agriculture, health, post office, <i>bazaar</i>, police in miles and hours agriculture, health, cottage industry, mason types, number type, agriculture, crop production location, size, user group, management plan winter/summer, other district type (fruit, forest, vegetable), year, ownership location, year, area affected source, schemes, cost, status source, schemes, cost, status type, number NGO, INGO, year, number of households, sector</p>

Table 7: Lamjung District Information System: Data Layers Based on Analysis

Description	GIS Type / Resolution
<ul style="list-style-type: none"> • Agroclimatic zones • Temperature regime • Moisture regime based on analysis • Digital elevation model (DEM) • Elevation zones • Aspect • Slope gradient • Agricultural cultivation types in relation to slope gradient • Land use changes from 1960 to 1979 • Boundaries of major watersheds and catchment areas • Accessibility of road infrastructure in 1990 • Accessibility of road infrastructure in 1995 • Accessibility of road infrastructure in the mid-term future • Agricultural land suitable for horticultural development • Agricultural land suitable for commercial horticultural development • Potential potato growing areas • Potential water supply for irrigation • Land cover in 1984 • Land cover in 1994 	<p>raster / 100m raster / 100m raster / 100m raster / 100m raster / 100m raster / 100m raster / 100m vector raster / 100m raster / 100m raster / 100m raster / 100m raster / 100m raster / 100m raster / 100m raster / 100m raster / 80m raster / 30m</p>

ducted on an IBM RISC System/6000™ and AIX™ Operation System; the data are now available on a PC platform. The universal transverse mercator (UTM) system was used for map projection. The Lamjung District lies in UTM zone 45 and is based on the Everest spheroid.

The data are stored in Arc/Info format and can be retrieved in spatial format with WINDOWS' driven ArcView software on PCs. The data are compiled in subdirectories, i.e., coverages. These coverages include different features, i.e., polygons, lines/arcs, and points as well as the database. The database is either stored in <coverage name>\PAT.DBF files (i.e., polygon or point attribute tables) or <coverage name>\AAT.DBF files (i.e., arc attribute tables). All data related to area (e.g., socioeconomic data of VDCs, land use data, etc) are stored in polygon attribute tables; data related to lines (e.g., roads, rivers, VDC boundaries, etc) are stored in arc attribute tables; data related to points (e.g., villages, settlements, bridges, etc) are stored in point attribute tables. The \PAT.DBF and \AAT.DBF database files can be retrieved and updated in dBASE software. Different layers/coverages have been prepared. The origins of data and features are presented in Tables 5 and 6. Details of the database area attached in Annexes 1 and 2.

3.1 Constraints, Data Problems and Limitations

In establishing the database the following problems were encountered.

- Data accuracy was limited by the fact that the main features of the database were digitised from maps on different scales (LRMP, 1:50,000; ONE INCH, 1:63,360; Central Service Map, 1:125,000) and/or maps which were out of date, e.g., the latest information on road infrastructure is not available on maps and had to be drawn from field trip investigations. Maps of VDC boundaries are available from the cadastral survey but only for the middle mountains, where farmers have registered their private land, or from preliminary maps of each VDC which were prepared in 1989. Since there is no proper reference point on these maps, the line features were delineated manually on the ONE INCH maps and only then were they digitised.
- Concerning the quality of the settlement database, there are two main constraints. Firstly, VDC secretaries were engaged to collect the data for their respective VDCs. Although they were briefed on the data collection method, the quality of data varies from VDC to VDC. Secondly, due to time/resource constraints, no clear guidelines on the distinction of settlements were provided. Thus, with some exceptions, i.e., in northern/high mountain VDCs with mainly Gurung populations and cluster settlements, in each VDC a minimum of nine settlements was recorded according to the number of wards. In one VDC, the number of settlements exceeds 50 settlements, indicating the hard work of the surveyor and a very detailed knowledge of the area and the people. The assessment of settlement locations and settlement names was based on the survey conducted by VDC secretaries. The ONE INCH maps were taken as a source, and the assessment completed through field visits. The initial idea to apply GPS technology for this purpose was dropped due to the lack of a handy instrument and the large number of settlements which made it impossible to visit each of them. Information was collected through discussions with villagers by walking mainly along the mountain ridges. Thus, the accuracy of the settlement location database is fairly low and may need to be updated and revised in future.

While there are limitations to and lack of data, it is essential to make the best use of what is available, knowing fully the limitations and responding to the needs as we proceed.