

**Part One**

# **INTRODUCTION**

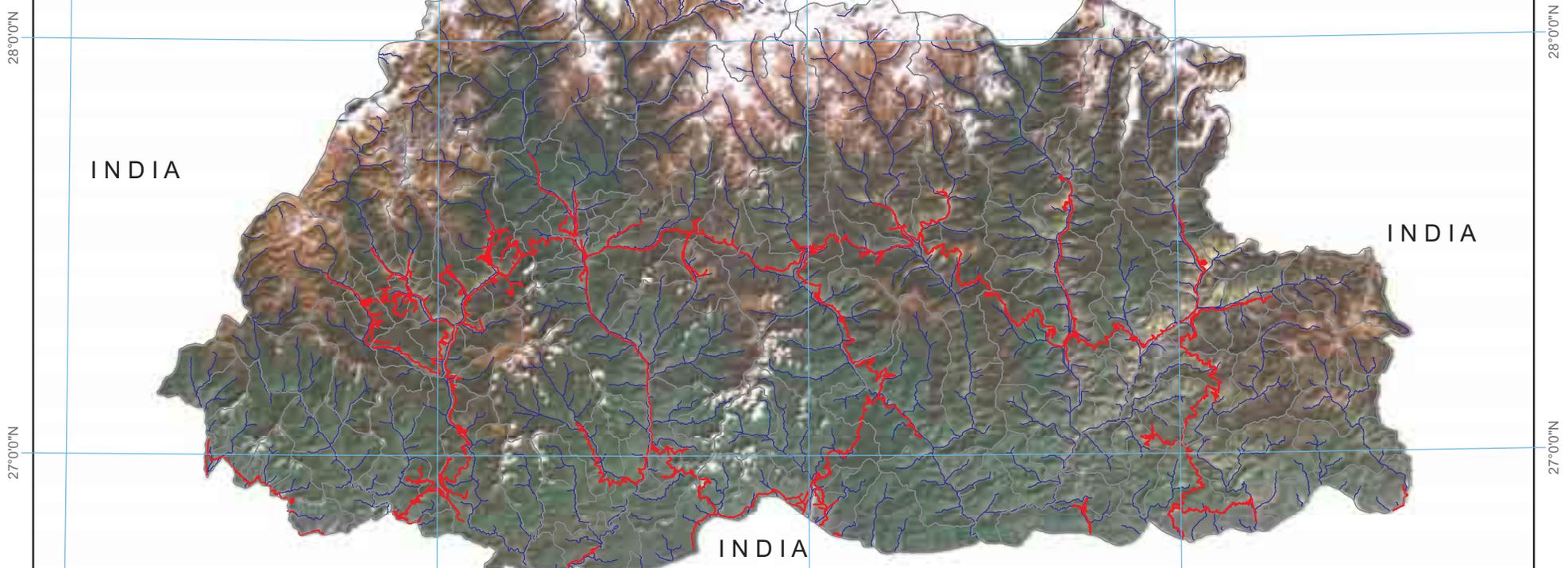
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# NaturalVue Mosaic of Bhutan

NaturalVue is a composite image from satellite images obtained from the Landsat ETM+ Satellite

## LEGEND

-  District boundary
-  Road
-  River



Base Map: Topographical District Map (1:250,000)  
 Department of Survey and Land Records,  
 Ministry of Agriculture, Bhutan

Imagery Source: Circa 2000 Landsat ETM+  
 GeoCover Ortho  
 NaturalVue Transformation, EarthSat



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## Introduction

The packaging of natural resources data into indicators simplifies the display of the complex and detailed data contained in tabulated statistics and so makes them more accessible to those who use this information to guide planning. Indicators help decision makers to set precise goals for future actions by giving them a better grasp of the current situation and the tools with which to monitor progress. There is a growing recognition that such indicators are a valuable addition to the other methods used for development planning. The advent of new tools based on GIS (geographic information systems) and related technologies means that indicators can now be presented relatively easily in the form of thematic maps; these maps allow a rapid, visual grasp of the area-wide distribution of resources and differences. Thematic maps have become an effective policy-planning tool which can help MoA to make sound decisions that will have a lasting and positive impact on people's lives. Renewable natural resources (RNR) data from the first agricultural census held in Bhutan in 2000 was published that same year in tabular form by the Ministry of Agriculture of Bhutan (MoA-Bhutan). While the tabular data was a good beginning, there was an additional need for a more comprehensive atlas of natural resource indicators (and accompanying analysis of trends) and this publication is the first attempt to produce such a graphical compendium.

The present volume 'Mapping the Status of Bhutan's Renewable (Agricultural) Natural Resources 2000' is the outcome of a collaboration between MoA-Bhutan and the International Centre for Integrated Mountain Development (ICIMOD). In this volume, agricultural resources indicators are abstracted at the district (dzongkhag) level from the data gathered in the Renewable Natural Resources Census 2000 and supplemented by other relevant sources. The indicators are grouped under the thematic headings of agricultural land, agricultural production, horticulture, agriculture inputs, livestock, agricultural marketing, and major constraints.

## The Ministry of Agriculture of Bhutan and ICIMOD

The Ministry of Agriculture (MoA) was formed in 1985 and is organised into three sectors: agriculture, livestock, and forestry. Since its inception, the ministry has been reorganised several times in order to deal more effectively with the changing situation and needs of the administration. It has, however, always maintained an integrated development approach between the three sectors which are jointly referred to as the RNR sector. Bhutan's vision for its renewable natural resources sector is that agriculture should ensure plentiful food while at the same time always being mindful to conserve Bhutan's rich natural environment for the benefit of present and future generations. Within the framework of the government's key policy objectives, the specific objectives for this sector include: the enhancement of household and national food security, the enhancement of rural livelihoods and income, the conservation and management of natural resources, and the generation of employment opportunities.

ICIMOD was established in 1983 as a regional research and development agency and since that time it has been working to support sustainable mountain development in the Hindu Kush-Himalayan (HKH) region. Its mission is to help promote the development of an environmentally and economically sound mountain ecosystem and to improve the living standards of mountain populations throughout the extended Himalayan region. ICIMOD's regional member countries are Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan.

ICIMOD's collaboration with various agencies in Bhutan are coordinated by the MoA-Bhutan. One of the major areas of collaboration has been in the field of GIS and remote sensing as applied to natural resources planning and management. ICIMOD has trained many Bhutanese professionals in geo-information systems and has been its most important partner in the development of geo-information technology. In 2003, ICIMOD and Bhutan signed a Memorandum of Understanding (MoU) on various collaborative activities, which clarified and further strengthened the relationship between the two. Following this, the Policy and Planning Division (PPD) of MoA-Bhutan and ICIMOD's Mountain Environment and Natural Resources Information Systems (MENRIS) under its IKM (Information and Knowledge Management) programme are now carrying out various activities intended to help Bhutan promote the development of an environmentally and economically sound mountain ecosystem. The current collaboration between the MENRIS division of ICIMOD and the PPD division of MoA-Bhutan has resulted in this volume and is one step in assisting policy preparation in the RNR sector using modern techniques.

### **The Policy and Planning Division at MoA-Bhutan**

Over the past ten years, ICIMOD's collaboration with Bhutan has been, and continues to be, coordinated by the Ministry of Agriculture through its secretariat, the Policy and Planning Division (PPD). Throughout this time, Bhutan has been able to make good use of ICIMOD's in-house expertise in various fields and ICIMOD has benefited from this collaboration by being able to expand its partner base and its activities in support of one of its member countries.

The PPD provides policy advice, resource mobilisation, and planning and coordination services to the various departments, non-departmental organisations and corporations under the Ministry of Agriculture. The main responsibilities of the PPD as executed through its four sections include the following.

- Formulation of policy and reviews, strategic and investment planning, formulation and development of guidelines and processes for the Five Year Plan of the RNR Sector and formulation, and drafting and revision of legislation.
- Resources mobilisation (donor-coordination), project formulation and monitoring, management of the sector's annual plans, and assistance to the Human Resources Management Division of the Ministry in the areas of human resources development and deployment.
- Strategic impact assessment and analysis, monitoring of policy implementation, and programme evaluation of RNR sector functions.
- Identification of information requirements; compilation, updating, and maintenance of RNR databases (based on the primary data collected by other agencies); responding to data requirements as needed; disseminating relevant data on a regular basis; and providing economic, statistical and GIS analytical services.

### **The MENRIS division at ICIMOD**

In 1990, ICIMOD established MENRIS as a geo-information technology resource centre for the HKH. According to its mandate, ICIMOD has worked mainly at the interface between research and development and acts as a facilitator for generating new mountain-specific knowledge relevant to mountain development. ICIMOD attempts to ensure that new knowledge on decision support systems (DSS) and tools is shared among all relevant institutions, organisations, and individuals in the region. In particular, ICIMOD works through its MENRIS programme, to help disseminate geographic information (GI) and the use of geo-information and related technologies in support of sustainable mountain development in the region. MENRIS works through four programme components, namely: capacity building and networking, integrated GIS data management, applications and decision support systems, and lastly by acting as a clearing house for geographic information based resources that can be used in the planning and decision making processes.

# Mapping Bhutan's Renewable (Agricultural) Natural Resources

## Rationale and objectives

Modern development planning and policy decision-making processes rely heavily on having data and information analysis readily available. Developmental planning in the natural resources sector is best guided by relevant time-series data collected continuously over many years for all relevant areas. The whole new generation of scientific tools based on GIS provides ways of displaying these large volumes of data and information in a way that makes them more easily understandable and renders them thus more policy relevant. Geographically displayed information can be used as a basis for displaying both the present status and future projected scenarios in the natural resources sector.

Until recently, all of the data collected by the MoA-Bhutan on the RNR sector has either been in the form of statistical outlines or manually produced geographic information e.g. maps, charts and other static information. These are useful data, but cannot be quickly compiled, compared, and contrasted as needed for multi-sector and/or problem oriented analysis. The result is that there are often long delays in presenting the data to decision makers and consequently long delays in the planning process. ICIMOD, as a centre for mountain knowledge and learning, has a specific focus on helping its partners improving their planning and decision making process by the scientific analysis of data. Presenting relevant data and information in a common GIS platform can help make them more accessible and readily usable for policy makers and development practitioners.

The primary objective of the present study was to present agricultural resource data in the form of an atlas showing the district-wise distribution of selected indicators to aid policy makers, development practitioners, researchers and the public at large.

The specific objectives were:

- to prepare a database of RNR indicators at the district level based mainly on the 2000 agricultural census;
- to prepare thematic maps of the RNR sector which could be used to give a rapid overview of Bhutan by district;
- to characterise the districts of Bhutan based on simple RNR indicators; and
- to prepare a printed atlas of RNR indicators and to complement this printed version by an interactive CD-Rom with simple GIS functionality that would allow the user to browse and query.

## Materials and methodology

The Renewable Natural Resources Statistics 2000 produced by the MoA-Bhutan was used as the basis for preparation of the maps. This was the first agricultural census ever carried out for the whole country and was based on complete enumeration with no stratification. Data were collected by administering a set of structured questionnaires to 'households'; households served as the ultimate sampling unit.

The base maps used for thematic mapping were obtained from the Policy and Planning Division, MoA. These maps had been prepared by the DANIDA-funded Land Use Planning Project (1993-2002) and were originally created based on topographical maps and other information provided by the Department of Survey and Land Records, MoA. The maps presented in Section 2 were obtained from various sources and the references are given therein.

Two types of information have been combined in most maps in order to enrich the presentation of information; the first is district ranking based on the proportion of a given indicator and the second is an indication of the relative magnitude of the indicator in a district and/or information in pie or bar chart form on components of the indicator. These two are superimposed on the geographical map of the country and, taken together, give at a glance the countrywide status with respect to that indicator. An explanation of how the maps function is given in detail below in the section 'Presentation of the RNR Census Data in Map Form'.

## **The RNR census 2000**

After the mandate for the generation of RNR statistics was transferred from the CSO (Central Statistical Organisation) to the Ministry of Agriculture in 1998, a 10% sample census was carried out in 1999. This was followed by the first complete RNR census in 2000. The main purpose of the census was to establish a reliable database for planning and monitoring development policies and programmes in the RNR sector. The immediate objective was to provide the data needed to prepare the 9th Five Year Plan (2002-2007) and to provide the data which would be a baseline for the new millennium. Furthermore, the experience gained in conducting this first-ever agricultural census provided a valuable starting point from which to improve and refine the skills needed during the preparation of annual RNR and other surveys.

The census encompassed all three RNR sectors, agriculture, forestry, and livestock. The agricultural sector data included land use classification, land tenancy, food grain crops and agricultural inputs. Livestock data included the type and number of heads of livestock as well as livestock products. Under forestry, wood, non-wood products, forestry issues, and fodder species were covered. In addition to these three main sectors, the census also covered aspects related to agricultural marketing, farming constraints, household food grain security, and accessibility.

The results of the RNR census were published as the RNR Statistics, 2000. The data were processed, analysed and presented by block (geog), district (dzongkhag), and sometimes region (within Bhutan), and were summarised at the national level. The publication features areas and production yields of the principle food crops – food grain, oil seeds, pulses, spices, and horticultural crops – as well as data on livestock and livestock products, and marketable surpluses. The publication also provides information on food security levels, farm constraints, and accessibility of communities to motorable roads.

### **Organisation of the census**

An Agricultural Census Steering Committee was established to guide the implementation of the census. The committee comprised the Heads of the Departments and Divisions of the Ministry of Agriculture and the Central Statistical Organisation, and representatives from the Ministry of Home Affairs and the Ministry of Trade and Industry. The committee provided financing as well as the necessary guidance in terms of policy directives and guidance in the development and approval of the census questionnaire used to collect the data.

A Census Management Unit comprising representatives from the PPD and four other technical departments was formed to serve as the implementing arm of the committee. This group worked closely with the renewable natural resources research centres (RNR-RCs), the districts, and the block extension agents, who assisted the management with the coordination and supervision of enumerators during the implementation of the census. The management also had the support of 13 Natural Resources Training Institute (NRTI) lecturers who served as field supervisors for a period of two months. NRTI trainees, including high school students, were employed as enumerators after completing a brief training organised by the census management.

All enumerators were trained for a period of eight days preceding their fieldwork. They were instructed in the methods and use of the field questionnaires as prescribed in the census questionnaire manual (of which they were also provided a copy). Some of the specific concepts and definitions used in the survey are summarised at the front of this book. All five core members of the team were available as resource persons during the training. Eighteen database managers from the districts, including seven (temporarily employed) computer operators, worked on data entry. Since all of these people were already computer literate, a three-day refresher course was all that was needed to bring them up to speed on the skills needed to use the required programs.

### ***Data validation at NRTI***

Preparations for data entry were underway even while the enumerators were still in the field. Eighteen district database managers (who had basic skills in access programming) were recruited to help with the task. An additional 7 skilled computer operators were also temporarily employed to help with data entry. While overall supervision rested with the Principal, NRTI, three other regular staff did the validation and supervision of the data entry work.

### ***Survey design and implementation procedures***

The census was a complete enumeration without stratification. Households, who were the basic units from which data were collected, were asked to respond to a questionnaire containing a set of structured questions. For the survey, enumerators were proportionately distributed among the four RNR-RCs, each of which was headed by a field coordinator. The census management team also received field support from the RNR-RCs and the districts as well as the NRTI lecturers and block extension agents. The enumerators were selected and grouped by their ability to speak the local dialects; they were then further sub-divided into smaller groups of seven to ten people headed by a supervisor. The enumerations were carried out in a step-wise fashion by district. One (or at the most two) districts were enumerated at a given time, once the enumeration for the district was complete the team moved to the next until the entire enumeration was completed. This step-wise approach facilitated the management and proper coordination of the enumerators. The supervisors were required to visit the farm households and were encouraged to follow a policy of interviewing respondents separately in order to avoid biased responses. In practice, it was not always possible for the enumerators to visit all of the households because of difficult terrain and because some settlements were very remote; in these cases, the farmers were requested to come to a central location to meet the enumerators for their interview. The NRTI trainees were only available for a limited time after which they had to return to their institutes. Enumeration of 17 of the 20 districts was completed during the first two months with the help of the NRTI trainees; the remaining districts were enumerated (without them) over the course of the following month. A second round enumeration was felt necessary because of the many absentees during the first round.

## Presentation of the RNR census data in map form

The geographical maps presented in this volume were created using the ArcGIS software from the Environment Systems Research Institute (ESRI) and the indicators were calculated by statistical analysis of the RNR Census data.

The maps show the districts ranked according to the values of a given indicator together with additional information in the form of numbers, pie charts, or bar charts. Pie charts are used to show the proportion of an indicator provided by different components. For example, map A2 on 'Different Types of Agricultural Land' shows the districts ranked according to the total amount of registered agricultural land in the district, and the pie charts show the proportion of agricultural land from different land use types (wetland, dry land, horticulture, kitchen garden, and shifting cultivation). The area of the pie charts indicates differences in size of the major indicator, in this case total agricultural land. They are not directly proportional to the indicator value, as the range of values to be represented is in most cases too large, instead they are proportional to the value within the range covered by the indicator. The range of values represented is shown in an additional legend which shows the smallest and largest pie chart size together with the numerical value of the indicator. Bar charts are used to show the relative values of components related to the major indicator, but which have not been directly summed to give the indicator value.

## Limitations

Bhutan is a small country, with a strong sense of its own identity and culture. The country has an advanced system of coordinated planning for development, particularly for the agricultural and forestry sectors, but has only recently started to use modern demographic tools to provide input to and support for planning processes. The first full population census will take place during the summer of 2005. The RNR Census held in 2000 was a first attempt to obtain coordinated standardised country-wide information using modern census methods, and was, in some sense, a forerunner to first demographic census. The aim of the RNR Census was to provide an initial assessment of the agricultural land use and production in order to support planning. Due to the novelty of the census process, as well as a lack of experience both on the part of the enumerators and the interviewees, it is likely that the data has some limitations.

One of the major limitations the census data is that the total area of land registered for agricultural use, as well as its designation for growing a particular crop, may be somewhat inaccurate. Factors that could have contributed to inaccuracies include, for example, the fact that some areas were inaccessible and enumerators had to rely on the farmers' own assessment; that some farmers may have misunderstood the questions being asked; or, conversely, that the enumerators may have misinterpreted some of the farmers' responses. Equally some of the definitions may not have been clear to the farmers – for example, whether fallow land is agricultural land even though it was not being used directly at the time of the census. Another problem is that farmers may not have been familiar enough with the units of area to accurately estimate land areas, particularly as there is a lack of properly surveyed maps that could be used for reference (these are only just being prepared for Bhutan). All of these may also have affected land registration. It seems likely that not all the land used for agriculture was actually captured in the statistics, which are based on officially registered land only. There are also likely to have been some considerable changes in the five years since the census was taken.

Similarly the values for production and consumption rely on farmers' own estimates, and these may not be very accurate since accurate estimation of production relies on a sophisticated grasp of concepts of weight and amounts produced over time. The great majority of agricultural products are either consumed at source or sold locally by the farmer; only a small amount enters a regulated supply chain in which products are weighed and amounts recorded. Similarly, few people in any country are able to estimate accurately the amounts by weight that they and their families consume, and this will have affected the values given for total consumption. Thus the absolute values given in the agricultural census data, particularly those related to land area, need to be viewed with caution. Nevertheless, the factors listed are likely to have been similar throughout the country, thus the census data provide a valuable indication of the relative status of different indicators among districts, which is the main information displayed in the maps in this publication. We expect that future census type undertakings that build on the experience gained, and a more detailed registration process accompanying modern surveying activities, as well as a closer look at 'registered' as against 'operated' agricultural land will provide a reliable picture of the exact status of agricultural land in the country, as well as confirming the comparative findings of this first census.

### **Census limitations**

Since the RNR Census 2000 was the first of its kind, there were some weaknesses. Despite the attempts to collect data from every rural household, the actual coverage achieved was only 87%. Most of the absentees were people on seasonal migration, away on pilgrimage or at hot springs, and/or away for business.

With regard to the precision of the data, uncertainties exist on the conversion rates for many non-wood forest products. Thus data were reported in different units such as bundles, baskets, pieces, head loads and back loads, many of which varied from place to place. Although training courses and various capacity development tools had been made available to the enumerators to enhance their ability to conduct the survey, and similar efforts were made to prepare the data entry technicians, it is possible that some errors may have crept into the statistics as a result of human factors. The primary informants were farmers who are not literate and do not maintain farm records. Therefore, data precision mainly depended on their memory recall. As far as possible, this problem was minimised by implementing the census soon after the main crop harvest and within the shortest period possible, but, once again, human error is a distinct possibility.

### **Data limitations**

There are some general data limitations, especially if data are used from different sources. The figures from the Land Use Planning Project (LUPP) 1995, which was prepared based on remote sensing and GIS, suggests that the total area of land available for agriculture in the country could be as high as 7.7%. These figures were officially published, but there may be some discrepancies as a result of generalisations made during the land use classification exercise and the definitions used. The remote sensing estimates of agricultural land were high compared to those generated from the RNR Survey in 2000, which recorded only 2.6% of the total land area as 'agricultural land'. There is also some discrepancy in the reported values for total land area of Bhutan. The exact location of the country boundary is still being defined. Thus different data sets use different values and some maps show a slightly different border. At the time the Agricultural Census was held, the total area of Bhutan was recorded as 40,973 sq.km. The current (2006) official figure is 38,394 sq.km. In the analysis related to the census data, the official recorded value at that time has been used.

## Organisation of the Publication

This publication is divided into four parts. The first part is this introduction with a brief background on the rationale for undertaking the work, and a description of the main features of the census as well as a discussion of its limitations.

Part Two provides a brief overview of Bhutan and gives descriptive information related to Bhutan's geophysical characteristics, climatic conditions, agro-ecological zones, vegetation, land use and land cover, national protected areas and biological corridors, economy, development vision and policy, and developments in the RNR (agricultural) sector including recent developments.

Part Three presents the RNR Statistics 2000 in the form of text, tables and maps in seven different sections – agricultural land, agricultural production, horticulture, agricultural inputs, livestock, agricultural marketing and major constraints to farming

Part Four provides a summary of the detailed data presented in Section 3 and a characterisation of the different districts using selected RNR indicators, followed by the conclusions and recommendations from the study and a short bibliography.