Mapping
The Status of Bhutan's Renewable (Agricultural) Natural Resources

ICIMOD

About the Organisations

International Centre for Integrated Mountain Development (ICIMOD)

The International Centre for Integrated Mountain Development (ICIMOD) is an independent 'Mountain Learning and Knowledge Centre' serving the eight countries of the Hindu Kush-Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and the global mountain community. Founded in 1983, ICIMOD is based in Kathmandu, Nepal, and brings together a partnership of regional member countries, partner institutions, and donors with a commitment for development action to secure a better future for the people and environment of the extended Himalayan region. ICIMOD's activities are supported by its core programme donors: the Governments of Austria, Denmark, Germany, Netherlands, Norway, Switzerland, and its regional member countries, along with over thirty project co-financing donors. The primary objective of the Centre is to promote the development of an economically and environmentally sound mountain ecosystem and to improve the living standards of mountain populations.

Ministry of Agriculture, Bhutan

Formed in 1985, the Ministry of Agriculture (MoA) is one of the ten ministries of the Royal Government of Bhutan. It comprises the agriculture, livestock, and forestry sectors. The Ministry places strong emphasis on an integrated development approach among the three sectors, which together are commonly referred to as the RNR (renewable natural resource) sector. The main mission of the MoA is to increase food production, raise rural income, and improve the livelihood of the nation's largely rural population, while preserving Bhutan's pristine natural environment and conserving its rich natural resources of land, water, forests, flora, and fauna for future generations. The Policy and Planning Division functions as a secretariat to the Ministry and 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 Policy and Planning Division is the focal government agency for ICIMOD collaborative activities in Bhutan.

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Ministry of Agriculture, Royal Government of Bhutan:
Policy and Planning Division (MoA/PPD)
and
International Centre for Integrated Mountain Development:
Mountain Environment and Natural Resources' Information Systems (ICIMOD/MENRIS)

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Foreword

The work published here is the result of a joint initiative between the Ministry of Agriculture, Royal Government of Bhutan, and the International Centre for Integrated Mountain Development to analyse and classify the renewable natural resources (RNR) of the districts of Bhutan with a special emphasis on agriculture, and livestock. Using the RNR statistics as the main data source, thematic maps were prepared which highlight various aspects of Bhutan's rural agriculture. The themes covered include agricultural land use characteristics, cereal production and yields, agricultural inputs, horticultural production, livestock population and production, agricultural marketing, and major constraints faced by the rural farm households.

As a predominantly agricultural economy, this study has a special importance for Bhutan: more than three-quarters of its population is engaged in agriculture and related activities and agriculture accounts for nearly one-third of its GDP. State-of-the-art geo-informatics tools have been used to organise and analyse RNR databases and to help visualise and present the ground realities. The results should assist development planners and policy makers by helping them to enhance their understanding and so enable them to make better informed policy decisions.

It is our hope that the organisation and presentation of the available data in the form of an atlas will help decision makers and the donor community in their quest to help the Royal Government of Bhutan in its efforts towards sustainable development. An attempt was made to integrate and present the available information in the best possible manner. It is our sincere hope that this volume will enhance the understanding of Bhutan's natural resources and the characteristics of its agricultural economy, and that it will help in bringing about positive changes that benefit people locally and the nation at large.

We commend the study team members from MENRIS/ICIMOD and PPD/MoA/Bhutan for bringing out this important report and assure them of our full support for other joint endeavours in the future.

Dr. J. Gabriel Campbell
Director General, ICIMOD

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Secretary, MoA, Bhutan

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Acronyms and Abbreviations

AEZ	agro-ecological zone
CSO	Central Statistical Organisation
DANIDA	Danish Agency for International Development
DOF	Department of Forest
ESRI	Environment Systems Research Institute
FCB	Food Corporation of Bhutan
FYM	farmyard manure
GDP	gross domestic product
Geo-ICT	geo-information and communication technology
GIS	geographic information system
HHs	households
ICIMOD	International Centre for Integrated Mountain Development
ICS	information and communication services
ICT	information and communications technology
IKM	Information and Knowledge Management (ICIMOD)
ISNAR	International Service for National Agricultural Research
LUSS	Land Use and Statistics Section
LUPP	Land Use Planning Project
masl	metres above sea level
MoA	Ministry of Agriculture
MENRIS	Mountain Environment and Natural Resources Information Systems (ICIMOD)
NCD	Natural Conservation Division
No.	number
NRTI	Natural Resources Training Institute
NSB	National Statistical Bureau
Nu	ngultrum
PPD	Policy and Planning Division
RGoB	Royal Government of Bhutan
RNR	Renewable Natural Resources
RNR-RC	Renewable Natural Resources Research Centres
SRTM	Shuttle Radar Topographic Mission
SSP	single superphosphate
WFP	World Food Programme

Units

kg	kilogram
km	kilometre
l	litre
t	tonne (1000 kgs)

Note: Land area in Bhutan is measured in acres.
1 acre = 4046.86 sq.m or approximately 0.4 ha

Currency

The Bhutanese unit of currency is the ngultrum, which is on a par with the Indian rupee. In 2000, 1 US$ = 45 Nu approx.; in 2003, 1 US$ = 47 Nu approx.

Concepts and Definitions

Some of the specific concepts and definitions used in the survey questionnaire are outlined below. Understanding these definitions is important for interpreting the information presented in this publication.

ArcGIS	ArcGIS is an integrated collection of GIS software products for building a complete GIS developed by the Environment System Research Institute (ESRI)
Agricultural constraints	Hindrances to achieving the full benefit of renewable natural resources potential
Agricultural input	Inputs applied to support agricultural production and productivity
Bearing trees	Fruit trees that are mature enough to bear fruit
Chemical fertiliser	Manufactured chemical compounds such as phosphate, potassium, nitrogen, and other mixed and complex fertilisers that can be applied to the soil to enhance or improve its productivity
Chushing (wetland in Bhutanese)	Terraced areas which are irrigated to grow crops – mainly paddy. When these terraces are also rainfed, other crops such as wheat, mustard, and vegetables may be grown as a second crop. The term is also used to refer to terraced areas that are only rainfed, but these are less common.
Dzongkhag	Bhutanese word for district
Farm household	A person or group of persons operating as one economic unit. The farm household usually has a common arrangement for the preparation and consumption of food, and share the same kitchen. (In this report, the terms 'farm household' and 'household' have the same meaning.)
Firewood	Consists of the woody parts of trees (wood, bark, branches, twigs, stumps, and roots) that are collected by farm households for cooking or heating
Geog	Bhutanese word for block
Improved breed	Animals whose characteristics have been improved either by selective breeding or by importing higher quality stock
Improved pasture	Land that contains improved pasture species or has been fertilised
Kamshing (dryland in Bhutanese)	Sloping agricultural land that has not been modified into terraces and where crops are grown mainly without irrigation. The main crops cultivated are maize, wheat, barley, buckwheat, and millet.
Kitchen garden	That part of cultivated farmland used to raise vegetables, spices, and fruit trees mainly to meet the household's table requirements. Kitchen gardens are generally located near the homestead.
Land use	Land operated by the farm household for renewable natural resource production
Livestock	Domesticated animals such as cattle, yak, sheep, goats, pigs, and horses
Local breed	Animals indigenous or native to the country
Mixed agriculture	A type of land use in which wetland, dryland, orchards, and kitchen gardens are adjacent to each other. This class was introduced during the 1995 mapping exercise and includes those variously used small patches of land that could not be classified uniquely as wetland, dry land, or orchard.
Plantation	Plantations of trees that are part of the afforestation or reforestation programmes carried out by the Department of Forests. Plantations of cardamom and areca nut are classified as 'orchard'.
Poultry	Birds such as hens, cocks, ducks, and so on both native and imported
Tseri/pangshing	Tseri and pangshing are Bhutanese terms for types of shifting cultivation, the practice of cultivating land for a year or two and then leaving it uncultivated for a number of years in order to allow the soil fertility to regenerate naturally.

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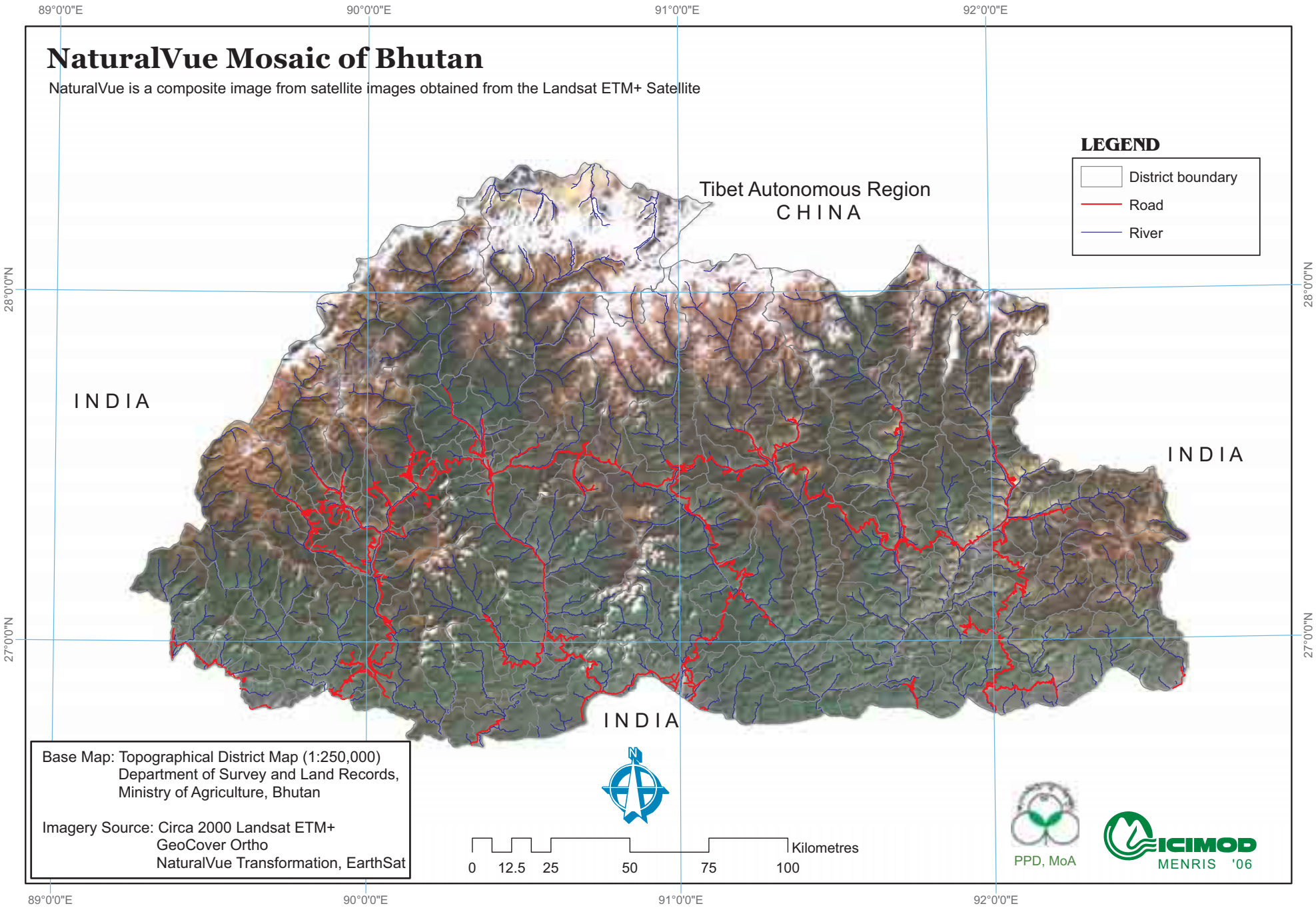
Part One

Introduction

NaturalVue Mosaic of Bhutan

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



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

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.

Part Two

Overview of Bhutan

Country-wide Characteristics

Physical features

Bhutan is a mountainous and landlocked Himalayan country situated between latitude 26°40' and 28°15'N and longitude 88°45' and 92°10'E. It borders the Tibet Autonomous Region of China to the north and the Indian states of Assam, West Bengal, Arunachal Pradesh and Sikkim to the south (Map 1). The country spans about 300 km from east to west and 170 km from north to south with a total land area of 40,973 sq.km* (Source: RNR Census 2000). The terrain is highly rugged and steep with very little flat area for productive agricultural farming. Elevation throughout the country ranges from less than 100 masl (in the south) to above 7000 masl in the north (Map 2).

The country can be divided into three distinct physiographic regions on the basis of altitude and corresponding rainfall and temperature. The southern foothills range in altitude from less than 100m to about 2000 masl and comprise the Siwalik Hills together with a narrow band of flat plains along the Indian border. The inner Himalayas make up the main river valleys and steep hills and rise in elevation from about 2000 to 4000m. The great Himalayas to the north along the Tibetan border consist of snow capped peaks and alpine rangelands above around 4000m (Map 3).

For administrative purposes, Bhutan is divided into twenty districts called dzongkhags, which are further subdivided into 202 sub-districts or blocks called geogs. The district and block boundaries are shown in Map 4.

Climate

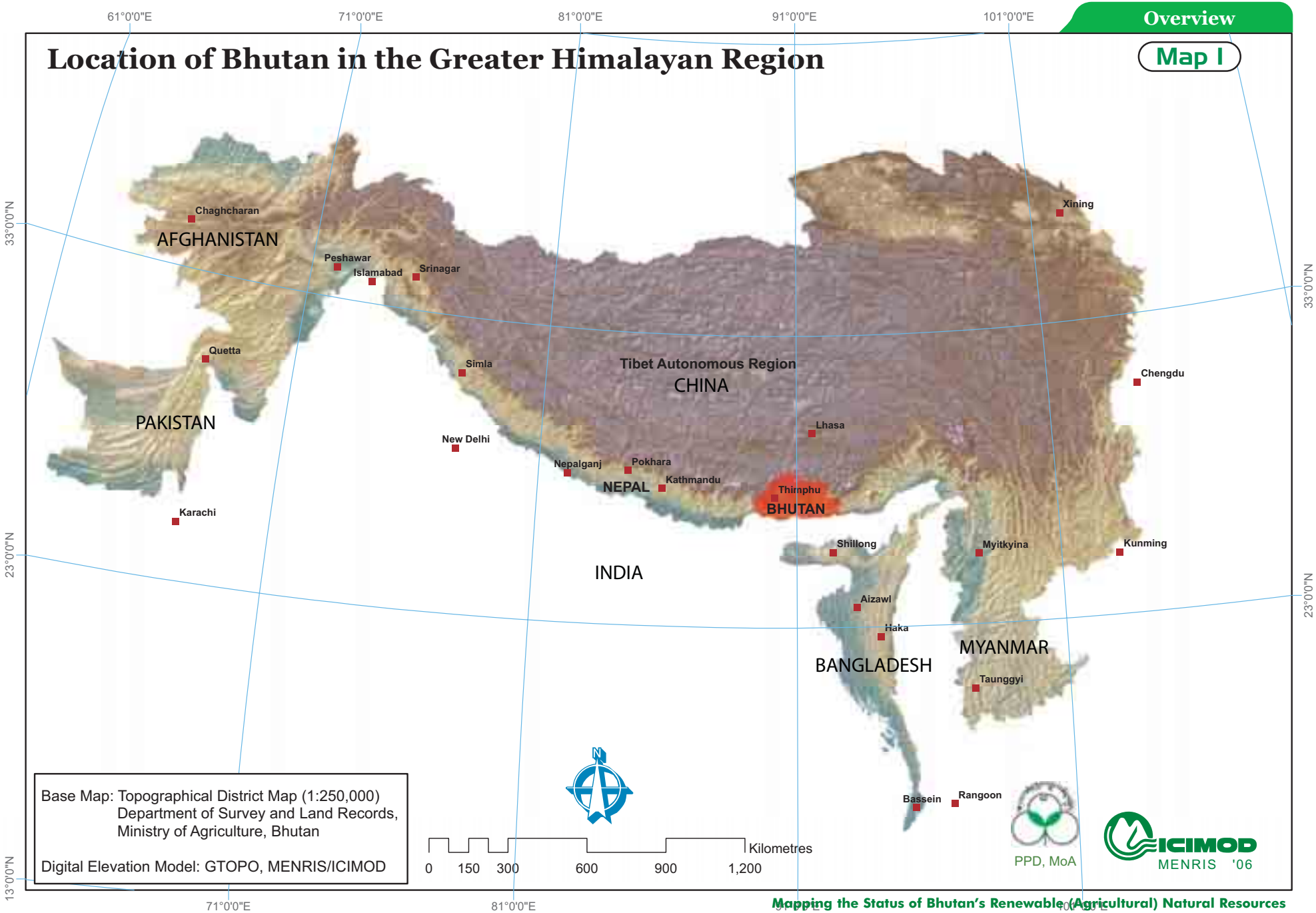
The large variation in elevation gives rise to a wide range of climatic conditions: from hot and humid subtropical in the low-lying south, to tundra with perpetual snow and ice conditions in the great Himalayan zone in the north. This is further modified by latitude, rainfall, slope gradient and exposure to sunlight and wind, to give each valley (and often even opposite facing slopes of a valley) a unique set of weather conditions. The south-west monsoon (which lasts from mid-June to September) is a dominant factor and accounts for 60-90% of the annual precipitation. The annual precipitation varies widely in different parts of the country. The high Himalayan region in the north receives only about forty millimetres of precipitation annually, primarily in the form of snow. The temperate central regions receive a yearly average of about 1,000 millimetres of rain, and in the subtropical south, plentiful precipitation (as much as 7,800 millimetres per year in some areas) gives rise to thick tropical forests.

Average daily temperatures in the sub-tropical foothills range from 15°-30°C. At elevations above about 1500m, the climate is cold and misty for much of the year as clouds move into the inner valleys. In the inner valleys, where the climate is temperate, the seasons are distinct; in Paro (2300m), for example, the temperature varies from 5°C in January to 25°C in July. Above 3500m, there is less recorded data on rainfall and temperature and the commonly used estimate of average daily temperature is 5°C. With increasing altitude the climate becomes more severe and is marked by short cool and wet summers and long cold winters.

* Current official figure (as of 2006) is 38,394 sq.km.

Location of Bhutan in the Greater Himalayan Region

Map I

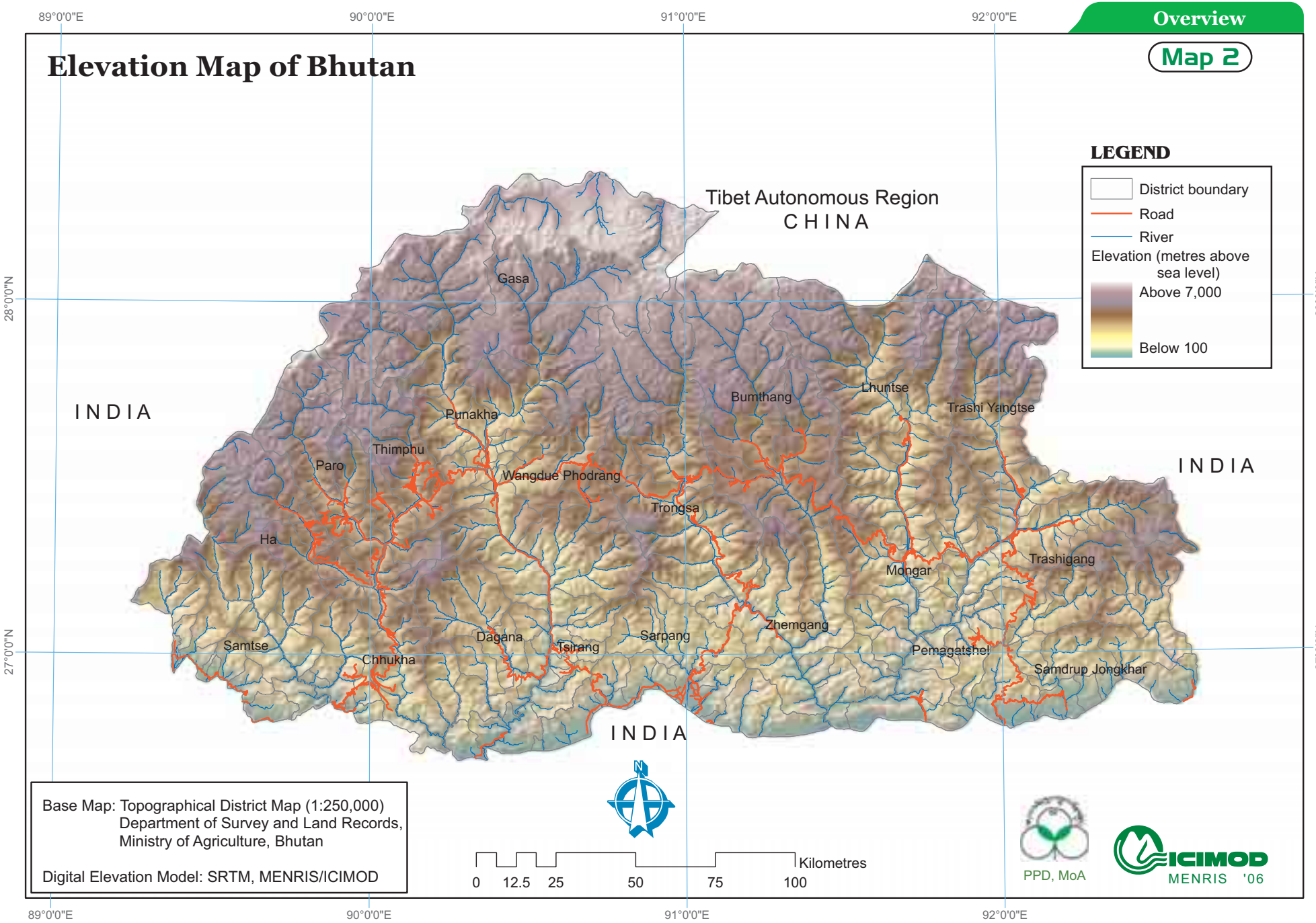


Base Map: Topographical District Map (1:250,000)
Department of Survey and Land Records,
Ministry of Agriculture, Bhutan

Digital Elevation Model: GTOPO, MENRIS/ICIMOD

Map 2

Elevation Map of Bhutan

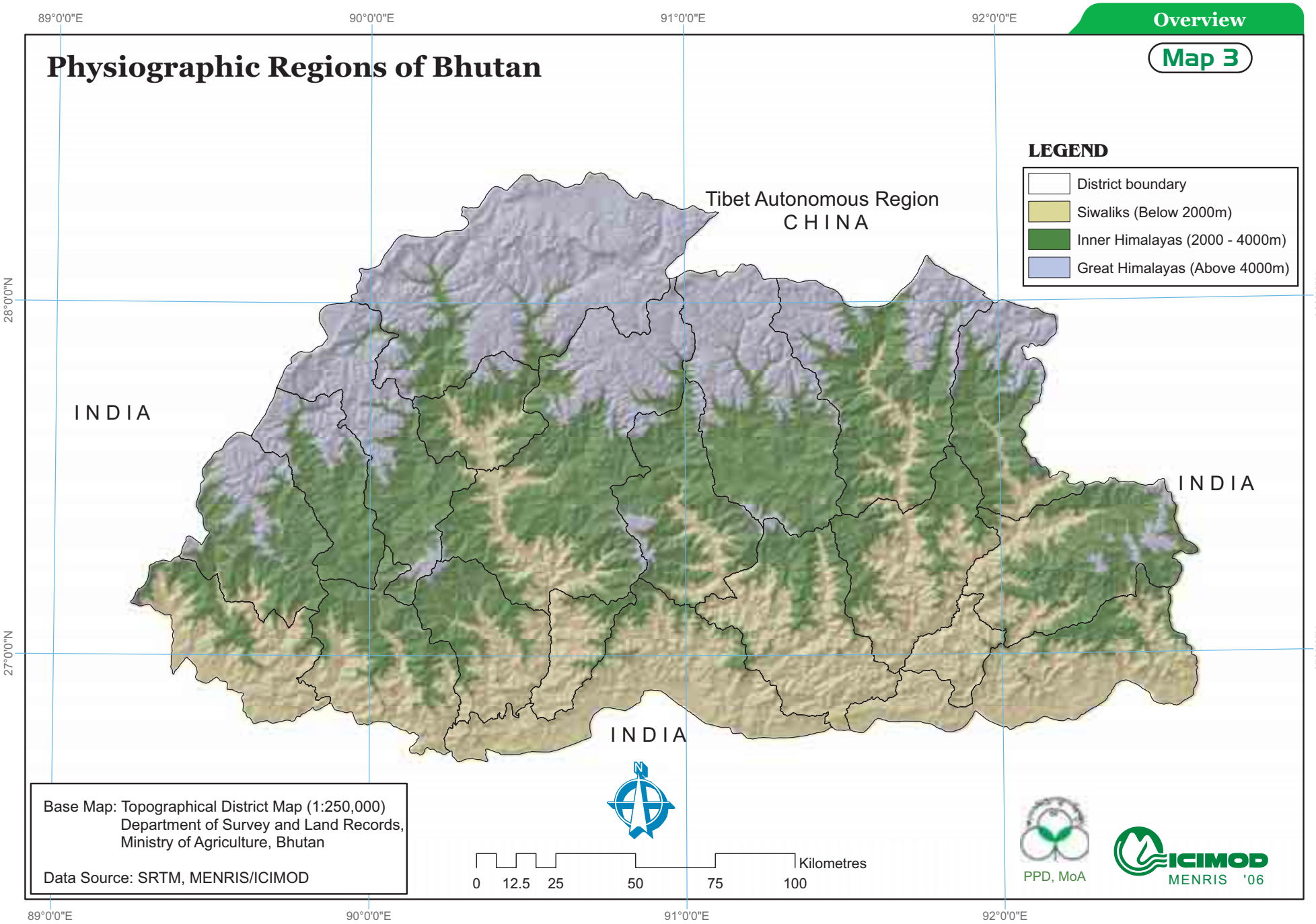


Base Map: Topographical District Map (1:250,000)
Department of Survey and Land Records,
Ministry of Agriculture, Bhutan

Digital Elevation Model: SRTM, MENRIS/ICIMOD

Map 3

Physiographic Regions of Bhutan

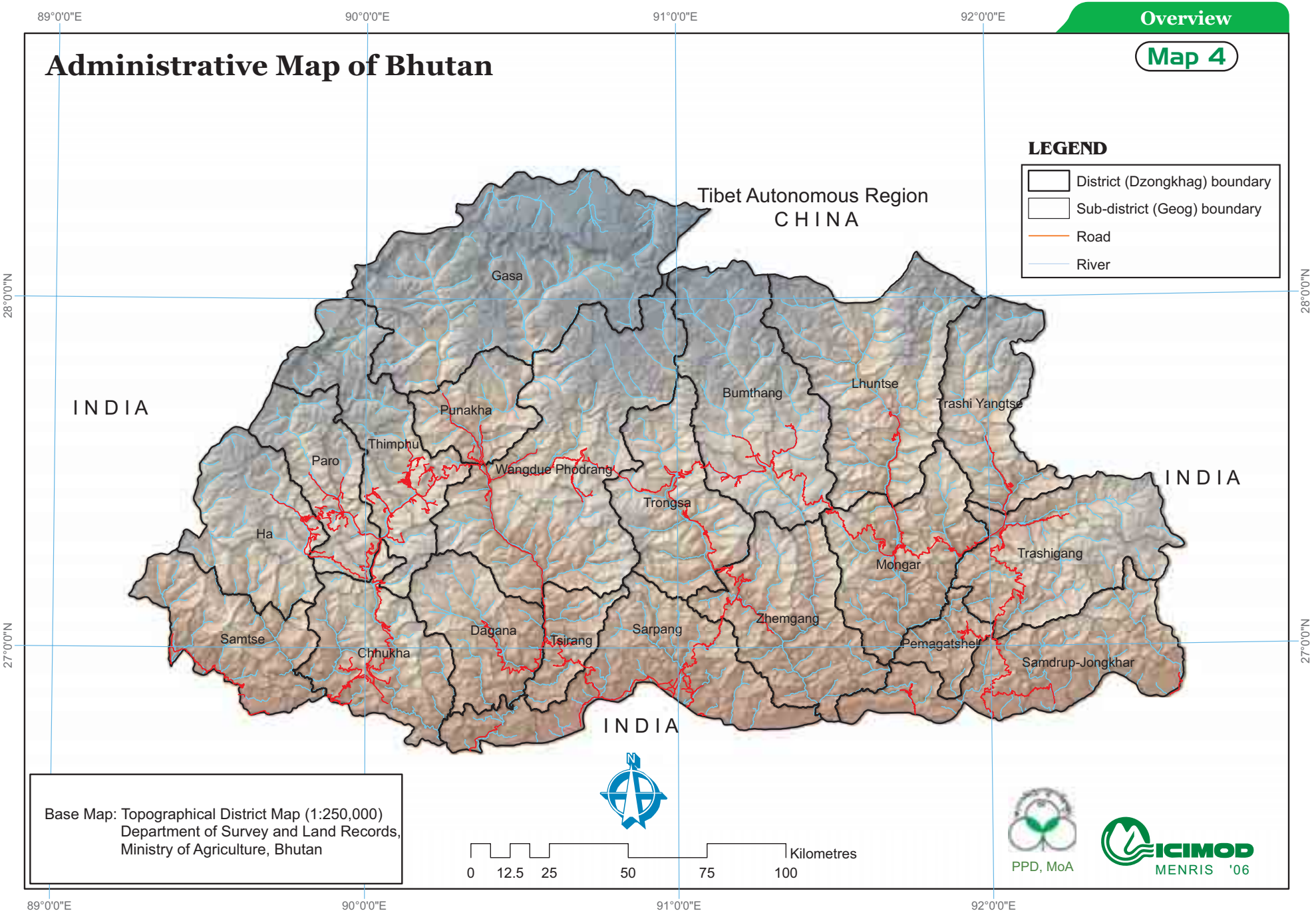


Base Map: Topographical District Map (1:250,000)
Department of Survey and Land Records,
Ministry of Agriculture, Bhutan

Data Source: SRTM, MENRIS/ICIMOD

Map 4

Administrative Map of Bhutan



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

Agro-ecological zones

MoA/ISNAR (1992) has proposed dividing Bhutan into six agro-ecological zones (AEZ) based mainly on altitude as shown in Table 2.1 and Map 5. These AEZ divisions are used to define the country's eco-floristic zones and agricultural ecosystems; each zone has a more or less distinct vegetation cover and agricultural practices. The AEZ divisions are alpine, cool temperate, warm temperate, dry sub-tropical, humid sub-tropical and wet sub-tropical. They do not correlate directly with the division into physiographic regions (the Southern Foothills, Inner Himalayas, and High Himalayas) although the division is similar. While such classifications work well in theory there are a number of difficulties in trying to use them in practice. The difficulties arise mainly because the terrain can vary greatly in elevation over very short distances so that it is common to find several agro-ecological zones within a few kilometres of each other in the same district.

Table 2.1: Agro-ecological Zones of Bhutan

Agro-ecological Zone	Altitude Range (masl approx.)	Annual Rainfall (mm approx.)	Air Temperature (°C)		
			Max	Min	Mean
Alpine	3600-4600	< 650	12.0	-0.9	5.5
Cool Temperate	2600-3600	650-850	22.3	0.1	9.9
Warm Temperate	1800-2600	650-850	26.3	0.1	12.5
Dry Sub-tropical	1200-1800	850-1200	28.7	3.1	17.2
Humid Sub-tropical	600 - 1200	1200-2500	33.0	4.6	19.5
Wet Sub-tropical	150-600	2500-5500	34.6	11.6	23.6

Source: MoA/ISNAR 1992

Vegetation

The wide variations in macro and micro-climatic conditions as a result of altitude, the number of hours of sunlight, and levels of precipitation, have resulted in the existence of a great diversity of vegetation within a limited geographic area. The southern foothills are mostly covered by dense forests of deciduous trees while the inner regions enjoy an almost endless variety of plants, flowers and trees. The fertile valleys of these inner regions are home to such varieties as birch, pine, chestnut, oak, apple, peach, and plum. The northern part, which is mostly tundra, can support flora such as coniferous trees and other alpine species such as magnolia, rhododendrons, birch, fir, and spruce (Table 2.2).

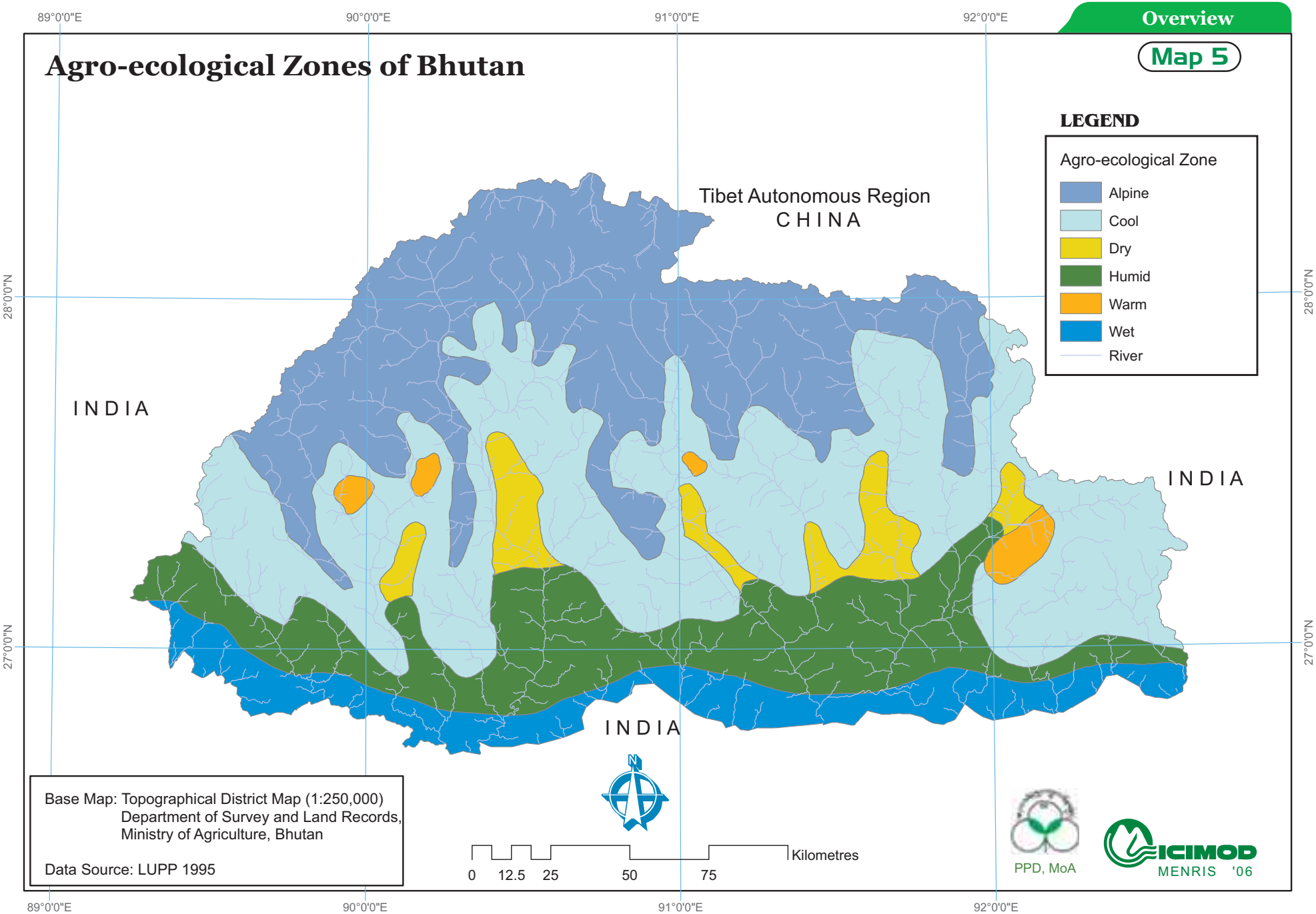
Table 2.2: Types of Vegetation

Agro-ecological Zone	Types of Vegetation		Agro-ecological Zone	Types of Vegetation	
	Common Name	Scientific Name		Common Name	Scientific Name
Wet Sub-Tropical	Sisso	*Dalbergia sissoo,*	**Warm Temperate**	Oaks	*Quercus semicarpifolia, Q. lanata, Q. grifithii*
	Khair	*Acacia catechu*		Blue pine	*Pinus wallichiana*
	Sal	*Shorea robusta*		Spruce	*Picea spinulosa*
	Sua grass	*Pollinia ciliata*		Bamboo	*Bambusa arundiacea*
Humid Sub-Tropical	Alnus	*Alnus nepalensis*		Rhododendron	*Rhododendron arboreum*
	Walnut	*Juglans regia*	**Cool Temperate**	Fir	*Albies densa*
	Magnolia	*Magnolia campbellii*		Juniper	*Juniperus recurva*
	Maple	*Acer cappadocicum*		Hemlock	*Tsuga dumosa*
	Rhododendron	*Rhododendron arboreum*		Larch	*Larix griffithiana*
				Birch	*Betula utilis, B. alnoides*

Source: Gyamtsho 1996 (citing Grierson and Long 1983, 1994)

Map 5

Agro-ecological Zones of Bhutan



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

Data Source: LUPP 1995

Land use and land cover

The last detailed survey of land use and land cover in Bhutan was carried out by the Land Use Planning Project in 1994 and was based on data from satellite images plus field verification (LUPP 1995). This survey showed that about 72% of Bhutan's total land area was forested of which 8% was scrub and the actual tree covered area about 64%. Much of Bhutan's forests are found on steep hillsides where they are relatively inaccessible for commercial exploitation and where there is a danger that tampering with the forest cover can have serious environmental implications. Arable agriculture land accounts for only about 8% of the total land area and this number is probably close to the maximum area suitable for cultivation. About 4% of the land is natural pasture; however, this does not reflect the total areas actually used as pasture since both forests, scrub forests and agricultural fallows are used for grazing at one time or other. The remaining 16% includes permanent snow covered areas, marshland, rocky outcrops, open eroded areas and landslides (Table 2.3 and Map 6).

The agricultural land mainly consists of chushing or wetland (terraced areas which are irrigated to grow crops), kamshing or dryland (sloping agricultural land that has not been modified into terraces where crops are grown mainly without irrigation), orchard, and shifting cultivation land (tseri). Paddy is the main crop cultivated on chushing, while kamshing is used to grow a variety of crops including maize, wheat, barley, buckwheat, millet, and vegetables. Shifting cultivation has decreased considerably during the last few years and is gradually giving way to sedentary cultivation.

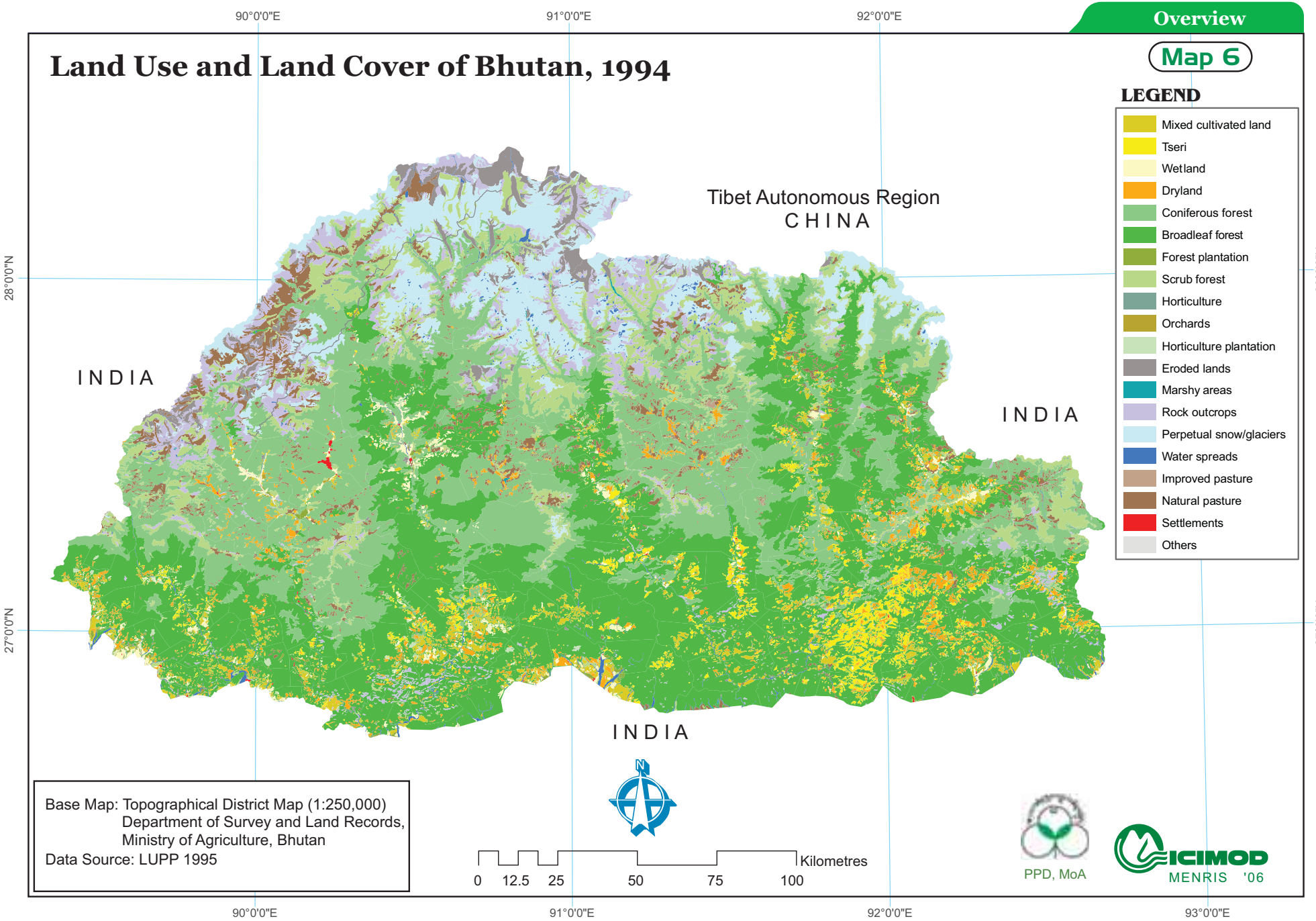
Table 2.3: Land Use and Land Cover, 1994

Land Use/Cover	Area (ha)	Percentage	
Total Forest	**2,904,521**		**72.5**
Coniferous forest	1,061,621	26.5	
Broadleaf forest	1,510,661	37.7	
Plantation	6,427	0.2	
Scrub	325,812	8.1	
Total Pasture	**156,441**		**3.9**
Natural pasture	155,346	3.9	
Improved pasture	1,095	0	
Total Agricultural Land	**308,844**		**7.7**
Chushing[a] (irrigated terraces)	38,761	1	
Kamshing (non-irrigated sloping land)	97,724	2.4	
Tseri (shifting cultivation)	88,332	2.2	
Mixed agriculture[b]	84,027	2.1	
Total Orchards	**5,788**		**0.1**
Orchards	2,222	0.1	
Plantations	3,566	0.1	
Settlements	**3,128**		**0.1**
Total Others	**628,949**		**15.7**
Perpetual snow	298,860	7.5	
Rocky outcrop	200,754	5	
Water bodies	30,376	0.8	
Marshland	3,528	0.1	
Landslips/eroded areas	95,431	2.4	
Total Land	**4,007,671[c]**		**100**

Source: LUPP 1995
[a] includes insignificant amount of non-irrigated terraces
[b] a type of land use in which wetland, dryland, orchard, and kitchen garden are adjacent
[c] value differs slightly from official value for land area

Map 6

Land Use and Land Cover of Bhutan, 1994



Base Map: Topographical District Map (1:250,000)
Department of Survey and Land Records,
Ministry of Agriculture, Bhutan
Data Source: LUPP 1995

National protected areas and biological corridors

The RGoB policy is to maintain at least 60% of the total land area of Bhutan under forest cover for the foreseeable future. Accordingly, conservation of the natural environment is given priority over the extraction and utilisation of natural resources for economic gain. However, in a country with a growing population, there is now increased demand on forest areas as the need for agricultural land and settlements increases. The government has responded by adopting policies aimed at protecting representative samples of remaining pristine Himalayan ecosystems, including the establishment of protected areas for the conservation of biodiversity and genetic resources. The national protected area system was established in 1993 and comprises four national parks, four wildlife sanctuaries, and one strict nature reserve (Table 2.4, Map 7). Protected areas now account for about 10,513 km^2 (26.2%) of the country's total land area. In 1999, a further 3804 km^2 was declared to be a 'biological corridor' intended to link the protected areas and to allow the free movement of wildlife between them. While these biological corridors are not strictly protected areas, they are intended to have only low intensity land use such as forest management units, community forests, agricultural land, and riparian corridors.

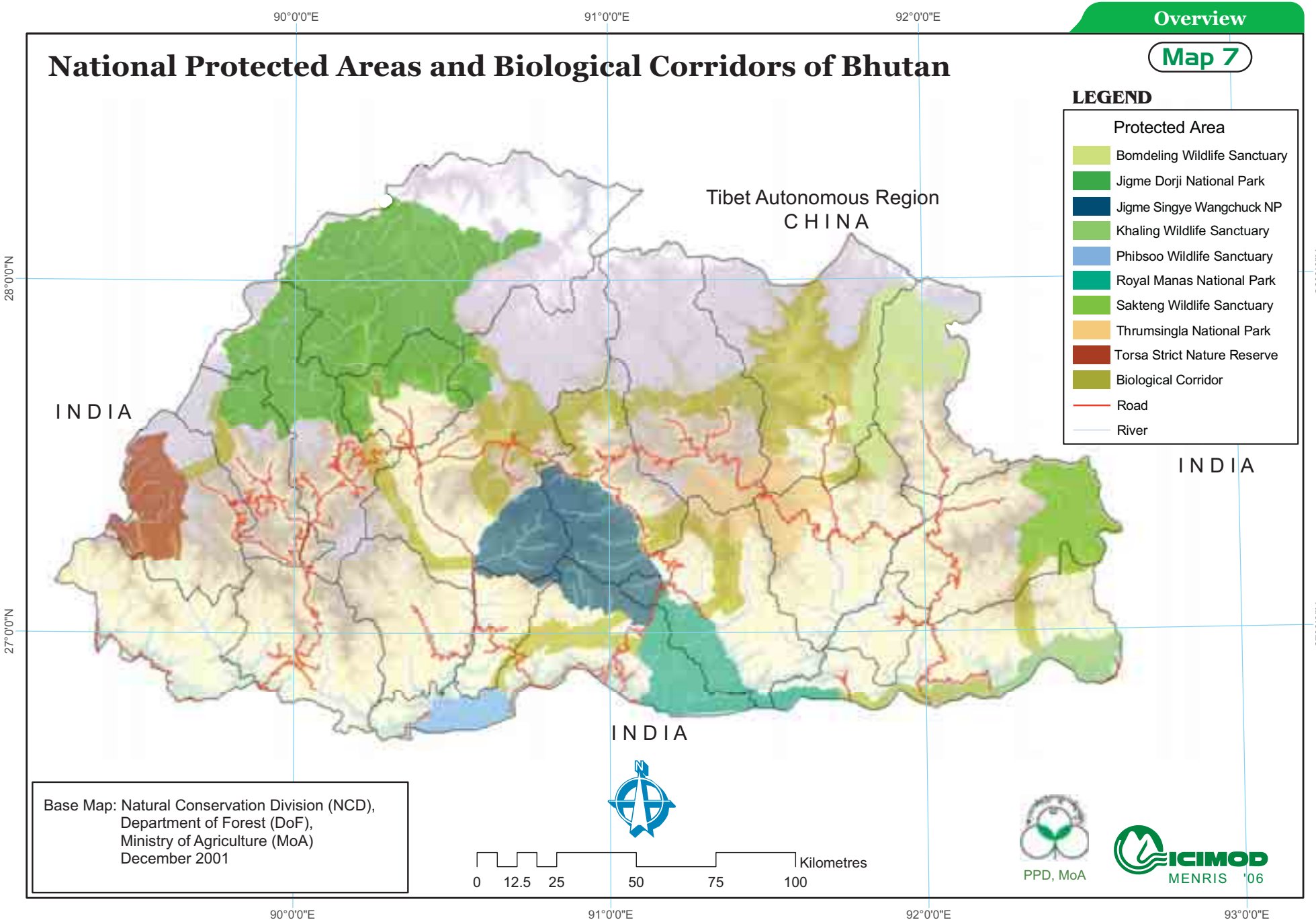
Table 2.4: Protected Areas

Name	Area (km^2)	Ecosystem Represented	Districts	Recorded species of Flora and Fauna	Status
Bomdeling Wildlife Sanctuary	1,300	Upland broadleaf forest, winter roosting area of migratory black-necked cranes	Trashi Yangtse, Lhuntse and Mongar	Mammals: na Birds : >290 Flora : >450	Fully operational
Jigme Dorji National Park	4,200	Habitat for takin, snow leopard, blue sheep, Chinese caterpillar, yarcha gunbu (*Cordyceps sinensis*), and rare alpine plant species	Gasa, Punakha, Thimphu and Paro	Mammals: >30 Birds : 300 Flora : 1400	Fully operational
Jigme Singye Wangchuk National Park	1,400	Pristine upland broadleaf forest, habitat for clouded leopard	Zhemgang, Tsirang, Trongsa, Sarpang and Wangdue	Mammals: >50 Birds : 395 Flora : na	Fully operational
Khaling Wildlife Sanctuary	273	Habitat of the pygmy hog	Samdrup Jongkhar	na	Notified by the RGOB in 1993
Phibsoo Wildlife Sanctuary	278	Country's only natural sal forest and also the habitat of the spotted deer	Sarpang	na	Operational plan under implementation
Royal Manas National Park	1,000	Prime subtropical forest; habitat for elephants, tigers, leopards, and golden langur (endemic)	Zhemgang and Sarpang	Mammals: 45 Birds : 366 Flora : >900 Herpeto-fauna: 28	Fully operational
Sakteng Wildlife Sanctuary	650	Pristine mixed coniferous forest; the highest number of rhododendron species are found here	Trashigang	na	Fully operational
Thrumsingla National Park	768	Old growth fir forest; prime habitat for the red panda, the satyr tragopan, and the monal pheasant	Bumthang, Mongar, Zhemgang and Lhuntse	Mammals: 68 Birds : 341 Flora : 7600	Fully operational
Torsa Strict Nature Reserve	644	Pristine temperate forest	Ha and Samtse	na	Notified by the Royal Government of Bhutan in 1993
Total Area	**10,513**				
Biological Corridors	3,800	Connect all protected areas			
Total Area	**14,313**	**About 35% of the total area of the country**			

Source: DFS 2003; ICS/MoA 2005 na = not available

Map 7

National Protected Areas and Biological Corridors of Bhutan



Base Map: Natural Conservation Division (NCD),
Department of Forest (DoF),
Ministry of Agriculture (MoA)
December 2001

The Economy

Agriculture and related activities continue to dominate Bhutan's economy. Current estimates show that about 79% of the population depends on agriculture. In 2003, the agriculture (RNR) sector contributed about 33% of GDP (total value Nu 10,595 million or approximately US$ 225 million) of which, crop production contributed 16%, livestock production 6%, and forestry and logging 11% (Table 2.5). Among the sectors, the contribution of the construction industry to the GDP has increased steadily from about 13% in 2000 to about 20% in 2003, which can be attributed to the government's emphasis on infrastructure development and the demand for housing. Despite the commissioning of new hydropower plants, the proportional contribution of the electricity and gas sector to the GDP has decreased slightly from 11.3% in 2000 to 9.6% in 2003. The GDP real growth rate in 2003 was 6.5%, with an inflation rate of 1.6%. Based on preliminary projections, real GDP is expected to grow by 7 to 9% per annum, and the average annual rate of growth by 8.2%, during the 9th Plan (2002-2007) period. The national currency is the 'ngultrum', which is pegged at par with the Indian rupee. Overall, the Bhutanese economy is closely interlinked with the Indian economy; India is Bhutan's main trading and development partner and provides the major share of its development assistance.

National development vision and policy

Bhutan's Vision 2020 document states that, "in our system of priorities for the future there is one priority that stands above all others: it is the need to ensure the future independence, sovereignty and security of our nation-state".

In keeping with this clear national priority, the important policy objectives include:

- human development – by addressing the need to improve standards of living, quality of life, and levels of well-being;
- welfare, culture, and heritage – promoting awareness and appreciation of the country's rich cultural heritage which is vital to Bhutan's unique identity, and interpreting traditional values in dynamic and development-oriented ways;
- balanced and equitable development – which requires special measures to support disadvantaged and vulnerable groups and ensure that development is regionally balanced;
- governance – for further development of institutions, human resources, and the system of governance; and
- environmentally sustainable development – the need for environmental conservation and environmentally sound development

Table 2.5: Sectoral Contributions to GDP 2003

Sector	% Contribution to GDP	
Renewable natural resources		32.7
Agriculture (crops)	*16.1*	
Livestock production	*6.2*	
Forestry and logging	*10.5*	
Mining and quarrying		1.9
Manufacturing		7.6
Electricity and gas		9.6
Construction		19.9
Trade and commerce		5.5
Transport and communication		8.6
Finance, insurance and real estate		6.5
Community, social and personal services		9.9

Source: NSB 2003

Renewable natural resources (RNR) development in Bhutan

As a result of the high priority placed by the government on the agricultural (RNR) sector, the rural economy has been transformed from a purely subsistence to a vibrant semi-subsistence cash economy. Despite the rapid growth in the hydropower and manufacturing sectors, agriculture (including livestock and forestry) remains the single biggest contributor to GDP, providing 33% of the total (Table 2.5). The proportion of the RNR contribution provided by agricultural crop production, livestock, and forestry over the years is shown in Table 2.6 and Figure 2.1.

People's access to food in terms of both quantity and quality have improved significantly an increase in production and the introduction of new crop varieties and improved farming practices. A small survey showed more than two-thirds of households to be fully self sufficient in rice (Table 2.7). The food basket has expanded to include more varieties of vegetables, fruits, and animal products. The range of options and opportunities available to rural people has increased manifold. The country now grows a wide range of food and cash crops, including maize, potatoes, apples, plums, walnuts, cabbage, tomato, broccoli, and asparagus. With a reduction in fallow lands, cropping intensity has increased significantly. While seasonal shortages of food still occur in some parts of the country, people are now able to manage by purchasing what they require from the market with the income they earn from the sale of cash crops and livestock products.

Export of agricultural products has increased consistently in spite of the constant challenge posed by the difficult climatic conditions, which can lead to both crop damage and the disruption of road transportation. Imports of major cereals have stabilised at around 38,000 tonnes annually. Livestock products such as meat, dairy products, and eggs continue to be imported, mainly for the urban population. The rural population has become mostly self-sufficient in cereal and livestock products, the deficit is mainly in urban areas.

Sale of timber and other forest products is a major source of revenue for the country. The forestry and logging sectors combined contribute 10.5% to the GDP and support some 270 industries, making them one of the country's main sources of employment.

Table 2.6: Trends in Contribution of the RNR Sector to GDP 1999-2003 (million Nu)

	1999	2000	2001	2002	2003
Agriculture (crops)	3,175	3,878	4,214	4,611	5,211
Livestock	1,487	1,637	1,770	1,788	2,002
Forestry	1,968	2,255	2,487	2,972	3,382
Total RNR	**6,630**	**7,772**	**8,471**	**9,371**	**10,595**

Source: NSB 2004

Figure 2.1: Contribution of RNR Sector to GDP (1999-2003)

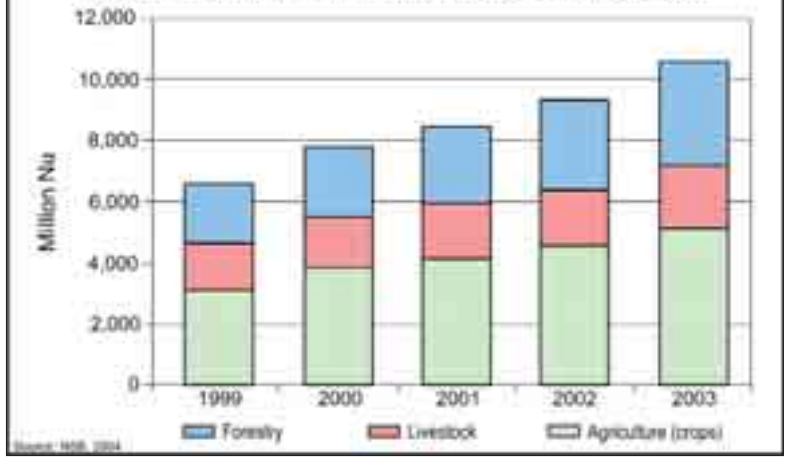


Table 2.7: Household Rice Self-sufficiency Status

Altitude	Total Sample	%HHs Sufficient	%HHs Deficit
High	105	73.3	26.7
Medium	83	71.1	28.9
Low	60	53.3	46.7
Overall	**248**	**67.7**	**32.3**

Source: RNRRC 2003

Over 77.5% of the households in rural Bhutan keep cattle. While the total number of cattle has been maintained at around 320,000, over 20% of these are now improved breeds (mostly cross breeds from Jersey and Brown Swiss stock). The production of milk and milk products has increased considerably as these crossbred cattle produce more than three times as much as the local cattle. The development of horse, sheep, and pig rearing has also been supported, as has the keeping of poultry birds for egg production.

As a direct result of the country's strong conservation policy, over 72% of the land area is now under forest cover – up from around 64% in the 1980s. Over 26% of the country's area is now protected in national parks and wildlife sanctuaries which are linked by a network of biological corridors occupying an additional 9% of the land area. Bhutan has gained international recognition for its conservation efforts; it is listed as one of the 10 global 'hot spots' of biodiversity. The recorded biodiversity includes 5400 species of vascular plants, 770 species of birds, and 178 species of mammals. Conservation has come hand in hand with a realisation of the need to balance both the social and commercial benefits from forests. Timber, firewood, and other forest products continue to be used by rural people to support their livelihoods. The commercial harvesting of timber is carried out in areas where it is feasible to do so but in accordance with a strict code of harvesting and post-harvesting management practices that conform to environmental principles.

Over the past few decades, the government has invested heavily in human resource and infrastructure development in the RNR Sector. As a result the Ministry of Agriculture now enjoys one of the best staffed ministries and employs professionals in nearly every area of its operation. The Ministry also has an elaborate network of field offices spread throughout the country; they include research and training centres, extension centres, livestock and seed production farms, veterinary hospitals, divisional forest offices, range and beat offices, soil and plant analysis laboratories, plant protection centres, and quarantine facilities.

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Part Three

Mapping the Status of Bhutan's Natural Resources

A. Agricultural Land

Agricultural land includes all land that is registered as land used for agriculture (even if it is occasionally left fallow). The two main types of arable agricultural land that are differentiated are 'chushing' or wetland, which is terraced, mostly irrigated, land used mainly to grow paddy, and 'kamshing' or dryland, which is sloping, mostly rainfed, but not terraced land.

This section provides some basic statistics related to agricultural land use in Bhutan and gives information on the size of the districts, the distribution of landholdings and the number of households.

The following maps and tables are included in this section:

A.1. Agricultural Land as a Percentage of Total District Area
A.2. Proportions of Different Types of Agricultural Land
A.3. Agricultural Area by Landholding Size
A.4. Farm Households by Agricultural Landholding Size
A.5. Households Owning Wetland (Chushing) and Size of Landholdings
A.6. Households Owning Dryland (Kamshing) and Size of Landholdings

In 2000, the breakdown by agricultural land type was as follows: chushing 21%, kamshing 43%, shifting cultivation 27%, orchards 8%, and kitchen garden 1%. Overall 58% of farm households owned wetland. The districts of Paro, Samtse, Punakha, Sarpang, Dagana, Tsirang, Wangdue, and Trashigang together contain about 71% of the country's total wetland.

Agricultural Land as a Percentage of Total District Area

Table A.1 shows the total land area of each of the twenty districts of Bhutan, the percentage of agricultural land in each districts (according to LUPP 1995), and the number of households per district arranged in descending order of agricultural land as a percentage of total district area. In the absence of demographic data, the number of households provides an approximation for the population. The map shows the districts ranked by agricultural land as a percentage of total district area.

According to the LUPP 1995, less than 8% of Bhutan's land area is agricultural land (Table 2.2). The LUPP was based on satellite imagery. At the district level, the agricultural land as percentage of total district area ranges from 45% in Pemagatshel to less than 1% in Gasa.

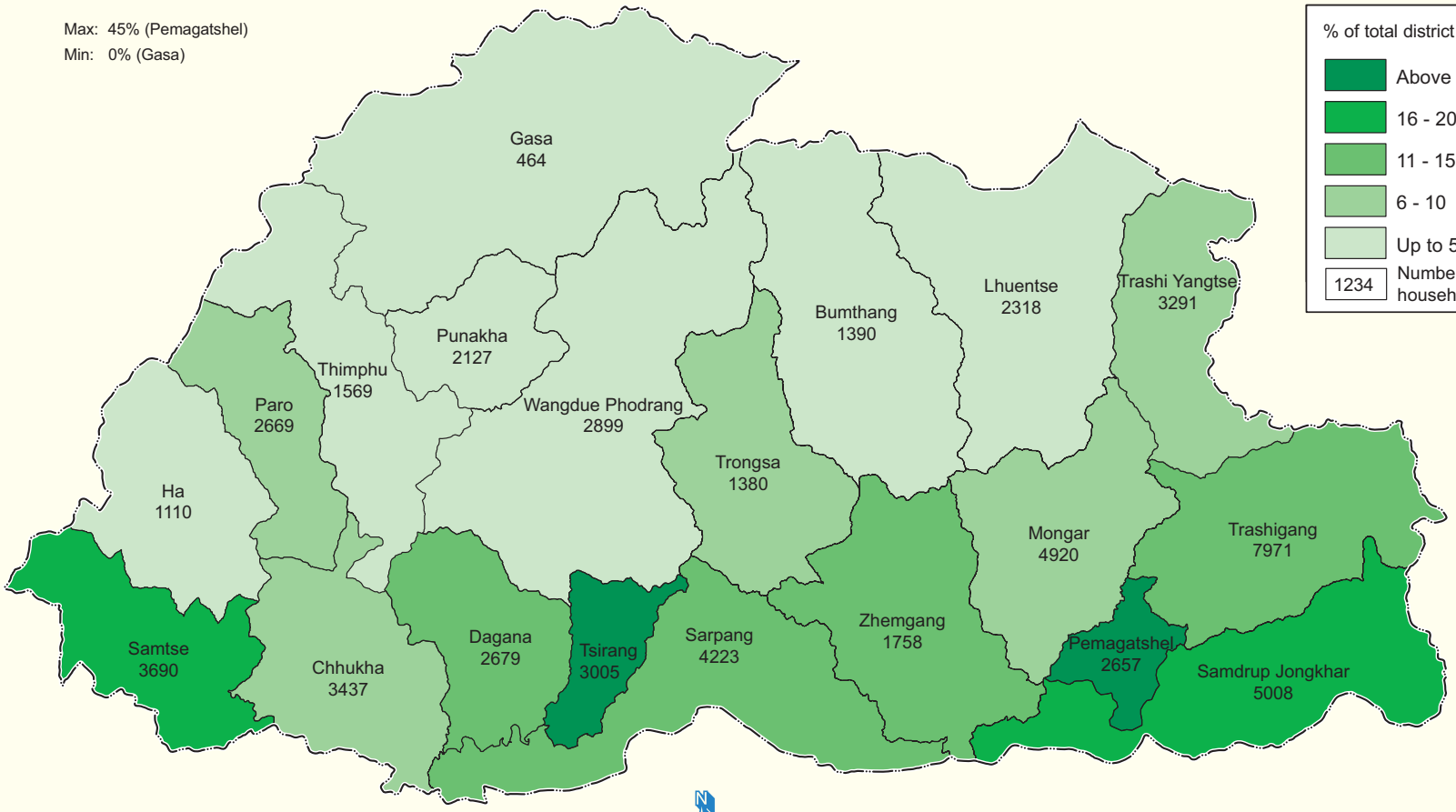
Table A.1

District	Total area* of district (km^2)	Agricultural Land*		No. of + farming households	District	Total area of district (km^2)	Agricultural Land		No. of farming households
		Total area (km^2)	% district area				Total area (km^2)	% district area	
Pemagatshel	518	235	45.3	2657	Trashi Yangtse	1643	128	7.8	3291
Tsirang	639	139	21.7	3005	Trongsa	1807	105	5.8	1380
Samdrup Jongkhar	2312	421	18.2	5008	Paro	1309	75	5.7	2669
Samtse	1584	249	15.7	3690	Punakha	975	46	4.7	2127
Trashigang	2316	329	14.2	7971	Lhuntse	3021	133	4.4	2318
Dagana	1389	176	12.7	2679	Wangdue	4070	94	2.3	2899
Sarpang	2344	284	12.1	4223	Bumthang	2831	59	2.1	1390
Zhemgang	2127	225	10.6	1758	Thimphu	2041	39	1.9	1569
Mongar	1947	191	9.8	4920	Ha	1747	33	1.9	1110
Chhukha	1792	167	9.3	3437	Gasa	4561	9	0.2	464
					Bhutan Total	**40,973**	3237	7.9	**58,565**

* Values from LUPP 1995
+ Values from RNR 2000

Agricultural Land as a Percentage of Total District Area

A I



LEGEND

% of total district area

- Above 20
- 16 - 20
- 11 - 15
- 6 - 10
- Up to 5
- 1234 Number of farm households

Scale 1:1,500,000

0 12.5 25 50 75

Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

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Proportion of Different Types of Agricultural Land

The values for the different types of agricultural land are taken from the RNR survey data. Table A.2 shows the districts in descending order of total agricultural land with the breakdown by agricultural land type. The map shows the districts ranked by total agricultural area with a pie chart showing the proportion of different land types. Note that the values for agricultural land area are rather different to those estimated by LUPP (1995) from satellite data. The total area of registered agricultural land was 262,363 acres or 1062 sq.km, 2.6% of the total land area.

Overall the southern districts have the most favourable conditions for agriculture in terms of both climatic conditions and general topography, Samtse, Sarpang, Chhukha, and Samdrup Jongkhar in the south, and Trashigang in the east, had the greatest amounts of agricultural area with more than 20,000 acres each on average. Samtse had the most agricultural area (37,390 acres) and Gasa the least (882 acres).

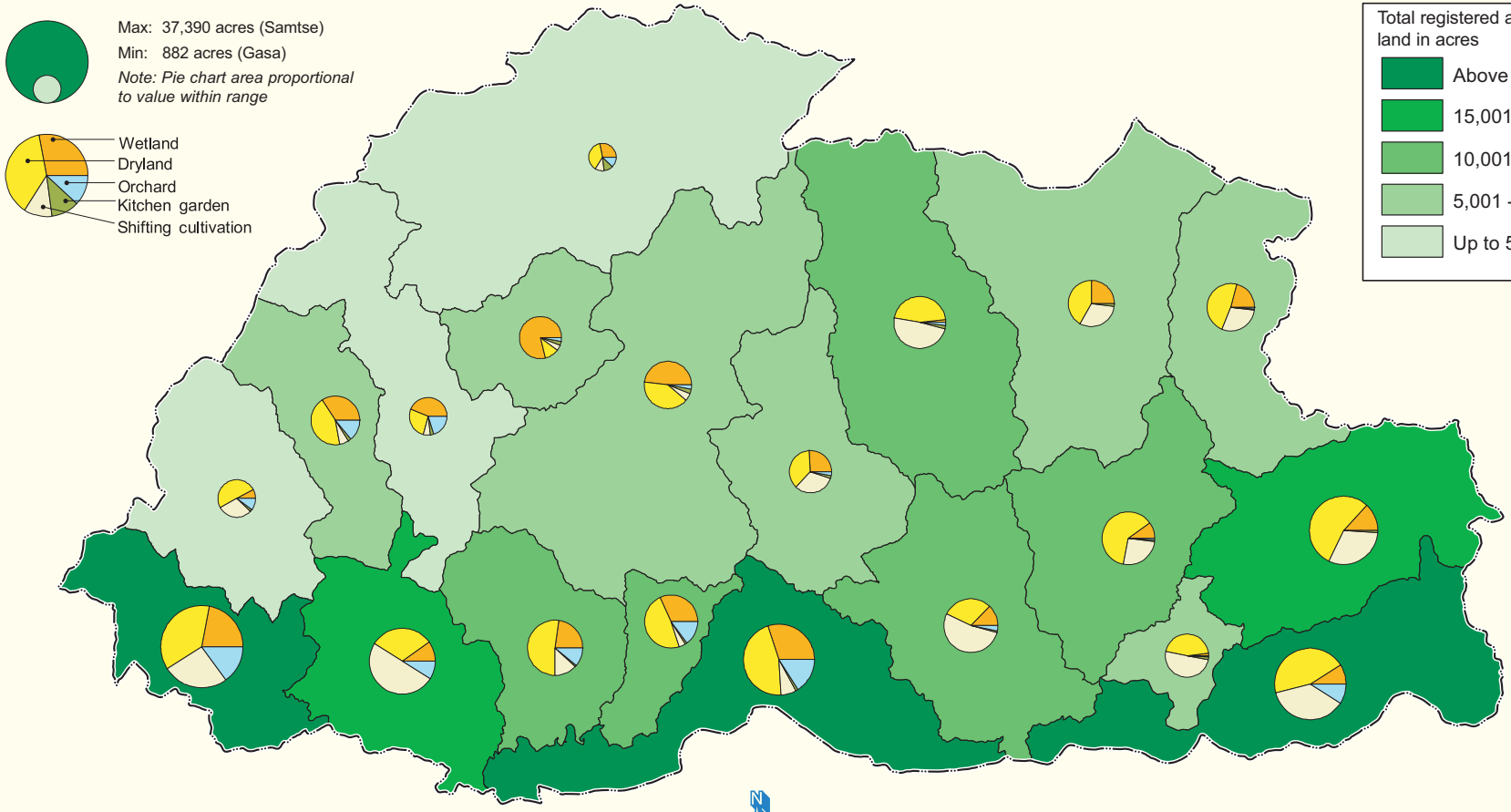
Table A.2

District	Wetland/ Chushing (acres)	Dryland/ Kamshing (acres)	Shifting Cultivation (acres)	Kitchen Garden (acres)	Orchard (acres)	Total* (acres)	District	Wetland/ Chushing (acres)	Dryland/ Kamshing (acres)	Shifting Cultivation (acres)	Kitchen Garden (acres)	Orchard (acres)	Total (acres)
Samtse	8,120	13,936	9,839	89	5,406	37,390	Paro	3,285	4,266	561	227	1,277	9,616
S/Jongkhar	2,407	12,058	9,991	96	2270	26,822	Trashi Yangtse	1,879	4,293	2,554	81	100	8,907
Sarpang	7,774	12,205	1,875	247	4,201	26,302	Wangdue	4,250	3,663	457	283	181	8,834
Trashigang	3,084	13,131	7,390	261	148	24,014	Lhuntse	2,006	3,388	2,544	123	100	8,161
Chhukha	2,108	6,859	11,068	98	1,799	21,932	Pemagatshel	100	2,960	3,309	75	145	6,589
Dagana	3,209	7,142	1,765	87	1,538	13,741	Trongsa	1,565	2,291	1,987	138	135	6,116
Zhemgang	1,630	3,779	6,751	79	543	12,782	Punakha	4,783	690	239	182	177	6,071
Tsirang	3,979	5,944	551	99	1,775	12,348	Thimphu	1,799	1,080	242	117	820	4,058
Mongar	1,234	7,549	3,122	110	157	12,172	Ha	339	2,020	1,197	78	413	4,047
Bumthang	275	5,183	5,708	253	160	11,579	Gasa	243	339	100	100	100	882
							Bhutan Total	**54,069**	**112,776**	**71,250**	**2,823**	**21,445**	**262,363**

* Total registered agricultural land

Proportion of Different Types of Agricultural Land

A 2



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

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Agricultural Area by Landholding Size

The proportion of agricultural land contained in landholdings of different size gives important information about the characteristics of land availability for agricultural farming. It provides an indication of the number of large or small farms and of production efficiency.

Table A.3 shows the percentage of agricultural land held in different sizes of landholdings in each district, with the districts listed in descending order of the percentage of land contained in large landholdings (more than 10 acres). The map shows the districts ranked according to the percentage of land in landholdings of more than 10 acres. The pie charts show the proportion of agricultural land in each of the three different landholding size categories and indicate the proportion in landholdings of more than 10 acres.

In 2000, around half of the agricultural land in all districts except Bumthang was held in medium size holdings (3-10 acres), with the remainder divided almost equally between small (<3 acres) and large (>10 acres) holdings depending on the district. Bumthang had the largest proportion of agricultural land in large landholdings (73%) and Trashi Yangtse the smallest (6%).

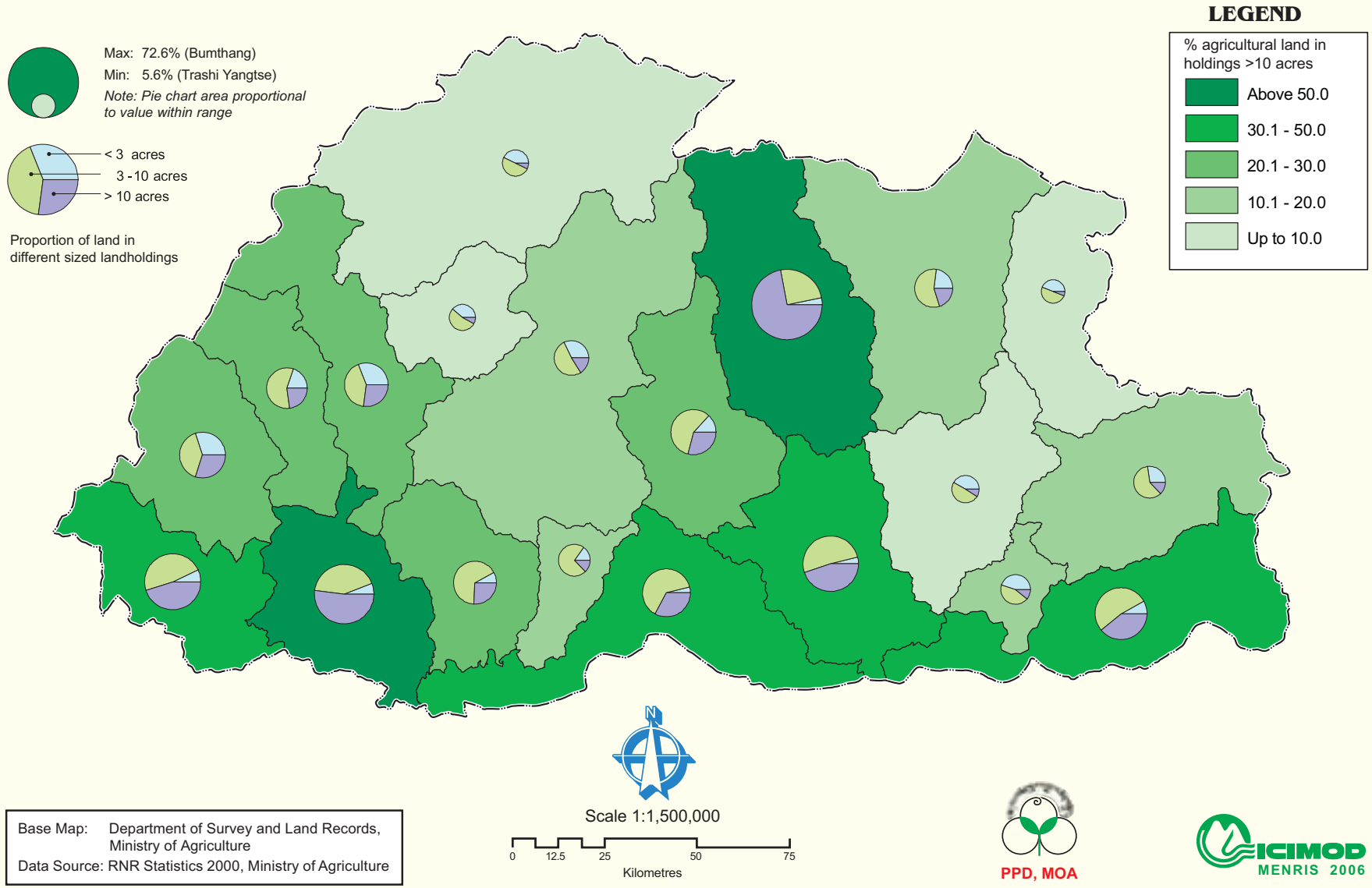
Table A.3

District	Landholding size (acres)			District	Landholding size (acres)		
	< 3	3 – 10	> 10		< 3	3 – 10	> 10
Bumthang	3.1	24.3	72.6	Paro	19.4	57.8	22.9
Chhukha	6.2	41.8	51.9	Lhuntse	23.2	57.0	19.8
Samtse	6.7	47.7	45.6	Wangdue	32.2	52.4	15.4
Zhemgang	4.2	51.3	44.5	Tsirang	15.0	71.8	13.2
S/Jongkhar	9.1	52.0	38.9	Trashigang	26.6	60.9	12.5
Sarpang	4.1	63.1	32.8	Pemagatshel	45.0	44.9	10.1
Ha	29.4	40.8	29.9	Mongar	42.1	49.1	8.7
Trongsa	13.4	57.7	28.9	Punakha	39.3	52.7	8.0
Dagana	7.9	65.5	26.5	Gasa	42.8	49.3	7.9
Thimphu	31.2	42.0	26.8	Trashi Yangtse	44.5	49.8	5.6
				Average*	**22.3**	**51.6**	**26.1**

* Simple averages, not weighted

Agricultural Area by Landholding Size

A 3



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD
MENRIS 2006

Farm Households by Agricultural Landholding Size

The percentage of farm households with landholdings of different sizes in each district gives an insight into the nature of land distribution among the farming communities in the country.

Table A.4 shows the percentage of households in 2000 having agricultural landholdingsthe in the size classes small (< 3 acres), medium (3-10 acres), and large (>10 acres) with the districts listed in order of the percentage with large landholdings. The map shows the districts ranked according to the percentage of households owning more than 10 acres. The pie charts show the proportion of households with landholdings in the different size classes.

In most districts, the great majority of households owned less than 10 acres, and in 15 districts the majority of households owned less than 3 acres. Bumthang had the highest percentage of households owning more than 10 acres (37%) and Trashi Yangtse the lowest (8%).

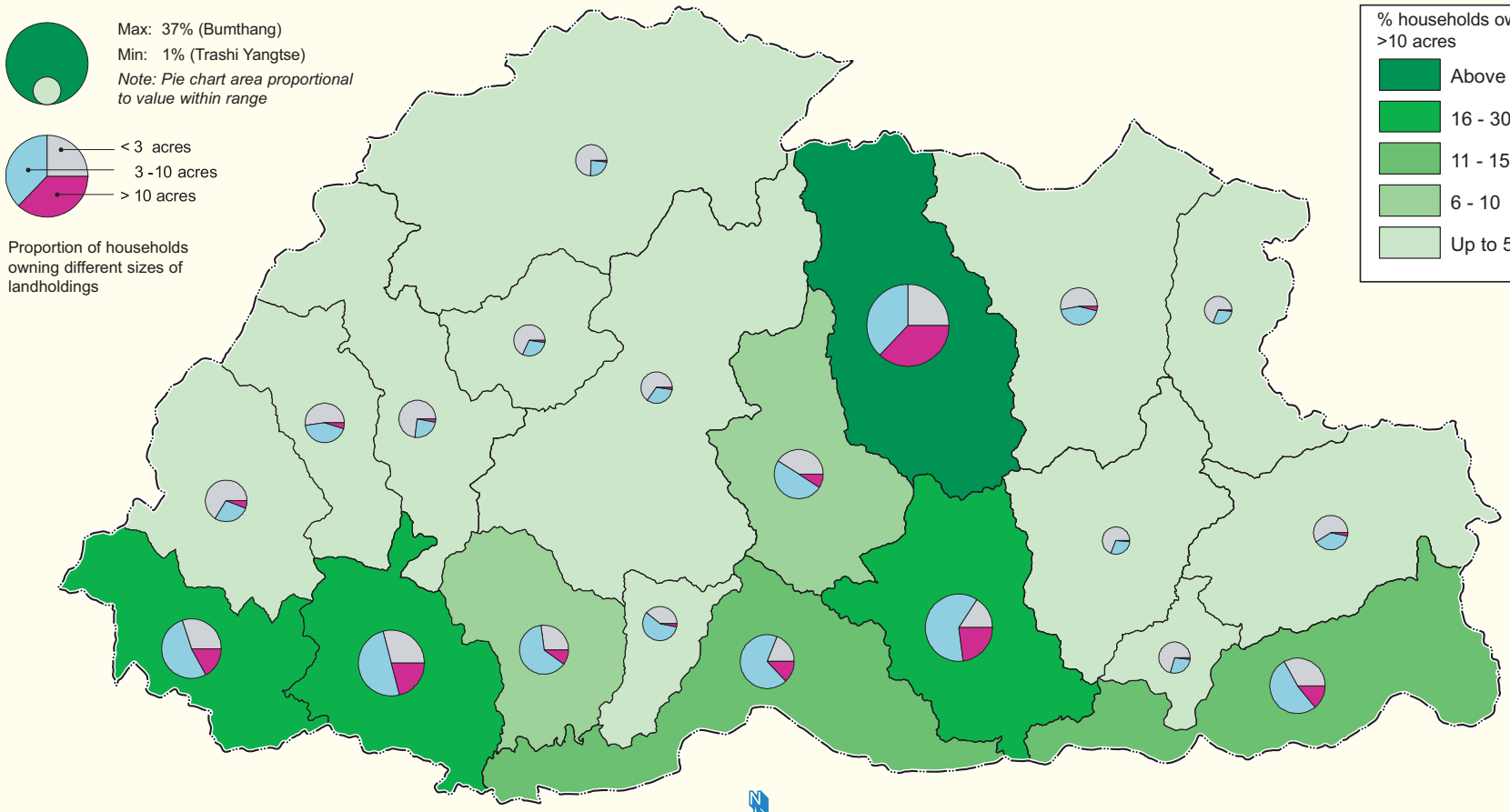
Table A.4

District	Landholding size (acres)			District	Landholding size (acres)		
	< 3	3 - 10	>10		< 3	3 - 10	> 10
Bumthang	25.4	37.9	36.8	Lhuntse	53.2	42.8	3.9
Zhemgang	16.1	61.6	22.2	Tsirang	38.7	57.8	3.5
Chhukha	28.3	50.2	21.5	Thimphu	73.0	23.6	3.4
Samtse	29.9	52.9	17.2	Trashigang	58.6	38.5	2.9
S/Jongkhar	33.2	52.8	14.0	Wangdue	65.0	32.9	2.1
Sarpang	18.6	68.9	12.4	Pemagatshel	71.4	25.9	1.8
Dagana	27.1	63.0	9.8	Punakha	68.9	29.7	1.5
Trongsa	40.8	49.7	9.7	Gasa	74.5	24.1	1.5
Paro	51.5	42.8	5.7	Mongar	69.4	29.2	1.3
Ha	66.0	28.3	5.6	Trashi Yangtse	69.7	29.5	1.0
				Average*	**47.4**	**43.9**	**8.0**

* Simple averages, not weighted

Farm Households by Agricultural Landholding Size

A 4



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

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MENRIS 2006

Households Owning Wetland (Chushing) and Size of Landholdings

Chushing or wetland cultivation, in which terraced areas are irrigated to grow crops (mainly paddy), constitutes an important form of land use. Ownership of chushing is normally considered a good indicator of food sufficiency.

Table A.5 shows the percentage of households that owned chushing in 2000 and the percentage of these landholdings in different size classes with the districts listed in descending order of the percentage of households owning chushing. The map shows districts ranked according to the percentage of households that own chushing. The superimposed pie charts show the proportion of chushing landholdings in the different size classes and indicate the overall percentage of households in each district who own chushing. Punakha district had the highest percentage of households owning chushing (90%), followed by Trongsa and Trashi Yangtse, and Pemagatshel the lowest (4%) followed by Bumthang.

The landholdings of chushing are relatively small with the majority of farm households in most districts, and more than 90% in Trashi Yangtse, Trashigang and Mongar, owning less than 3 acres.

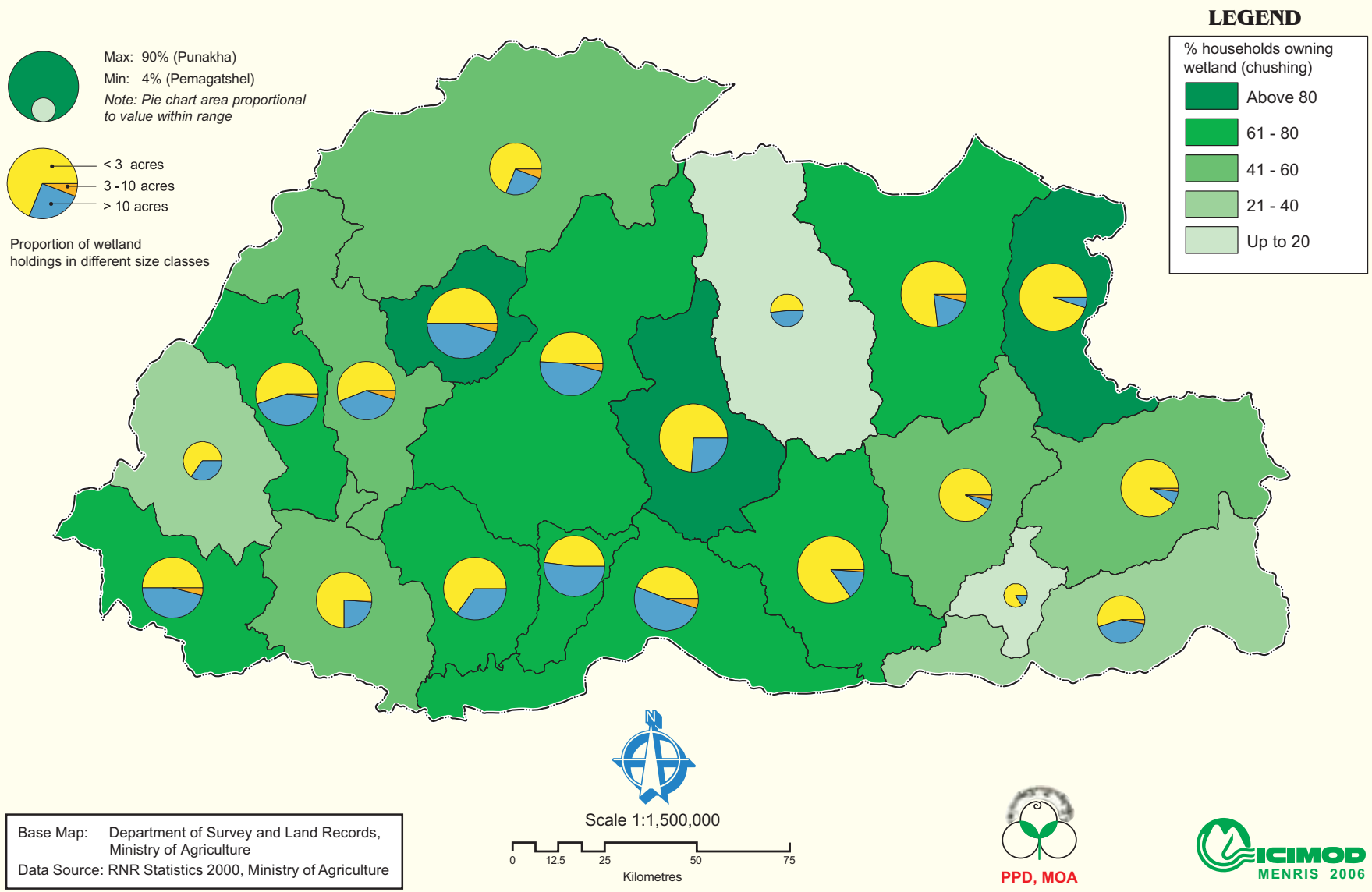
Table A.5

District	Landholding Size (acres)			% of HHs Owning Chushing	District	Landholding Size (acres)			% of HHs Owning Chushing
	< 3	3 - 10	> 10			< 3	3 - 10	> 10	
Punakha	50.4	46	3.6	90	Tsirang	47.3	52.7	0.0	65
Trongsa	74.3	25.7	0.0	84	Thimphu	46.7	37.1	5.2	59
Trashi Yangtse	95.5	4.5	0.0	82	Trashigang	90.3	7.9	1.8	57
Zhemgang	84.8	13.9	1.3	80	Chhukha	65.1	24.1	0.8	53
Lhuntse	77.4	19.1	3.6	77	Mongar	90.9	5.8	3.2	47
Sarpang	45.2	50.2	5.6	73	Gasa	69.3	24.5	6.2	45
Wangdue	48.9	46.6	4.5	71	S/Jongkhar	54.8	41.9	3.2	36
Dagana	65.6	34.4	0.0	70	Ha	64.8	35.2	0.0	21
Paro	54.6	43.3	2.1	69	Bumthang	52.6	47.5	0.0	13
Samtse	50.5	45.6	3.8	65	Pemagatshel	84.1	15.9	0.0	4
					Average*	**60.2**	**36.9**	**2.4**	**58**

* Simple averages, not weighted

Households Owning Wetland (Chushing) and Size of Landholdings

A 5



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD
MENRIS 2006

Households Owning Dryland (Kamshing) and Size of Landholdings

Kamshing or dryland agriculture, growing of crops on unterraced and mostly unirrigated sloping land, is another important form of agricultural land use. Almost all farm households own some dryland where they cultivate crops such as maize, wheat, barley, buckwheat, millet, and potato.

Table A.6 shows the percentage of households owning kamshing in each district in 2000 and the percentage of these landholdings in different size classes listed in descending order of the percentage of households owning kamshing. The map shows the districts ranked according to the percentage of households that own kamshing. The superimposed pie charts show the proportion of kamshing landholdings in different size classes and indicate the overall percentage of households in each district who owned kamshing. Overall the percentage of households owning kamshing was considerably higher than the percentage owning chushing (average 85% across the districts compared to 58%). Typically, the districts in the eastern part of the country led in terms of kamshing ownership. Mongar had the highest percentage of households owning kamshing (98%), followed by Trashi Yangtse, and Pemagatshel. Punakha district, which had the highest percentage of households owning chushing, had the lowest percentage of households (38%) owning kamshing.

In general kamshing landholdings are larger than chushing landholdings, with the proportion of landholdings being almost equally distributed between the small and medium classes.

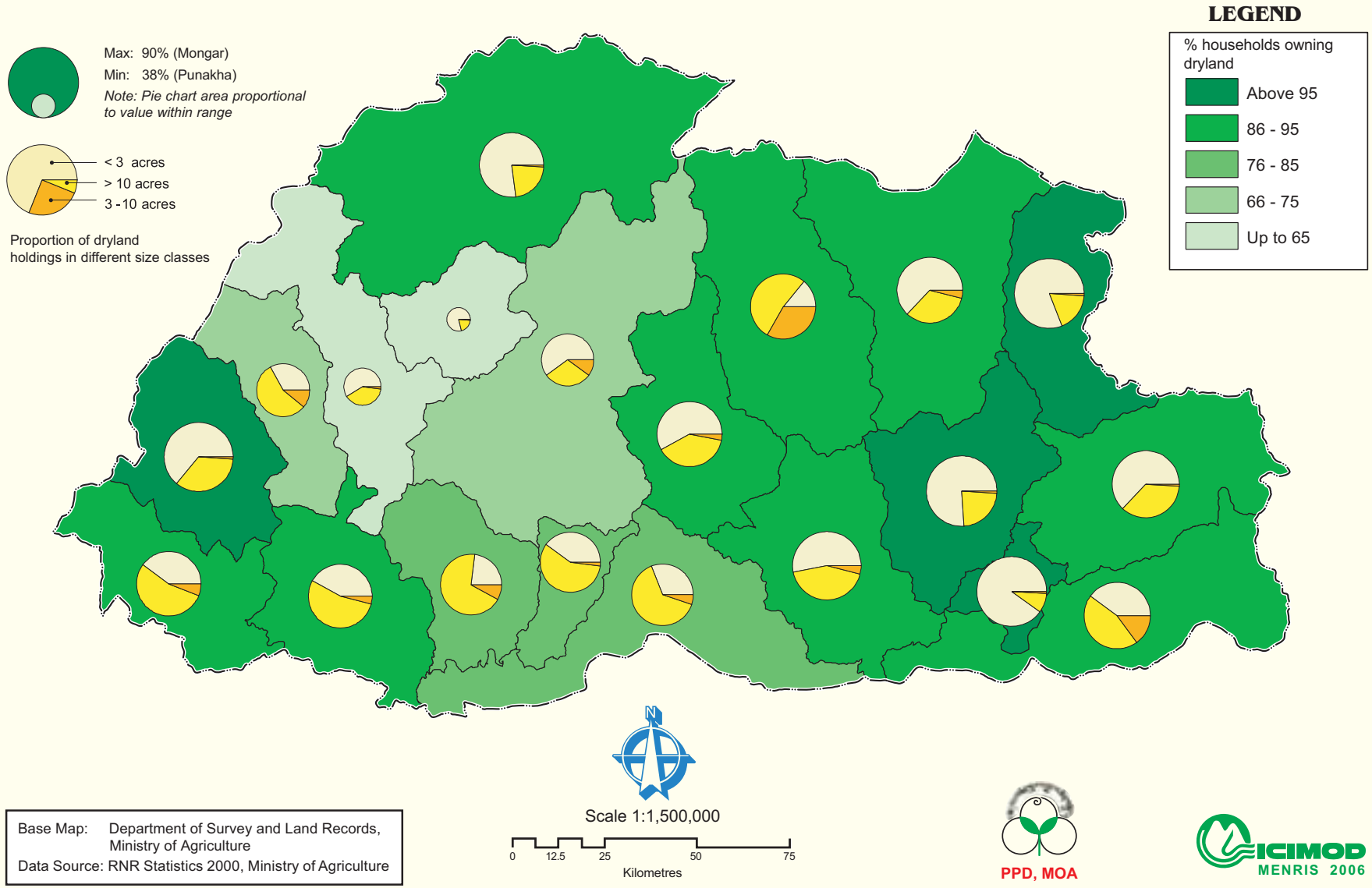
Table A.6

District	Landholding Size (acres)			%HHs Owning Kamshing	District	Landholding Size (acres)			%HHs Owning Kamshing
	< 3	3 - 10	> 10			< 3	3 - 10	>10	
Mongar	75.6	23.2	1.2	98	Samtse	40.2	53.6	6.2	89
Trashi Yangtse	82.1	17.1	0.8	97	Gasa	78.2	21.7	0.0	89
Pemagatshel	90.2	9.0	0.7	97	Chhukha	42.1	54.2	3.8	88
Ha	64.7	35.2	0.0	96	Sarpang	30.8	64.3	4.2	85
Zhemgang	52.9	43.4	3.6	95	Dagana	23.8	68.0	8.2	84
S/Jongkhar	40.0	44.9	15.0	95	Tsirang	40.0	58.1	1.8	83
Trashigang	62.7	35.9	1.3	93	Paro	33.5	55.5	11.0	73
Lhuntse	63.1	33.6	2.3	91	Wangdue	60.5	29.1	10.4	72
Bumthang	14.6	52.5	32.9	90	Thimphu	59.7	40.2	0.0	53
Trongsa	58.2	38.4	3.4	90	Punakha	80.4	19.6	0.0	38
					Average*	**49.0**	**44.7**	**5.8**	**85**

* Simple averages, not weighted

Households Owning Dryland (Kamshing) and Size of Landholdings

A 6



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD MENRIS 2006

B. Agricultural Production

Paddy and maize are Bhutan's two major cereal crops. Paddy is grown mainly in the temperate region (up to a maximum altitude of 2300m), where the temperatures and rainfall are higher than elsewhere in the country and there is more irrigated land. Maize is also grown at these lower elevations, but there is a preference for paddy in the western areas and for maize in the eastern areas. Wheat, buckwheat, barley, and millet are also grown, but the success rate for each depends very much on the local conditions. All farmers grow a few vegetables for their own home consumption, but increasingly farmers are turning to crops like potato and chilli that can be cultivated on larger areas and can be sold or traded.

Data on paddy and maize are provided separately, data on the less widely cultivated cereals are presented collectively. Due to their emerging importance for Bhutanese agriculture, data on potato and chilli are also provided. No detailed data are presented on other vegetable crops as their production is still insignificant compared to the main crops.

The following maps and tables are presented in this section:

Area Used to Grow Paddy

Table B.1 shows the number of acres per district used to grow paddy in 2000, with the districts listed in descending order of paddy area. The map shows the districts ranked acording to paddy area.

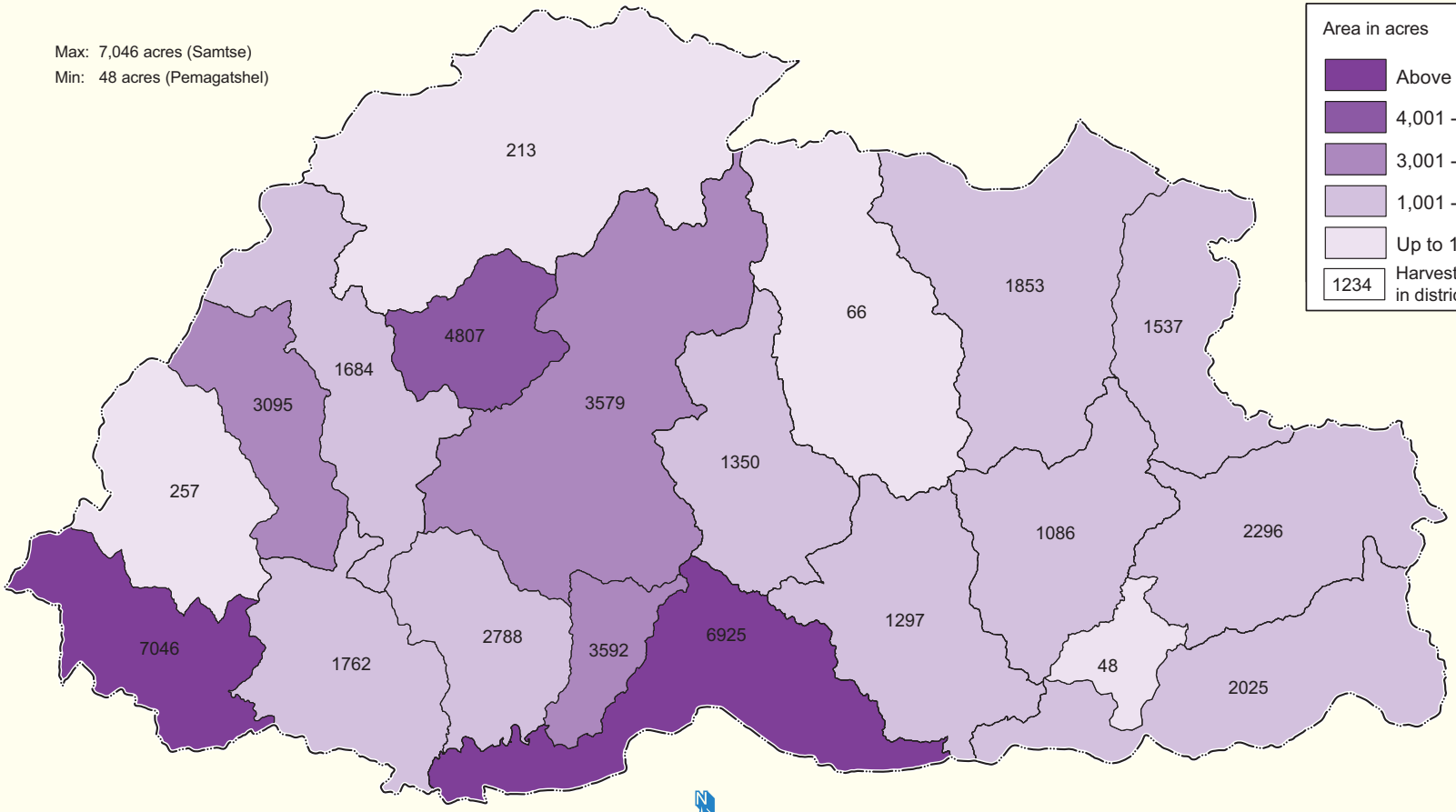
In 2000, over 47,000 acres of paddy were harvested. Samtse district had the largest harvested area (over 7000 acres) followed by Sarpang and Punakha; Pemagatshel and Bumthang had the lowest areas (less than 100 acres each).

Table B.1

District	Paddy Area (acres)	District	Paddy Area (acres)
Samtse	7,046	Chhukha	1,762
Sarpang	6,925	Thimphu	1,684
Punakha	4,807	Trashi Yangtse	1,537
Tsirang	3,592	Trongsa	1,350
Wangdue	3,579	Zhemgang	1,297
Paro	3,095	Mongar	1,086
Dagana	2,788	Ha	257
Trashigang	2,296	Gasa	213
S/Jongkhar	2,025	Bumthang	66
Lhuntse	1,853	Pemagatshel	48
		Bhutan Total	**47,306**

Area Used to Grow Paddy

B I



LEGEND

Area in acres

- Above 5,000
- 4,001 - 5,000
- 3,001 - 4,000
- 1,001 - 3,000
- Up to 1,000
- 1234 Harvested area in district

Scale 1:1,500,000

0 12.5 25 50 75

Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD MENRIS 2006

Area Used to Grow Maize

Table B.2 shows the number of acres per district used to grow maize in 2000, with the districts listed in descending order of maize area. The map shows the districts ranked according to maize area.

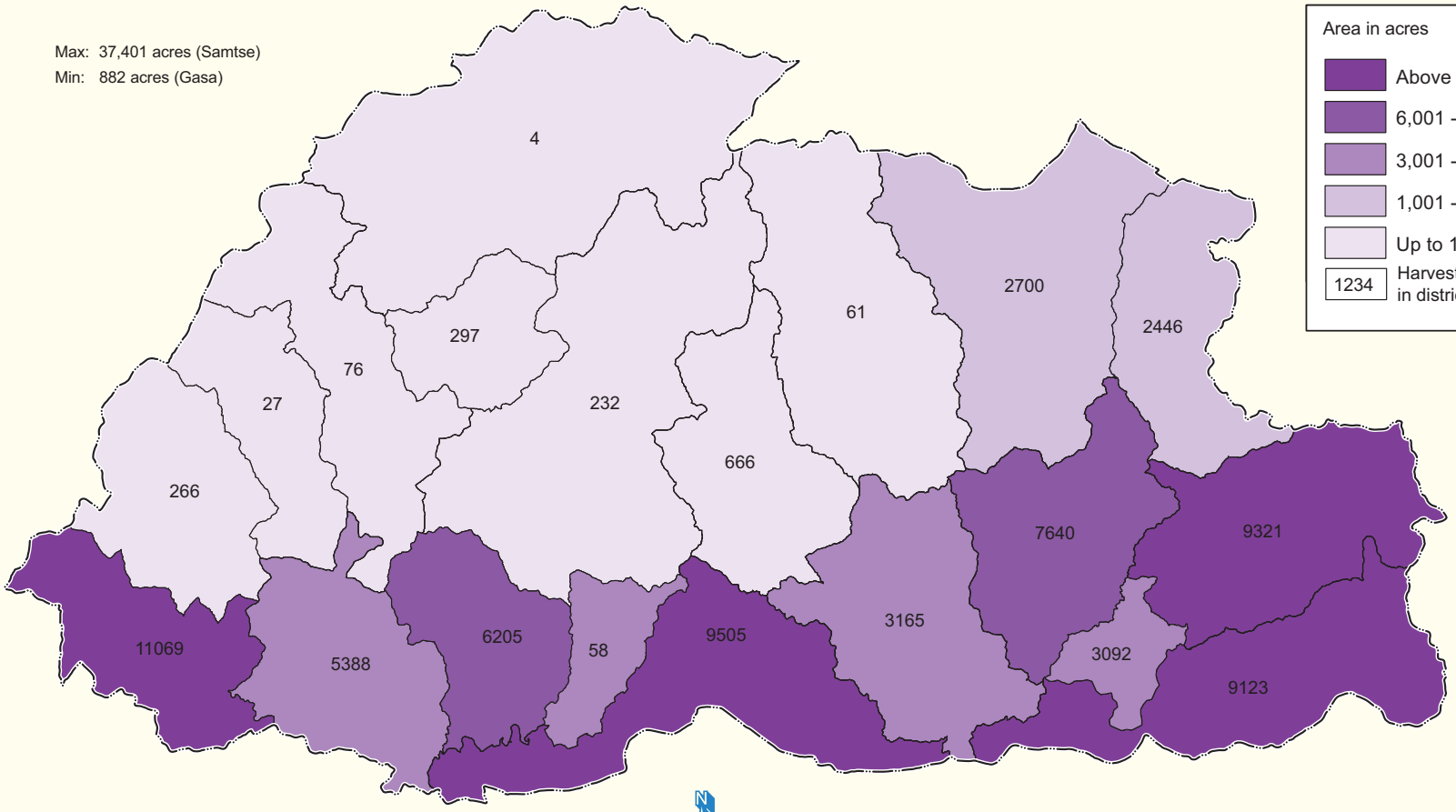
In 2000, nearly 77,000 acres of maize were harvested. Maize was much more common in the southern and eastern parts of the country. Samtse had the largest harvested area (over 11,000 acres) followed by Sarpang, Trashigang, and Samdrup Jongkhar; Gasa and Paro had the lowest areas (less than 50 acres each).

Table B.2

District	Maize (acres)	District	Maize (acres)
Samtse	11,069	Lhuntse	2,700
Sarpang	9,505	Yangtse	2,446
Trashigang	9,321	Trongsa	666
S/Jongkhar	9,123	Punakha	297
Mongar	7,640	Ha	266
Dagana	6,205	Wangdue	232
Tsirang	5,658	Thimphu	76
Chhukha	5,388	Bumthang	61
Zhemgang	3,165	Paro	27
Pemagatshel	3,092	Gasa	4
		Bhutan Total	**76,941**

Area Used to Grow Maize

B 2



LEGEND

Area in acres

- Above 9,000
- 6,001 - 9,000
- 3,001 - 6,000
- 1,001 - 3,000
- Up to 1,000
- 1234 Harvested area in district

Scale 1:1,500,000

0 12.5 25 50 75

Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD

MENRIS 2006

Area Used to Grow Wheat, Barley, Millet and Buckwheat

Table B.3 below shows the number of acres per district used to grow wheat, barley, millet, and buckwheat in 2000, with the districts listed in descending order of total area for all four crops. The map shows the districts ranked according to area for all four crops together. The superimposed pie charts show the proportion of the total area used for each of the crops, and indicate differences in the total area for all crops per district.

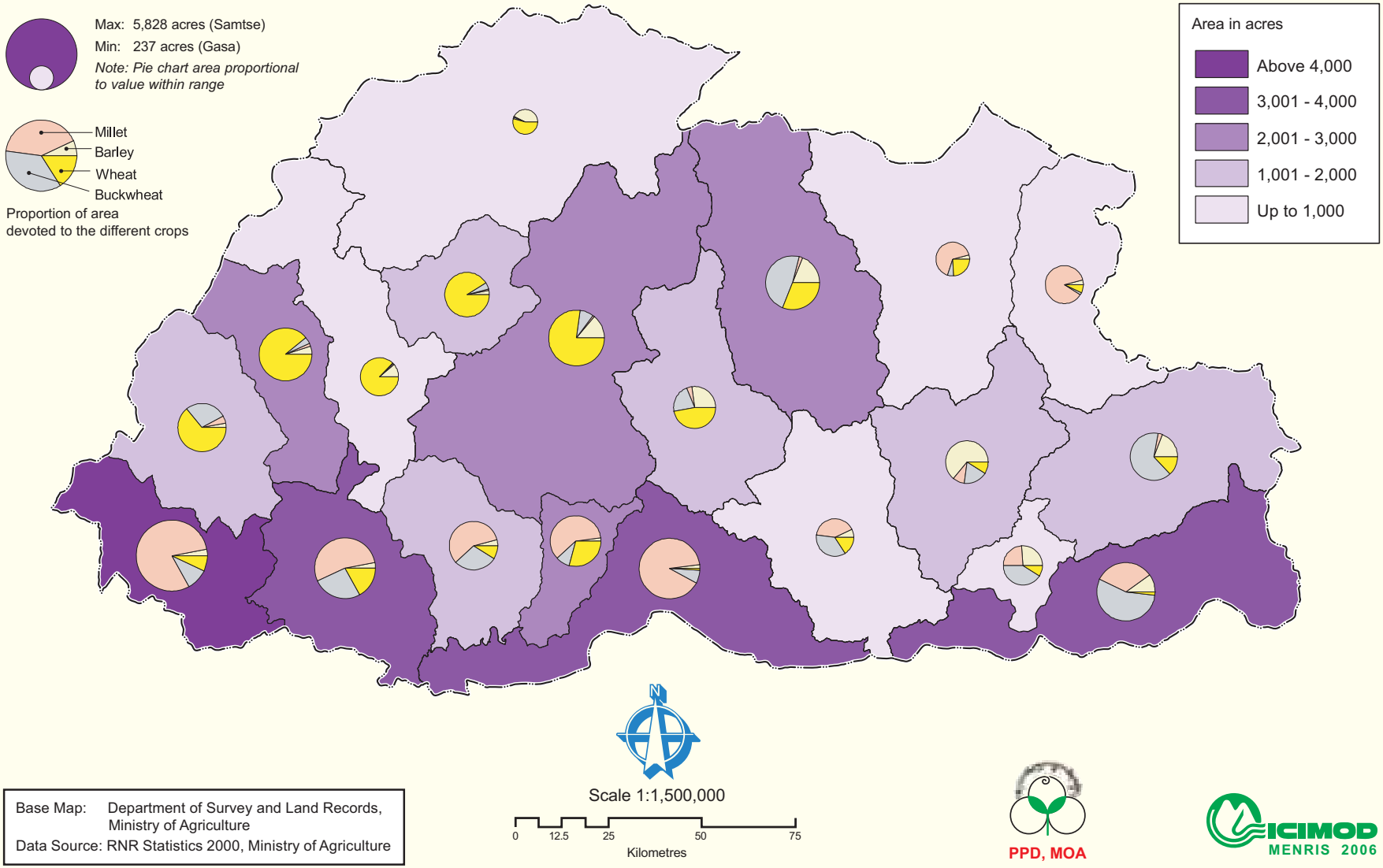
The areas used to grow wheat, barley, millet and buckwheat were considerably smaller than those used for paddy or maize, but they are still considerable in the context of the nation's food security policy. These cereals are particularly important for farm households at high altitudes where other cereals cannot grow. In 2000, over 11,500 acres wheat were harvested, more than half of it in the four districts of Wangdue, Paro, Punakha, and Ha. About 15,000 acres of millet (including both finger millet and foxtail millet) were harvested with the largest areas in Samtse, Sarpang, and Chhukha; and about 9,000 acres of buckwheat (both sweet and bitter) were larvested with the largest areas in Samdrup Jongkhar, Bumthang, and Trashigang.

Table B.3

District	Harvested Area (acres)				Total	District	Harvested Area (acres)				Total
	Wheat	Barley	Millet	Buckwheat			Wheat	Barley	Millet	Buckwheat	
Samtse	439	148	4,640	601	5,828	Trashigang	229	322	51	1,102	1,704
Chhukha	626	110	2,039	997	3,772	Punakha	1,229	40	16	63	1,348
Sarpang	45	58	3,401	262	3,766	Mongar	97	733	100	208	1138
S/Jongkhar	97	321	1,099	1,827	3,344	Trongsa	519	289	44	237	1089
Wangdue	2,251	401	36	229	2,917	Pemagatshel	70	213	193	328	804
Bumthang	839	499	40	1,250	2,628	Thimphu	608	77	6	6	697
Paro	2,195	113	44	110	2,462	Trashi Yangtse	49	29	597	15	690
Tsirang	625	48	1,276	195	2,144	Zhemgang	100	47	269	234	650
Dagana	171	82	1,062	527	1,842	Lhuntse	89	14	240	21	364
Ha	1,177	55	83	504	1,819	Gasa	129	102	2	4	237
						Bhutan Total	**11,585**	**3,701**	**15,238**	**8,720**	**39,243**

Area Used to Grow Wheat, Barley, Millet and Buckwheat

B 3



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

Area Used to Grow Potato and Chilli

Every farm household has at least some land area dedicated to a kitchen garden where they cultivate a variety of vegetables to meet daily household needs. In areas where there is easy access to market, surplus vegetables are sold for cash income. In the past, potatoes and chilli were simply backyard kitchen items, but increasing market opportunities mean that farmers are now turning to these crops to provide most of their cash income from farming. There is a large in-country demand for chilli, and both because there is a limited market outside and because this crop is perishable, chilli is marketed only within the country. Potatoes are both sold within the country and exported to India.

Table B.4 shows the number of acres per district used to grow potato and chilli in 2000, with the districts listed in descending order of total area for the two crops. The map shows the districts ranked according to the total area for the two crops together. The superimposed pie charts show the proportion of the total area used for each of the crops, and indicate differences in the total area for both crops per district. The recorded area includes both simple kitchen gardens and bigger farm plots.

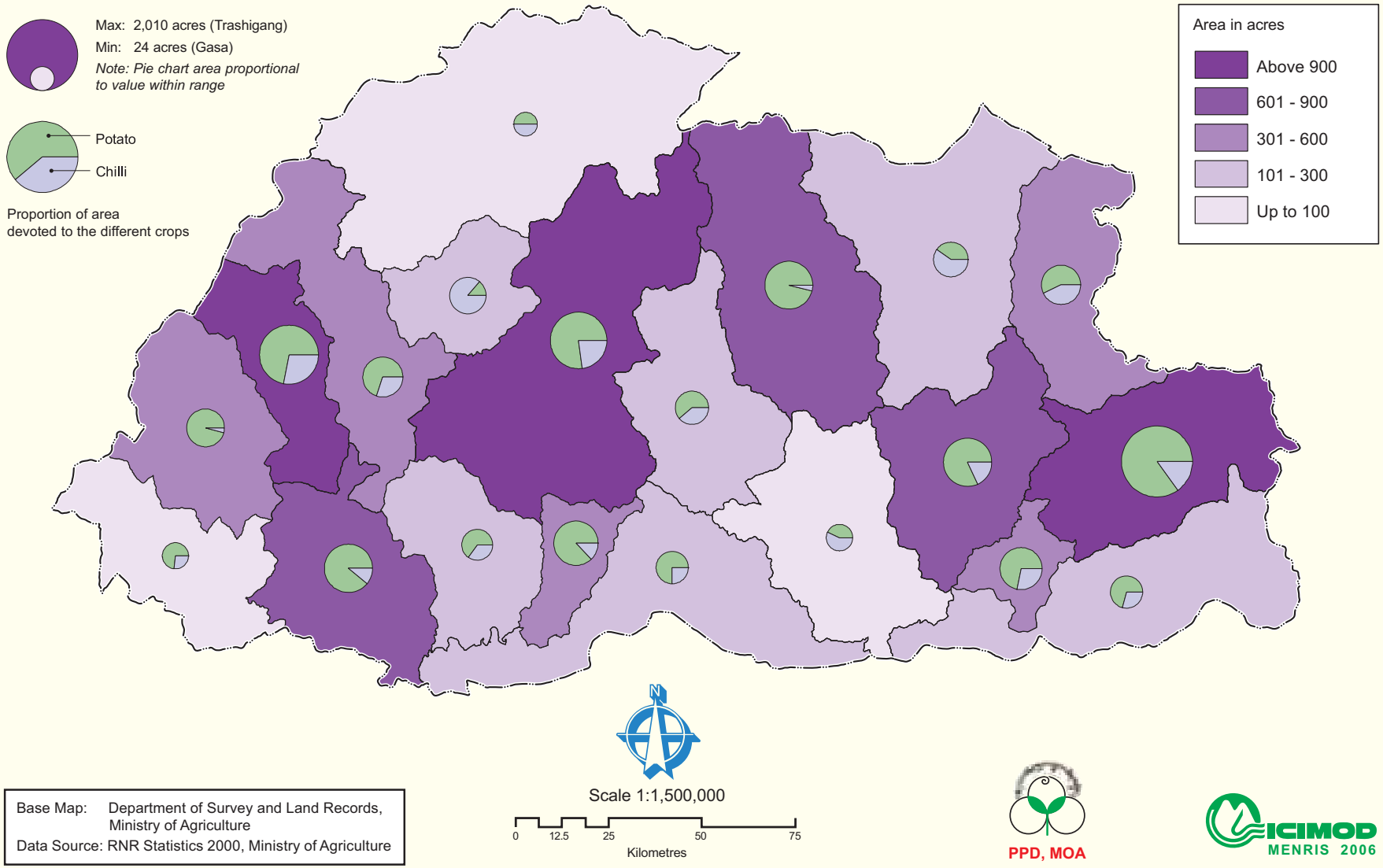
In 2000, over 7,700 acres were used to grow potato and more than 2,300 acres to grow chilli. Trashigang, Paro, and Wangdue had the largest areas under potato and chilli both separately and together. Gasa, Samtse and Zhemgang had the smallest total areas of these crops.

Table B.4

District	Potato (acres)	Chilli (acres)	Total (acres)	District	Potato (acres)	Chilli (acres)	Total (acres)
Trashigang	1,713	297	2,010	Ha	314	14	328
Paro	902	355	1,257	Punakha	41	245	286
Wangdue	872	260	1,132	Lhuntse	95	141	236
Mongar	595	130	725	Trongsa	120	77	197
Chhukha	640	81	721	Sarpang	131	44	175
Bumthang	678	27	705	S/Jongkhar	122	50	172
Tsirang	485	73	558	Dagana	93	49	142
Pemagatshel	344	131	475	Zhemgang	26	34	60
Thimphu	278	121	399	Samtse	40	15	55
Trashi Yangtse	214	159	373	Gasa	12	12	24
				Bhutan Total	**7,715**	**2,315**	**10,030**

Area Used to Grow Potato and Chilli

B 4



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

Farm Households Cultivating Paddy

Paddy is a very important cereal crop as rice is the main staple food in Bhutan. Table B.5 shows the percentage of households cultivating paddy in each district in 2000, listed in descending order. The map shows the districts ranked according to the percentage of households cultivating paddy.

More than two-thirds of all households in the central and northeastern districts cultivate paddy, with the largest percentage in Punakha (92%) followed by Trongsa (82%). Very few households grew paddy in Pemagatshel, where there is little chushing land and households that do produce paddy mainly do so on non-irrigated land under shifting cultivation. Similarly almost no paddy is grown in Bumthang because it is too cold; the households in Bumthang that grow paddy actually cultivate it in other districts.

Table B.5

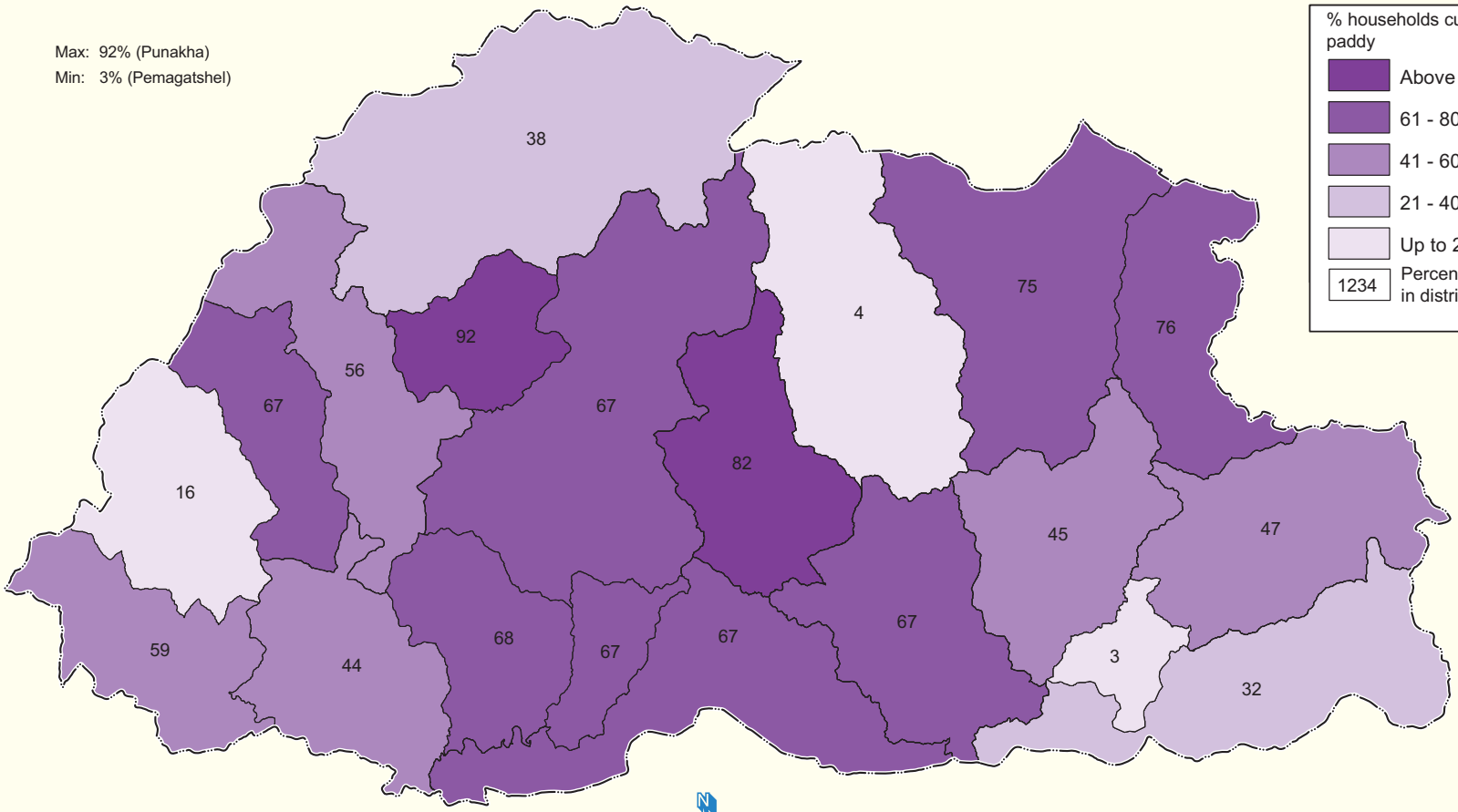
District	% HHs Cultivating Paddy	District	% HHs Cultivating Paddy
Punakha	92	Samtse	59
Trongsa	82	Thimphu	56
Trashi Yangtse	76	Trashigang	47
Lhuntse	75	Mongar	45
Dagana	68	Chhukha	44
Zhemgang	67	Gasa	38
Wangdue	67	S/Jongkhar	32
Paro	67	Ha	16
Tsirang	67	Bumthang	4
Sarpang	67	Pemagatshel	3
		Average*	**54**

* Simple average, not weighted

Farm Households Cultivating Paddy

B 5

Max: 92% (Punakha)
Min: 3% (Pemagatshel)



LEGEND

% households cultivating paddy

- Above 80
- 61 - 80
- 41 - 60
- 21 - 40
- Up to 20
- 1234 Percentage in district

Scale 1:1,500,000

0 12.5 25 50 75
Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD
MENRIS 2006

Farm Households Cultivating Maize

Maize is the second most important cereal crop in Bhutan. In addition to being a food crop, maize is also fermented to prepare local beverages and both the grain and its by-products are used for livestock feed. Table B.6 shows the percentage of households cultivating maize in each district in 2000, listed in descending order. The map shows the districts ranked according to the percentage of households cultivating maize.

Around 80% or more of households in the eastern and southern districts (apart from Chhukha) cultivate maize, with the largest percentage in Pemagatshel and Mongar. Maize is only grown very sparingly in the more northern and western districts despite favourable climatic conditions, and is more often used as livestock feed than for human consumption.

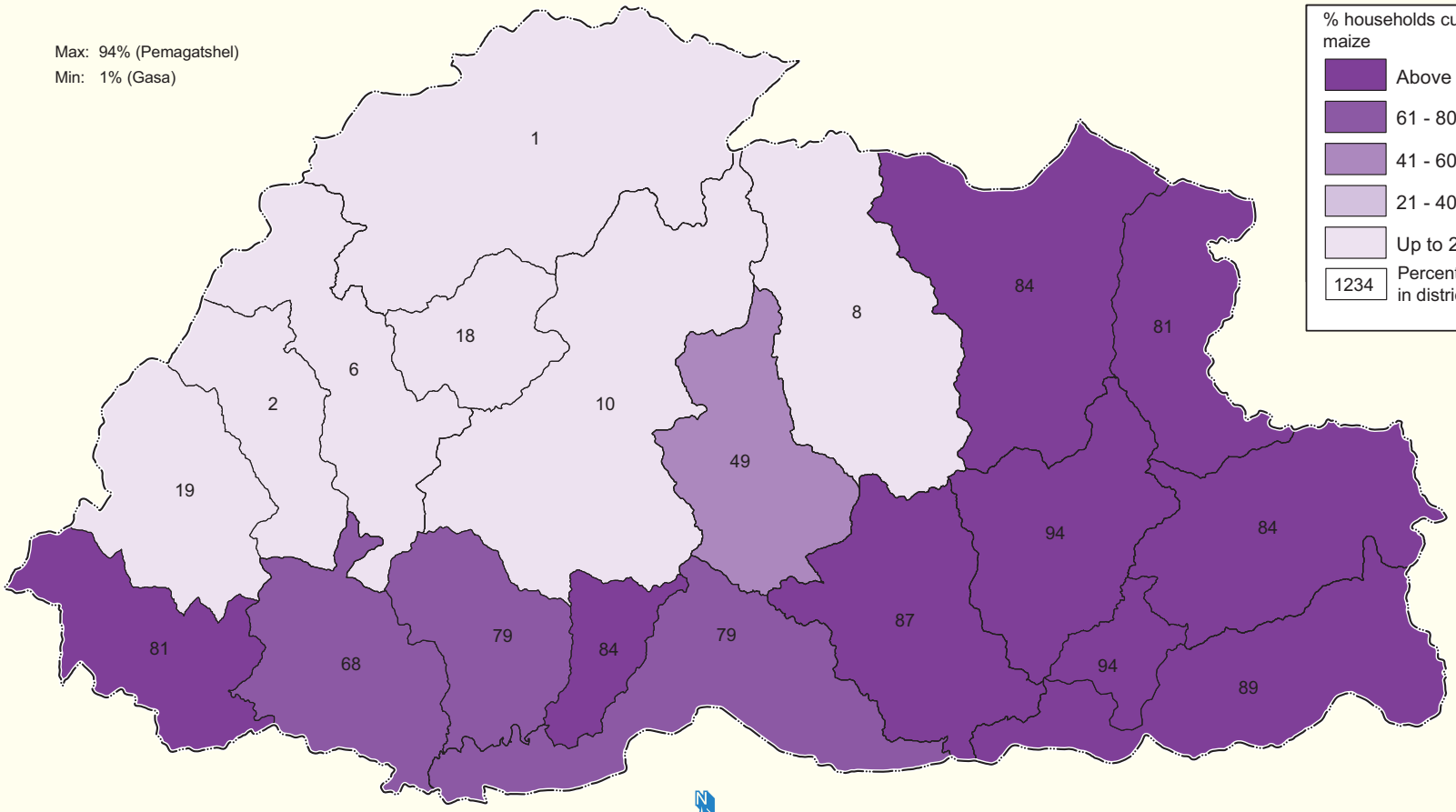
Table B.6

Districts	% HHs Cultivating Maize	Districts	% HHs Cultivating Maize
Pemagatshel	94	Sarpang	79
Mongar	94	Chhukha	68
S/Jongkhar	89	Trongsa	49
Zhemgang	87	Ha	19
Tsirang	84	Punakha	18
Trashigang	84	Wangdue	10
Lhuntse	84	Bumthang	8
Yangtse	81	Thimphu	6
Samtse	81	Paro	2
Dagana	79	Gasa	1
		Average*	**69**

* Simple average, not weighted

Farm Households Cultivating Maize

B 6



LEGEND

% households cultivating maize

- Above 80
- 61 - 80
- 41 - 60
- 21 - 40
- Up to 20
- 1234 Percentage in district

Scale 1:1,500,000

0 12.5 25 50 75

Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD MENRIS 2006

Availability of Wheat, Barley, Millet and Buckwheat and Percentage of Households Cultivating Them

Table B.7 shows the percentage of households cultivating wheat, barley, millet, and buckwheat (both sweet and bitter) in 2000, listed in descending order of total availability per household (number of kg produced divided by total farm households in district; see also Table B.10 and Map 10). The map shows the districts ranked according to the total availability per farm household of the four crops together. The superimposed bar charts show the percentage of households cultivating each of the different crops.

Wangdue had the highest percentage of farm households cultivating wheat (60%) and Sarpang the lowest (<1%); Gasa had the highest percentage of households cultivating barley (48%) with Sarpang again the lowest (1%); Sarpang and Chhukha districts had the highest percentage producing millet (37%); and Bumthang the highest percentage of households producing buckwheat (75%).

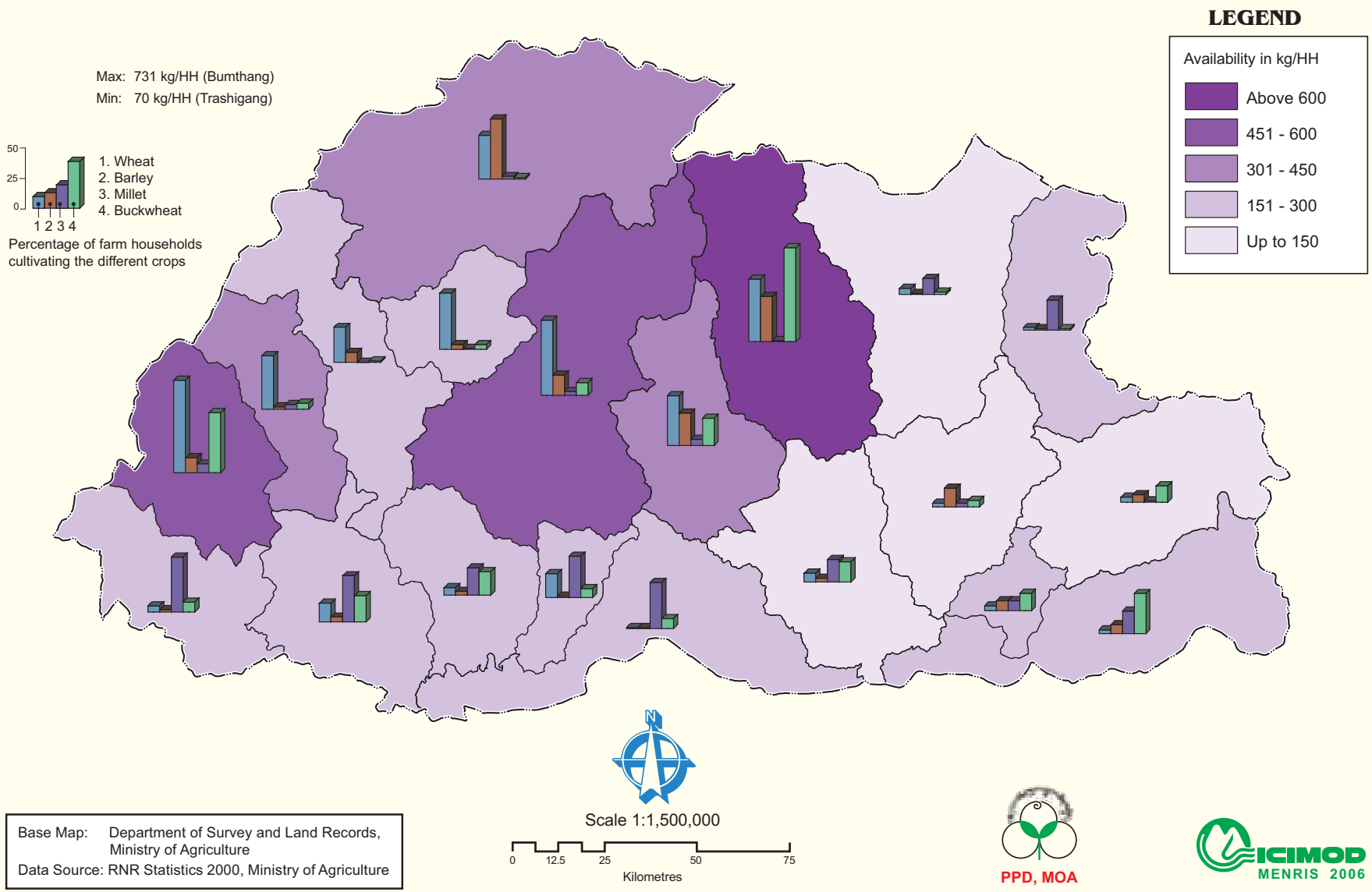
Bumthang and Ha districts, which had a low percentage of households growing either paddy or maize, had the highest availability per household of the other cereals, indicating the importance of these cereals in districts where paddy and maize cannot be grown.

Table B.7

District	% Households Cultivating				Availability kg/HH	District	% Households Cultivating				Availability kg/HH
	Wheat	Barley	Millet	Buckwheat			Wheat	Barley	Millet	Buckwheat	
Bumthang	50	36	1	75	670	Dagana	6	3	22	19	219
Ha	74	12	7	48	548	Sarpang	1	1	37	8	184
Wangdue	60	16	3	10	431	Pemagatshel	4	8	8	14	177
Gasa	35	48	2	1	322	Tsirang	19	1	33	7	174
Trongsa	40	26	5	22	303	Samtse	5	2	44	8	157
Paro	43	2	4	5	301	Trashi Yangtse	2	1	24	1	154
Chhukha	15	4	37	21	295	Zhemgang	7	3	18	16	154
S/Jongkhar	3	7	18	32	273	Mongar	3	15	3	5	119
Punakha	45	4	1	4	271	Lhuntse	5	1	13	2	104
Thimphu	28	8	0	1	241	Trashigang	4	6	1	13	70
						Average*	**13.3**	**6.8**	**16.9**	**14.3**	**214**

* Simple averages, not weighted

Availability of Wheat, Barley, Millet and Buckwheat and % of HHs Cultivating Them B 7



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD
MENRIS 2006

Production of Paddy and Availability per Household

Table B.8 shows the total production of paddy in 2000 in each district in tonnes (t) and the total availability per farm household (total production divided by number of farm households), with the districts listed in descending order of availability per household. The map shows the districts ranked according to total production, and the superimposed values show the availability per household in kg.

In 2000, the total national production of paddy was 68,573t; with the highest quantity produced in Sarpang (9,382t), followed by Punakha and Samtse. Punakha had by far the highest availability of paddy per household (4109 kg), almost twice the value of the next district on the list, and Pemagatshel, Ha, and Bumthang the lowest.

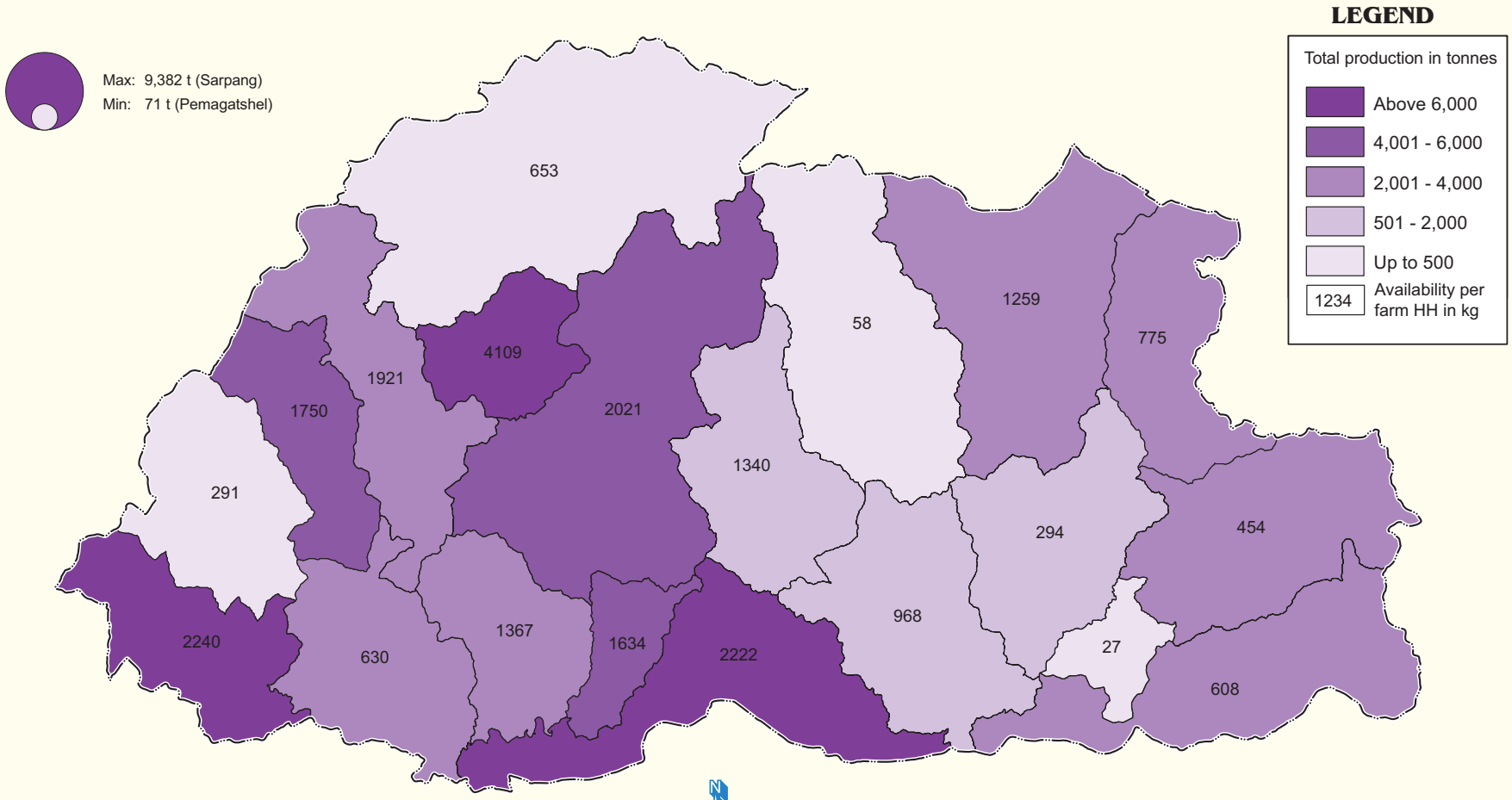
Table B.8

District	Total Annual Production (t*)	No. of Farming HH	Availability kg/HH	District	Total Annual Production (t*)	No. of Farming HH	Availability kg/HH
Punakha	8,740	2127	4109	Zhemgang	1,706	1758	968
Samtse	8,265	3690	2240	Yangtse	2,552	3291	775
Sarpang	9,382	4223	2222	Gasa	303	464	653
Wangdue	5,860	2899	2021	Chhukha	2,166	3437	630
Thimphu	3,015	1569	1921	S/Jongkhar	3,043	5008	608
Paro	4,671	2669	1750	Trashigang	3,617	7971	454
Tsirang	4,909	3005	1634	Mongar	1,445	4920	294
Dagana	3,663	2679	1367	Ha	323	1110	291
Trongsa	1,850	1380	1340	Bumthang	80	1390	58
Lhuntse	2,918	2318	1259	Pemagatshel	71	2657	27
				Bhutan Total	**68,573**	**58,565**	1170

* 1t = 1000kg

Production of Paddy and Availability per Household

B 8



N

Scale 1:1,500,000

0 12.5 25 50 75

Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD

MENRIS 2006

Production of Maize and Availability per Household

Maize is the most significant cereal crop after paddy especially in the eastern and central parts of Bhutan. Table B.9 shows the total production of maize in 2000 in each district in tonnes (t) and the total availability per farm household (total production divided by number of farming households), with the districts listed in descending order of availability per household. The map shows the districts ranked according to total production and the superimposed values show the availability per household in kg.

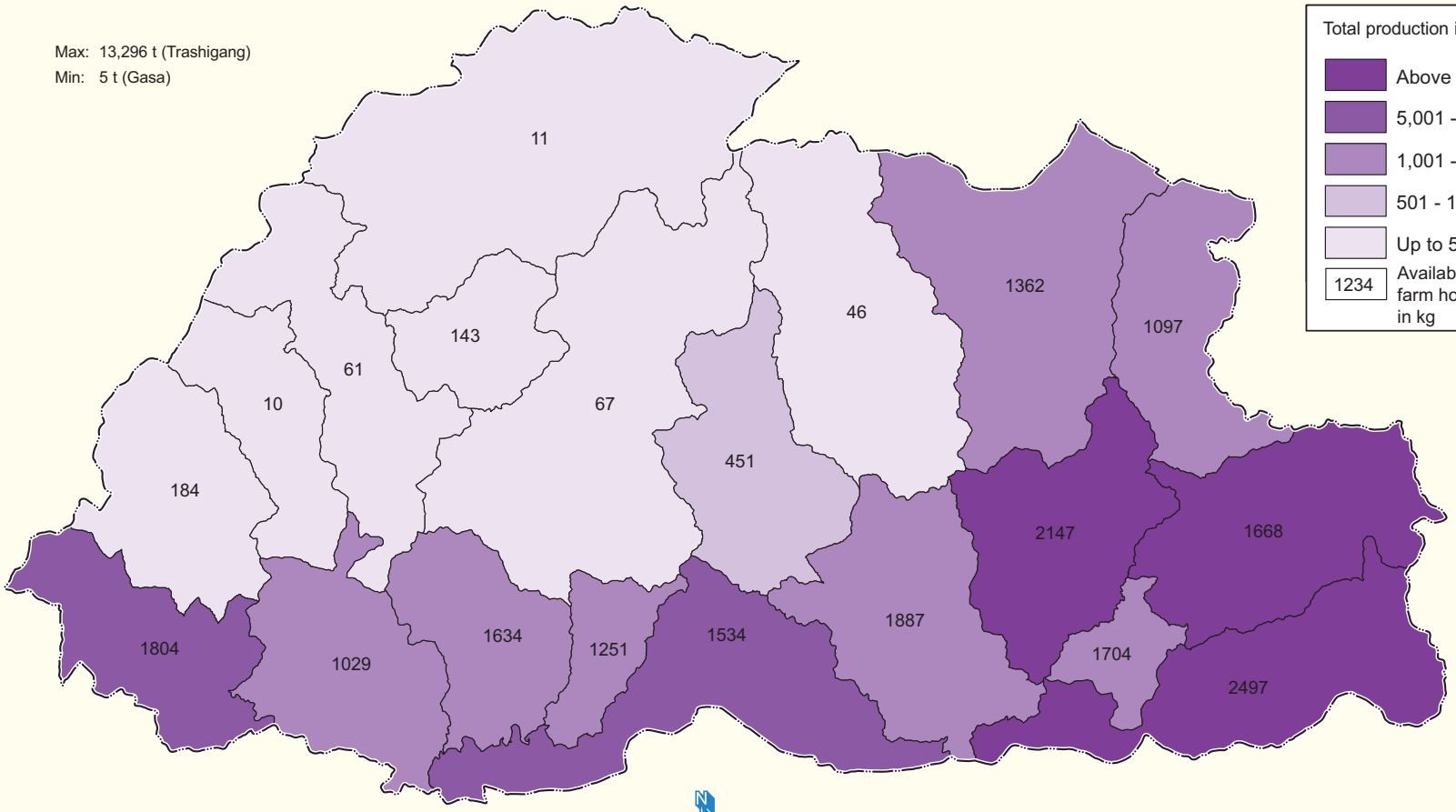
In 2000, maize was produced in all districts except Gasa. The total national production of maize was 77,000t; with the highest quantity produced in Trashigang (>13,000t) followed by Samdrup Jongkhar and Mongar. Samdrup Jongkhar had the highest availability of maize per household (2497 kg), and Paro and Gasa the lowest.

Table B.9

District	Total Annual Production (t)	No. of Farming HHs	Availability (kg/HH)	District	Total Annual Production (t)	No. of Farming HHs	Availability (kg/HH)
S/Jongkhar	12,507	5,008	2,497	Trashi Yangtse	3,611	3,291	1,097
Mongar	10,565	4,920	2,147	Chhukha	3,536	3,437	1,029
Zhemgang	3,317	1,758	1,887	Trongsa	622	1,380	451
Samtse	6,656	3,690	1,804	Ha	205	1,110	184
Pemagatshel	4,528	2,657	1,704	Punakha	305	2,127	143
Trashigang	13,296	7,971	1,668	Wangdue	193	2,899	67
Dagana	4,377	2,679	1,634	Thimphu	96	1,569	61
Sarpang	6,478	4,223	1,534	Bumthang	64	1,390	46
Lhuntse	3,158	2,318	1,362	Paro	27	2,669	10
Tsirang	3,758	3,005	1,251	Gasa	5	464	11
				Bhutan Total	**77,298**	**58,565**	**1,320**

Production of Maize and Availability per Household

B 9



LEGEND

Total production in tonnes

- Above 10,000
- 5,001 - 10,000
- 1,001 - 5,000
- 501 - 1,000
- Up to 500
- 1234 Availability per farm household in kg

Scale 1:1,500,000

0 12.5 25 50 75

Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD

MENRIS 2006

Production of Wheat, Barley, Millet and Buckwheat and Availability per Household

Although wheat, barley, millet, and buckwheat are generally considered secondary to paddy and maize, these cereals also play an important role in the nation's overall food self-sufficiency. In many parts of Bhutan, these crops are consumed as staple foods in different forms.

Table B.10 shows the total production of wheat, barley, millet, and buckwheat in 2000 in each district in tonnes (t) and the total availability per farm household (total production divided by number of farming households), with the districts listed in descending order of availability per household. The map shows the districts ranked according to total production in tonnes. The superimposed pie charts show the proportion of total production from the different grains and indicate differences in the total production per district. The superimposed values show the availability per household in kg..

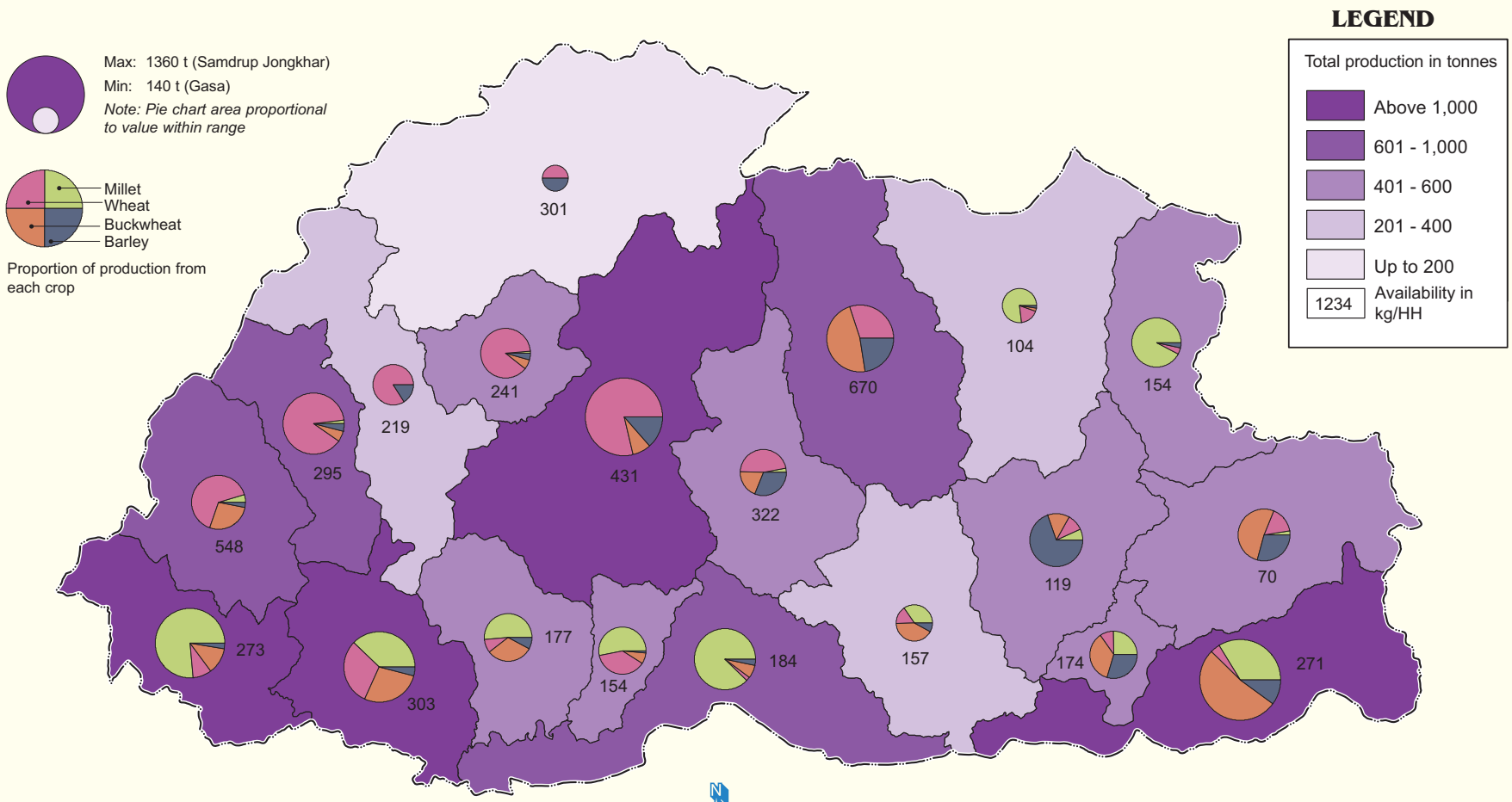
In 2000, the total production of wheat was 4,352t, barley 1,735t, millet 3,793t, and buckwheat 2,887t. Wangdue led in wheat production (977t), Mongar in barley (407t), Sarpang in millet (684), and Samdrup Jongkhar in buckwheat (713t). Samdrup Jongkhar produced the maximum total amount of these cereals (1,360t) followed by Wangdue, Samtse, and Chhukha; and Gasa the lowest (139t). Bumthang and Ha districts had the maximum per household availability, and Trashigang had the lowest.

Table B.10

District	Annual Production (t)					Availability (kg/HH)	District	Annual Production (t)					Availability (kg/HH)
	Wheat	Barley	Millet	Buckwheat	Total			Wheat	Barley	Millet	Buckwheat	Total	
Bumthang	279	210	7	435	932	670	Thimphu	286	55	<1	2	343	219
Ha	395	19	29	166	609	548	Sarpang	16	25	684	54	778	184
Wangdue	977	167	9	95	1,249	431	Dagana	43	36	244	152	475	177
Trongsa	207	138	13	86	444	322	Pemagatshel	44	136	116	166	462	174
Chhukha	316	41	396	290	1,042	303	Zhemgang	43	23	96	113	275	157
Gasa	70	69	<1	<1	140	301	Tsirang	175	8	246	33	462	154
Paro	697	31	14	44	786	295	Trashi Yangtse	21	18	464	5	508	154
Samtse	86	27	770	123	1,006	273	Mongar	59	407	39	78	584	119
S/Jongkhar	52	136	459	713	1,360	271	Lhuntse	44	6	185	7	242	104
Punakha	452	21	7	32	513	241	Trashigang	91	163	14	291	558	70
							Bhutan Total	**4,352**	**1,735**	**3,793**	**2,887**	**12,767**	**218**

Production of Wheat, Barley, Millet and Buckwheat and Availability per Household

B10



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

Scale 1:1,500,000

0 12.5 25 50 75

Kilometres

PPD, MOA

ICIMOD MENRIS 2006

Production of Vegetables and Availability per Household

A variety of vegetables are cultivated in the country; most are produced for household consumption on a subsistence basis but a few are also sold in the market. With the exception of potato and chilli, cultivation of vegetables on a commercial scale is still limited. Potato and chilli constitute the major vegetable crops providing cash income. Vegetables cultivated on a lesser scale include radish, turnip, beans, carrot, cabbage, cauliflower, tomato, ginger, garlic, and onion.

Table B.11 shows the total production of potatoes, chilli, and other vegetables in 2000 in each district in tonnes (t), and the total availability per farm household (total production divided by number of farming households), with the districts listed in descending order of availability per household. The map shows the districts ranked according to total production of all vegetables. The superimposed pie charts show the proportion of production from the different vegetables and indicate differences in the total production per district. The superimposed values show the availability per household in kg.

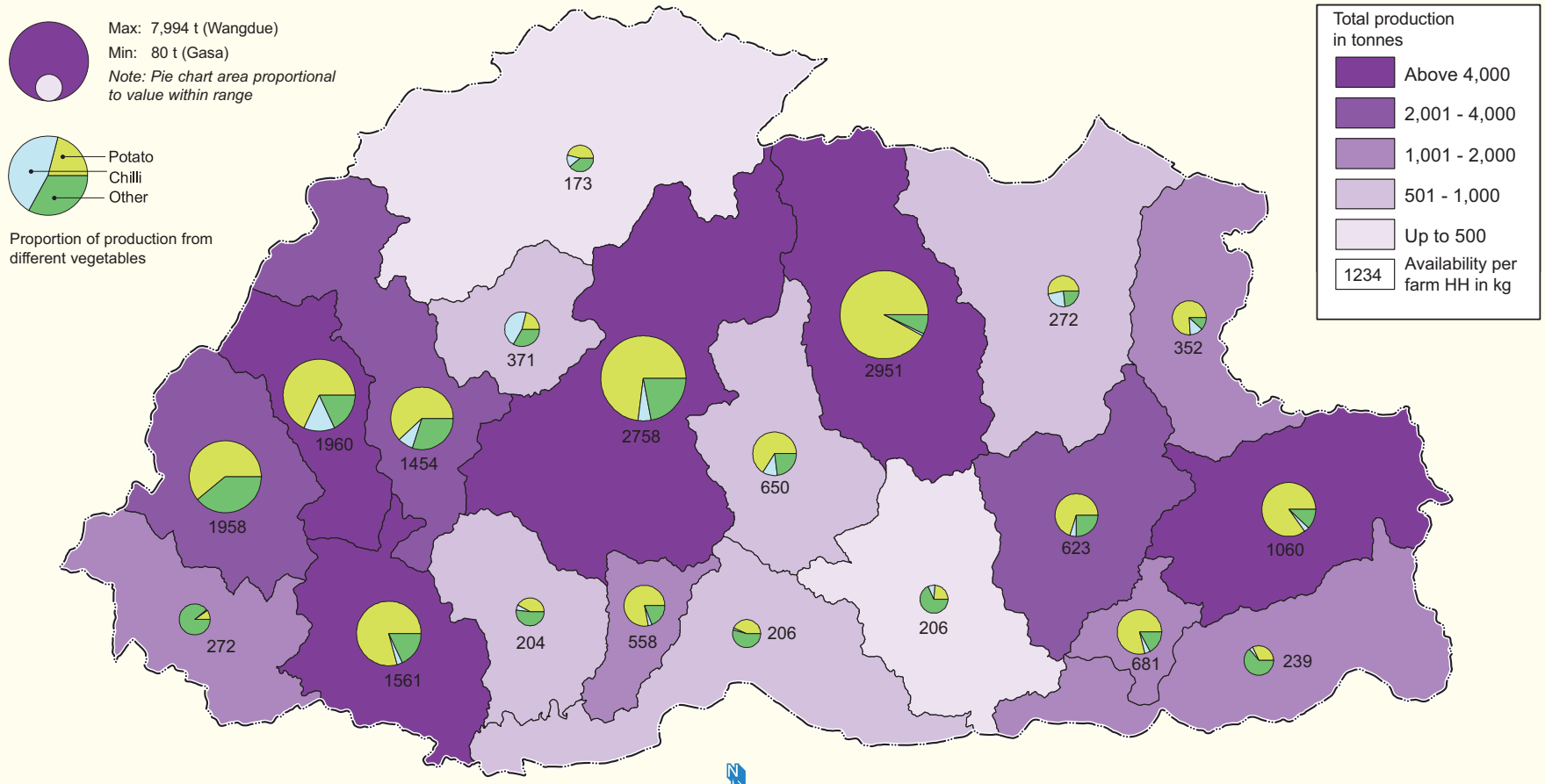
In 2000, the total production of potato was 35,340t, of chilli 2,849t, and of other vegetables 11,401t. Trashigang led in potato production followed by Wangdue and Chhukha; and Paro led in chilli production followed by Wangdue and Punakha. Bumthang had the overall highest household availability of vegetables.

Table B.11

District	Annual Production (t)				Availability (kg/HH)	District	Annual Production (t)				Availability (kg/HH)
	Potato	Chilli	Others	Total			Potato	Chilli	Others	Total	
Bumthang	3,778	29	295	4,102	2951	Tsirang	1,306	48	322	1,676	558
Wangdue	5,871	365	1,758	7,994	2758	Punakha	166	363	261	790	371
Paro	3,566	708	957	5,231	1960	Trashi Yangtse	881	136	142	1,159	352
Ha	1,323	11	840	2,173	1958	Samtse	97	5	903	1,005	272
Chhukha	4,257	151	958	5,366	1561	Lhuntse	332	151	146	630	272
Thimphu	1,419	176	687	2,282	1454	S/Jongkhar	379	45	774	1,198	239
Trashigang	7,189	238	1,025	8,451	1060	Zhemgang	85	28	250	362	206
Pemagatshel	1,423	74	312	1,809	681	Sarpang	369	23	477	869	206
Trongsa	596	99	202	897	650	Dagana	231	32	283	546	204
Mongar	2,132	154	780	3,067	623	Gasa	37	12	31	80	173
						Bhutan Total	**35,340**	**2,849**	**11,401**	**49,687**	**848**

Production of Vegetables and Availability per Household

B II



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

Scale 1:1,500,000

0 12.5 25 50 75
Kilometres

PPD, MOA

ICIMOD
MENRIS 2006

Yields of Paddy, Maize, Wheat and Barley

Average yields were estimated from total production of a crop in a district divided by the total area designated as being used to grow that crop. These figures must be used with some caution since, for example, land designated as used for a particular crop could have been fallow during the census year, and some land designated to grow one crop may also have been used to grow another. The values are thus to be viewed as rough estimates to indicate relative differences between districts rather than absolute values.

Table B.12 shows the estimated yields of paddy, maize, wheat, and barley in each district, listed in the order of paddy yield. Districts with higher paddy yield also do comparatively better in terms of food self-sufficiency, thus paddy yield gives a good indication of the relative well-being of a district. The map shows the districts ranked according to paddy yield. The superimposed bar charts show the average yield of each crop.

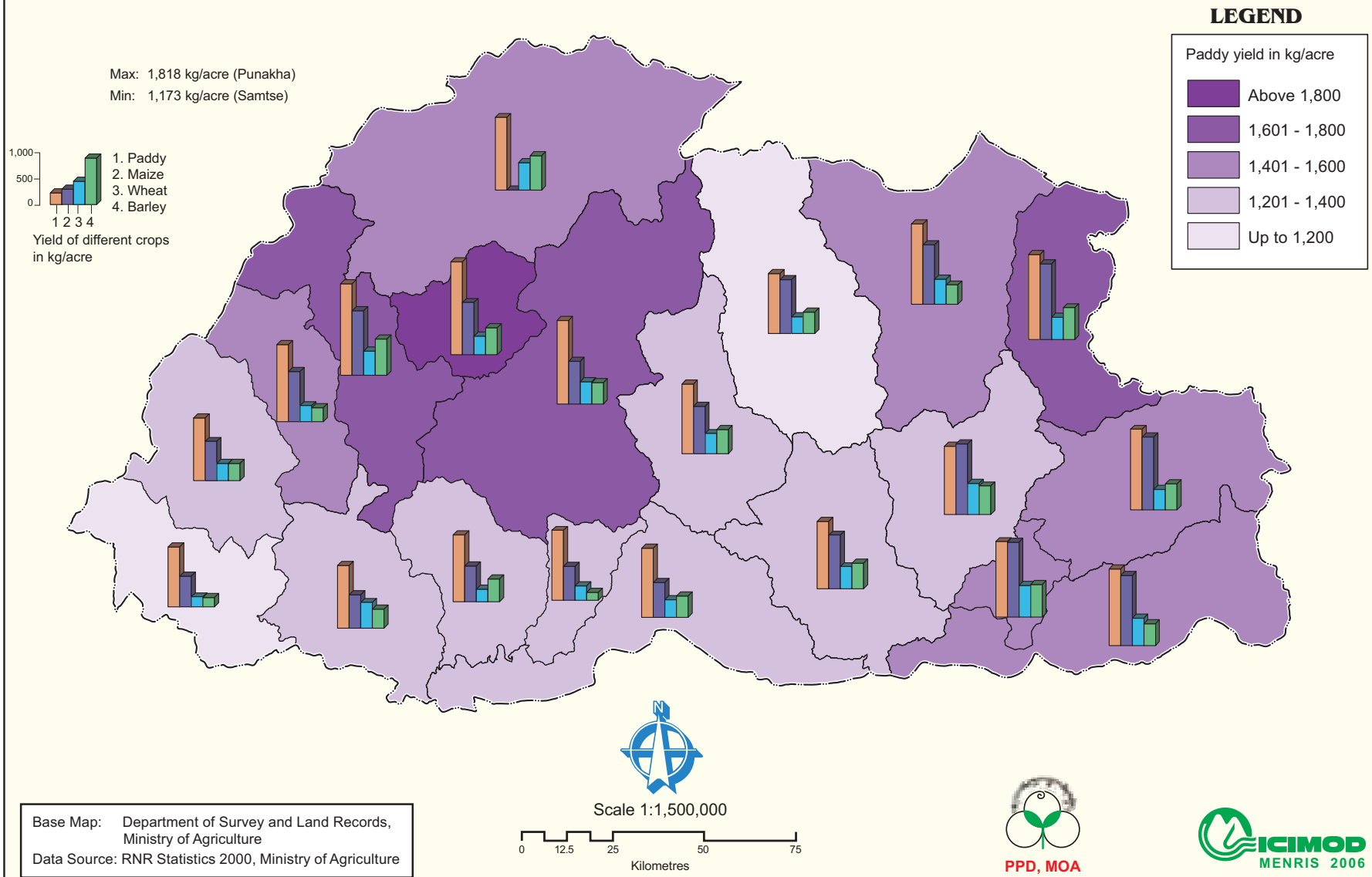
The estimated overall yield for paddy (1,449 kg/acre) was higher than for any other cereal crop, with Punakha and Thimphu having the highest district yields (1,818 and 1,790 kg/acre respectively). The yield of maize about 1000 kg/acre, with Trashi Yangtse, Pemagatshel and Trashigang having the highest yields. The yields of wheat and barley were quite low at 376 kg/acre and 469 kg/acre respectively.

Table B.12

District	Yield (kg/acre)				District	Yield (kg/acre)			
	Paddy	Maize	Wheat	Barley		Paddy	Maize	Wheat	Barley
Punakha	1,818	1,026	368	534	Trongsa	1,370	933	399	477
Thimphu	1,790	1,266	470	709	Tsirang	1,367	664	280	156
Trashi Yangtse	1,660	1,477	436	620	Sarpang	1,355	682	344	422
Wangdue	1,637	835	434	416	Mongar	1,331	1,383	603	556
Trashigang	1,575	1,426	399	505	Dagana	1,314	705	251	447
Lhuntse	1,574	1,169	492	380	Zhemgang	1,312	1,048	429	494
Paro	1,509	983	317	274	Ha	1,231	769	335	341
S/Jongkhar	1,502	1,371	533	424	Chhukha	1,229	656	505	372
Pemagatshel	1,481	1,464	621	640	Bumthang	1,177	1,055	333	421
Gasa	1,422	0	539	674	Samtse	1,173	601	197	181
					Bhutan Total	**1,449**	**1,005**	**376**	**469**

Yields of Paddy, Maize, Wheat and Barley

B12



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD
MENRIS 2006

C. Horticulture

Horticulture in Bhutan is defined as fruit and nut crops, generally from trees. The statistics were prepared in terms of the numbers of trees owned rather than the area of land designated as orchard area. Most fruit crops are grown for sale rather than household consumption and owning fruit trees usually indicates improved economic status. The climate in some parts of Bhutan is very favourable for growing crops such as apples which can be exported within the country to hotter areas where these crops do not grow.

In 2000, there were some 2.6 million cultivated fruit and nut trees in Bhutan, mainly apples, areca nuts, guavas, oranges, peaches, pears, plums, and walnuts. The three commercially most significant crops are oranges and areca nuts in the sub-tropical areas and apples in the temperate areas. These three crops account for 96% of horticultural trees planted and 92% of production. A total of 36,000 tonnes of fresh oranges, apples and areca nuts were produced in 2000.

The following maps and tables are presented in this section:

- C.1. Total Number of Horticultural Trees
- C.2. Total Production of Horticultural Crops
- C.3. Apple Production and Households with Different Numbers of Apple Trees
- C.4. Apple Production and Households with Different Numbers of Orange Trees

Total Number of Horticultural Trees

Apples and oranges are the two most important horticultural crops in Bhutan. Table C.1 shows the total number of apple, orange, and other horticultural trees planted in the different districts in 2000. The map shows the districts ranked according to the total number of trees in each district. The superimposed pie charts show the proportion of apple, orange and other trees, and indicate differences in the total number of trees per district.

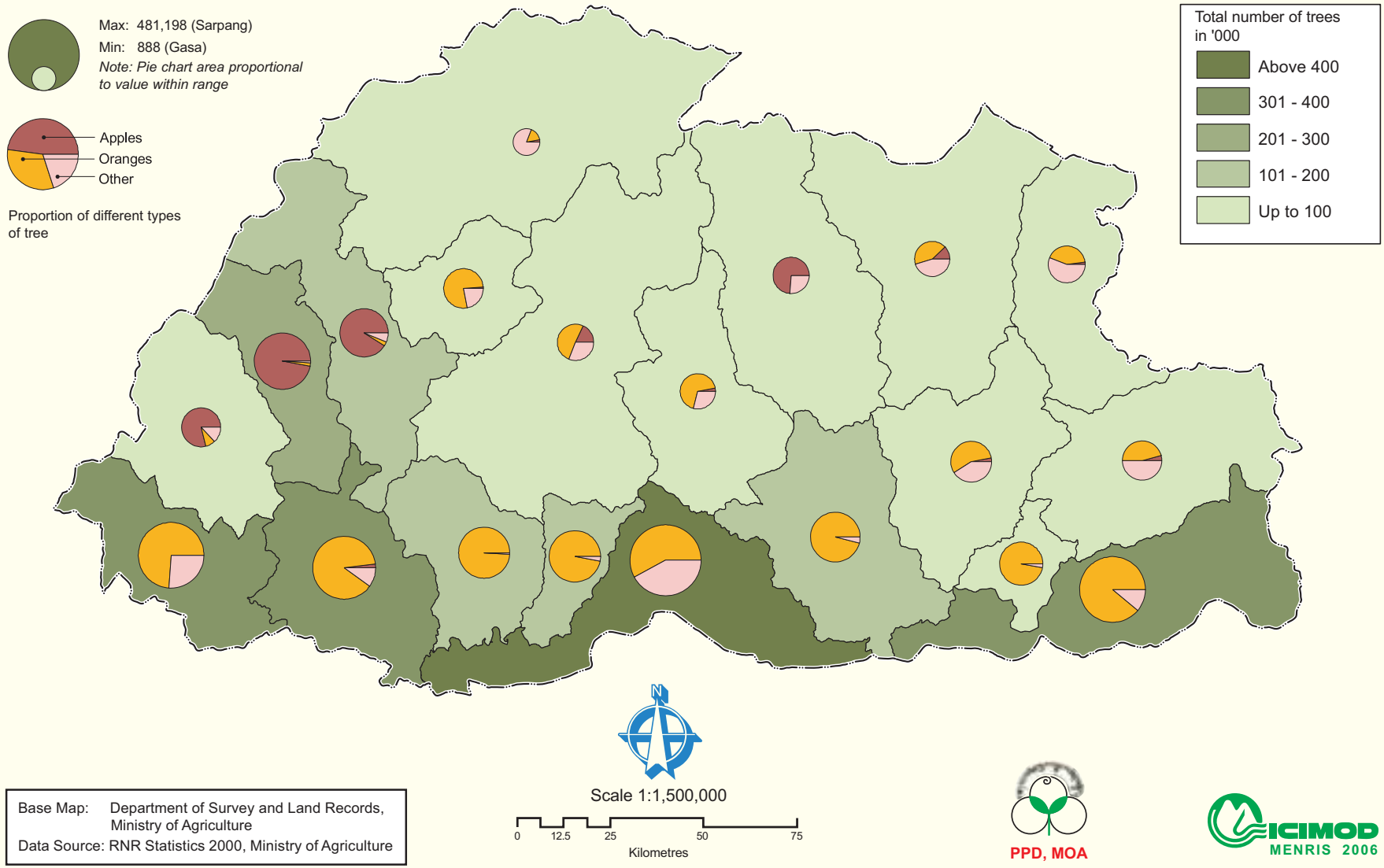
In 2000, oranges alone accounted for about 68% of all horticultural trees and apples about 14%. About two-thirds of all orange trees are located in the four major orange producing districts of Sarpang, Samdrup Jongkhar, Samtse, and Chhukha. Production is forecast to increase substantially over the next few years as more young orange trees start fruiting and the management of horticulture improves. Apple cultivation is mainly limited to the two districts of Thimphu and Paro, which together account for about 86% of the country's apple production. Areca nut is another important tree crop and is grown mostly in the southern foothills, especially in Samtse and Sarpang. Other less commercially important fruits include guava, walnut, pear, peach, and plum.

Table C.1

District	Number of Trees				District	Number of Trees			
	Apple	Orange	Others	Total		Apple	Orange	Others	Total
Sarpang	390	278,104	202,704	481,198	Mongar	1,423	24,575	18,033	44,031
S/Jongkhar	92	334,988	40,307	375,387	Punakha	274	26,777	7,757	34,808
Samtse	301	276,293	98,165	374,759	Trashigang	1,233	15,563	16,827	33,623
Chhukha	7,090	287,026	33,258	327,374	Ha	24,841	2,476	4,155	31,472
Paro	212,036	3,522	2,427	217,985	Trashi Yangtse	443	7,835	10,455	18,733
Tsirang	26	147,442	4,156	151,624	Wangdue	2,935	8,277	5,117	16,329
Dagana	262	146,254	1,380	147,896	Bumthang	11,812	25	4,020	15,857
Zhemgang	113	124,822	5,086	130,021	Trongsa	385	7,896	3,386	11,667
Thimphu	103,305	2,978	7,662	113,945	Lhuntse	1,286	4,810	5,001	11,097
Pemagatshel	141	61,226	1,883	63,250	Gasa	25	141	722	888
					Bhutan Total	**368,413**	**1,761,030**	**472,501**	**2,601,944**

Total Number of Horticultural Trees

C I



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

Total Production of Horticultural Crops

Table C.2 shows the annual production in tonnes of apples, oranges, and other horticultural tree crops in the different districts in 2000. The map shows the districts ranked in order of total production of all fruits. The superimposed pie charts show the proportion of production from apples, oranges and other crops, and indicate differences in the total production per district. (Maps C3 and C4 on the following pages show the production of apples and oranges separately.)

Around 90% of Bhutan's apple production in 2000 came from the two districts of Thimphu and Paro. Paro had twice as many apple trees as Thimphu but the apple production was greater in Thimphu. Bumthang and Ha districts also produce a fair number of apples, but their quality is still not comparable to those produced in Thimphu and Paro. As new varieties are introduced, it is likely that apple production will increase in other districts as well.

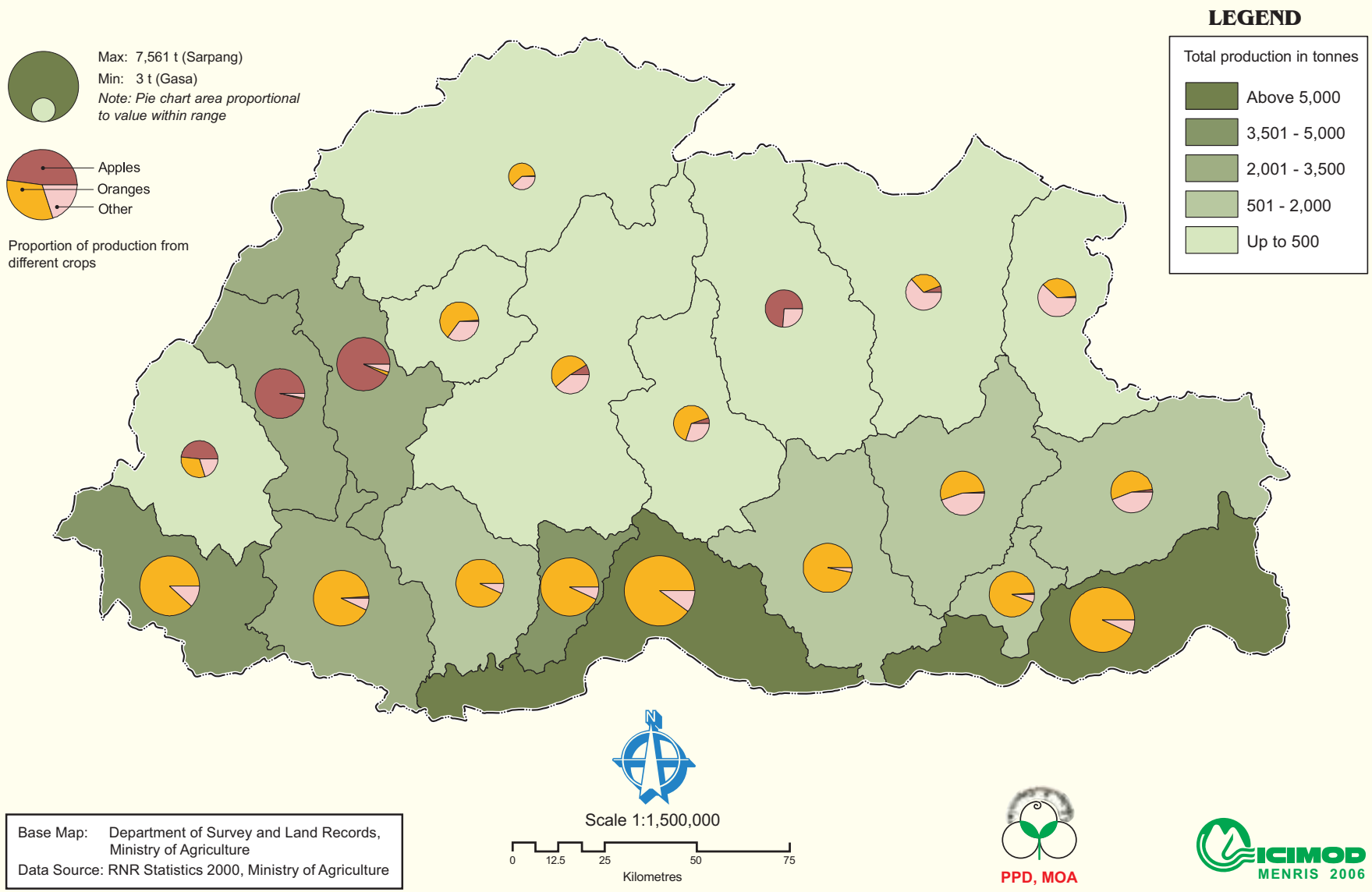
Oranges account for more than 75% of total horticultural production and are more widespread than apples. Whereas apple production is more or less limited to two districts, orange production is widespread in the south where climatic conditions are favourable. All the southern districts produced over 1,000t of oranges. Five districts produce large quantities of oranges, and nine can be considered important producers. Sarpang produced the most oranges (6800t) followed by Samdrup Jongkhar, Samtse, and Tsirang. Oranges are grown to some extent in almost all districts, but as with apples the scale and quality of production, and therefore their commercial value, are generally not comparable to those in the main producing areas. The production of oranges is much higher than the production of apples due to the more favourable climactic conditions, thus the southern districts had a much higher total production of horticultural tree crops. Sarpang produced the most overall, followed by Samdrup Jongkhar and Samtse. Gasa produced almost no horticultural tree crops.

Table C.2

District	Annual Production (t)				District	Annual Production (t)			
	Apples	Oranges	Others	Total		Apples	Oranges	Others	Total
Sarpang	21	6,812	728	7,561	Mongar	12	594	488	1,094
S/Jongkhar	1	5,436	406	5,844	Trashigang	20	428	344	792
Samtse	10	3,914	518	4,442	Punakha	4	303	169	477
Tsirang	0	3,670	288	3,957	Trashi Yangtse	3	145	245	393
Chhukha	42	3,069	213	3,324	Wangdue	33	190	143	365
Thimphu	2,585	46	138	2,769	Bumthang	243	<1	83	326
Paro	1,966	30	61	2,057	Ha	133	90	56	279
Zhemgang	2	1,888	51	1,941	Trongsa	10	128	61	199
Dagana	2	1,603	122	1,727	Lhuntse	11	60	126	198
Pemagatshel	15	1,207	79	1,301	Gasa	<1	2	1	3
					Bhutan Total	**5,113**	**29,616**	**4,319**	**39,048**

Total Production of Horticultural Crops

C2



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Apple Production and Households with Different Numbers of Apple Trees

The census data do not indicate the total number of households that grow apples, they simply show the percentage of apple growing households with numbers of trees in each of three classes. Table C.3 shows these values for the different districts, in order of the percentage of producer households with more than 100 trees. The map shows the districts ranked according to the total production of apples (see Table C.2). The superimposed pie charts show the proportion of producer households with different numbers of trees, and indicate differences in the total production per district.

Apple production is mainly focused in the two districts of Thimphu and Paro, and these districts have to largest proportion of producer households with more than 100 apple trees, indicating a commercial scale of production. There were very few trees in Sarpang, but all were in medium to large plantations. In most other districts, apples are grown by farm households for their own consumption and not for commerce. The total number of trees in Gasa and Tsirang was less than the smallest holding size class.

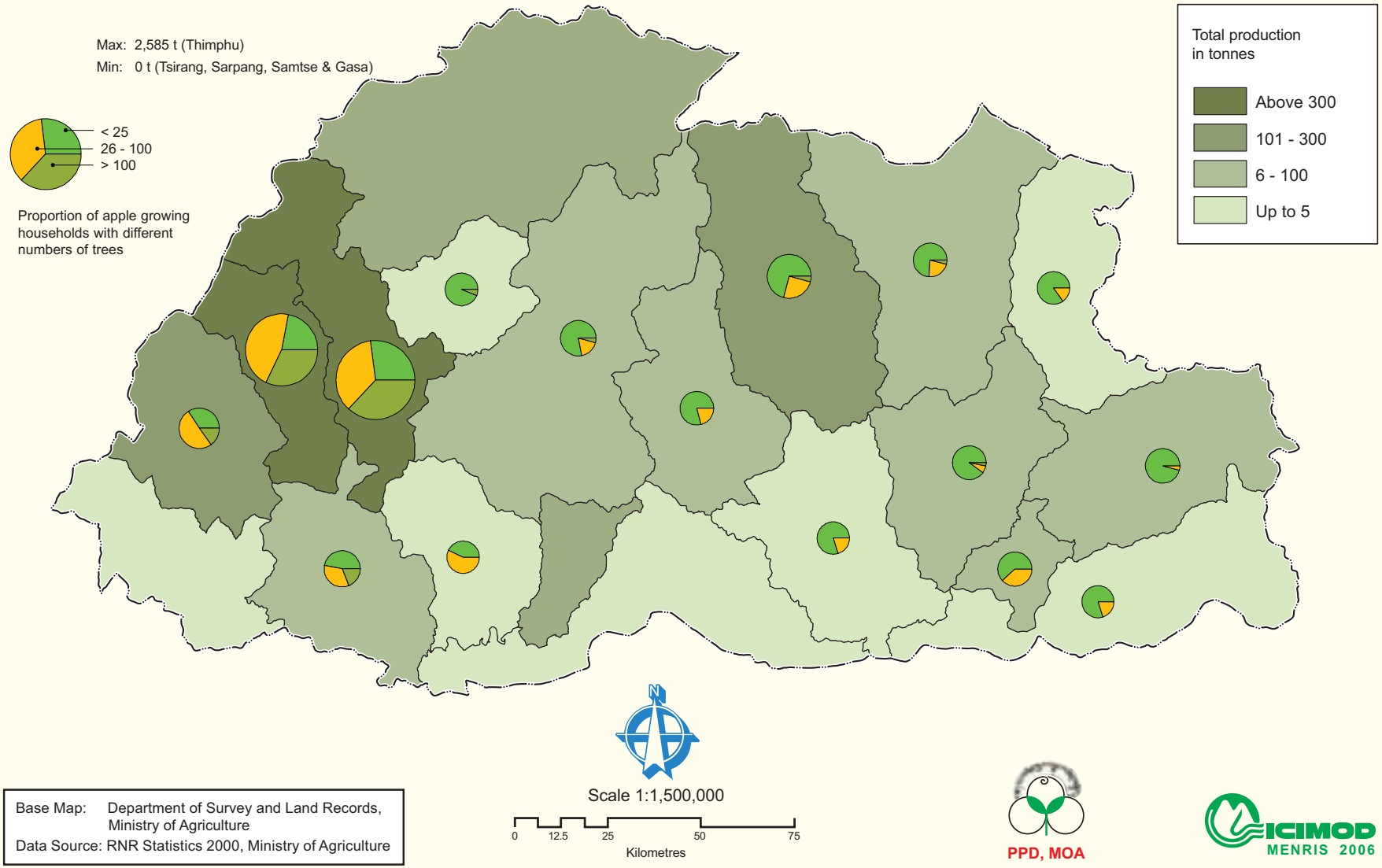
With continuing research, horticultural production in the country can increase. Different varieties are needed that are better suited to the different agro-ecological conditions – especially varieties of apples better suited to conditions in the south.

Table C.3

Districts	< 25	25 – 100	> 100	Districts	< 25	25 – 100	> 100
Thimphu	27	36	37	Gasa	(100)	0	0
Paro	22	46	32	Trongsa	79	21	0
Ha	34	51	15	Zhemgang	80	20	0
Chhukha	47	34	19	Sarpang	0	(33)	(67)
Punakha	94	0	6	Mongar	90	7	3
Lhuntse	74	22	4	Tsirang	(100)	0	0
Wangdue	78	18	4	Trashi Yangtse	85	15	0
Bumthang	71	25	4	Trashigang	96	4	0
Dagana	43	57	0	Pemagatshel	63	38	0
Samtse	na	na	na	S/Jongkhar	80	20	0
				Average*	**41**	**36**	**22**

na = not available; * simple averages, not weighted

Apple Production and Households with Different Numbers of Apple Trees C 3



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

Orange Production and Households with Different Numbers of Orange Trees

The census data does not indicate the total number of households that grow oranges, but only the percentage of orange growing households with numbers of trees in each of three classes. Table C.4 shows these values for the different districts, in order of the percentage of producer households with more than 100 trees. The map shows the districts ranked according to the total production of oranges (see Table C.2). The superimposed pie charts show the proportion of producer households with different numbers of trees, and indicate differences in the total production per district.

In the important orange growing districts, one to two-thirds of producer households had more than 100 trees. In all other districts except Ha, most producers had less than 25 trees. There were few trees in Ha, but all were in medium to large plantations. The total number of trees in Bumthang was less than the smallest holding size class.

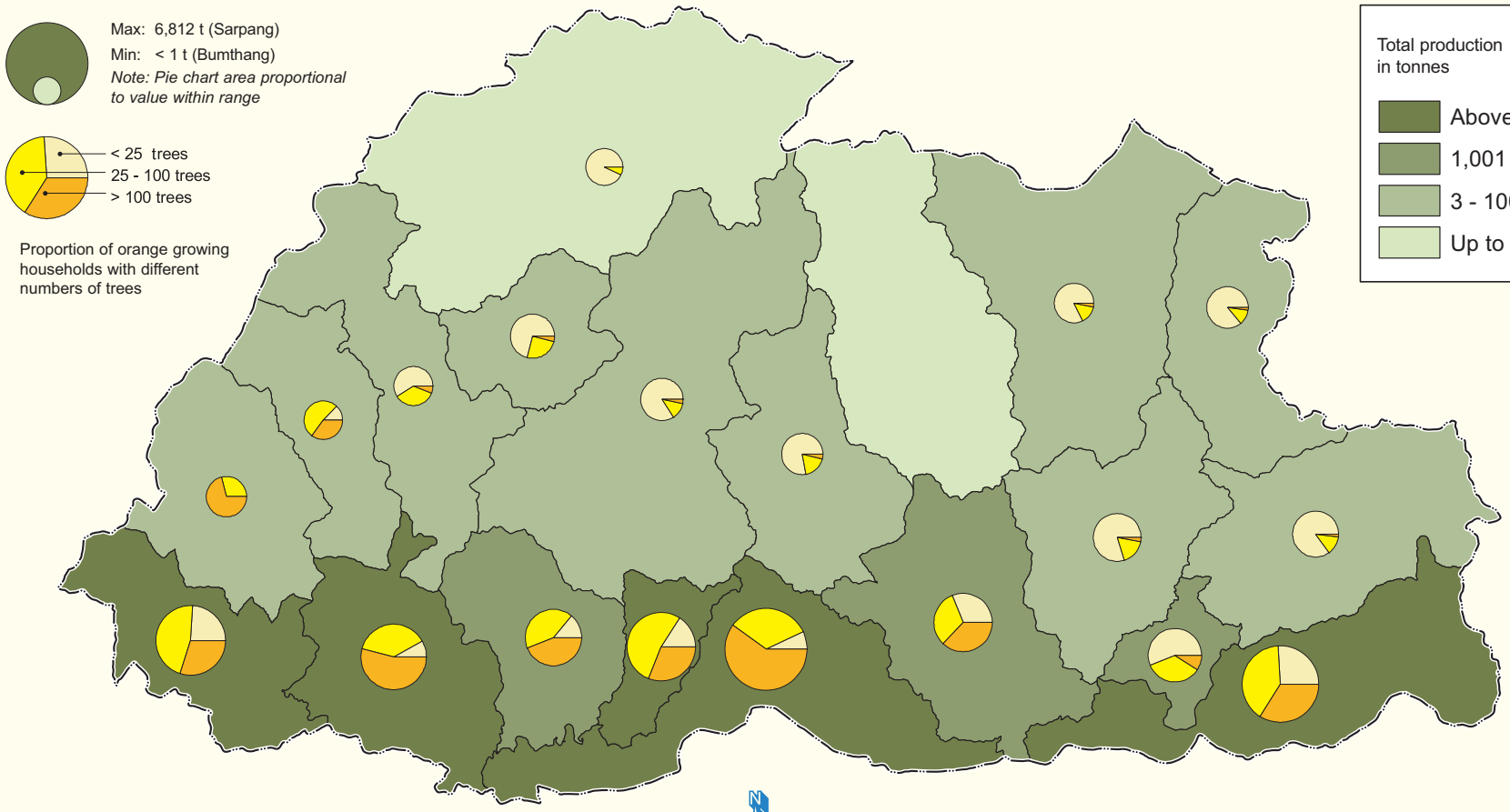
Oranges are an important horticultural crop and an increasingly important export commodity. It is forecast that orange production will continue to increase in the near future as many of the younger trees start fruiting.

Table C.4

Districts	< 25 Trees	25-100	> 100 Trees	Districts	< 25 Trees	25-100	> 100 Trees
Ha	0	29	71	Thimphu	59	35	6
Sarpang	7	33	60	Punakha	71	25	4
Chhukha	8	38	55	Trongsa	77	18	4
Dagana	14	42	44	Wangdue	85	13	3
Zhemgang	31	32	38	Mongar	80	17	3
Paro	13	52	35	Lhuntse	83	15	3
S/Jongkhar	26	40	34	Yangtse	86	12	2
Tsirang	16	53	31	Trashigang	86	13	2
Samtse	24	46	29	Gasa	93	7	0
Pemagatshel	57	35	9	Bumthang	(100)	0	0
				Average*	**46**	**28**	**22**

* Simple averages, not weighted

Orange Production and Households with Different Number of Orange Trees C 4



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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D. Agricultural Inputs

Farmyard manure (FYM) and artificial chemical fertilisers are the two main sources of added soil nutrients. FYM mainly comprises a mixture of animal excrement and vegetative matter like leaf litter, hay, and others that has been used as bedding by stall-fed animals. The amounts of FYM were estimated by farmers in terms of 'basket loads', thus the values reported are indicative not absolute. FYM continues to be the single most important source of soil nutrients and around 140,000t were applied to cereals and horticultural crops in the year 2000. Although important, it was not within the scope of the census to quantify the actual amount of excreta dispersed on the fields either directly by grazing animals or mixed with bedding material as FYM.

Unlike FYM, the use of chemical fertilisers is restricted mainly to crops with a higher rate of return. These include paddy, potato, chilli, and tree crops such as apples and oranges. Close to 30% of households reported having used some chemical fertilisers, with a total of 1800t applied in 2000, of which 1260t was applied to cereal crops. The recent strong emphasis on organic farming may see the use of fertilisers decline. The most common chemical fertilisers used are urea, suphala (compound fertiliser), and single superphosphate (SSP) although muriate of potash, calcium ammonium nitrate (CAN), bone meal, and borax are also applied in minor quantities.

The following maps and tables are presented in this section:

- D.1. Application of Chemical Fertiliser to Cereal Crops
- D.2. Application of Farmyard Manure (FYM) on Cereal Crops
- D.3. Farm Households Applying Chemical Fertilisers
- D.4. Farm Households Applying FYM and Chemical Fertilisers to Paddy
- D.5. Farm Households Applying FYM and Chemical Fertilisers to Maize
- D.6. Farm Households Applying FYM and Chemical Fertilisers to Potato
- D.7. Farm Households Applying FYM and Chemical Fertilisers to Chilli

Application of Chemical Fertiliser to Cereal Crops

The amount of chemical fertiliser used in Bhutan is generally low and application is mainly restricted to cash crops or crops with a higher yield of return. The three major types of chemical fertilisers used are urea, suphala (compound fertiliser), and SSP (single superphosphate). Table D.1 shows the total amount of chemical fertilisers applied to cereal crops (separately and together) in each district in 2000, with the districts listed in descending order of total chemical fertiliser applied. The map shows the districts ranked according to the total amount of fertilisers applied to cereals. The superimposed pie charts show the proportions applied to paddy, maize, and other cereal crops, and indicate differences in the total amount applied per district

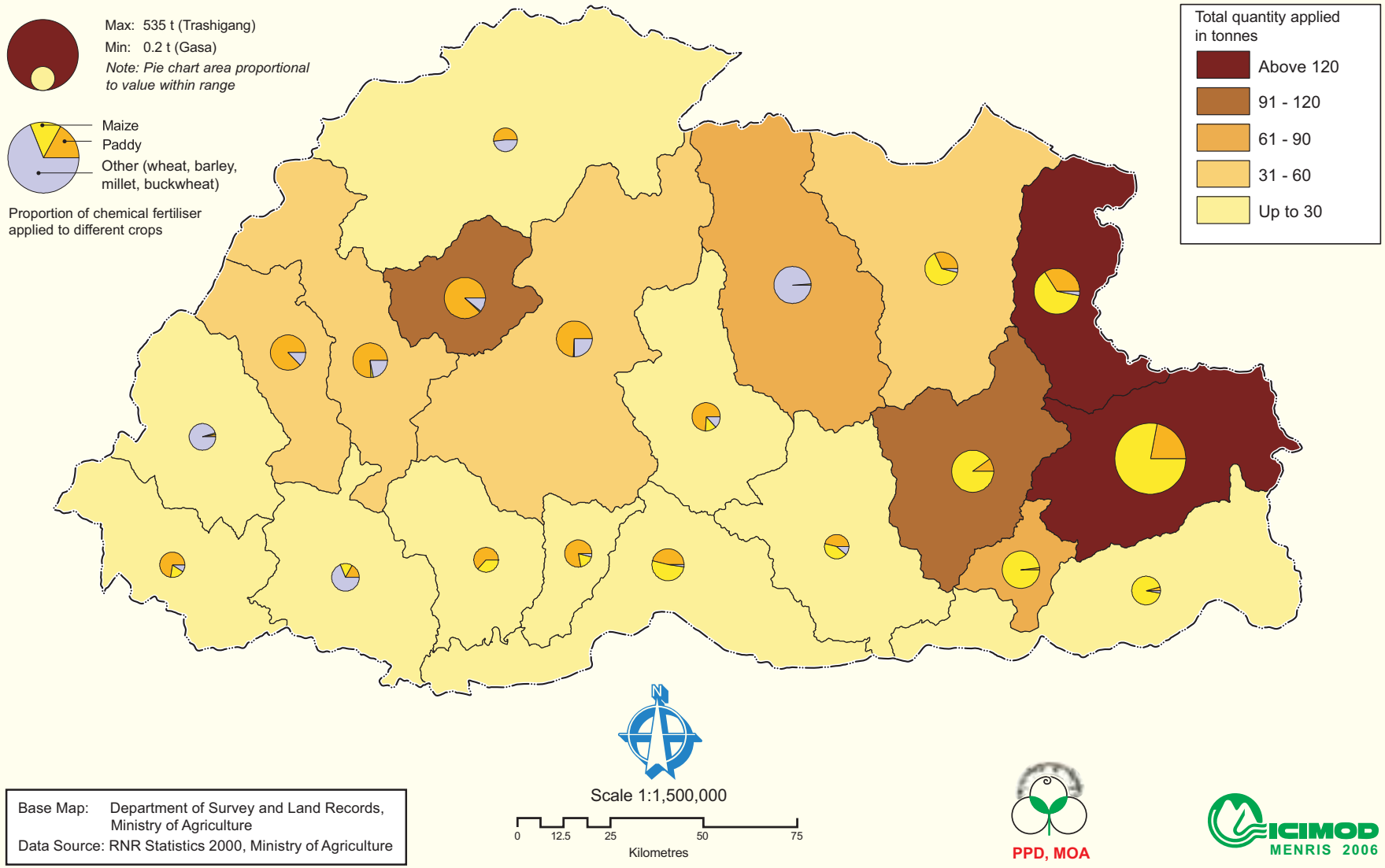
Nationally, 1,262t of fertiliser was applied to cereal crops in 2000 of which about 720t was applied to maize, 420t to paddy, and 120t to other crops such as wheat, barley, millet and buckwheat. The greatest amounts were applied in Trashigang, both for paddy and maize and in total. Fertiliser application in Trashigang accounted for nearly 45% of the total amount applied to cereals in Bhutan, and 35% of the amount applied to maize. Very little fertiliser was applied to cereals in Gasa or Zhemgang.

Table D.1

District	Quantity of Chemical Fertiliser Applied (t)				District	Quantity of Chemical Fertiliser Applied (t)			
	Paddy	Maize	Other	Total		Paddy	Maize	Other	Total
Trashigang	117.2	415.4	2.4	534.9	Sarpang	13.0	14.7	0.5	28.3
Trashi Yangtse	48.6	90.2	5.1	144.0	S/Jongkhar	0.5	11.3	0.3	12.2
Mongar	10.4	94.9	0.2	105.5	Trongsa	8.0	1.4	1.5	10.8
Punakha	85.9	0.7	10.7	97.4	Chhukha	1.4	1.1	5.6	8.1
Pemagatshel	1.0	63.2	0.5	64.7	Tsirang	5.5	1.3	0.3	7.0
Bumthang	0.1	0.7	60.3	61.1	Ha	0.2	0.1	5.2	5.4
Wangdue	38.9	0.4	13.3	52.6	Samtse	1.6	0.4	0.9	2.2
Paro	42.3	0.1	5.9	48.3	Dagana	0.9	0.5	0.0	1.4
Thimphu	33.4	0.9	9.7	44.0	Zhemgang	0.4	0.4	0.1	0.9
Lhuntse	10.7	21.1	1.3	33.1	Gasa	0.1	0.0	0.1	0.2
					Bhutan Total	**420.1**	**718.8**	**123.2**	**1,262.1**

Application of Chemical Fertiliser to Cereal Crops

D I



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Application of Farmyard Manure (FYM) to Cereal Crops

The traditional practice of using farmyard manure as a fertiliser continues all over Bhutan. In keeping with the government's policy of sustainable agricultural development and the emerging emphasis on organic farming, this practice is likely to continue to grow. The amount of FYM used was estimated by farmers in terms of 'headloads'. Thus the values shown are estimates rather than exact figures.

Table D.2 shows the total amount of FYM applied to cereal crops (separately and together) in each district in 2000, with the districts listed in descending order of total FYM applied. The map shows the districts ranked according to the total amount of FYM applied to cereals. The superimposed pie charts show the proportion applied to paddy, maize, and other cereal crops, and indicate differences in the total amount applied per district.

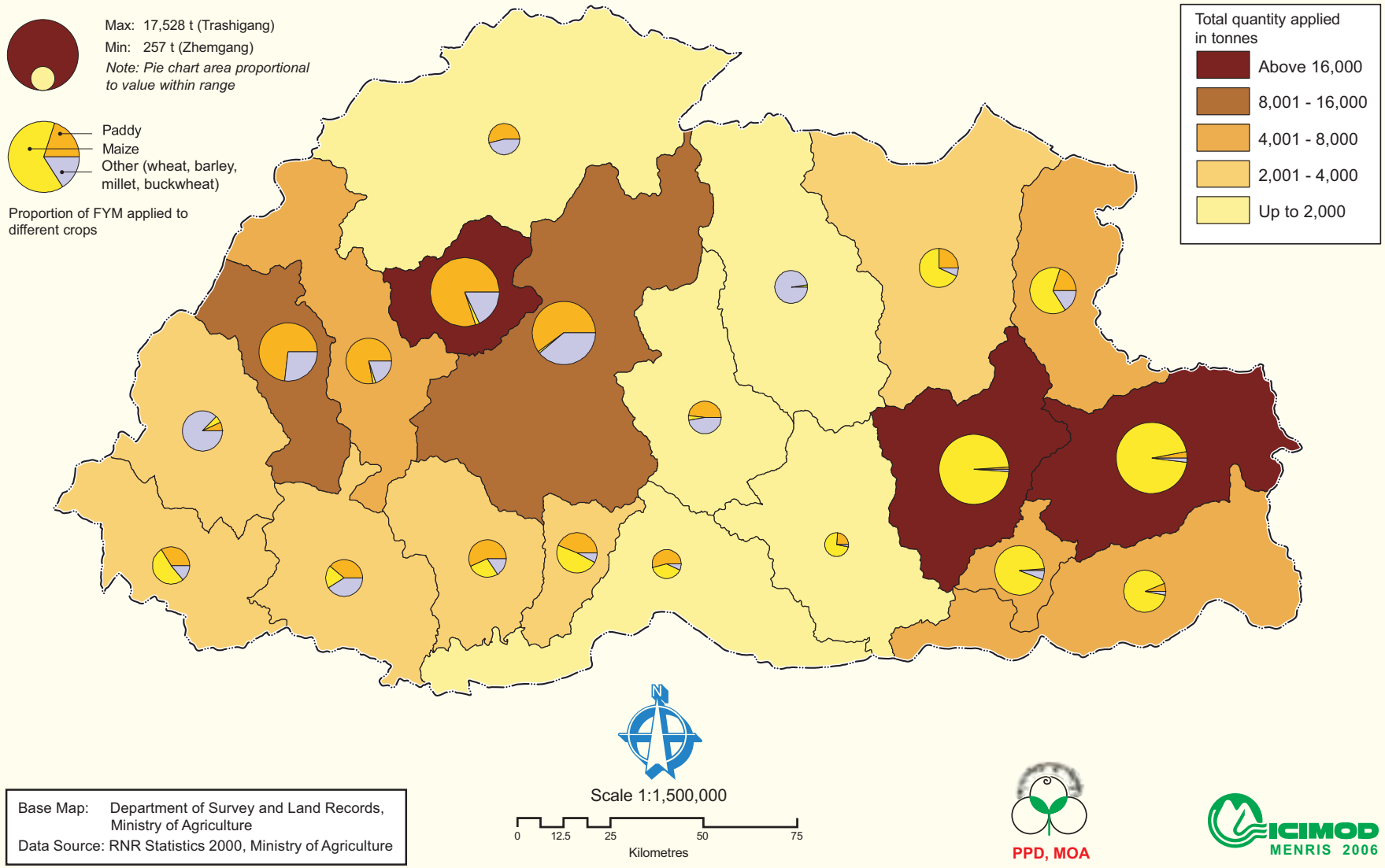
It is estimated that a total of 121,400t of FYM was applied to cereal cropland in the country as a whole, of which about 36% was applied to paddy, 46% to maize, and 18% to other crops, mostly wheat. The greatest amounts in total were applied in Trashigang, Mongar, and Punakha (each around 14% of the national total); with the greatest amounts applied to paddy in Punakha (13,000t), almost twice as much as in any other district; to maize in Trashigang and Mongar (more than 16,000t each); and to other cereal crops in Wangdue (over 5,000t).

Table D.2

District	Quantity of FYM Applied (t)				District	Quantity of FYM Applied (t)			
	Paddy	Maize	Other	Total		Paddy	Maize	Other	Total
Trashigang	589	16,685	254	17,528	Ha	255	233	3,107	3,596
Mongar	242	16,625	31	16,899	Lhuntse	809	2,225	232	3,265
Punakha	13,050	333	2,876	16,258	Dagana	1,630	767	460	2,857
Wangdue	7,949	179	5,024	13,152	Samtse	949	1,450	372	2,772
Paro	7,826	23	2,917	10,765	Chhukha	1,041	543	1,067	2,651
Pemagatshel	72	6,421	386	6,879	Bumthang	0	34	1,664	1,698
Yangtse	1,105	3,566	945	5,616	Trongsa	802	87	792	1,681
Thimphu	4,193	94	1,107	5,394	Gasa	733	0	617	1,350
S/Jongkhar	261	3,799	110	4,170	Sarpang	523	379	68	969
Tsirang	1,614	1,739	289	3,642	Zhemgang	61	187	9	257
					Bhutan Total	**43,705**	**55,369.9**	**22,326.5**	**121,401**

Application of Farmyard Manure (FYM) to Cereal Crops

D 2



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

Farm Households Applying Chemical Fertilisers

The three major types of chemical fertilisers used in Bhutan are urea, suphala (compound fertiliser), and SSP (single super phosphate). Of these, urea is by far the most commonly used. Table D.3 shows the percentage of households applying each of the three types of fertiliser in each district in 2000, with the districts listed in descending order of urea use. The map shows the districts ranked according to the percentage of households applying urea. The superimposed bar charts show the percentage of households using each of the three types of fertiliser.

Trashigang had the greatest percentage of households applying urea is (76%), followed by Trashi Yangtse (59%). In all other districts, less than 50% of households used urea, and in eight districts (all the southern districts except Sarpang) less than 10%. Significantly more households applied Suphala in Bumthang (24%), Punakha (14%), and Thimphu (11%) than anywhere else in the country; and the only significant use of SSP was also in Bumthang (18%).

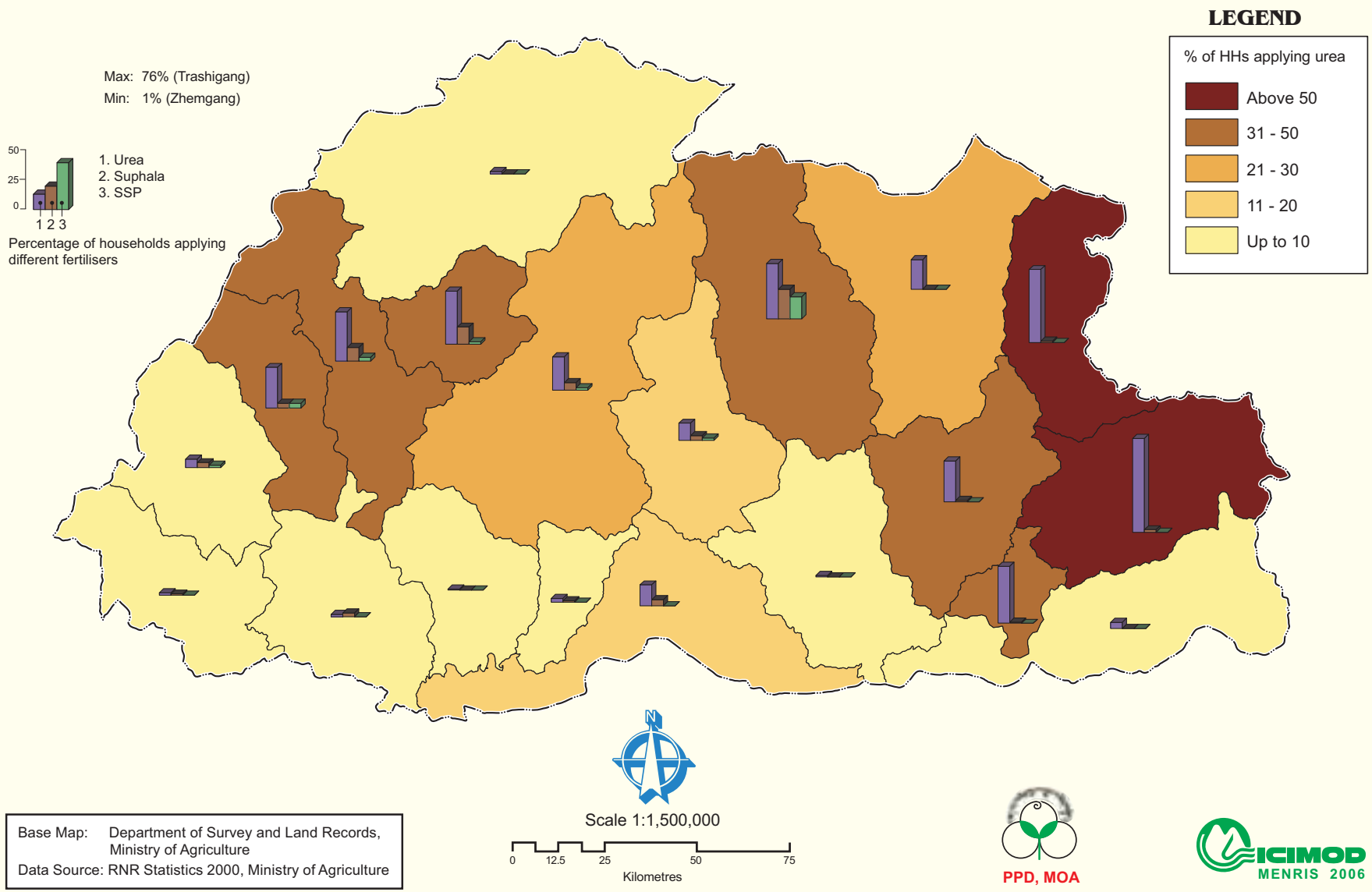
Table D.3

Districts	Urea	Suphala	SSP	Districts	Urea	Suphala	SSP
Trashigang	76	2	0	Sarpang	17	5	0
Trashi Yangtse	59	1	0	Trongsa	14	4	2
Pemagatshel	46	1	0	Ha	7	4	2
Bumthang	45	24	18	S/Jongkhar	5	0	0
Punakha	43	14	2	Tsirang	3	1	0
Thimphu	40	11	3	Samtse	2	1	0
Mongar	33	1	0	Gasa	2	0	0
Paro	33	4	4	Chhukha	2	3	0
Wangdue	27	6	2	Dagana	1	0	0
Lhuntse	24	0	0	Zhemgang	1	0	0
				Average*	**27.5**	**2.6**	**1**

* Simple averages, not weighted

Farm Households Applying Chemical Fertilisers

D 3



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Farm Households Applying FYM and Chemical Fertilisers to Paddy

Table D.4 shows the percentage of households growing paddy who applied FYM or chemical fertiliser to the crop in 2000, with the districts listed in descending order of application of at least one or other type of fertiliser. Some households applied both FYM and chemical fertiliser, but the number of these, and the total percentage of farmers who applied any type of fertiliser, cannot be ascertained from the census data. The map shows the districts ranked according to the total production of paddy (see Table B8 and map) and the superimposed bar charts the percentage of producer households applying FYM or chemical fertiliser to the crop.

More than 90% of the farm households growing paddy in Gasa, Punakha, Paro, and Thimphu applied FYM, none in Bumthang (where little paddy is grown), and only 4% in Zhemgang. A little more than half of paddy farmers in Punakha, Thimphu, Trashigang, and Yangtse applied chemical fertilisers, but far fewer elsewhere.

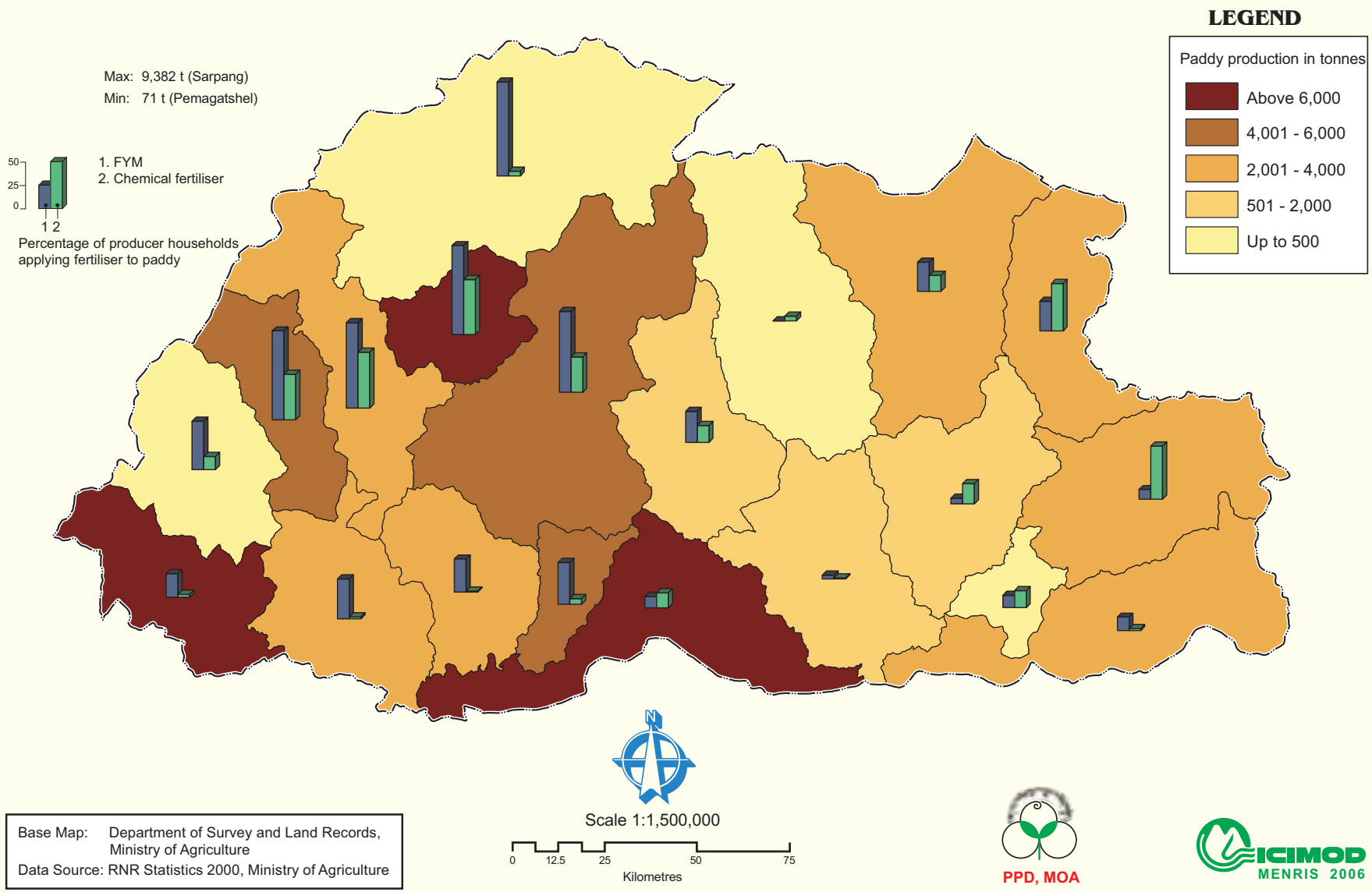
Table D.4

District	FYM	Chemical Fertiliser	District	FYM	Chemical Fertiliser
Gasa	99	5	Dagana	35	1
Punakha	94	59	Trongsa	33	18
Paro	94	47	Lhuntse	31	17
Thimphu	90	59	Samtse	25	3
Wangdue	85	37	Mongar	6	21
Trashigang	10	56	Pemagatshel	13	18
Yangtse	31	51	Sarpang	12	16
Ha	51	14	S/Jongkhar	14	2
Tsirang	44	5	Bumthang	0	5
Chhukha	42	2	Zhemgang	4	1
			Average*	**41**	**22**

* Simple averages, not weighted

Farm Households Applying FYM and Chemical Fertilisers to Paddy

D 4



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Farm Households Applying FYM and Chemical Fertilisers to Maize

Table D.5 shows the percentage of households growing maize who applied FYM or chemical fertiliser to the crop in 2000, with the districts listed in descending order of application of at least one or other type of fertiliser. Some households applied both FYM and chemical fertiliser, but the number of these, and the total percentage of farmers who applied any type of fertiliser, cannot be ascertained from the census data. The map shows the districts ranked according to the total production of maize (see Table B9 and map) and the superimposed bar charts show the percentage of producer households applying FYM or chemical fertiliser to the crop.

Around three-quarters of all maize growing households in Pemagatshel, Trashigang, Trashi Yangtse, and Mongar applied FYM to the crop, but only around 10% in Sarpang, Zhemgang, and Trongsa. Between a half and three-quarters of all maize growing households in Trashigang, Trashi Yangtse, and Pemagatshel applied chemical fertilisers, but far fewer elsewhere.

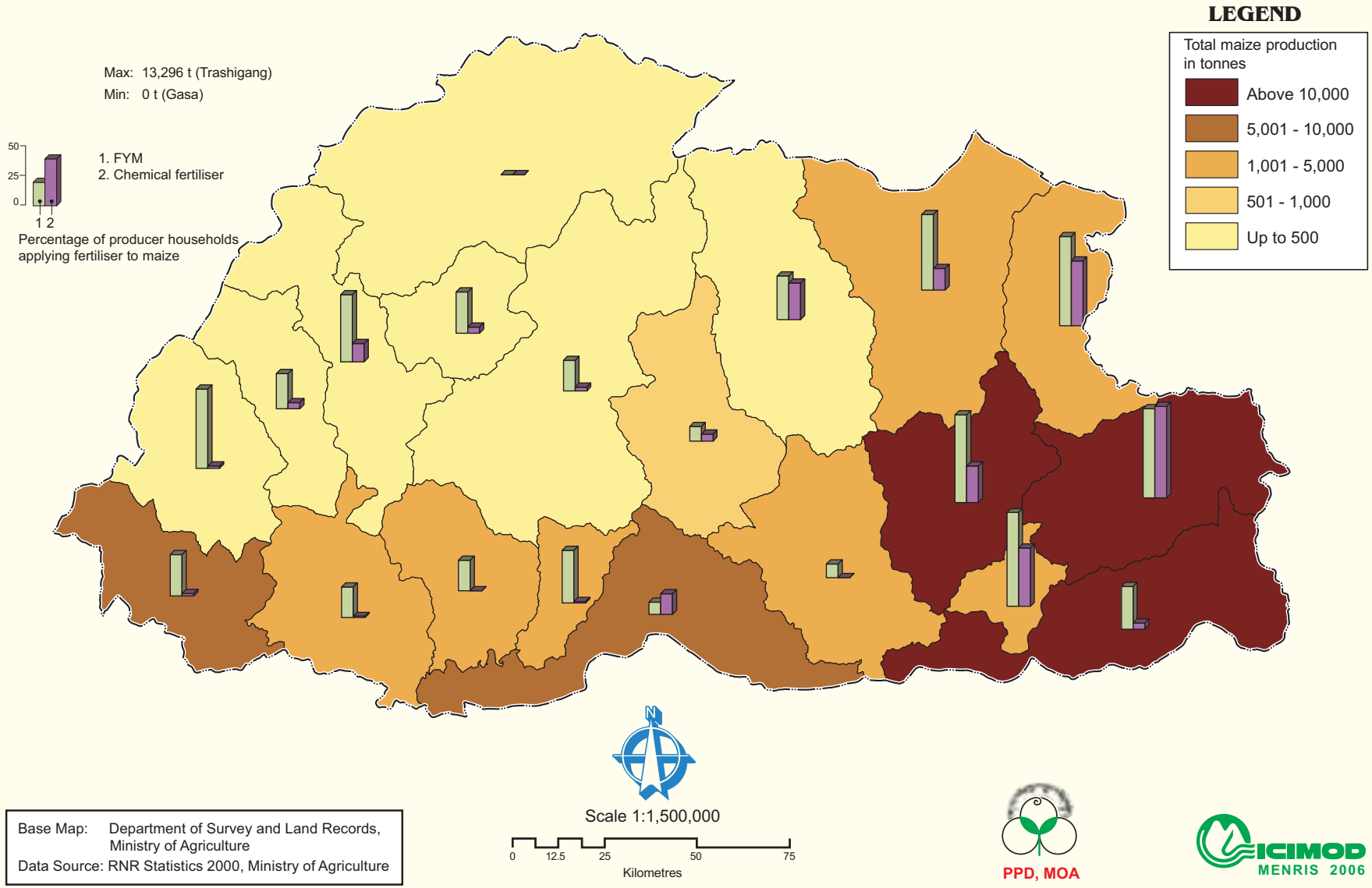
Table D.5

District	FYM	Fertilisers	District	FYM	Fertilisers
Pemagatshel	77	47	S/Jongkhar	35	5
Trashigang	73	75	Samtse	34	2
Trashi Yangtse	73	54	Paro	29	5
Mongar	72	31	Wangdue	25	3
Ha	65	2	Chhukha	25	1
Lhuntse	62	18	Dagana	25	0
Thimphu	55	15	Sarpang	10	17
Tsirang	43	1	Trongsa	12	6
Bumthang	36	31	Zhemgang	11	0
Punakha	34	6	Gasa	NA+	NA+
			Average*	**48**	**25**

* Simple averages, not weighted; + not applicable as no maize grown

Farm Households Applying FYM and Chemical Fertilisers to Maize

D 5



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

ICIMOD
MENRIS 2006

Farm Households Applying FYM and Chemical Fertilisers to Potato

Table D.6 shows the percentage of households growing potato who applied FYM or chemical fertiliser to the crop in 2000, with the districts listed in descending order of application of at least one or other type of fertiliser. Some households applied both FYM and chemical fertiliser, but the number of these, and the total percentage of farmers who applied any type of fertiliser, cannot be ascertained from the census data. The map shows the districts ranked according to total production of potato (see Table B11 and map) and the superimposed bar charts the percentage of producer households applying FYM or chemical fertiliser to the crop.

Around three-quarters of all potato growing households in Ha, Paro, Wangdue, and Chhukha applied FYM to the crop, but less than 20% in Samdrup Jongkhar, Lhuntse, and Sarpang. More than half of all potato growing households in Paro, Wangdue, Bumthang, and Chhukha applied chemical fertilisers, but fewer elsewhere.

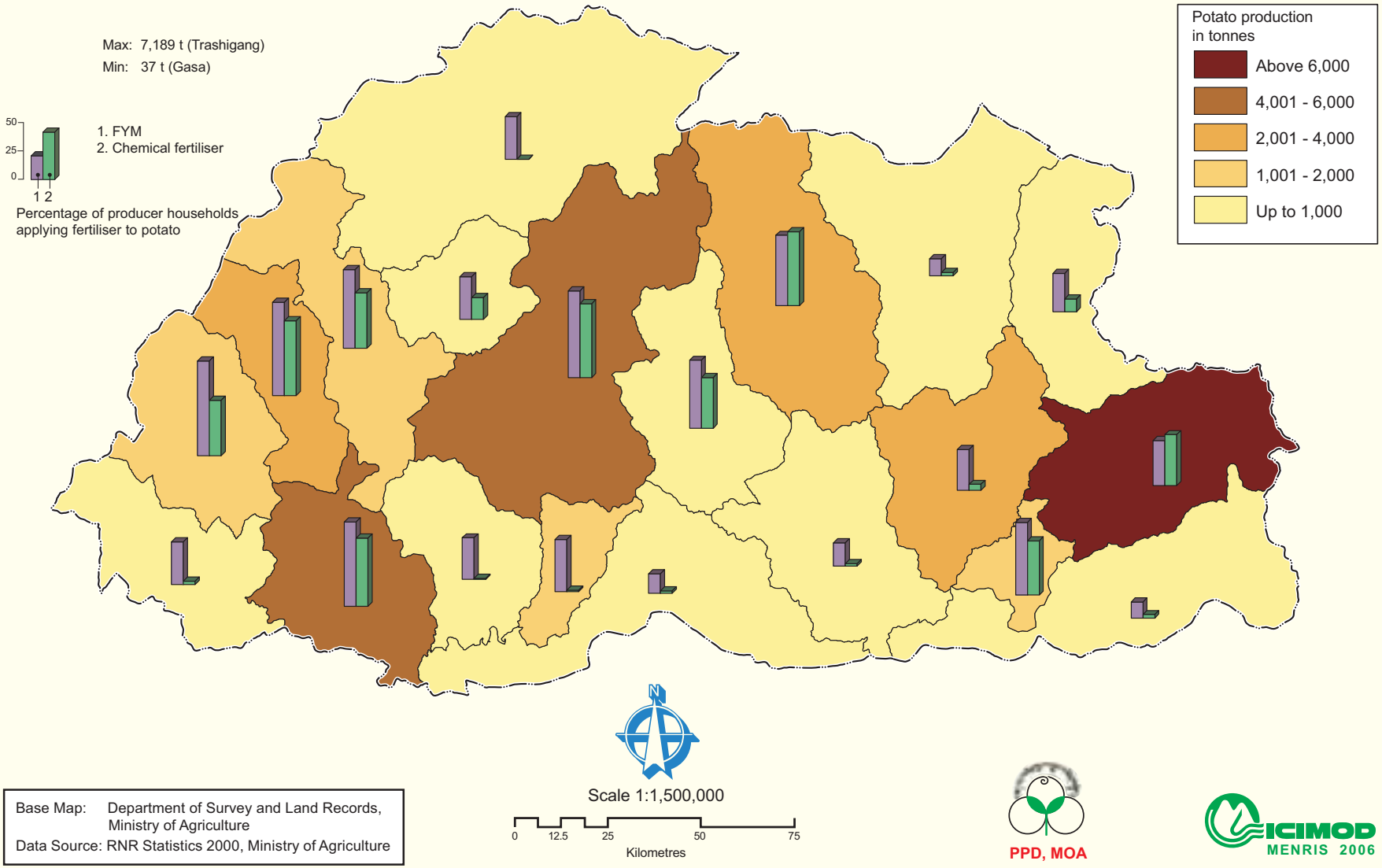
Table D.6

District	FYM	Fertiliser	District	FYM	Fertiliser
Ha	82	48	Punakha	37	19
Paro	81	65	Samtse	37	3
Wangdue	75	64	Gasa	37	0
Chhukha	73	59	Dagana	36	1
Thimphu	68	48	Mongar	35	5
Bumthang	61	64	Trashi Yangtse	33	11
Pemagatshel	63	47	Zhemgang	20	2
Trongsa	59	44	Sarpang	17	2
Tsirang	45	1	Lhuntse	15	3
Trashigang	39	44	S/Jongkhar	14	3
			Average*	**49**	**35**

* Simple averages, not weighted

Farm Households Applying FYM and Chemical Fertilisers to Potato

D 6



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Farm Households Applying FYM and Chemical Fertilisers to Chilli

Table D.7 shows the percentage of households growing chilli who applied FYM or chemical fertiliser to the crop in 2000, with the districts listed in descending order of application of at least one or other type of fertiliser. Some households applied both FYM and chemical fertiliser, but the number of these, and the total percentage of farmers who applied any type of fertiliser, cannot be ascertained from the census data. The map shows the districts ranked according to the total production of chilli (see Table B11 and map) and the superimposed bar charts the percentage of producer households applying FYM or chemical fertiliser to the crop.

Just over half of all chilli growing households in Paro, Pemagatshel, and Thimphu applied FYM to the crop, but only 20% or less in half of the districts, with the least in Samtse (11%).

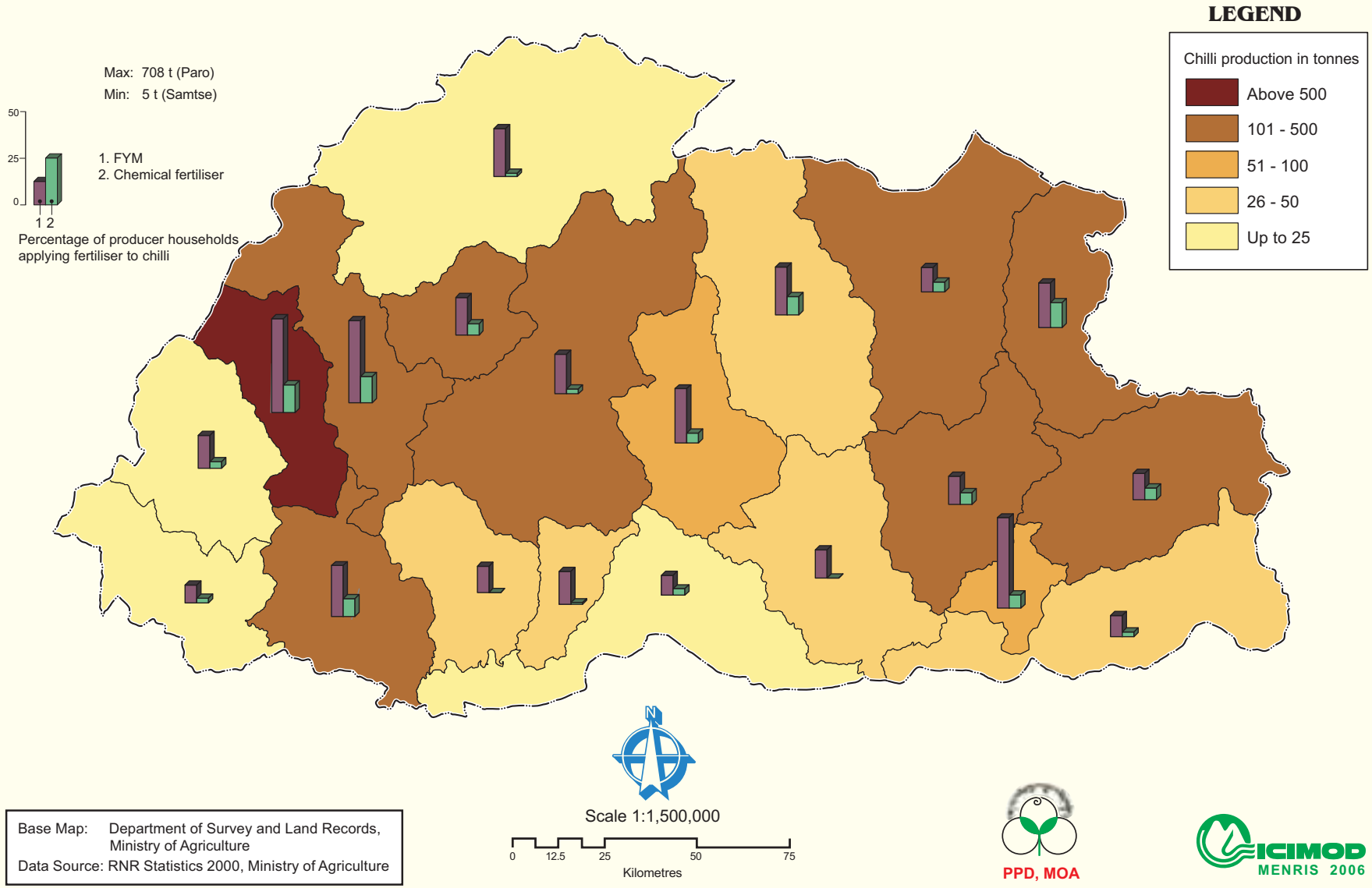
Table D.7

District	FYM	Fertiliser	District	FYM	Fertiliser
Paro	57	17	Ha	20	4
Pemagatshel	55	8	Tsirang	20	1
Thimphu	50	16	Mongar	17	7
Trongsa	33	6	Zhemgang	17	0
Chhukha	31	11	Trashigang	16	7
Bumthang	29	11	Dagana	16	0
Gasa	29	2	Lhuntse	15	6
Yangtse	27	15	S/Jongkhar	13	3
Wangdue	24	3	Sarpang	12	4
Punakha	23	7	Samtse	11	3
			Average*	**27**	**7**

* Simple averages, not weighted

Farm Households Applying FYM and Chemical Fertilisers to Chilli

D 7



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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E. Livestock

Livestock are an integral part of the Bhutanese farming system. The value of keeping livestock extends beyond the immediate benefits of milk, meat, and fibre production. In many areas, the primary purpose of keeping livestock is to provide draught power and to supply manure to support crop production. In addition, livestock also provide a sense of security for rural farmers in times of crop failure since they can be exchanged readily for cash or food grain. There is a strong emphasis on milk production and processing at the household level since butter and the local cheese are major components of the Bhutanese diet.

The main types of livestock owned and reared by farmers are cattle, yak, buffalo, equine (horses, mules, and donkeys), sheep, goats, pigs, and poultry. Open grazing continues to be the main source of fodder for the majority of livestock since both improved pastures and stall feeding remain limited.

Due to strong religious sentiments, culling of livestock is quite limited and in most cases animals (including poultry) are kept for purposes other than meat. However, animals that die naturally or that die as a result of accidents are consumed or sold. In rural areas people still eat very little meat although meat consumption is increasing among the urban population. A fair amount of meat is imported to meet the country's growing need but the values for this are not included here.

The following maps and tables are presented in this section:

- E.1. Population of Cattle, Yak and Equine
- E.2. Population of Sheep, Goats and Pigs
- E.2A. Farm Households Owning Cattle, Yak, Equine and Buffalo (Table only)
- E.2B. Farm Households Owning Sheep, Goats, Pigs and Poultry (Table only)
- E.3. Production of Milk, Butter, and Cheese
- E.4. Meat Production from Farm Livestock
- E.5. Consumption of Farm-Produced Meat
- E.6. Milk Availability and Production by Local, Jersey and Brown Swiss Cattle
- E.7. Sources of Livestock Feed and Fodder

Population of Cattle, Yak and Equine

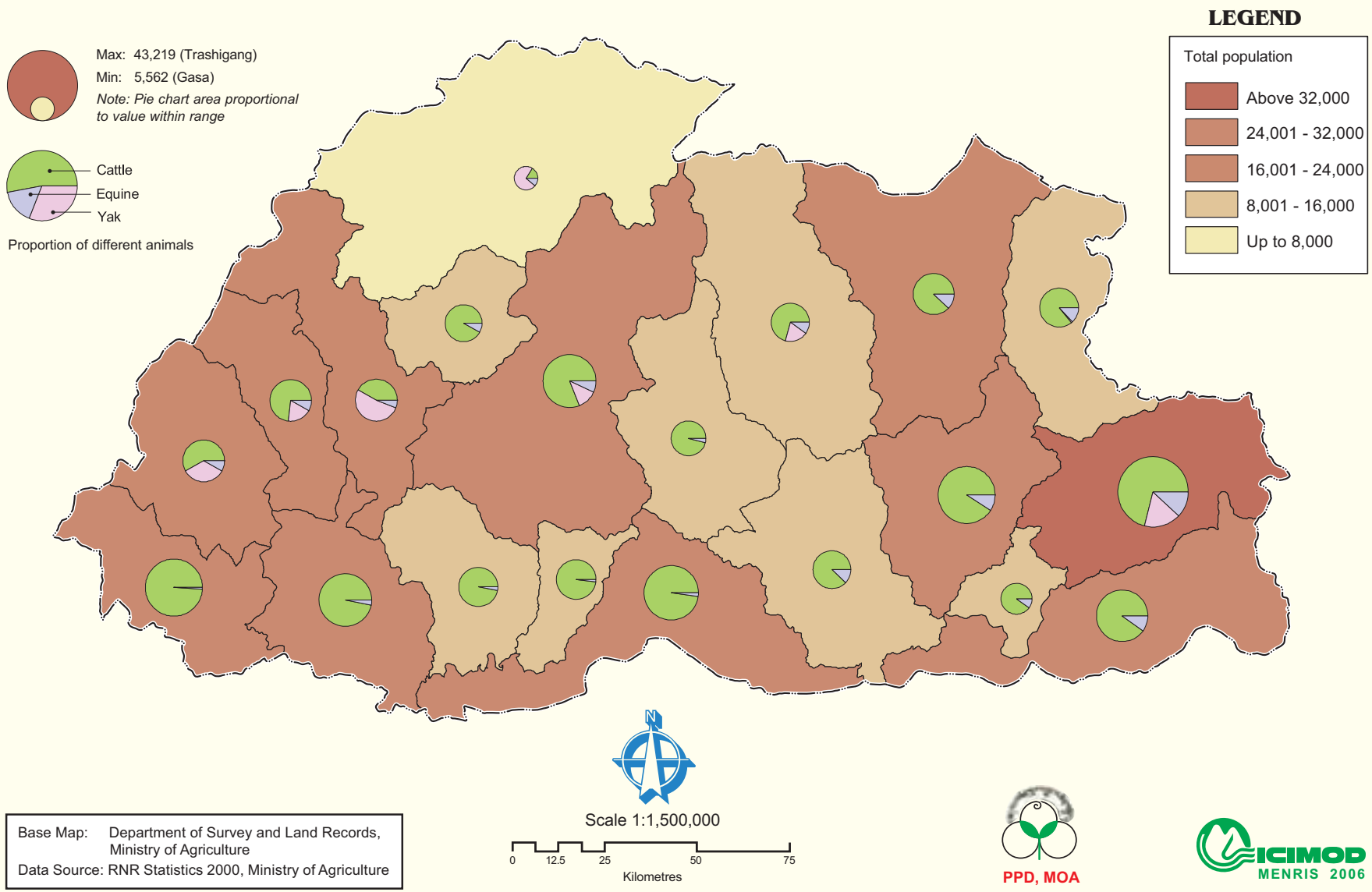
Table E.1 shows the population of cattle, yak, and equine (horses, mules, and donkeys) in each district in 2000, with the districts listed in descending order of total number of animals. The map shows the districts ranked according to the total population of animals; the superimposed pie charts show the proportion of each animal type and indicate differences in the total population per district.

In 2000, the total population of cattle in the country was 320,510, of yak (including crossbreeds) 34,936, and of equine 27,882. In addition, there were 1800 buffaloes concentrated in the southern belt, but these constitute an insignificant 0.3% of the total livestock population and were not included in the maps. Generally both cattle and equine are found in all districts, while yak, due to their adaptation to cold climates, are only found at higher altitudes. Trashigang had the highest number of cattle (>30,000) and Gasa the lowest (<1000); Trashigang also had the highest equine population (>5000) and Samtse the lowest (only 311); and Thimphu had the highest number of yak (>8,500), with few or none in 13 districts, primarily in the south.

Table E.1

District	Cattle	Yak	Equine	Total	District	Cattle	Yak	Equine	Total
Trashigang	30,825	7,369	5025	43,219	Lhuntse	14,089	44	1950	16,083
Samtse	29,341	0	311	29,652	Tsirang	14,695	0	349	15,044
Mongar	26,635	46	2655	29,336	Dagana	14,296	0	426	14,722
Sarpang	26,611	0	482	27,093	Trashi Yangtse	12,505	115	1987	14,607
Wangdue	20,893	3,057	1821	25,771	Bumthang	10,002	2,672	1414	14,088
Chhukha	24,870	12	657	25,539	Zhemgang	12,156	0	1678	13,834
S/Jongkhar	21,967	60	2399	24,426	Punakha	12,125	24	1064	13,213
Thimphu	6,990	8,699	1045	16,734	Trongsa	11,336	0	446	11,782
Ha	9,639	5,629	1365	16,633	Pemagatshel	8,570	0	923	9,493
Paro	12,102	3,158	1237	16,497	Gasa	863	4,051	648	5,562
					Bhutan Total	**320,510**	**34,936**	**27,882**	**383,328**

Population of Cattle, Yak and Equine



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Population of Sheep, Goats and Pigs

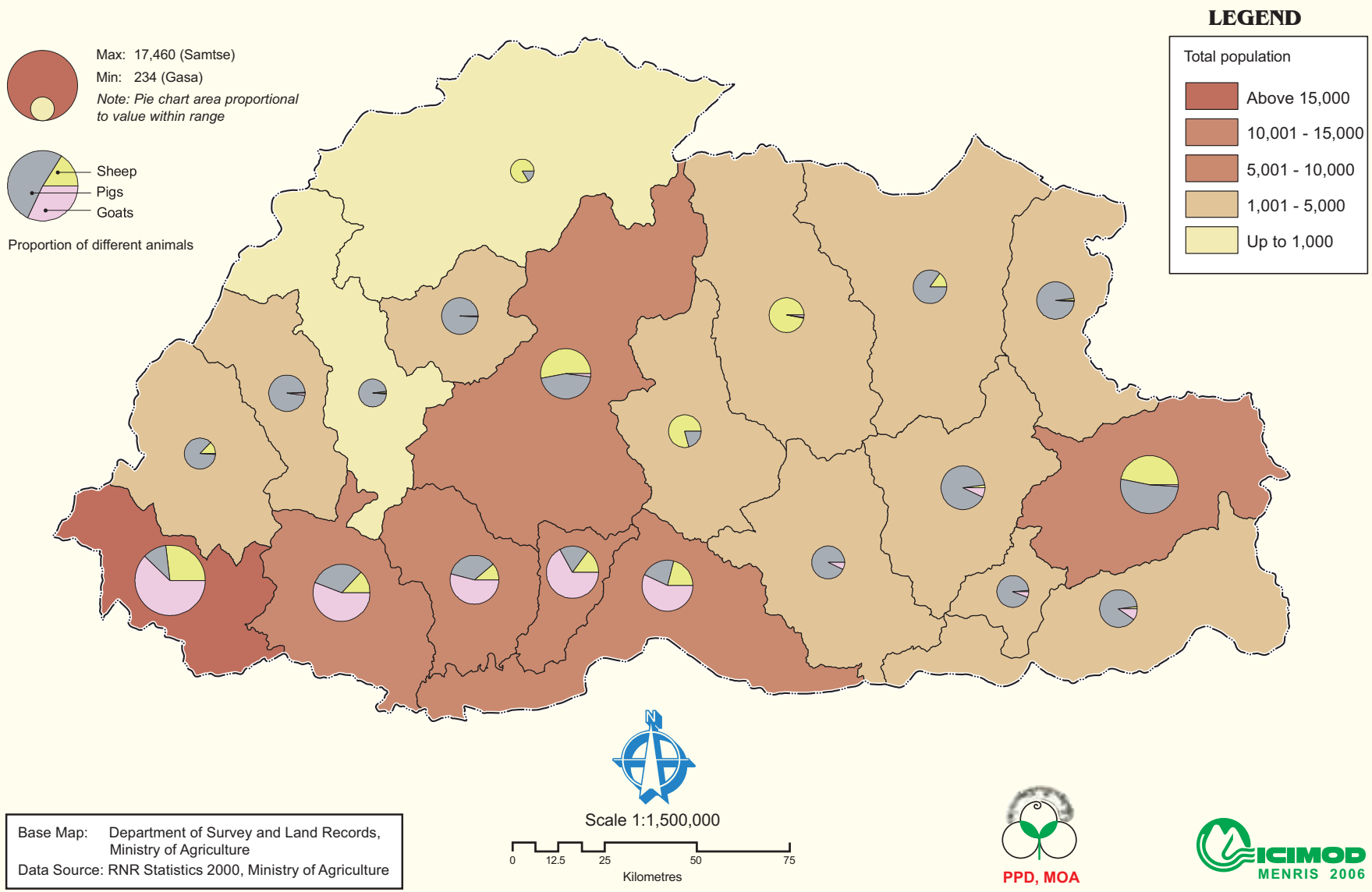
Table E.2 shows the population of sheep, goats, and pigs in each district in 2000, with the districts listed in descending order of total number of animals. The map shows the districts ranked according to the total population of animals; the superimposed pie charts show the proportion of each type and indicate differences in the total population per district.

In 2000, there were 22,879 sheep, 41,404 pigs, and 31,328 goats in the country, nearly 96,000 animals. Almost 20% of the total were in Samtse (>17,000). Trashigang had the most sheep and pigs (>5000 of each), and Samtse the most goats (>11, 000). Overall, there were very few animals in Thimphu (786) and Gasa (234).

Table E.2

District	Sheep	Pigs	Goats	Total	District	Sheep	Pigs	Goats	Total
Samtse	4,659	1,885	10,916	17,460	Punakha	0	2,640	15	2,655
Trashigang	5,047	5,643	104	10,794	Paro	15	2,511	58	2,584
Chhukha	1,375	3,154	5,739	10,268	Bumthang	2,147	30	28	2,205
Tsirang	1,189	1,451	5,441	8,081	Lhuntse	279	1,617	7	1,903
Sarpang	1,588	1,640	4,371	7,599	Zhemgang	7	1,618	112	1,737
Wangdue	3,884	3,304	139	7,327	Trongsa	1,337	350	7	1,694
Dagana	732	2,378	3,612	6,722	Pemagatshel	20	1,414	91	1,525
Mongar	105	4,398	341	4,844	Ha	173	1,179	12	1,364
S/Jongkhar	61	2,599	281	2,941	Thimphu	18	762	6	786
Trashi Yangtse	47	2,793	48	2,888	Gasa	196	38	0	234
					Bhutan Total	**22,879**	**41,404**	**31,328**	**95,611**

Population of Sheep, Goats and Pigs



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Farm Households Owning Cattle, Yak, Equine and Buffalo

Table E.2A shows the percentage of farm households owning cattle, yak (including crossbreeds), and equine (horses, mules, and donkeys) in each district in 2000, with the districts listed in alphabetical order.

Cattle constitute the most important livestock for farm households in Bhutan because of their manifold uses. Nearly 90% or more of farm households in Ha, Trongsa, and Wangdue owned cattle; with the lowest percentage (still 58%) in Gasa. Very few households owned yak with the highest percentage in Gasa (41%) followed by Ha (20%), but none to less than 10% in all other districts. Although Thimphu and Trashigang had the highest number of yak (Table E.1), these were owned by only 7% and 5% of farm households, respectively. Gasa had the highest percentage of households owning equine (65%) followed by Zhemgang (51%). Both of these districts had over 50% of their households situated in locations more than 8 hours walking distance from the main road (Table G.4). Less than 5% of households owned buffalo in any district.

Table E.2A

District	Cattle	Yak	Equine	Buffalo	District	Cattle	Yak	Equine	Buffalo
Bumthang	82	11	34	0	Samtse	75	0	2	3
Chhukha	78	<1	9	<1	Sarpang	80	0	9	3
Dagana	83	0	12	1	S/Jongkhar	69	<1	33	<1
Gasa	57	41	65	0	Thimphu	69	7	17	0
Ha	92	20	42	<1	Trashigang	71	5	31	0
Lhuntse	78	<1	41	0	Trashi Yangtse	70	<1	37	0
Mongar	83	<1	34	0	Tsirang	82	0	9	5
Paro	80	3	19	0	Trongsa	90	0	19	0
Pemagatshel	67	0	24	0	Wangdue	89	6	32	0
Punakha	87	<1	24	0	Zhemgang	87	0	51	0
					Average*	**78**	**2**	**24**	**<1**

* Simple averages, not weighted

Farm Households Owning Sheep, Goats, Pigs and Poultry

Table E.2B shows the percentage of farm households owning sheep, goats, pigs, and poultry in each district in 2000, with the districts listed in alphabetical order.

Poultry were owned by half or more of all households in all districts except Gasa (38%) and Trashi Yangtse (48%), with a maximum in Dagana (79%). Pigs were the second most common small livestock. Punakha had the highest percentage of households owning pigs (68%) followed by Wangdue (57%), and Bumthang the least (<1%) followed by Gasa (11%). Household ownership of goats was relatively small and concentrated predominantly in the five southwest districts of Tsirang (63%), Samtse, Dagana, Chhukha, and Sarpang. Sheep were even less common; Bumthang had the highest percentage of households owning sheep (21%).

Table E.2B

District	Sheep	Goats	Pigs	Poultry	District	Sheep	Goats	Pigs	Poultry
Bumthang	21	<1	<1	58	Samtse	15	48	22	78
Chhukha	6	38	46	78	Sarpang	9	34	25	63
Dagana	8	48	51	79	S/Jongkhar	<1	2	29	54
Gasa	2	0	11	38	Thimphu	<1	<1	28	46
Ha	<1	<1	47	74	Trashigang	6	<1	39	62
Lhuntse	1	<1	40	78	Trongsa	11	<1	19	63
Mongar	<1	5	47	73	Tsirang	12	63	35	78
Paro	<1	1	52	50	Trashi Yangtse	<1	<1	49	48
Pemagatshel	<1	2	25	50	Wangdue	10	2	57	63
Punakha	0	<1	60	68	Zhemgang	<1	3	46	74
					Average*	**6**	**16**	**38**	**66**

* Simple averages, not weighted

Production of Milk, Butter and Cheese

Almost all processing and production of milk, butter, and cheese is at the farm household level. The main kind of cheese produced is a soft fresh cheese called churpi (sometimes dried) which is used widely in Bhutanese cooking. Bhutan has only recently started to introduce central processing centres in urban areas. Table E.3 shows the total production of milk, the amount processed into butter and cheese in 2000, the amount left as milk, and the total production of butter and cheese with the districts listed in descending order of total milk production. The map shows the districts ranked according to total milk production and the superimposed bar charts the total production of 'end products' (remaining milk, and butter and cheese).

The total production of milk in 2000 was about 25 million litres, of which more than 20 million litres or about 83% was processed to produce around 1,300t of butter and 2,200t of cheese. Sarpang, Chhukha, and Mongar districts produced the largest quantities of milk in the country (>2 million litres each). The production of both butter and cheese was highest in Chhukha, followed by Trashigang and Mongar for butter and Trashigang and Wangdue for cheese. The census statistics show that 27% of all butter and 34% of all cheese produced was sold by farmers for cash (see Table F.4).

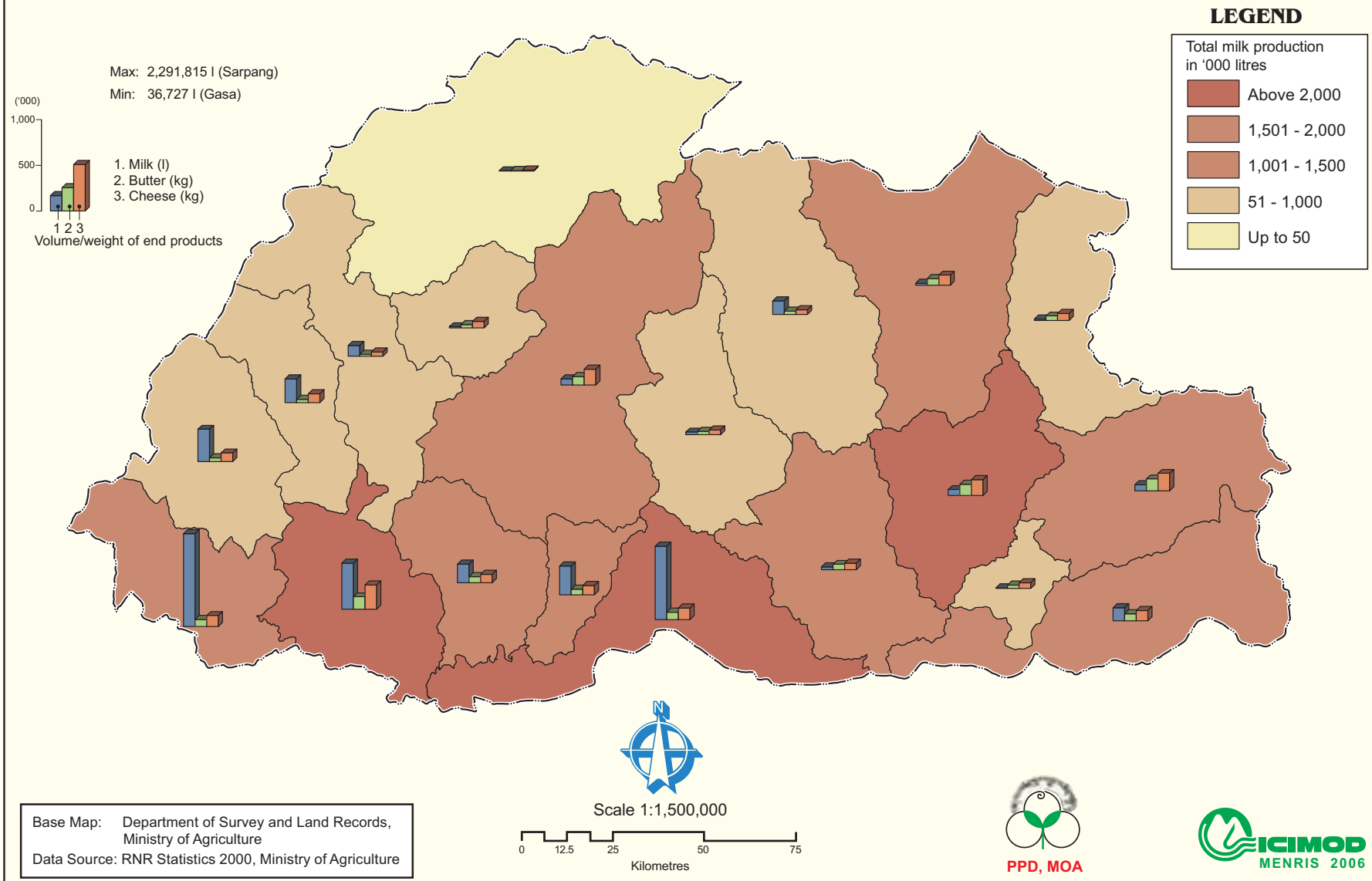
The production of milk is not in direct proportion to the population of cattle and yak, mainly because cattle and yak are also bred for transport and the population includes lactating and non-lactating cows as well as bulls; there are also differences in productivity between different breeds (see Table E.6).

Table E.3

District	Milk Production		End Products			District	Milk Production		End Products		
	Total ('000 litres)	Amount Processed ('000 litres)	Milk* ('000 l)	Butter (kg)	Cheese (kg)		Total ('000 litres)	Amount Processed ('000 litres)	Milk* ('000 l)	Butter (kg)	Cheese (kg)
Sarpang	2,292	1,460	832	86,447	132,506	Lhuntse	1,098	1,074	24	75,974	115,336
Chhukha	2,266	1,746	520	139,653	272,377	Ha	950	584	366	43,621	98,148
Mongar	2,051	1,987	64	123,307	178,585	Trongsa	944	913	31	39,944	54,705
Trashigang	1,984	1,917	67	132,696	196,477	Paro	929	659	270	38,882	102,370
Samtse	1,838	786	1,052	79,637	124,405	Trashi Yangtse	864	851	13	49,089	76,873
S/Jongkhar	1,655	1,508	147	78,482	115,331	Pemagatshel	824	815	9	40,275	63,903
Wangdue	1,463	1,393	70	93,918	180,163	Bumthang	747	595	152	40,165	55,207
Dagana	1,331	1,121	210	67,927	95,735	Punakha	678	663	15	40,058	76,671
Zhemgang	1,157	1,126	31	58,651	73,540	Thimphu	575	452	123	20,618	45,889
Tsirang	1,154	829	325	61,317	104,188	Gasa	37	35	2	5,411	10,432
						Bhutan Total	**24,837**	**20,514**	**4,323**	**1,316,072**	**2,172,841**

* Total not processed into butter or cheese

Production of Milk, Butter and Cheese



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Meat Production from Farm Livestock

Farm meat, especially beef, is limited because people generally do not slaughter their domestic cattle. Beef produced on farm mainly comprises animals that have died a natural death or have been killed by accidents or by wild animals. People do, however, slaughter yak, pigs, sheep, chickens, and goats for their own consumption and sale. Meat production was calculated from estimates given by respondents in the census enumeration.

Table E.4 shows the total weight of farm-produced meat together with the amount of different types, listed in descending order of total production. The map shows the districts ranked according to the total meat production; the superimposed pie charts show the proportion of each type and indicate differences in the total production per district.

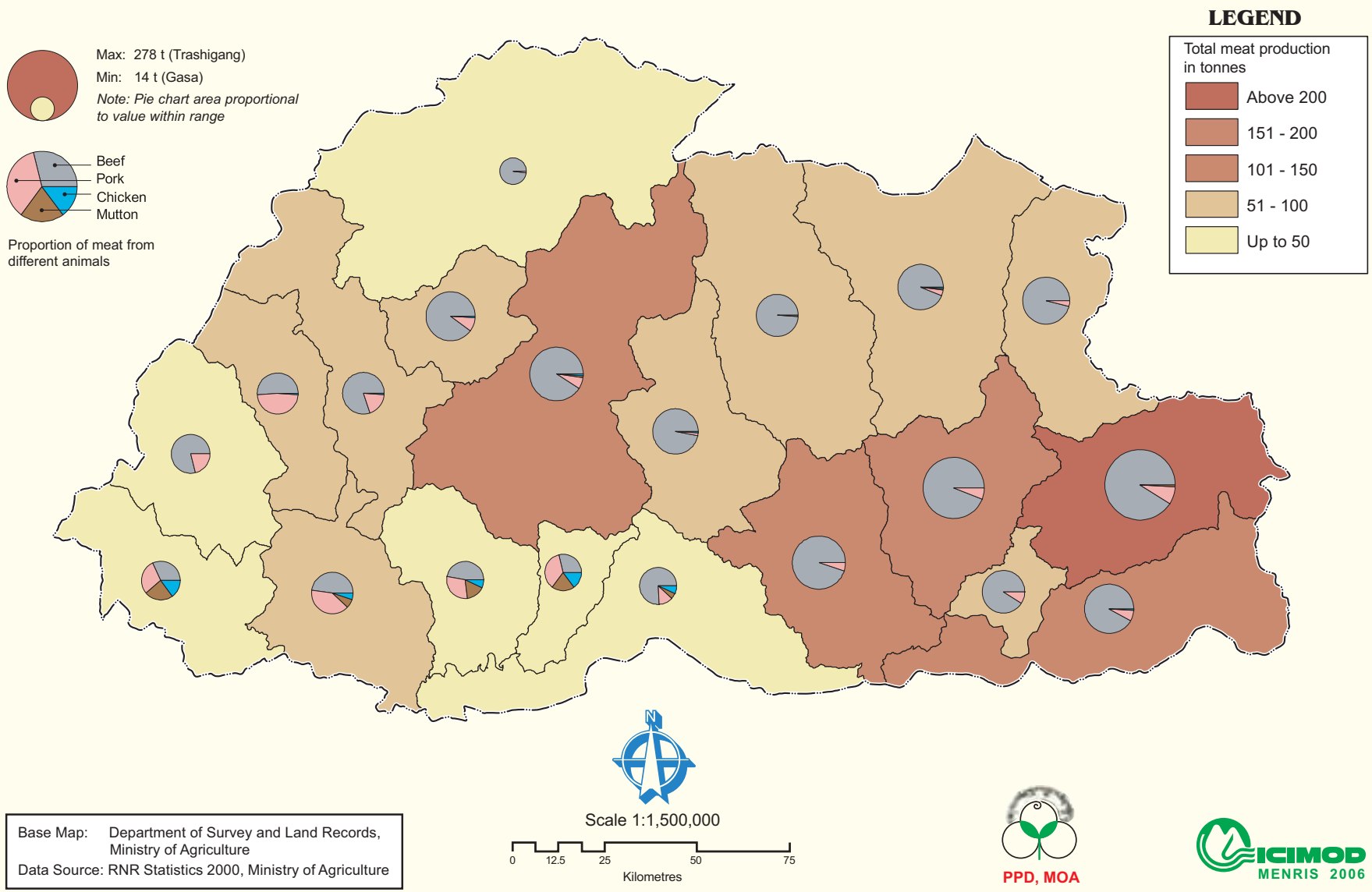
In 2000, beef accounted for more than 85% of the total weight of farm-produced meat. The total meat production was very low, amounting to little more than 2kg per head per year. Trashigang had the highest production of meat followed by Mongar and Wangdue, and Gasa the lowest. Trashigang also had the highest production of beef with about 18% of the total for the country, followed by Wangdue, Zhemgang, and Mongar. Pork accounted for about 11% of total meat production, with the greatest amount in Paro, and chicken and mutton together accounted for about 3%.

Table E.4

District	Total Meat Production (kg)					District	Total Meat Production (kg)				
	Beef	Pork	Mutton	Chicken	Total		Beef	Pork	Mutton	Chicken	Total
Trashigang	251,551	22,609	3,144	240	277,544	Bumthang	57,948	0	507	84	58,539
Mongar	179,763	10,949	541	294	191,547	Thimphu	45,208	10,929	155	54	56,346
Wangdue	119,110	9,741	1,240	101	130,192	Chhukha	26,804	22,334	4,212	2,820	56,170
Zhemgang	120,817	6,350	283	357	127,807	Paro	27,150	25,653	152	8	52,963
S/Jongkhar	92,259	7,427	150	441	100,277	Ha	33,438	8,764	203	71	42,476
Punakha	90,253	9,400	0	106	99,759	Samtse	13,467	11,941	10,031	6,297	41,736
Yangtse	83,451	3,402	0	46	86,899	Sarpang	26,320	4,099	1,807	2,541	34,767
Lhuntse	72,598	3,147	1,027	123	76,895	Dagana	16,155	10,338	5,389	2,835	34,717
Trongsa	74,466	1,608	333	173	76,580	Tsirang	9,523	11,789	6,649	4,635	32,596
Pemagatshel	55,322	5,747	0	53	61,122	Gasa	14,113	349	0	0	14,462
						Bhutan Total	**1,409,716**	**186,576**	**35,823**	**21,279**	**1,653,394**

Meat Production from Farm Livestock

E 4



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

Consumption of Farm-Produced Meat

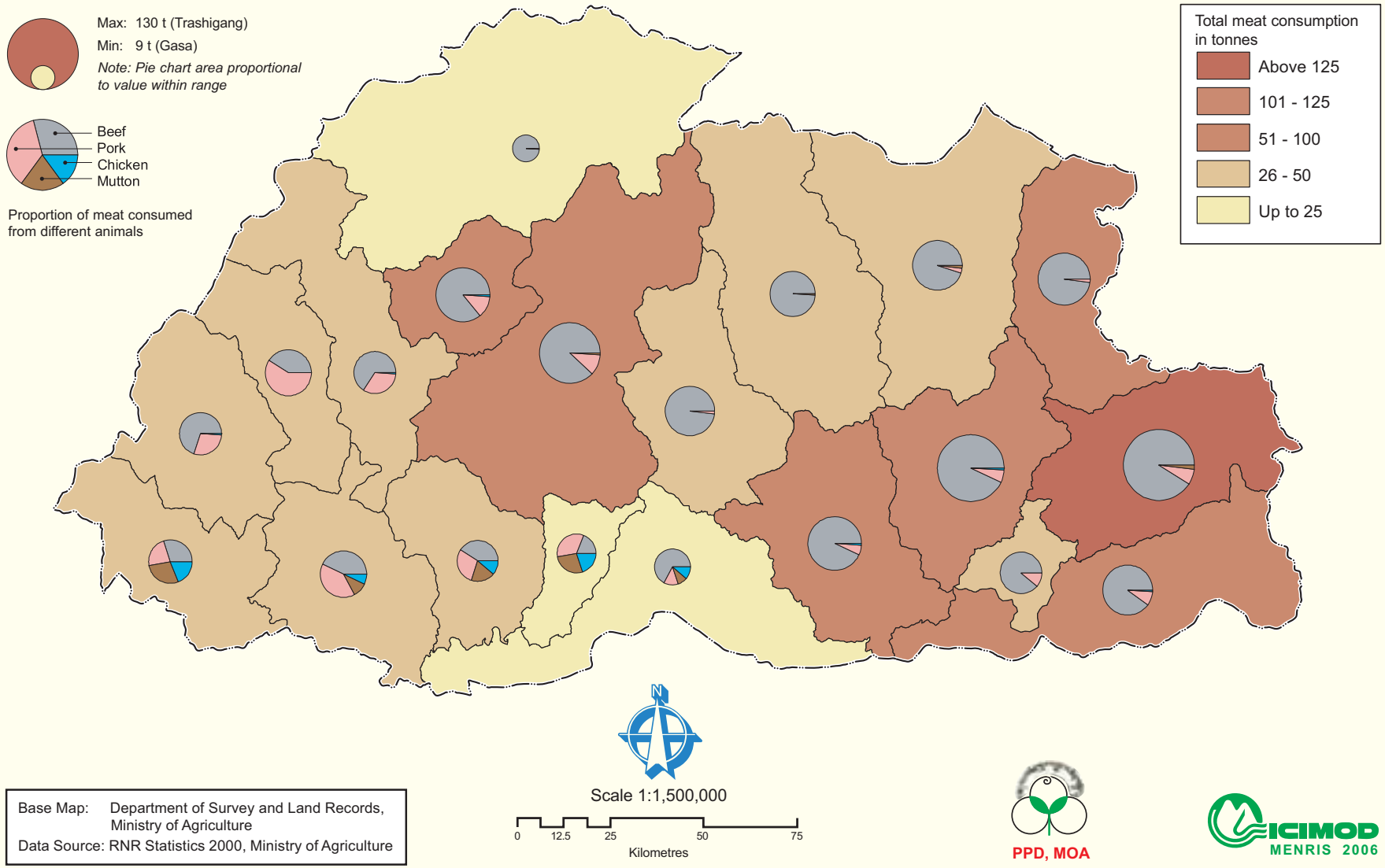
Meat consumption was calculated from the estimates of average consumption given by the farm households in the census enumeration. Table E.5 shows the total meat consumed by farm households in each district in 2000 together with the amount of different types, with the districts listed in descending order of total consumption. The map shows the districts ranked according to the total meat consumed; the superimposed pie charts show the proportion of each type and indicate differences in the total consumption per district.

Both production and consumption were highest in Trashigang district, where about 48% of the total meat produced was consumed, followed by Mongar and Wangdue. Beef accounted for more than 80% of all meat consumed, and pork for about 13%. Paro and Chhukha districts were the major consumers of pork. Both mutton and chicken consumption were highest in Samtse followed by Tsirang and Dagana for mutton and Tsirang and Chhukha for chicken.

Table E.5

District	Total Consumption (kg)					District	Total Consumption (kg)				
	Beef	Pork	Mutton	Chicken	Total		Beef	Pork	Mutton	Chicken	Total
Trashigang	118,230	8,628	2,419	232	129,509	Paro	16,127	23,263	152	8	39,550
Mongar	104,137	6,468	535	270	111,410	Bumthang	36,590	0	470	78	37,138
Wangdue	76,000	9,403	1,222	93	86,718	Samtse	9,923	7,500	9,304	6,251	32,978
Punakha	54,869	8,576	0	106	63,551	Ha	20,959	8,612	121	71	29,763
Zhemgang	57,671	3,805	137	339	61,952	Thimphu	19,504	9,781	39	54	29,378
Yangtse	55,784	1,246	0	46	57,076	Pemagatshel	25,243	3,010	0	44	28,297
S/Jongkhar	45,141	4,682	132	441	50,396	Dagana	10,921	7,654	5,124	2,830	26,529
Lhuntse	47,080	1,338	1,011	109	49,538	Tsirang	4,180	7,571	5,965	4,593	22,309
Trongsa	47,889	741	168	172	48,970	Sarpang	10,962	2,157	1,561	1,803	16,483
Chhukha	17,465	16,303	3,887	2,793	40,448	Gasa	9,099	116	0	0	9,215
						Bhutan Total	**787,774**	**130,854**	**32,247**	**20,333**	**971,208**

Consumption of Farm-Produced Meat



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

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Milk Availability and Production by Local, Jersey and Brown Swiss Cattle

There is a large difference in the production of milk among various breeds of cattle. The per head productivity of milk is estimated to be highest from Jersey cows, at approximately 852 litres annually, followed by Brown Swiss cows with 658 litres. Local cows give an average of only 393 litres annually.

Table E.6 shows the total annual milk production from each of the three types of cattle in 2000, together with the overall household availability (total production from all three types of cattle divided by number of farm households), listed in descending order of household availability. The milk availability from all sources is slightly higher (see Table E.3 for milk production from all sources). The map shows the districts ranked according to the total milk availability per household; the superimposed bar charts show the total annual milk production from each of the three types of cattle.

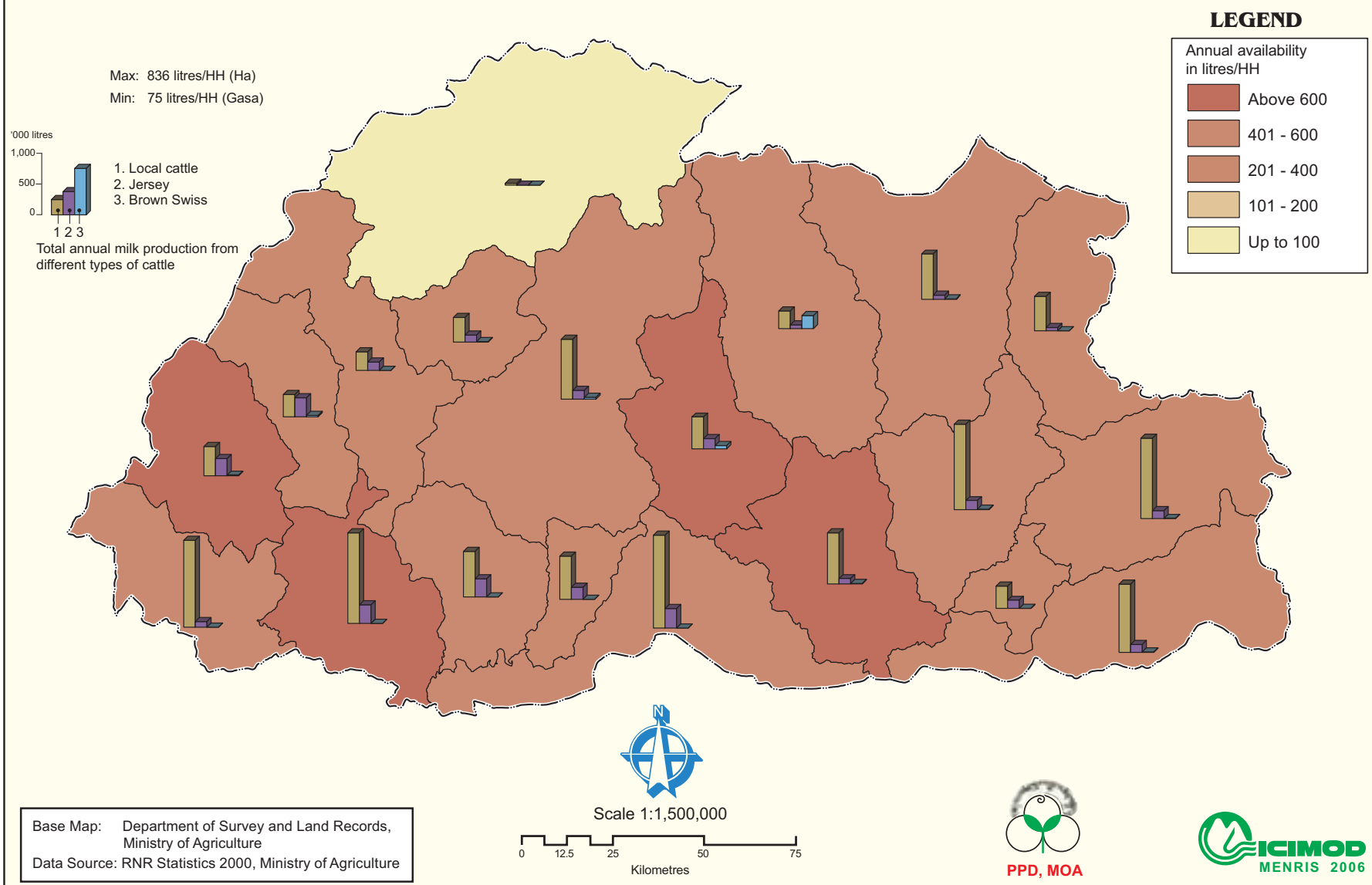
Although Jersey and Brown Swiss cows have a higher per head productivity of milk, the great majority of milk production is still from local cattle. Ha district had the highest average annual milk availability per farm household (836 litres) followed by Trongsa. Gasa had by far the lowest annual milk availability (75 litres).

Table E.6

Districts	Annual Milk Production ('000 litres)			Total Annual Milk Availability* (litres per HH)	Districts	Annual Milk Production ('000 litres)			Total Annual Milk Availability (litres per HH)
	Local Cattle	Jersey	Brown Swiss			Local Cattle	Jersey	Brown Swiss	
Ha	573	340	15	836	Mongar	1,676	176	7	378
Trongsa	627	205	64	650	Tsirang	843	236	0	359
Zhemgang	1,004	102	4	632	Thimphu	364	164	3	338
Chhukha	1,776	368	4	624	Paro	443	373	30	317
Sarpang	1,823	385	>1	523	Punakha	484	142	16	301
Bumthang	349	75	260	493	S/Jongkhar	1341	156	4	300
Samtse	1,704	108	<1	491	Pemagatshel	444	164	5	230
Wangdue	1,172	176	39	479	Trashi Yangtse	672	59	0	222
Dagana	893	361	3	469	Trashigang	1,576	152	2	217
Lhuntse	892	87	14	428	Gasa	32	3	0	75
					Bhutan Total	**18,688**	**3,832**	**472**	**8,362#**

*average availability over all farm households, excluding milk from other animals; # Average milk availability; simple average, not weighted

Milk Availability and Production by Local, Jersey and Brown Swiss Cattle E 6



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Sources of Livestock Feed and Fodder

Various sources of livestock feed are used throughout Bhutan including tree fodder and crop residues, but the 2000 census surveyed only registered pasture, improved pasture, and fodder collection. The main source of fodder for the majority of livestock in Bhutan continues to be open grazing; Bhutan has about 430,000 acres of registered pasture land. Fodder is mainly collected for stall-fed animals, and in general only by households that have a small number of cattle and primarily for the calves.

Table E.7 shows the total livestock population (cattle, yak, equine, sheep, goats) in each district together with the area of registered and improved pasture and amount of fodder collected. The map shows the districts ranked according to the total registered pasture area. The superimposed bar charts show the area of improved pasture and headloads of fodder collected and the superimposed values the total number of livestock.

Improved pasture is still very limited at less than 1000 acres most of which is on specialised livestock farms. Improved pasture at the household level is very low. Trashigang district, with the highest number of livestock, had the greatest amount of registered pasture land; Gasa with the least number of livestock had the smallest amount of registered pasture land.

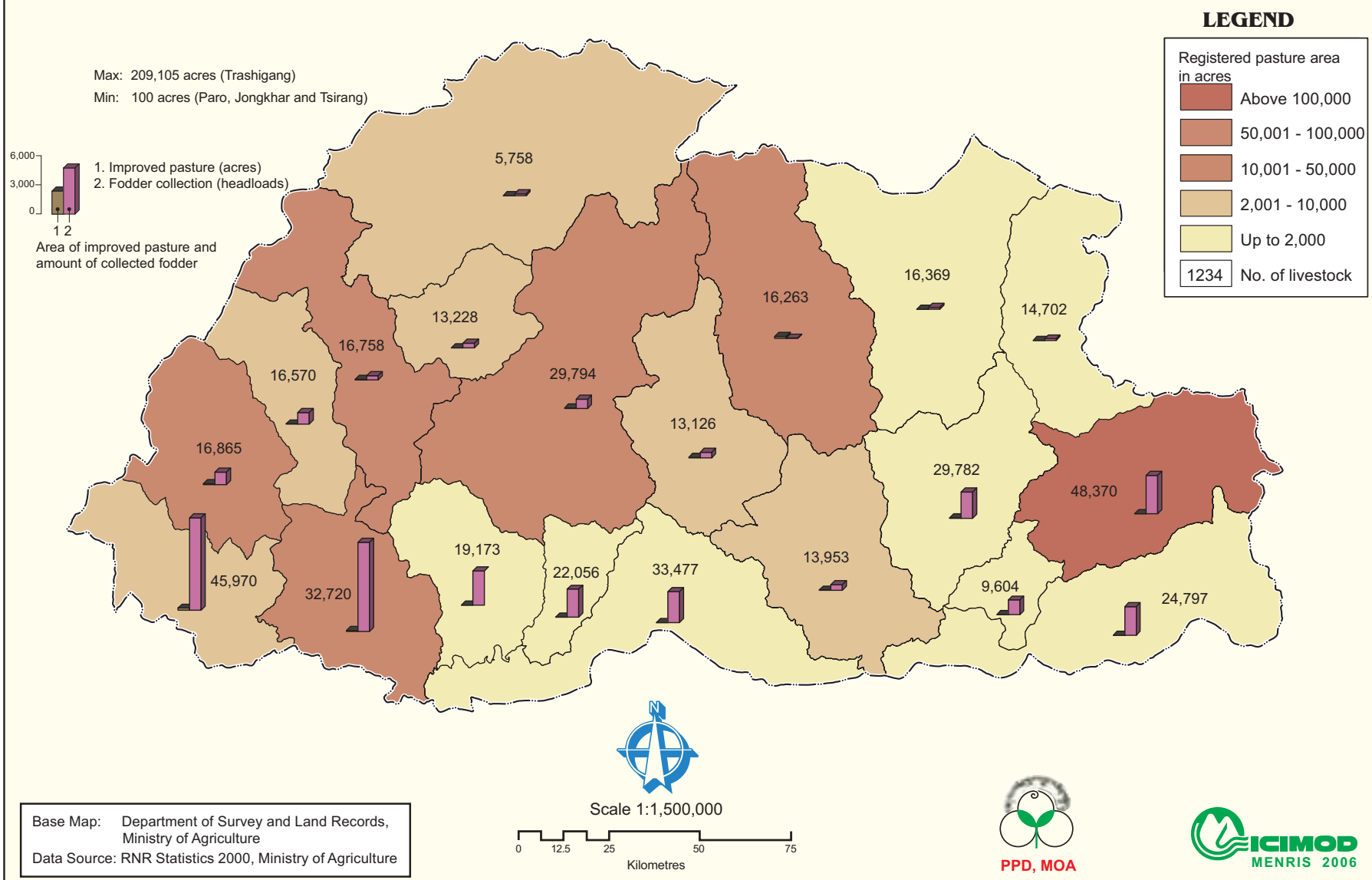
Table E.7

District	Registered Pasture (acres)	Improved Pasture (acres)	Fodder Collection (100 head-loads)	Livestock* Population	District	Registered Pasture (acres)	Improved Pasture (acres)	Fodder Collection (100 headloads)	Livestock* Population
Bumthang	14,726	217	35	16,263	Samtse	7,543	228	9953	45,970
Chhukha	28,943	101	9595	32,720	Sarpang	138	22	3356	33,477
Dagana	1,706	5	3681	19,173	S/Jongkhar	100	2	3088	24,797
Gasa	5,123	8	206	5,758	Thimphu	75,303	42	466	16,758
Ha	13,632	117	1340	16,865	Trashigang	209,105	0	4122	48,370
Lhuntse	1,953	3	202	16,369	Trashi Yangtse	355	0	166	14,702
Mongar	907	17	2802	29,782	Trongsa	3,800	86	610	13,126
Paro	4,366	42	1256	16,570	Tsirang	100	6	3001	22,056
Pemagatshel	100	10	1594	9,604	Wangdue	48,025	38	974	29,794
Punakha	5,121	10	522	13,228	Zhemgang	7,335	14	564	13,953
					Bhutan Total	**428,381**	**968**	**47,533**	**439,335**

* Cattle, yak, equine, sheep, goats

Sources of Livestock Feed and Fodder

E 7



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

F. Agricultural Marketing

Proceeds from the sale of agricultural produce continue to be the major source of income for farmers across the country. Oranges, apples, potato, cardamom, and vegetables are the predominant crops sold at market. External markets for cereals are limited, but substantial local trading takes place. Substantial trading of meat, butter, and cheese also takes place within the country.

The following maps and tables are presented in this section:

- F.1. Sale of Locally Produced Rice and Maize
- F.2. Sale of Wheat, Barley, Millet and Buckwheat
- F.3. Sales of Horticultural Tree Crops
- F.4. Sales of Farm Produced Dairy Products
- F.5. Sales of Farm Produced Meat
- F.6. Sales of Vegetables

Sales of Locally Produced Rice and Maize

Paddy is widely grown country-wide. It is also the most preferred cereal and there is a large market potential for paddy (sold as rice) within the country itself. Sale of rice is a good source of revenue for farmers. Less maize is sold than rice even though more maize is produced. Maize is sold either in the form of kharang (ground to eatable size) or tegma (flattened maize). Since much maize is being produced, the government is making efforts to market the maize and is making arrangements for farmers to sell their surplus either to the Food Corporation of Bhutan or to the World Food Programme (WFP) (who supply to schools).

Table F.1 shows the amount of rice and maize sold in 2000 in each district, listed in order of the total amount sold of the two grains. The map shows the districts ranked according to the total quantity sold. The superimposed pie charts show the proportion of rice and maize and indicate differences in the total amount per district.

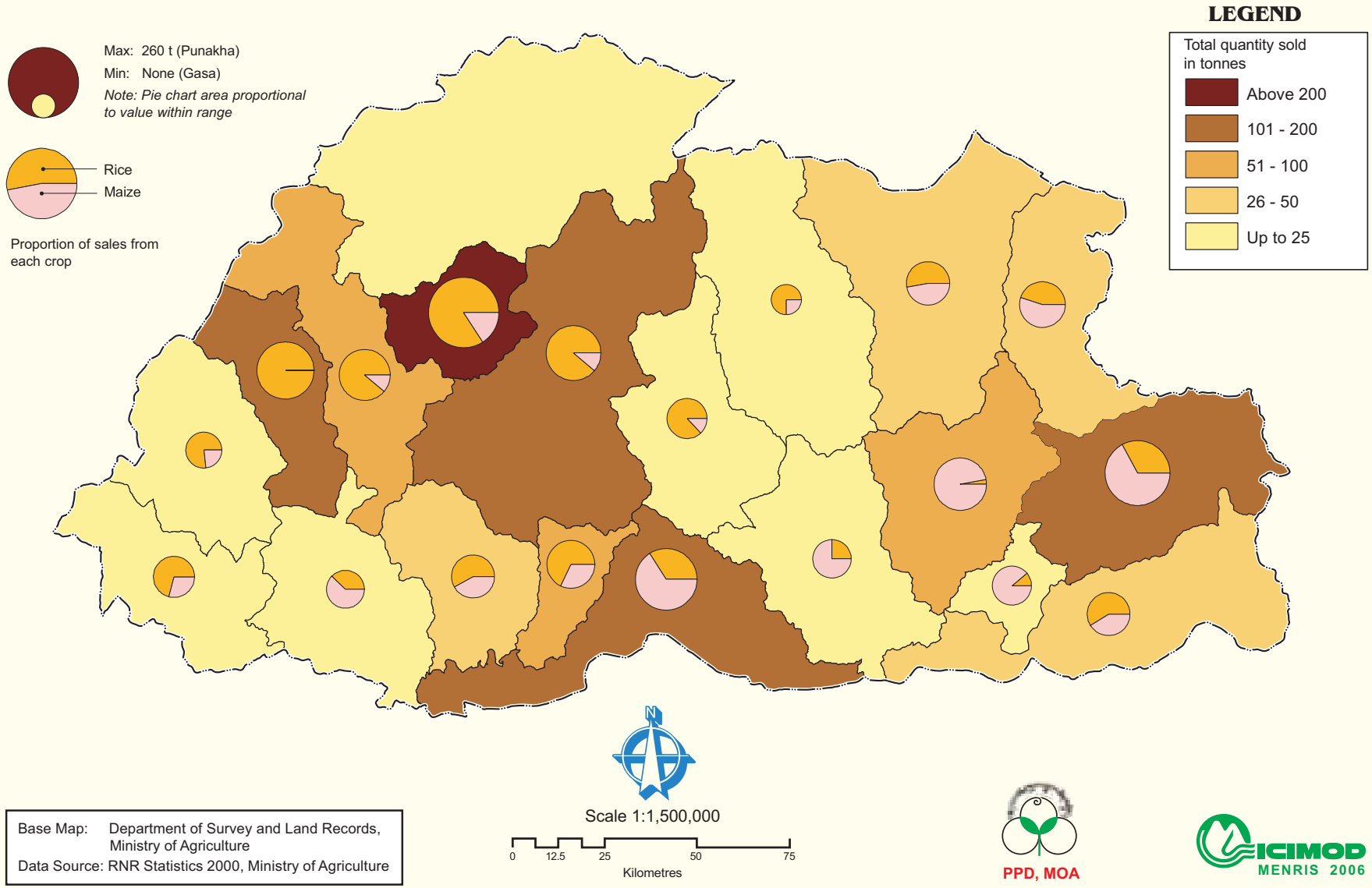
Some 800t of rice was sold in the country in 2000; Punakha district accounted for about 27% of sales (219t), and Paro for about 16% (126t). Trashigang and Sarpang districts had the highest sales of maize, together accounting for about 47% of the country's total sales.

Table F.1

District	Quantity Sold (kg)			District	Quantity Sold (kg)		
	Rice	Maize	Total		Rice	Maize	Total
Punakha	218,506	41,489	259,995	Dagana	18,317	13,132	31,449
Trashigang	65,109	132,963	198,072	S/Jongkhar	18,256	12,507	30,763
Sarpang	56,292	110,128	166,420	Samtse	16,530	6,656	23,186
Paro	126,111	27	126,138	Trongsa	16,648	2,487	19,135
Wangdue	93,755	11,980	105,735	Pemagatshel	1,698	13,583	15,281
Mongar	2,889	85,517	88,406	Zhemgang	3,402	9,950	13,352
Thimphu	69,357	8,803	78,160	Chhukha	4,332	7,072	11,404
Tsirang	39,276	18,789	58,065	Ha	4,838	1,432	6,270
Yangtse	20,414	25,280	45,694	Bumthang	3,770	1,287	5,057
Lhuntse	17,510	15,788	33,298	Gasa	0	0	0
				Bhutan Total	**797,010**	**518,870**	**1,315,880**

Sales of Locally Produced Rice and Maize

F1



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Sales of Wheat, Barley, Millet and Buckwheat

Nationally, sales of wheat, barley, millet, and buckwheat are very low, only about 7% of that of paddy and maize. However, proceeds from sales are significant for local farmers in areas where these crops are grown.

Table F.2 shows the amount of wheat, barley, millet, and buckwheat sold in 2000 in each district, listed in order of the total amount sold of all four grains. The map shows the districts ranked according to the total quantity sold. The superimposed pie charts show the proportion of sales of the four grains and indicate differences in the total amount sold per district.

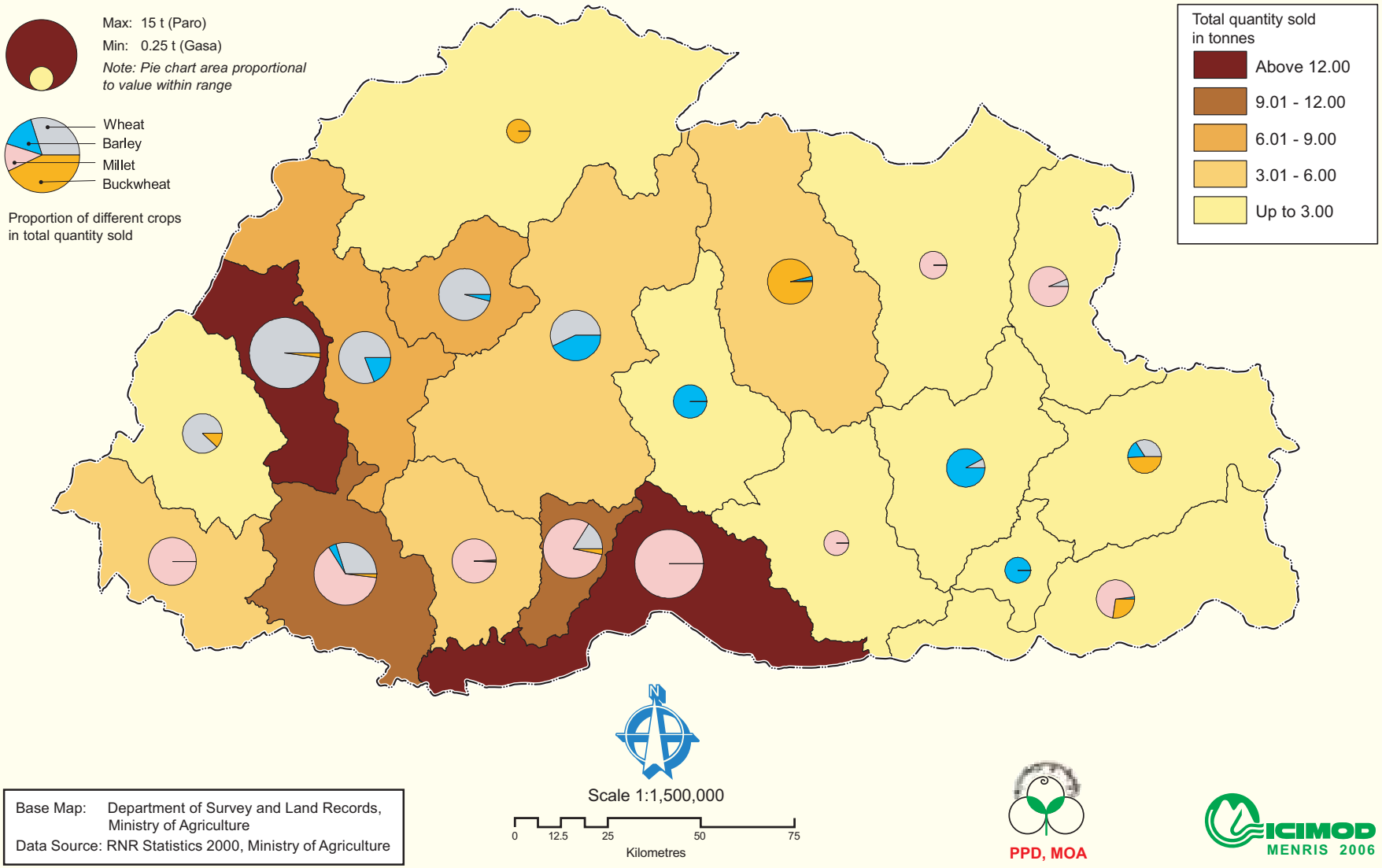
Of the four grains, sales of millet were highest (about 40t). Millet is mainly used to brew a local alcoholic beverage, although it is also consumed as a food item in small quantities. Sarpang had the highest sales of millet and sales from this district alone accounted for about 34% of the country's total. Wheat was the second most commonly sold grain at 36t; mostly in the form of flour. Paro had the highest sales of wheat, 40% of the county's total, followed by Punakha and Thimphu. Sales of barley and buckwheat were small in comparison with the other cereals; Wangdue had the highest sales of barley and Bumthang the highest sales of buckwheat.

Table F.2

District	Quantity Sold (kg)					District	Quantity Sold (kg)				
	Wheat	Barley	Millet	Buckwheat	Total		Wheat	Barley	Millet	Buckwheat	Total
Paro	14,630	0	0	224	14854	Trashi Yangtse	156	0	2,314	0	2470
Sarpang	0	0	13,648	0	13648	Ha	2,151	0	0	283	2434
Chhukha	3,232	450	6,892	216	10790	Mongar	161	1,976	0	0	2137
Tsirang	1,434	0	7,368	322	9124	S/Jongkhar	0	42	1,467	560	2069
Thimphu	5,002	1,177	0	0	6179	Trashigang	385	196	0	543	1124
Punakha	5,867	257	0	0	6124	Trongsa	0	1,081	0	0	1081
Wangdue	3,212	2,434	0	0	5646	Lhuntse	0	0	282	0	282
Samtse	0	0	4,763	0	4763	Pemagatshel	0	135	0	0	135
Bumthang	27	128	0	3,785	3940	Zhemgang	0	0	67	0	67
Dagana	34	0	3,560	50	3644	Gasa	0	0	0	25	25
						Bhutan Total	**36,291**	**7,876**	**40,361**	**6,008**	**90,536**

Sales of Wheat, Barley, Millet and Buckwheat

F2



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Sales of Horticultural Tree Crops

The sale of apples, oranges and other horticultural tree crops is currently one of the major sources of income for farmers in Bhutan. The government is making efforts to promote horticultural production and is exploring the potential of export markets. It is expected that income from the sale of tree crops will continue to increase.

Table F.3 shows the percentage of farm households that sold apples, oranges, or other fruit tree crops (areca nut, walnut, plums, pears, and others) in 2000 in each district, with districts listed in order of the total quantity sold in tonnes (cf. Table C.2 showing total production). The map shows the districts ranked according to the total quantity sold. The superimposed bar charts show the percentage of households selling the different crops.

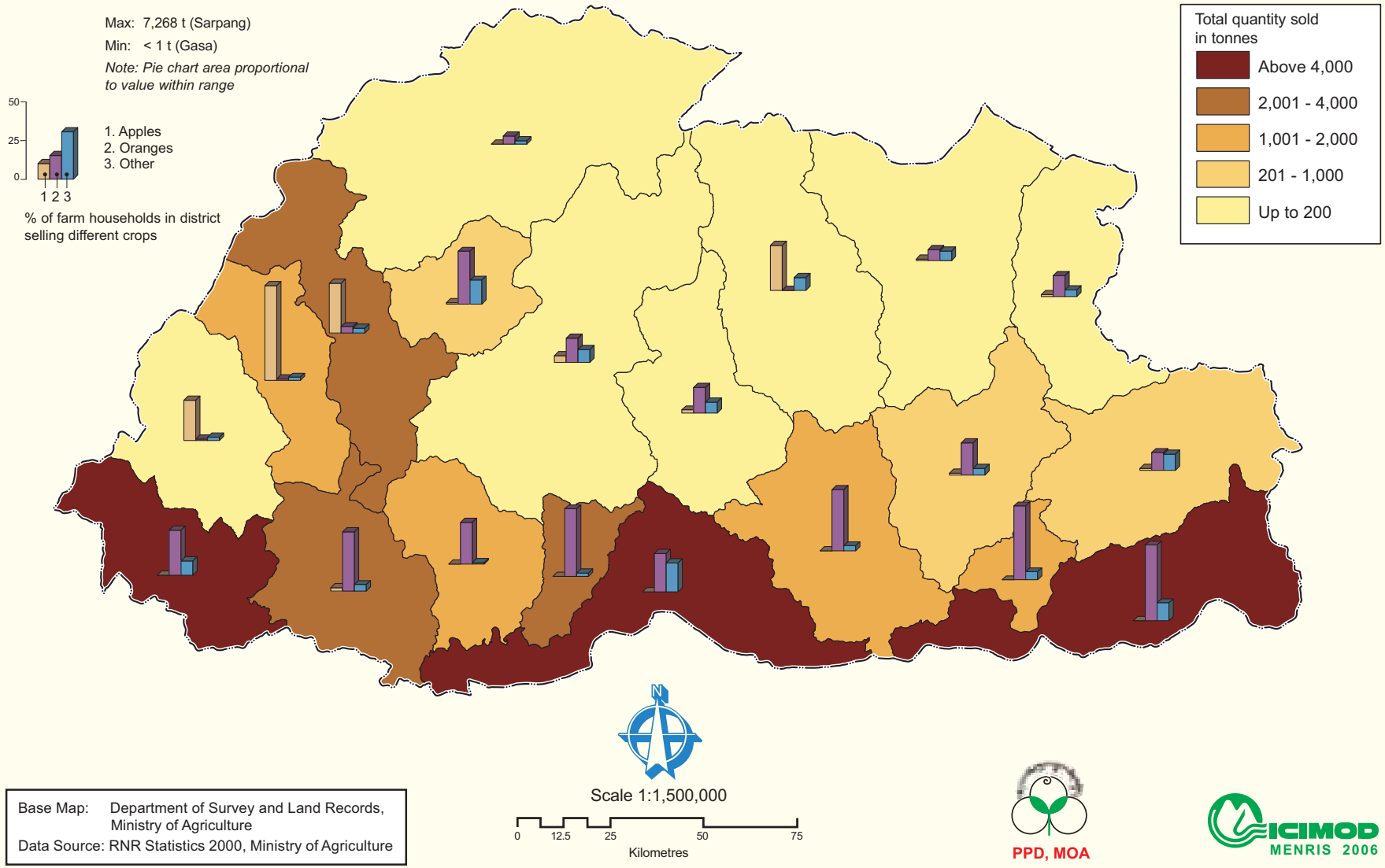
Less than 5% of households sold apples in all districts except Paro, Thimphu, Bumthang, and Ha (between 25 and 59%). In contrast, more than 10% of households sold oranges in 15 of the 20 districts, with the greatest percentage in the southern districts, especially Samdrup Jongkhar (47%), Pemagatshel, and Tsirang. Less than 10% of households sold other fruit in all districts except Sarpang (18%), Punakha, Samdrup Jongkhar, and Trashigang. The southern districts showed the overall greatest quantity sold, as oranges are the most widely traded fruit, but the districts with the highest sales did not necessarily have the highest percentage of farm households selling fruit.

Table F.3

District	% of Households Selling			Total Quantity Sold (t)	District	% of Households Selling			Total Quantity Sold (t)
	Apples	Oranges	Others			Apples	Oranges	Others	
Sarpang	<1	24	18	7,268	Mongar	1	20	4	351
S/Jongkhar	<1	47	11	5,169	Punakha	<1	33	15	306
Samtse	0	28	9	4,105	Trashigang	1	11	10	261
Tsirang	0	42	2	3,521	Wangdue	4	15	8	160
Chhukha	2	37	4	3,149	Bumthang	28	<1	8	159
Thimphu	31	4	3	2,674	Ha	25	<1	2	152
Paro	59	1	2	1,895	Trongsa	2	16	7	115
Zhemgang	<1	38	3	1,736	Trashi Yangtse	<1	13	4	91
Dagana	<1	26	1	1,525	Lhuntse	<1	7	6	42
Pemagatshel	<1	46	5	1,016	Gasa	0	5	2	<1

Sales of Horticultural Tree Crops

F3



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Sales of Farm Produced Dairy Products

Farmers earn a good income from the sale of milk, butter, and cheese since there is a ready market within the country. A survey conducted by the Natural Resources Training Institute in 1998 on rural income sources showed that 22% of farm income comes from livestock products. Dairy sales mainly comprise butter and cheese, but a considerable amount of milk is also sold. Sales of milk have increased following the promotion of peri-urban dairy development schemes, especially in Thimphu district. The sale of dairy products is more evenly distributed than the sale of cereals and horticultural tree crops; thus although income from dairy products may be smaller it is more equitably distributed.

Table F.4 shows the amount of milk, butter and cheese sold in 2000 in each district, together with the approximate value in million Nu calculated using average prices of Nu 15 per litre for milk, Nu 200 per kg for butter, and Nu 130 per kg for cheese (approximate prices in 2000). The districts are listed in order of the approximate total value of sales. The map shows the districts ranked according to the total value of sales. The superimposed pie charts show the proportion of total sales contributed by milk, butter, and cheese, and also indicate differences in the total value of sales per district.

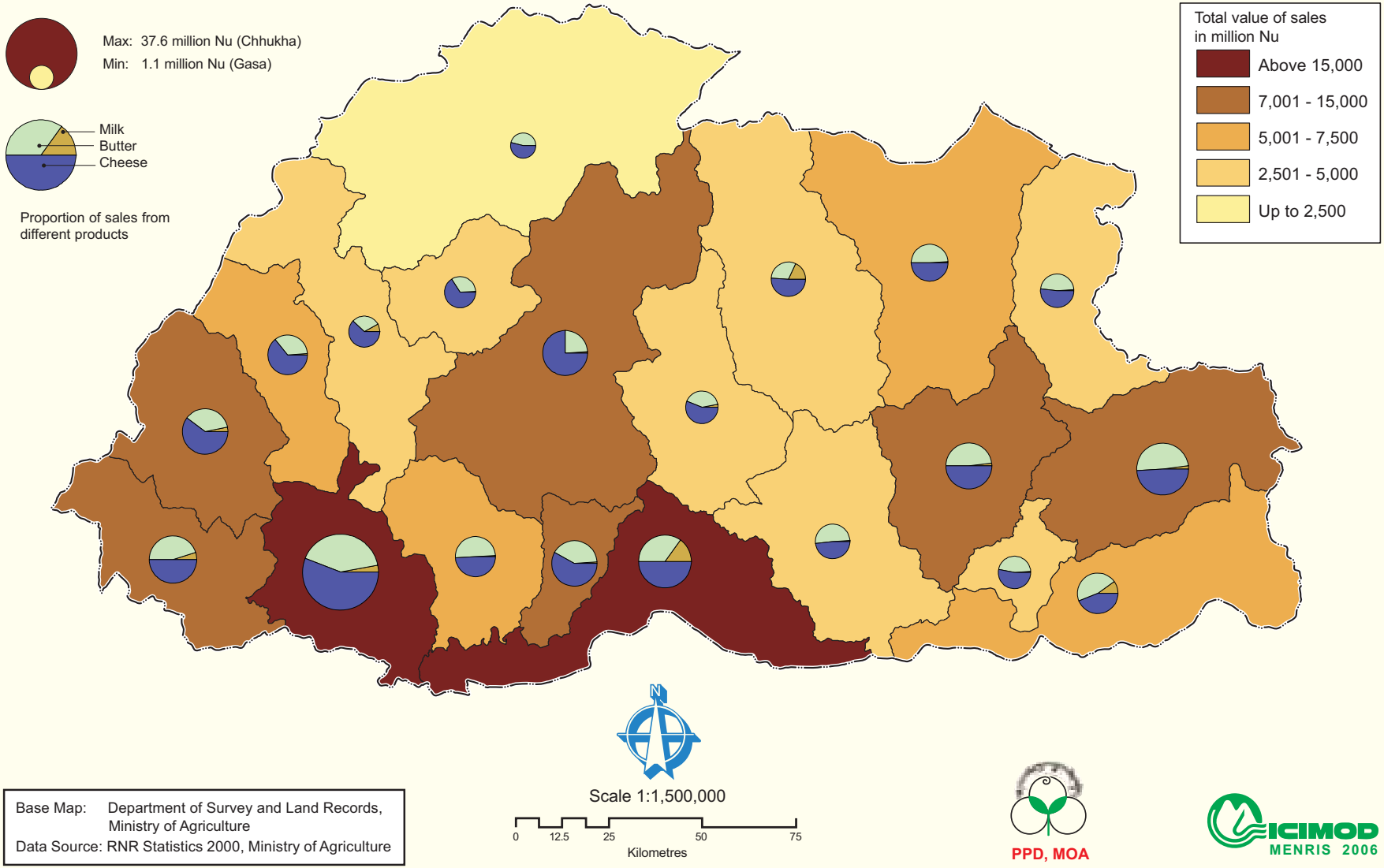
Milk was sold in all districts except Gasa. Sarpang, which had the highest milk production (Table E.5), also had the highest volume of milk sales (155,000 l), more than twice as much as the next district Chhukha, where a higher proportion of the milk produced is processed. Overall, approximately 27% of the butter and 34% of the cheese produced are sold for cash by farmers. Butter was sold widely in all districts with the greatest amount in Chhukha (76,100 kg) and the least in Gasa (2,400 kg). Sales of cheese were more than double sales of butter, with by far the greatest amount sold in Chhukha (163,000 kg) followed by Sarpang (60,000 kg), and the least in Gasa (4,500 kg).

Table F.4

District	Milk		Butter		Cheese		Value mill. Nu	District	Milk		Butter		Cheese		Value mill. Nu
	Litres	Value Nu	Litres	Value Nu	Litres	Value Nu			Litres	Value Nu	Litres	Value Nu	Litres	Value Nu	
Chhukha	72,619	1,089,285	76,079	15,215,800	163,495	21,254,350	37.6	Paro	6,822	102,330	11,974	2,394,800	33,307	4,329,910	6.8
Sarpang	154,653	2,319,795	27,122	5,424,400	59,542	7,740,460	15.5	Lhuntse	2,918	43,770	13,136	2,627,200	20,905	2,717,650	5.4
Trashigang	17,933	268,995	36,161	7,232,200	56,426	7,335,380	14.9	Zhemgang	3,710	55,650	11,027	2,205,400	15,663	2,036,190	4.3
Samtse	36,475	547,125	26,113	5,222,600	44,665	5,806,450	11.6	Bumthang	49,815	747,225	6,652	1,330,400	16,621	2,160,730	4.2
Mongar	11,170	167,550	25,628	5,125,600	41,153	5,349,890	10.6	Trashi Yangtse	2,822	42,330	9,040	1,808,000	15,170	1,972,100	3.8
Ha	17,623	264,345	18,946	3,789,200	48,020	6,242,600	10.3	Pemagatshel	2,439	36,585	7,811	1,562,200	13,923	1,809,990	3.4
Tsirang	8,720	130,800	21,002	4,200,400	45,677	5,938,010	10.3	Trongsa	6,875	103,125	6,895	1,379,000	14,783	1,921,790	3.4
Wangdue	9,827	147,405	12,160	2,432,000	56,570	7,354,100	9.9	Punakha	2,350	35,250	4,736	947,200	14,669	1,906,970	2.9
S/Jongkhar	50,395	755,925	16,694	3,338,800	24,648	3,204,240	7.3	Thimphu	14,850	222,750	4,209	841,800	13,585	1,766,050	2.8
Dagana	4,266	63,990	17,471	3,494,200	26,898	3,496,740	7.0	Gasa	0	0	2,434	486,800	4,467	580,710	1.1
								Bhutan Total	**476,282**	**7,144,230**	**355,290**	**71,058,000**	**730,187**	**94,924,310**	**173**

Sales of Farm Produced Dairy Products

F 4



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

Sales of Farm Produced Meat

Sales of meat are far smaller both in quantity and value than sales of dairy produce.

Table F.5 shows the amount of beef, pork, mutton, and chicken sold in 2000 in each district, together with the approximate total value in million Nu calculated using average prices of Nu 45 per kg for beef, Nu 50 per kg for chicken, Nu. 60 per kg for pork, and Nu 130 per kg for mutton (approximate prices in 2000). The districts are listed in order of the approximate total value of sales. The map shows the districts ranked according to the total value of sales. The superimposed pie charts show the proportion by weight of the different types of meat sold per district and also indicate differences in the total value of sales per district.

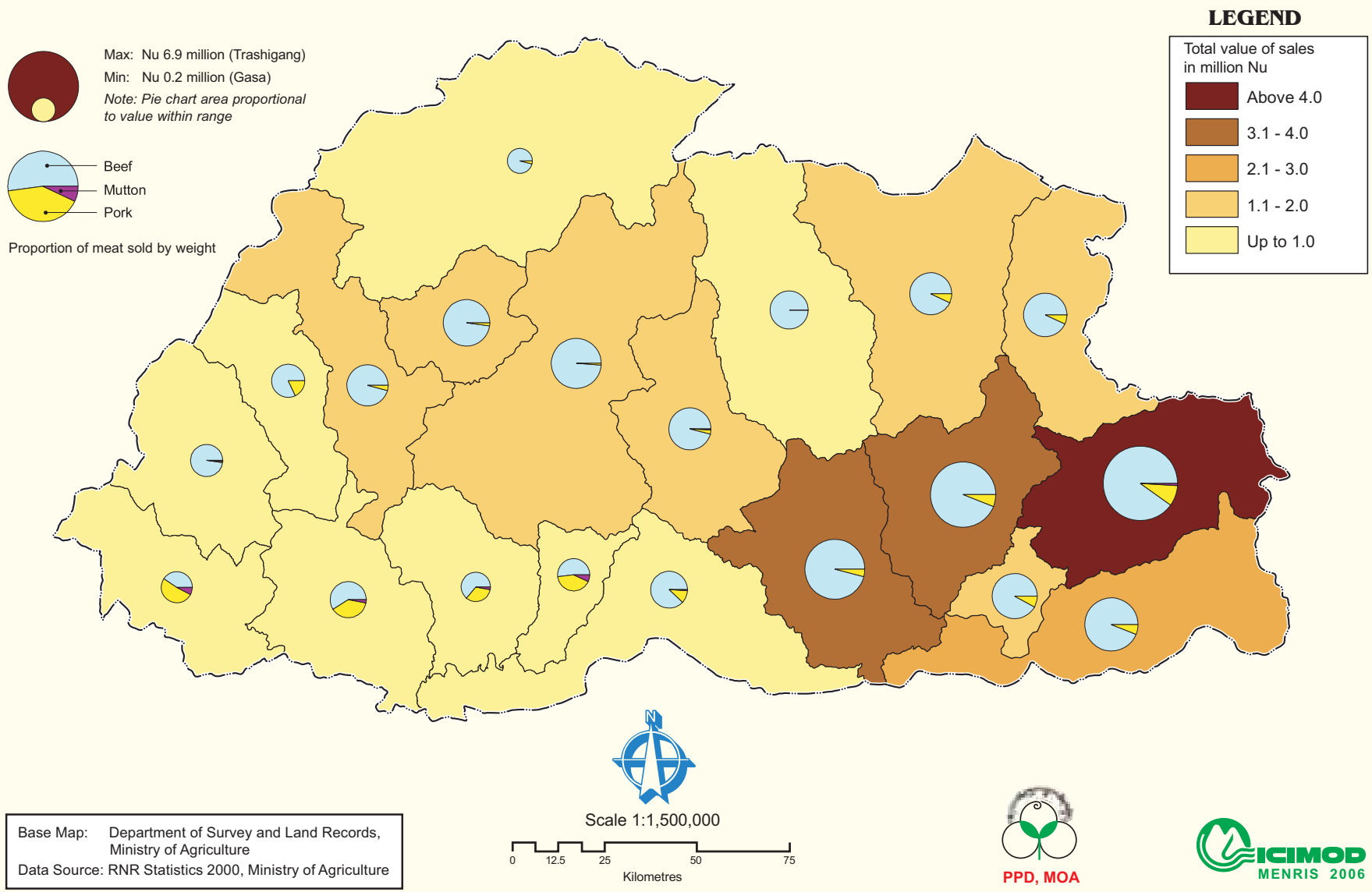
Total farm production and home consumption of meat are shown in Tables E.6 and E.7. Nationally about 40% of all meat produced on farms in 2000 was sold: a total of some 680t worth 32 million Nu, of which 620t was beef, 56t pork, 4t mutton, and about 1t chicken. Trashigang had the highest sales overall, and by far the highest weight sold of beef (133t) and pork (14t). Sales of mutton were highest in Samtse (0.7t), Trashigang, and Tsirang; and of chicken in Sarpang (0.7t). Very little chicken was sold in any other district. Gasa had the lowest sales of meat overall.

Table F.5

District	Quantity Sold (kg)				Total Sold		District	Quantity Sold (kg)				Total Sold	
	Beef	Pork	Mutton	Chicken	kg	Approx. Value (mill. Nu)		Beef	Pork	Mutton	Chicken	kg	Approx. Value (mill. Nu)
Trashigang	133,321	13,981	725	8	148,035	6.9	Thimphu	25,131	1,148	0	0	26,279	1.2
Mongar	75,626	4,481	6	24	80,137	3.7	Bumthang	21,358	0	37	7	21,402	1
Zhemgang	63,145	2,545	146	18	65,854	3.0	Sarpang	15,358	1,942	245	737	18,282	0.9
S/Jongkhar	47,119	2,745	18	0	49,882	2.3	Chhukha	9,339	6,031	326	27	15,723	0.8
Wangdue	43,110	338	18	8	43,474	2.0	Paro	11,023	2,390	0	0	13,413	0.6
Punakha	35,384	824	0	0	36,208	1.6	Tsirang	5,344	4,218	684	42	10,288	0.6
Pemagatshel	30,079	2,736	0	9	32,824	1.5	Ha	12,479	153	82	0	12,714	0.6
Trashi Yangtse	27,667	2,156	0	0	29,823	1.4	Samtse	3,543	4,440	728	46	8,757	0.5
Trongsa	26,578	867	165	1	27,611	1.3	Dagana	5,234	2,684	265	5	8,188	0.4
Lhuntse	25,519	1,809	16	14	27,358	1.3	Gasa	5,014	233	0	0	5,247	0.2
							Bhutan Total	**621,942**	**55,722**	**3,576**	**946**	**682,186**	**31.8**

Sales of Farm Produced Meat

F 5



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Sales of Vegetables

As with cereals, dairy products, and horticultural tree crops, the sale of vegetables constitutes an important source of income for farmers. Potato and chilli are the most important vegetable cash crops. Other income generating vegetables include radish, tomato, onion, carrot, cabbage, beans, spinach, and even forest products such as mushrooms and fern tops. India is Bhutan's most important export market and most of the potato is exported to India through auction yards. Chilli is mainly sold within the country since there is a big internal demand.

Table F.6 shows the weight of potato, chilli, radish, and other vegetables sold in 2000 in each district, separately and in total. The map shows the districts ranked according to the total quantity sold in each district. The superimposed pie charts show the proportion of the total provided by the different types of vegetable and also indicate differences in the total weight sold in each district.

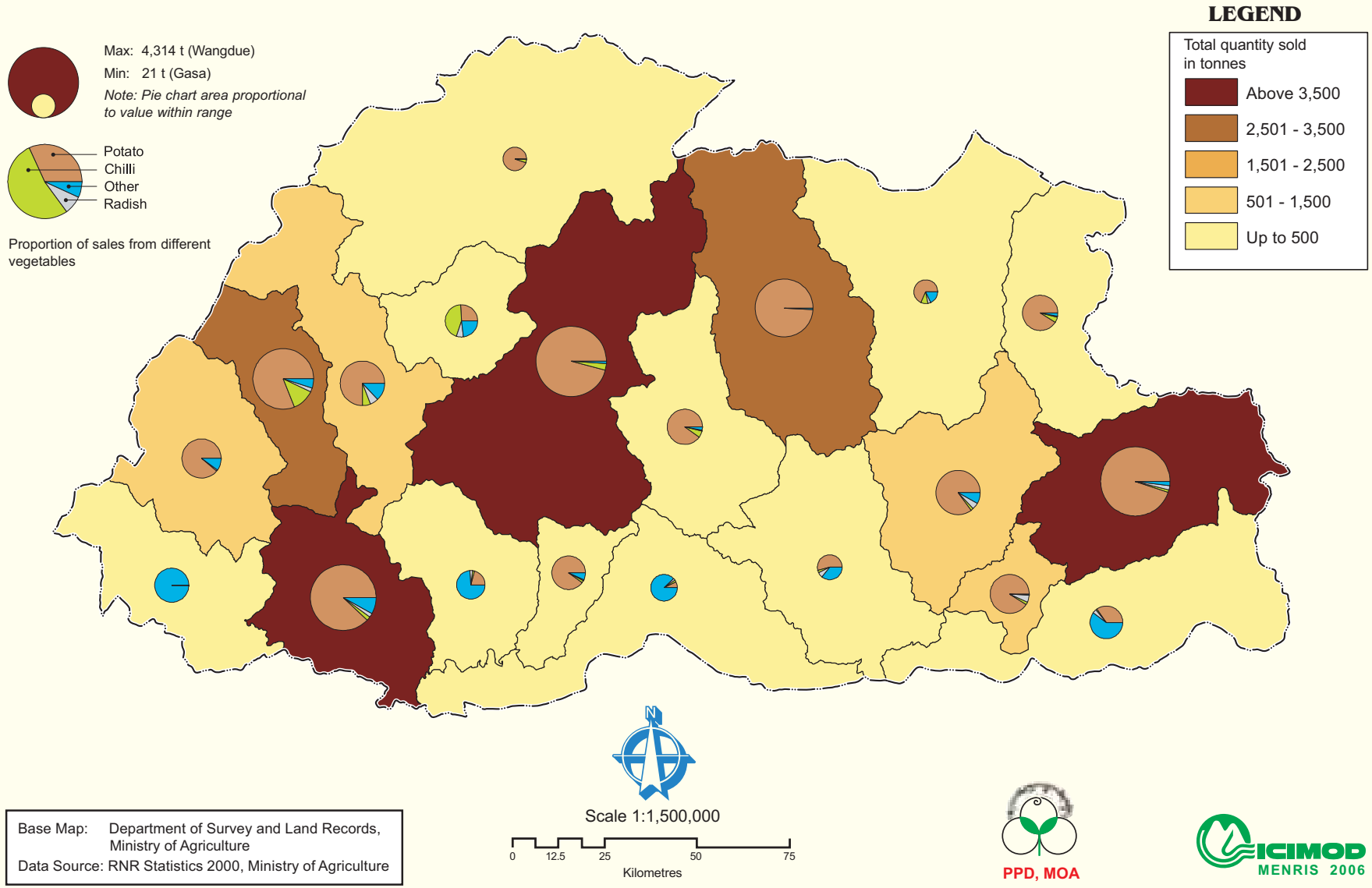
In 2000, a total of 50,000t of vegetables were produced (Table B.11) of which 24,000t were sold. The greatest weight of vegetables was sold in Wangdue and Trashigang, which also produced the most. Potato sales were highest in Wangdue, followed by Trashigang, Chhukha, Bumthang, and Paro. Chilli sales were highest in Paro followed by Punakha and Wangdue.

Table F.6

District	Quantity Sold (kg)					District	Quantity Sold (kg)				
	Potato	Chilli	Radish	Others	Total		Potato	Chilli	Radish	Others	Total
Wangdue	4,138,956	115,841	13,953	45487	4,314,237	Trongsa	437,948	27,676	3,606	15,507	484,737
Trashigang	3,961,067	43,974	68,991	76,536	4,150,568	Samtse	0	952	289	414,888	416129
Chhukha	3,197,224	86,659	63,639	267,832	3,615,354	Tsirang	352,606	9,675	4,837	24,424	391,542
Paro	2,367,609	347,559	54,532	163,006	2,932,706	S/Jongkhar	120,206	3,706	15,194	204,415	343,521
Bumthang	2,576,643	3,723	3,714	6509	2,590,589	Punakha	84,649	141,983	22,451	75,991	325,074
Thimphu	872,822	69,060	70,019	159516	1,171,417	Dagana	32,365	3,193	5,125	115,388	156,071
Mongar	980,740	23,816	56,819	87,259	1,148,634	Sarpang	5,908	2,785	1,589	80,283	90,565
Ha	666,814	333	7,798	72366	747,311	Zhemgang	25,726	1,264	3,127	17,132	47,249
Pemagatshel	668,727	16,326	43,385	5,831	734,269	Lhuntse	17,915	2,570	1,091	4798	26,374
Trashi Yangtse	444,760	23,960	4,011	17,555	490,286	Gasa	19,945	907	42	127	21,021
						Bhutan Total	**20,972,630**	**925,962**	**444,212**	**1,854,850**	**24,197,654**

Sales of Vegetables

F 6



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

G. Major Constraints to Farming

Destruction of food crops by wildlife presents a continuing significant loss to farmers. Wild boar (a recurring theme at any agricultural meeting) is a particular hazard; more than 36% of farm households reported losses directly caused by these creatures. Monkeys, elephants, deer, and bears also trouble farmers. Farmers also experience constraints related to labour shortages, lack of irrigation facilities, and limited access to markets. Mechanisation of farming has limited scope in Bhutan's rugged terrain and is restricted to small flat agricultural pockets; however, in places where mechanisation has been introduced, it has helped to ease the problem of labour shortages and has increased productivity.

The following maps and tables are presented in this section:

- G.1. Farm Households Reporting Constraints Affecting Crop Production
- G.2. Animal Damage by Type of Animal
- G.3. Percentage of Farm Households Reporting General Constraints
- G.4. Farm Households by Distance (Walking Time) to the Nearest Motorable Road

Farm Households Reporting Constraints Affecting Crop Production

Table G1 shows the percentage of households affected by constraints of different types in 2000 in each district, listed in order of the percentage suffering problems from wild animals. The map shows the districts ranked according to the total percentage of households affected by wild animals. The superimposed bar charts show the percentage of households affected by wild animals, pests and diseases, and others.

Damage cause by wild animals remained the single worst constraint faced by farm households all over Bhutan and is the leading factor in loss of food grain. The problem is exacerbated by the fact that farm settlements are widely scattered and that the government strong encourages conservation of wildlife. In 2000, between 21% and 72% of households in the different districts reported crop damage by wild animals. The district most affected was Bumthang, followed closely by Ha and Pemagatshel.

Problems related to outbreaks of pests and diseases were reported by a small proportion of farmers in all districts except four, with the greatest proportion in Thimphu (10%). Such outbreaks can occur suddenly when crops are vulnerable, and usually there is little possibility for mitigation. Fortunately, the incidence of such outbreaks is quite low and usually localised. Few farmers reported constraints related to weather, such as drought (between 0 and 5%), excessive rain (between 0 and 8%), and hailstorms (between 0 and 2%). Excessive rain occasionally destroys paddy when it falls during the harvest season; similarly hail can destroy horticultural tree crops when it falls during the flowering stage.

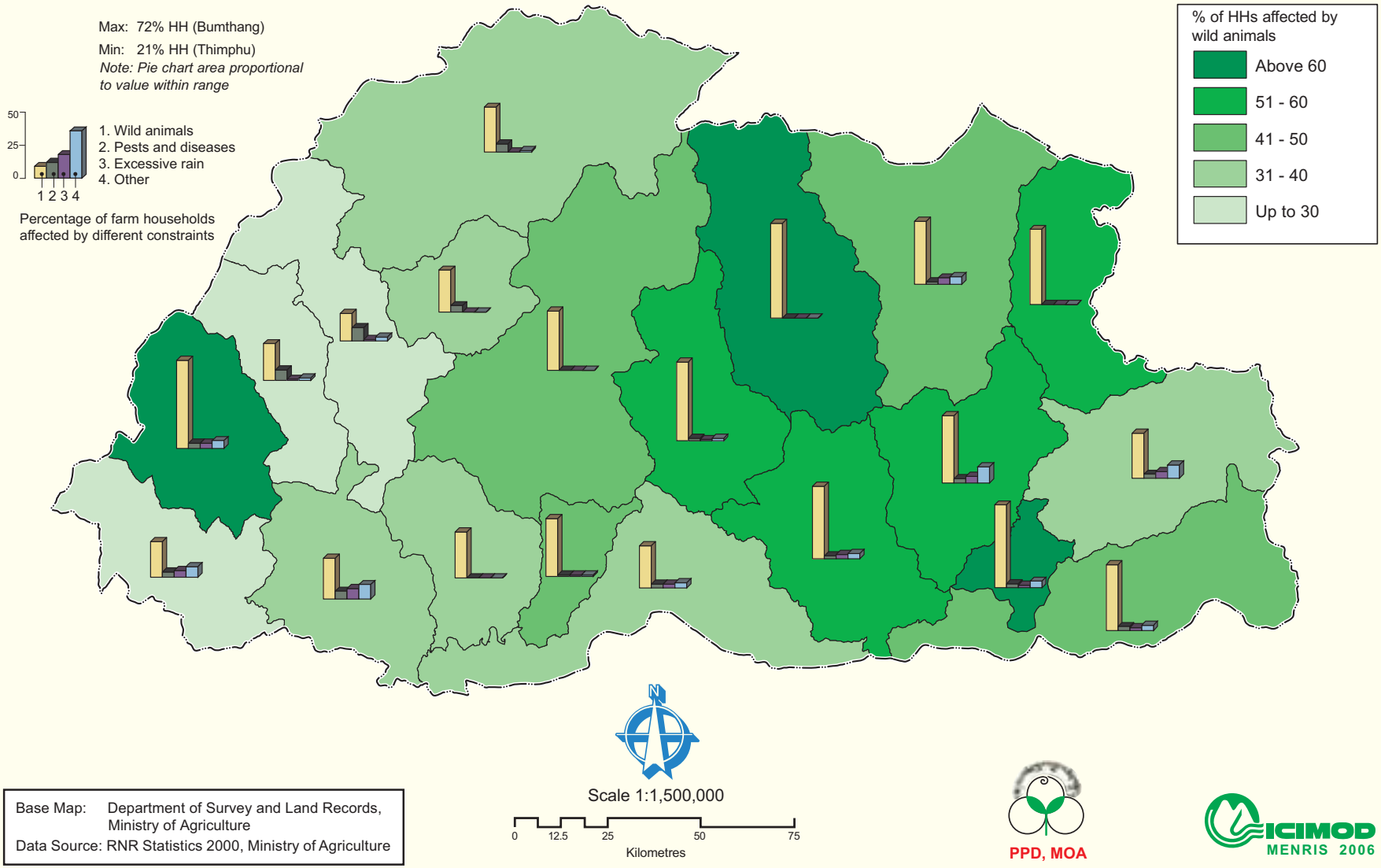
Table G.1

District	Wild Animals	Pests & Diseases	Drought	Excessive Rain	Hailstorms	District	Wild Animals	Pests & Diseases	Drought	Excessive Rain	Hailstorms
Bumthang	72	0	0	0	0	Tsirang	44	1	0	1	0
Ha	67	4	1	4	1	Dagana	35	0	0	0	0
Pemagatshel	63	3	3	2	0	Gasa	34	6	1	0	0
Trongsa	60	2	1	1	0	Trashigang	34	3	3	5	2
Trashi Yangtse	57	0	0	0	0	Punakha	32	5	0	0	0
Zhemgang	55	2	1	3	0	Sarpang	32	3	1	3	0
Mongar	51	3	5	5	2	Chhukha	31	6	2	8	1
S/Jongkhar	50	3	1	2	1	Paro	28	8	1	1	0
Lhuntse	48	2	1	5	0	Samtse	27	4	2	5	1
Wangdue	45	0	0	0	0	Thimphu	21	10	1	1	1
						Average*	**41.9**	**3.6**	**1.7**	**3.3**	**0.7**

* Simple averages, not weighted

Farm Households Reporting Constraints Affecting Crop Production

G I



Base Map: Department of Survey and Land Records, Ministry of Agriculture

Data Source: RNR Statistics 2000, Ministry of Agriculture

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Animal Damage by Type of Animal

Table G.2 shows the proportion of reported damage attributed to wild boar, deer, and other animals (bears, monkeys, elephants, porcupines, and others) in each district (percentage of all households reporting crop damage who reported damage by different types of animal). The map shows the districts ranked according to the total percentage of damage attributed to wild boar. The superimposed pie charts show the relative proportions of damage attributed to different animals, and indicate differences in the percentage attributed to wild boar in the different districts.

Wild boar was the single most commonly reported cause of damage, responsible for 23% (Samtse) to 63% (Punakha) of damage reports in the different districts. Deer were responsible for 16% (Samtse) to 34% (Paro) of all reports, with other animals, especially monkeys and bears, being cited in 15 to 61% of all cases. Damage by elephants was confined to a few districts in the south. There were also reports of porcupines causing damage.

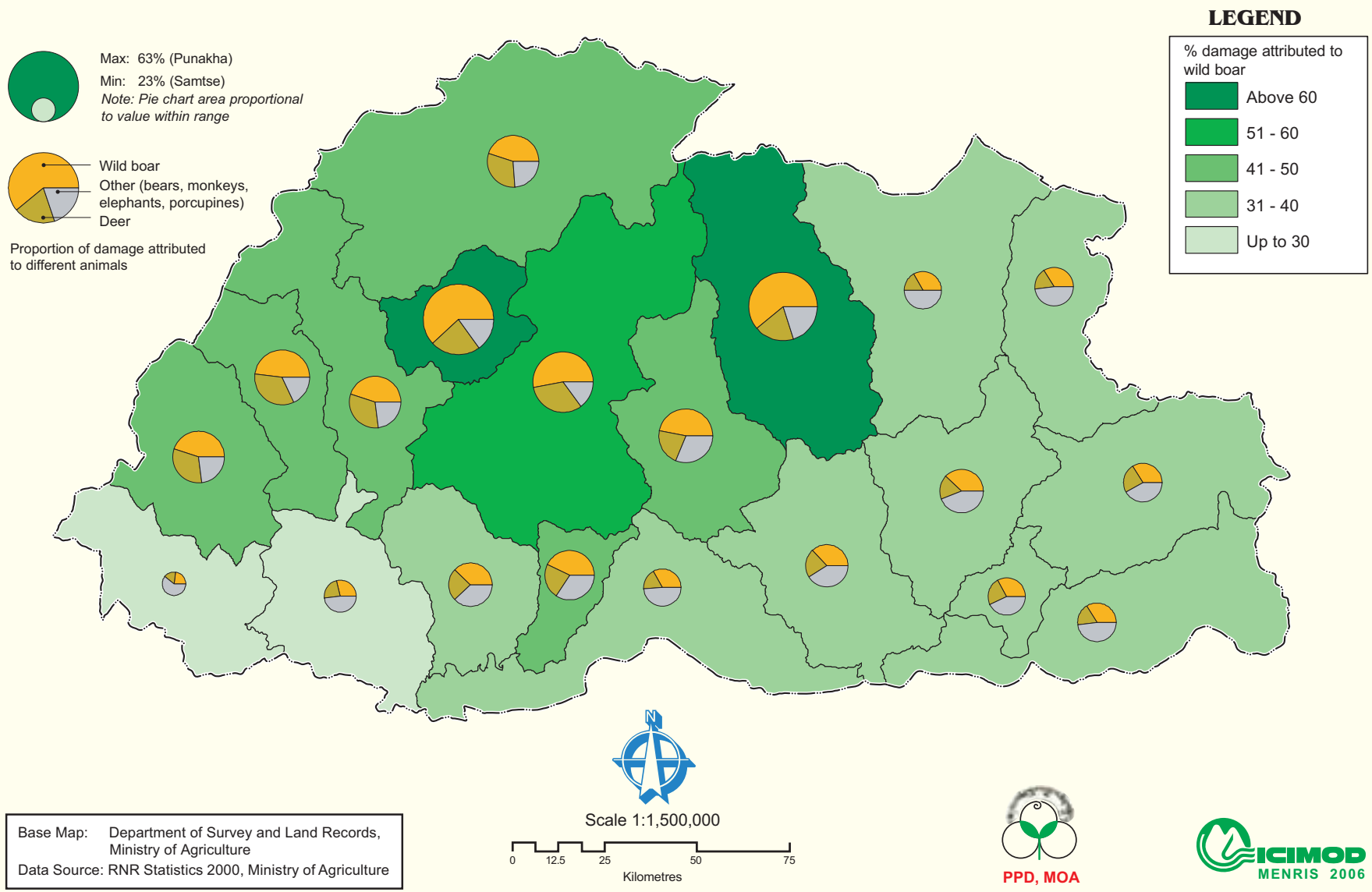
Table G.2

District	Wild Boar	Deer	Other	District	Wild Boar	Deer	Other
Punakha	63	23	16	Mongar	38	18	43
Bumthang	61	19	20	Zhemgang	37	22	41
Wangdue	53	32	15	Trashi Yangtse	34	18	48
Paro	48	34	17	Trashigang	34	24	42
Trongsa	47	22	31	S/Jongkhar	34	18	49
Thimphu	45	32	23	Sarpang	33	18	49
Ha	45	32	22	Lhuntse	33	17	50
Gasa	45	31	23	Pemagatshel	33	24	42
Tsirang	43	23	34	Chhukha	29	23	48
Dagana	38	24	47	Samtse	23	16	61
				Average*	**36.7**	**21.6**	**41.8**

* Simple averages, not weighted

Animal Damage by Type of Animal

G 2



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Percentage of Farm Households Reporting General Constraints

Farmers also face other more general constraints. One is poor irrigation facilities or (often) no irrigation facilities at all. This problem is most acute in the paddy growing districts where the number of farm households is high. Labour shortages, caused mainly by the recent trend in rural-urban migration, are also increasingly a constraint for farmers, as is lack of agricultural land. Farmers with excess crops which could be sold face the constraint of limited access to markets, mainly because of inadequate roads

Table G1 shows the percentage of households affected by general constraints of different types in 2000 in each district, listed in order of the percentage facing problems as a result of lack of an irrigation supply. The map shows the districts ranked according to the total percentage of houses affected by lack of irrigation. The superimposed bar charts show the percentage of households that cited different constraints.

The most commonly cited constraint faced by farm households was lack of an irrigation supply, with up to 40% of farm households (Sarpang) experiencing the problem. Labour shortages (maximum 14% in Gasa, Punakha, and Trashigang) and land shortages (maximum 15% in Samtse) were the next most common problems, with limited market access less prominent (maximum 10% of households in Trashigang and Samdrup Jongkha). None of the farm households in Bumthang, Dagana, Trashi Yangtse, and Wangdue districts reported any of these constraints.

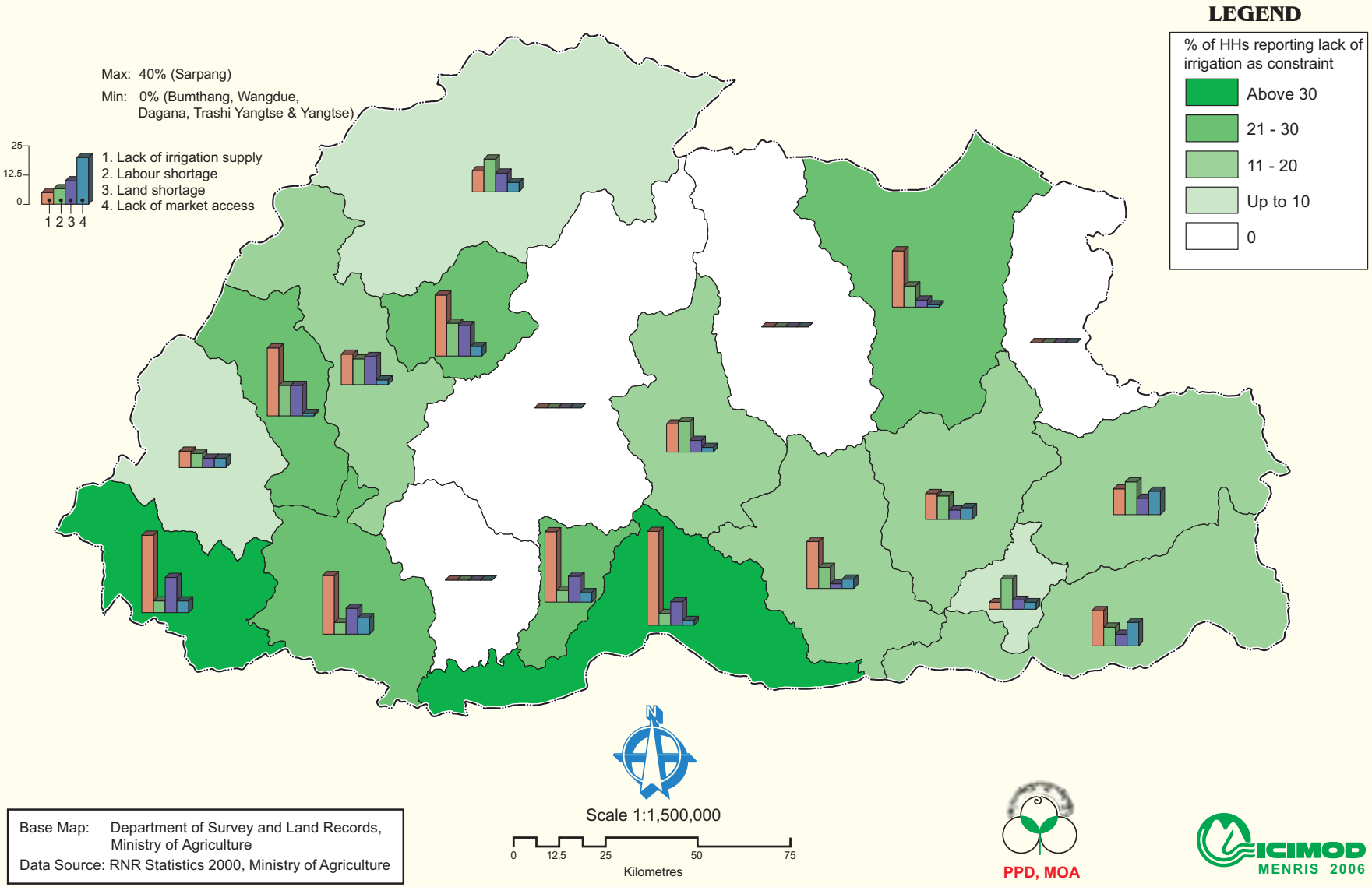
Table G.3

District	Lack of Irrigation Supply	Labour Shortage	Land Shortage	Limited Market Access	District	Lack of Irrigation Supply	Labour Shortage	Land Shortage	Limited Market Access
Sarpang	40	5	10	2	Trongsa	12	13	5	2
Samtse	33	5	15	5	Mongar	11	10	4	5
Tsirang	30	5	11	4	Trashigang	11	14	7	10
Paro	29	13	13	1	Gasa	9	14	8	4
Punakha	26	14	13	4	Ha	7	6	4	4
Chhukha	25	5	11	7	Pemagatshel	3	13	4	3
Lhuntse	24	9	3	1	Wangdue	0	0	0	0
Zhemgang	20	9	2	4	Dagana	0	0	0	0
S/Jongkhar	15	8	5	10	Trashi Yangtse	0	0	0	0
Thimphu	13	11	12	2	Bumthang	0	0	0	0
					Average*	**20.6**	**9.6**	**8.1**	**5.2**

* Simple averages, not weighted

Percentage of Farm Households Reporting General Constraints

G 3



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Farm Households by Distance (Walking Time) to the Nearest Motorable Road

Many farm households are still located more than a day's walk from the nearest roadhead. However, the government is dedicated to improving market accessibility by improving the road network, and to improving rural connectivity by constructing farm roads. Given the current rate of construction, the situation is expected to change rapidly.

Table G.4 shows the percentage of farm households in 2000 in each district located less than 3 hours, between 3 and 8 hours, and more than 8 hours walking time from the nearest motorable road, listed in order of the percentage of households more than 8 hours from a road. The map shows the districts ranked according to the total percentage of households more than 8 hours from a road, together with the existing road network. The superimposed pie charts show the percentage of households living at different distances from a road.

Two districts, Gasa and Zhemgang had nearly 60% of households living more than 8 hours walk from the next road; in contrast the proportion was 10% or less in 13 districts, with no households this far from a road in Punakha, Tsirang, or Bumthang. In Bumthang, Punakha, and Paro, 98% of households were located less than three hours walk from a road point.

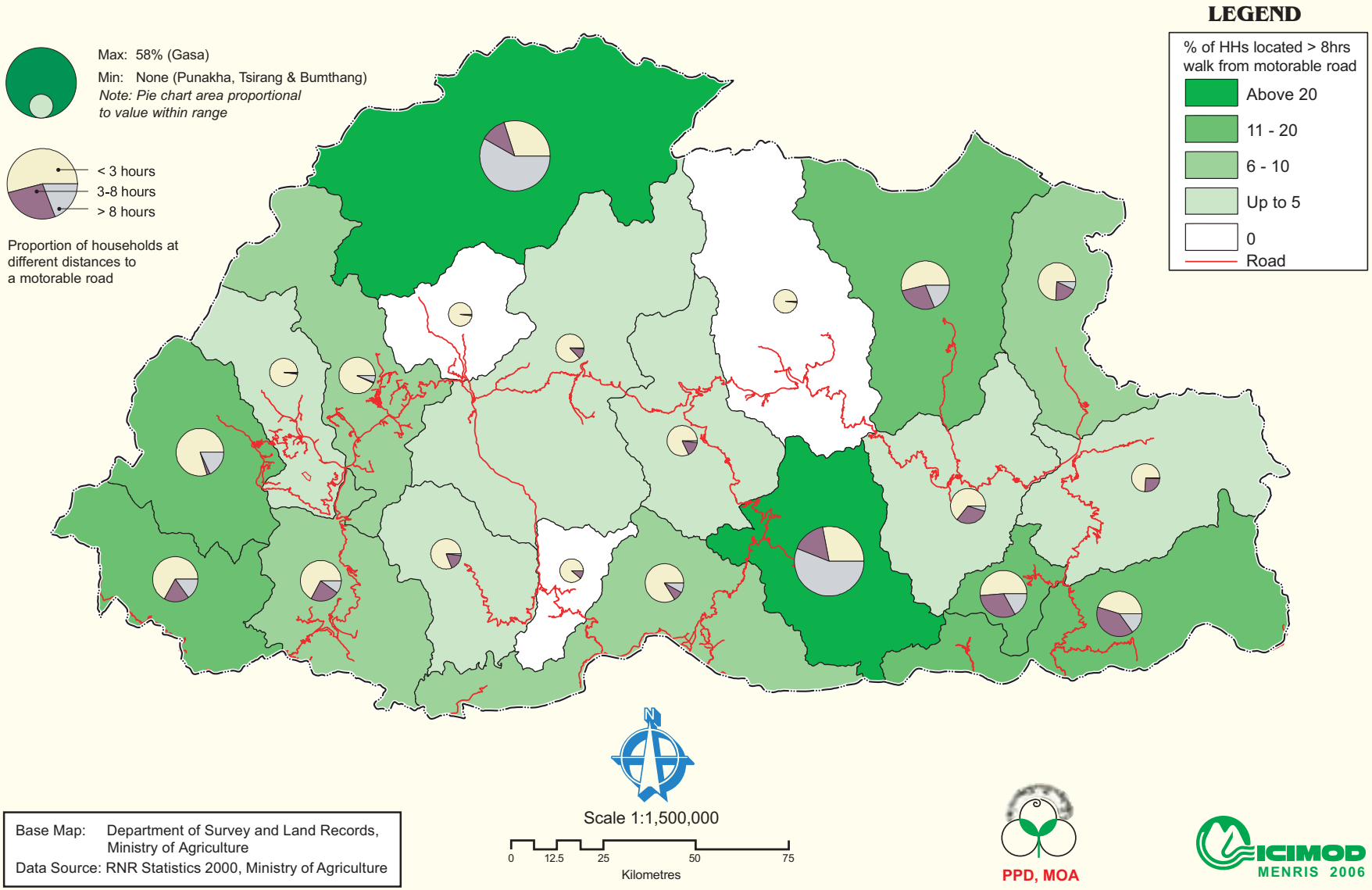
Table G.4

District	< 3 hrs	3-8 hrs	> 8 hrs	District	< 3 hrs	3-8hrs	> 8 hrs
Gasa	30	12	58	Thimphu	93	1	6
Zhemgang	28	16	56	Mongar	64	31	5
Lhuntse	54	27	19	Dagana	81	17	2
Ha	80	2	18	Trongsa	82	16	2
Pemagatshel	51	32	17	Paro	98	1	1
Samtse	67	18	15	Wangdue	87	12	1
S/Jongkhar	45	40	15	Trashigang	74	25	1
Chhukha	67	23	10	Punakha	98	2	0
Sarpang	85	7	8	Tsirang	89	11	0
Yangtse	74	19	7	Bumthang	98	2	0
				Average*	**71**	**19**	**10.4**

* Simple averages, not weighted

Farm Households by Distance (Walking Time) to the Nearest Motorable Road

G 4



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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Part Four

Summary and Conclusions

Characterisation of Districts Based on Selected RNR Indicators

Despite its small size, Bhutan has a very diverse landscape with widely varying agroecological characteristics. The land types range from lowlands suitable for arable farming to purely pastoral rangelands and high mountains. The overall characteristics of and differences between the districts of Bhutan can be shown using selected indicators related to land use, agricultural production, and other factors. These indicators can be used to explore the limitations and potential for agricultural development.

A total of eleven RNR indicators were identified and developed by the Policy and Planning Division, Ministry of Agriculture, Bhutan, and used to define indicators of development in the context of a spatial food security assessment. The indicators were selected on the basis of data availability (either already available or likely to be available in the future), reliability, and validity for the purpose; and whether they could be quantified and were not biased with respect to social, economic, productive, or other considerations. These indicators are useful because they facilitate characterisation of the districts, and enable rapid comparisons to be made.

In this section, the indicators are listed and the district rank for each shown in a table. This information is presented visually in the formal of maps to provide an 'at-a-glance' view of the agricultural development status of the districts.

RNR indicators

A total of eleven indicators were identified as listed below (in no particular order).

1. *Percentage of households owning wetland* (chushing; i.e. terraced land, mostly irrigated) is defined as the number of households owning wetland divided by the total number of households. Ownership of wetland is associated with stable, productive farming. This indicator essentially shows the distribution of paddy fields.
2. *Percentage of households owning three or more acres of arable land* is defined as the percentage of total households owning at least three acres of wetland (chushing)and dryland (kamshing) together. Owning more than three acres of arable land is a good indication that a household is self-sufficient in and has stable food production.
3. *Cereal production per household* is defined as the total cereal production for that district (in tonnes) divided by the total number of households. This indicator is directly related to food security and income generation and shows the potential for food self-sufficiency in a district.
4. *Wetland area per household* is defined as the total area of wetland in a district (acres) divided by the total number of households per district. The wetland area per household, especially when considered in conjunction with the percentage of households owning wetland, is indicative of the rate of food self-sufficiency.
5. *Wetland as a percentage of total arable land* is defined as the area of wetland in a district divided by the total of wetland plus dryland, multiplied by 100. This value is used to indicate areas where agriculture is relatively productive, stable, and sustainable, and may have a good potential for further intensification.

6. *Percentage of households that do not practise shifting cultivation* is defined as the total number of households minus those that practise shifting cultivation divided by the total number of households multiplied by 100. Low values mean that a large proportion of households practise shifting cultivation and indicate the likelihood of food insecurity, tenure insecurity, and risks of degradation if shifting cultivation is converted to permanent cultivation*.
7. *Arable land as a percentage of total agricultural land* is defined as the total area of wetland plus the total area of dryland divided by the total agricultural land times 100. Total agricultural land is total arable land plus total shifting cultivation area, thus the indicator indicates the relative proportion of shifting cultivation land. A high value indicates stability and relative food and tenure security.
8. *Percentage of households producing apples and oranges* is defined as the percentage of households cultivating apples plus the percentage of households cultivating oranges. [Note that in some cases a household may be counted twice.] Apples and oranges are important horticultural tree crops; a high degree of this type of horticulture indicates land use intensification, market access, and potential income generation.
9. *Number of fruit trees per household*. This is the total number of cultivated fruit trees in a district divided by the number of households. It indicates the relative importance of fruit trees in a district and the implied land use intensification, market access, and potential income generation.
10. *Number of economic livestock units per household*. The number of livestock are converted into 'economic livestock units' using the conversion of one unit equals 1 yak, 1 mule, 1 donkey, 2 cows, 2 horses, 5 pigs, 10 sheep or goats, or 100 poultry. The number of livestock units in a district is divided by the total number of households. This value indicates stored or accumulated wealth and the ability to purchase food grain and other food; it is an alternative way of showing food self-sufficiency.
11. *Percentage of households less than one hour from a motorable road* is defined as the number of households that reported that they were living less than one hour from a motorable road as a percentage of the total number of households. It indicates the potential for marketing agricultural products and the opportunity to purchase basic food requirements.

The values of each of the above indicators were calculated for each of the 20 districts and the districts ranked in the order of the values with rank 20 the best and rank 1 the least good. The rank values for individual indicators were summed to provide an overall indication of the relative district rank. The summing was not weighted, that is indicators were rated as equally important. The results are shown in Table 4.1 and illustrated in Maps R1 to R3 (individual indicators) and R4 (overall ranking). In the maps, the ranking is shown in ranges of ranks 15-20 (high), ranks 8-14 (medium) and ranks 1-8 (low).

* But note that ideas on the appropriateness of shifting cultivation (better called rotational agroforestry) are changing with increasing recognition of its benefits and the positive role this form of agriculture can play. See the recent ICIMOD publication E. Kerkhoff and E. Sharma (2006) Debating Shifting Cultivation in the Eastern Himalayas – Farmers' Innovations as Lessons for Policy [ed]

Table 4.1 District ranking according to different agricultural indicators

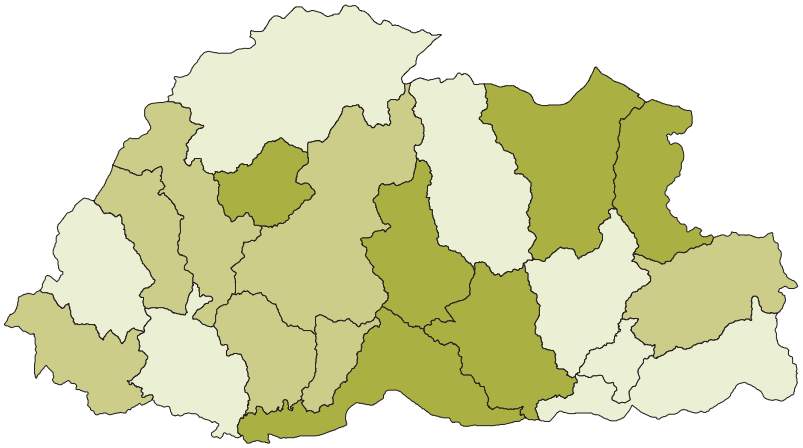
District	% of HHs owning wetland	% of HHs owning >3 acres arable land	Cereal production per HH	Wetland per HH	% Wetland / arable land	% Not practising shifting cultivation	% arable land/ tot. agric. land	% HH producing apples/ oranges	Fruit trees/HH	Livestock Units per HH	% HHs <1 hr from road	Sum of Values	Overall Ranking
Paro	12	11	9	15	17	11	9	15	18	14	20	168	20
Punakha	20	5	20	20	20	5	20	20	9	7	15	166	19
Sarpang	15	19	19	19	13	19	19	19	20	9	16	162	18
Thimphu	9	7	6	12	19	7	6	12	15	18	18	152	17
Tsirang	11	12	16	17	14	12	16	17	12	5	13	146	16
Gasa	5	3	3	8	16	3	3	8	5	16	12	141	15
Dagana	13	15	17	14	10	15	17	14	13	8	11	130	14
Trongsa	19	13	8	13	15	13	8	13	7	15	14	127	13
Zhemgang	17	18	15	11	9	18	15	11	16	12	2	121	12
Samtse	10	16	12	16	11	16	12	16	14	4	9	120	11
Chhukha	7	17	5	9	7	17	5	9	19	13	10	109	10
Mongar	6	4	11	3	3	4	11	3	4	11	7	104	9
S/Jongkhar	4	14	18	6	5	14	18	6	17	3	4	104	9
Ha	3	8	2	2	4	8	2	2	11	19	17	101	7
Wangdue	14	6	13	18	18	6	13	18	1	20	1	91	6
Bumthang	2	20	1	2	2	20	1	2	8	17	19	87	5
Lhuntse	16	10	14	10	12	10	14	10	6	6	6	79	4
Trashi Yangtse	18	2	7	7	8	2	7	7	2	10	3	79	4
Trashigang	8	9	10	5	6	9	10	5	3	2	8	74	2
Pemagatshel	1	1	4	1	1	1	4	1	10	1	5	49	1

Note: Acre is the standard unit of area used in Bhutan.

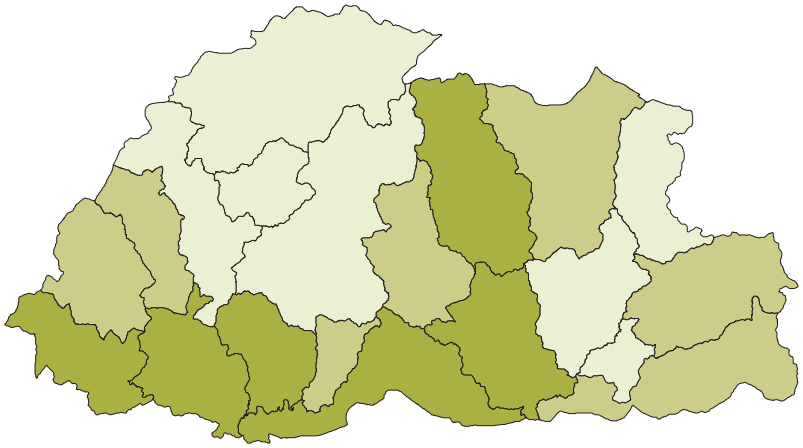
Ranking of Districts Based on Selected RNR Indicators

RI

Percentage of households owning wetland



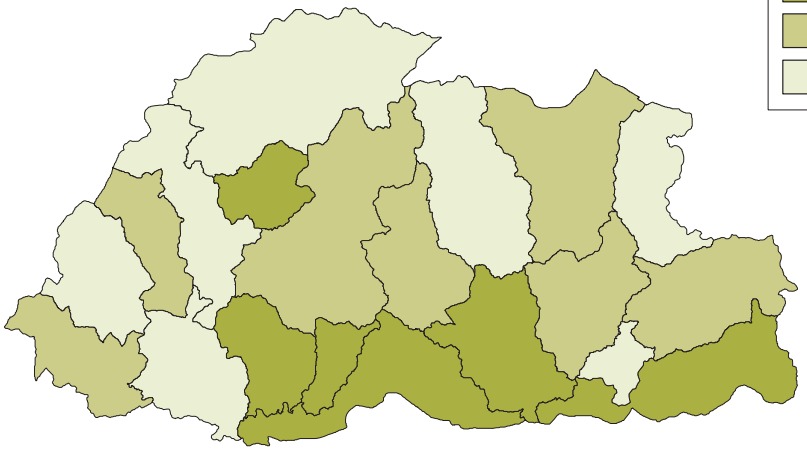
Percentage of households owning >3 acres arable land



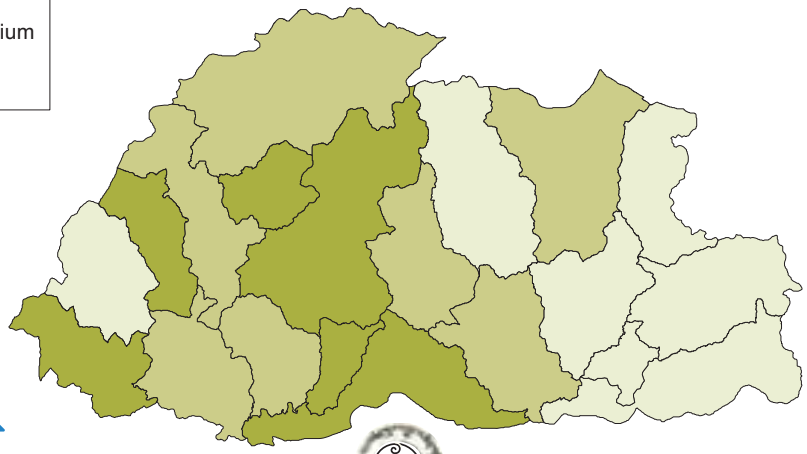
LEGEND

Rank
- High
- Medium
- Low

Cereal production per household



Wetland area per household



0 12.5 25 50 75 100
Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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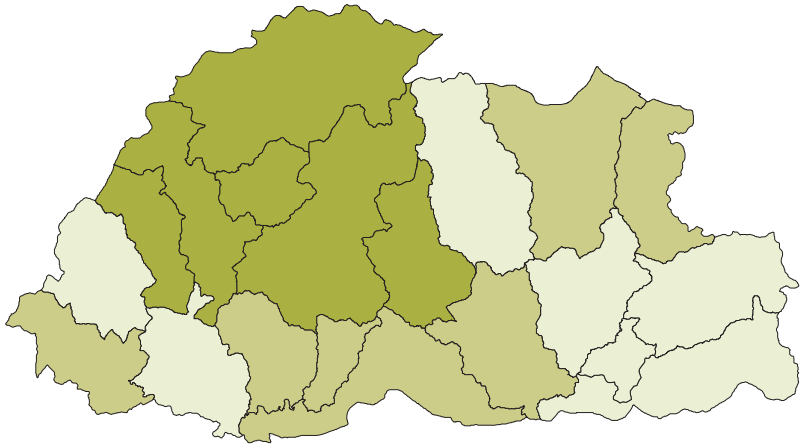
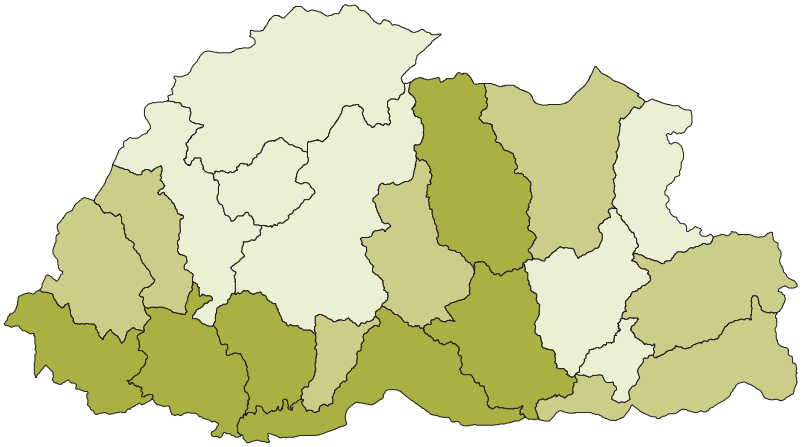
Ranking of Districts Based on Selected RNR Indicators

R 2

Wetland as a percentage of total arable land



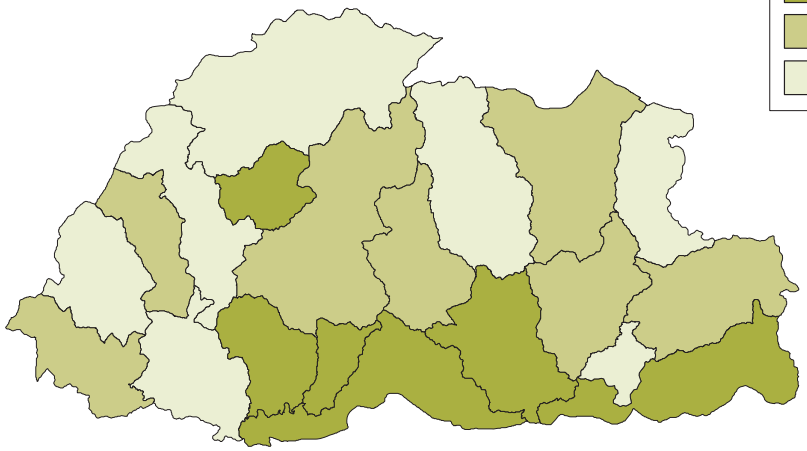
Percentage of households that DO NOT practise shifting cultivation



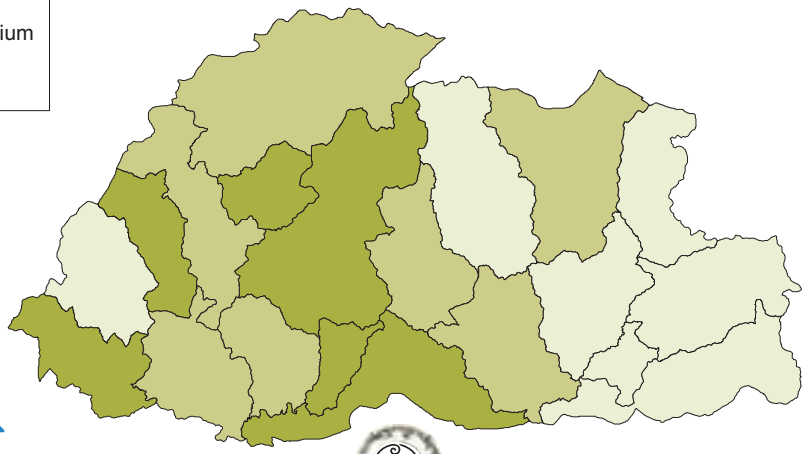
LEGEND

Rank
- High
- Medium
- Low

Arable land as a percentage of total agricultural land



Percentage of households producing apples and oranges



0 12.5 25 50 75 100
Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

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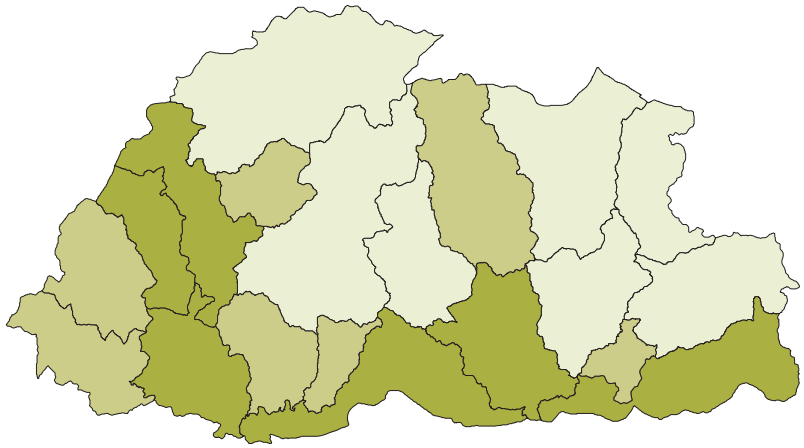
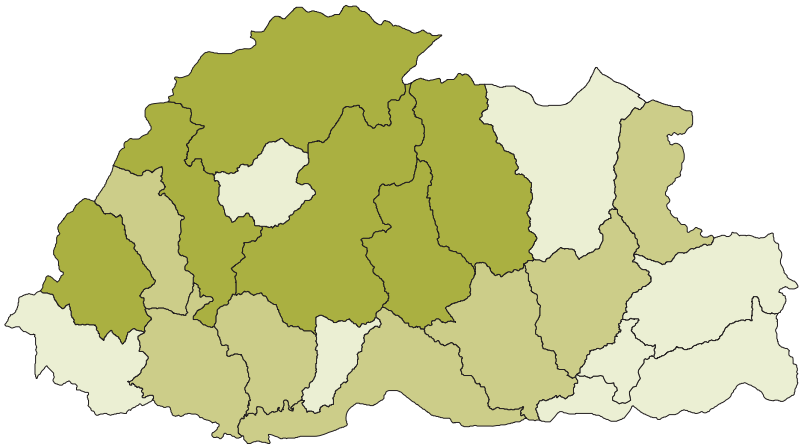
Ranking of Districts Based on Selected RNR Indicators

R 3

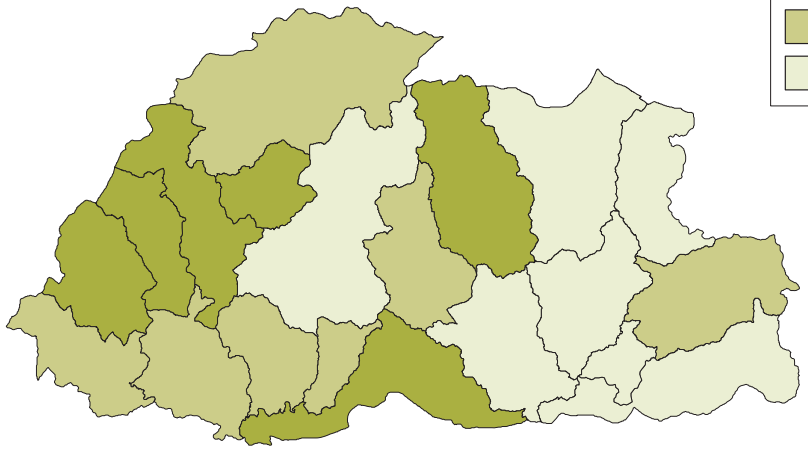
Number of fruit trees per household



Number of economic livestock units per household

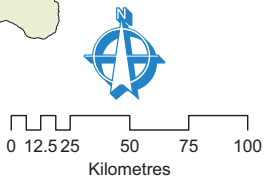


Percentage of households less than one hour from a motorable road



LEGEND

Rank
- High
- Medium
- Low



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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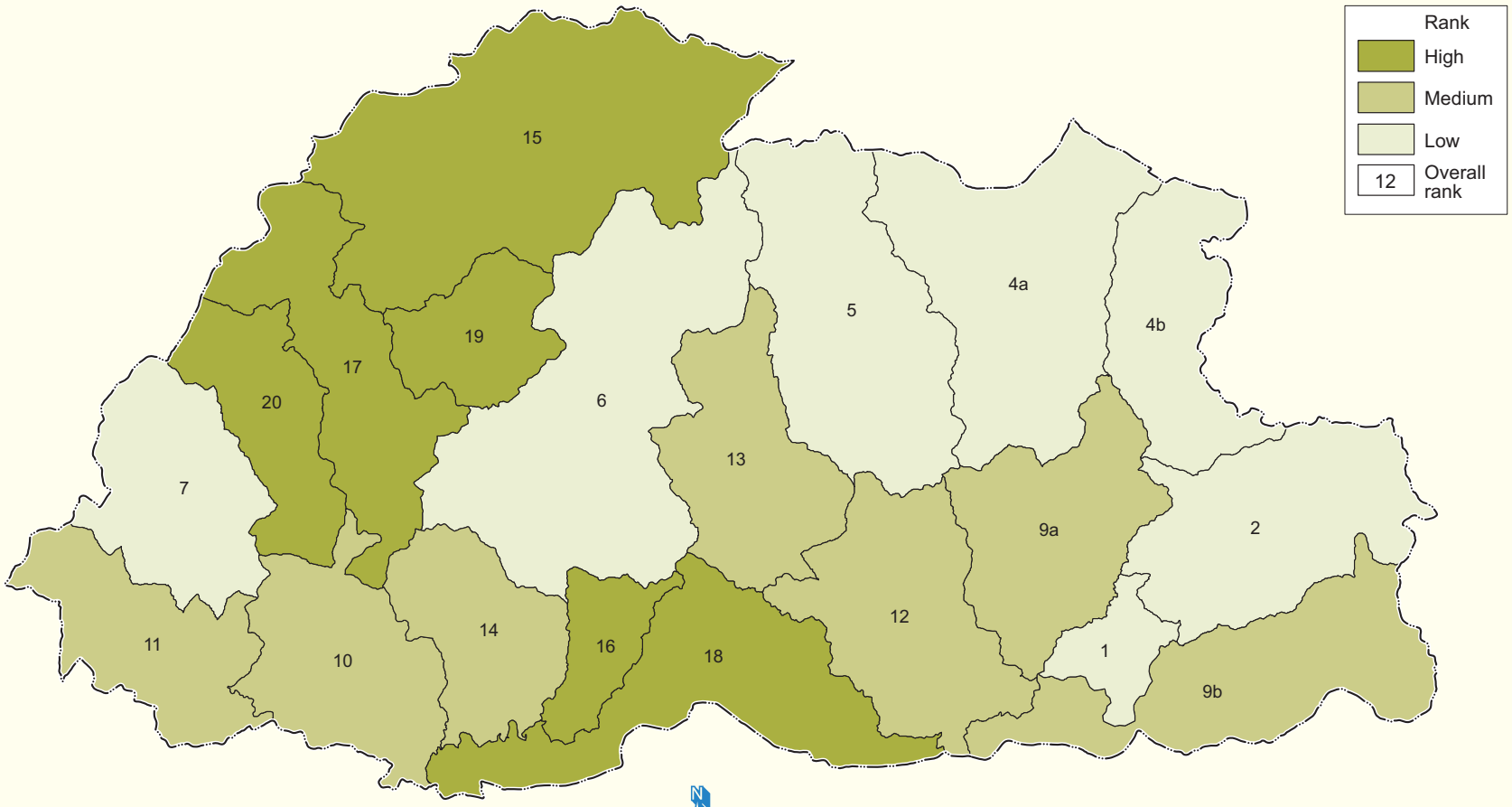
Ranking of Districts Based on Selected RNR Indicators

R 4

Overall Ranking



LEGEND

Rank
- High
- Medium
- Low
- 12 Overall rank

Scale 1:1,500,000

0 12.5 25 50 75
Kilometres

Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

PPD, MOA

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Conclusions and Recommendations

In mountainous countries like Bhutan, people generally rely primarily on subsistence agriculture and natural resources for their livelihoods. The importance of agriculture to the national economy in Bhutan cannot be underestimated. Informed decision-making in agriculture needs to be founded on accurate and up-to-date information about the country's natural resource base and its rural economy. Synthesis and analysis of natural resources data yields the information that provides a basis for developing a policy framework, policy design, and plans and programmes.

The Royal Government of Bhutan has consistently endeavoured to improve the rural economy by emphasising increased agricultural production, and accessibility and marketing of farm products. Given the limited resources, informed planning, based on reliable data and information, is essential. Bhutan is making increasing use of relevant statistical data as a necessary input to the planning design process and is becoming increasingly aware of the need for more data. The need for more data and information in RNR management and decision making prompted Bhutan to conduct its first RNR census in 2000. The used of ICT including geo-informatics, (together known as geo-ICT) to help in the planning and management of natural resources and the environment, features prominently in the ongoing Five-Year Plan for the RNR sector.

The RNR census was an important undertaking in Bhutan. The present publication is the result of a joint attempt on the part of MoA Bhutan and ICIMOD to present the RNR census data in a more accessible form. The data were abstracted into simple indicators and presented visually in map form. This volume should help in the dissemination of RNR information to development practitioners and policy and decision makers. Within the limits of the data available, the study also demonstrates how geo-ICT tools can be applied to link data and information to policy.

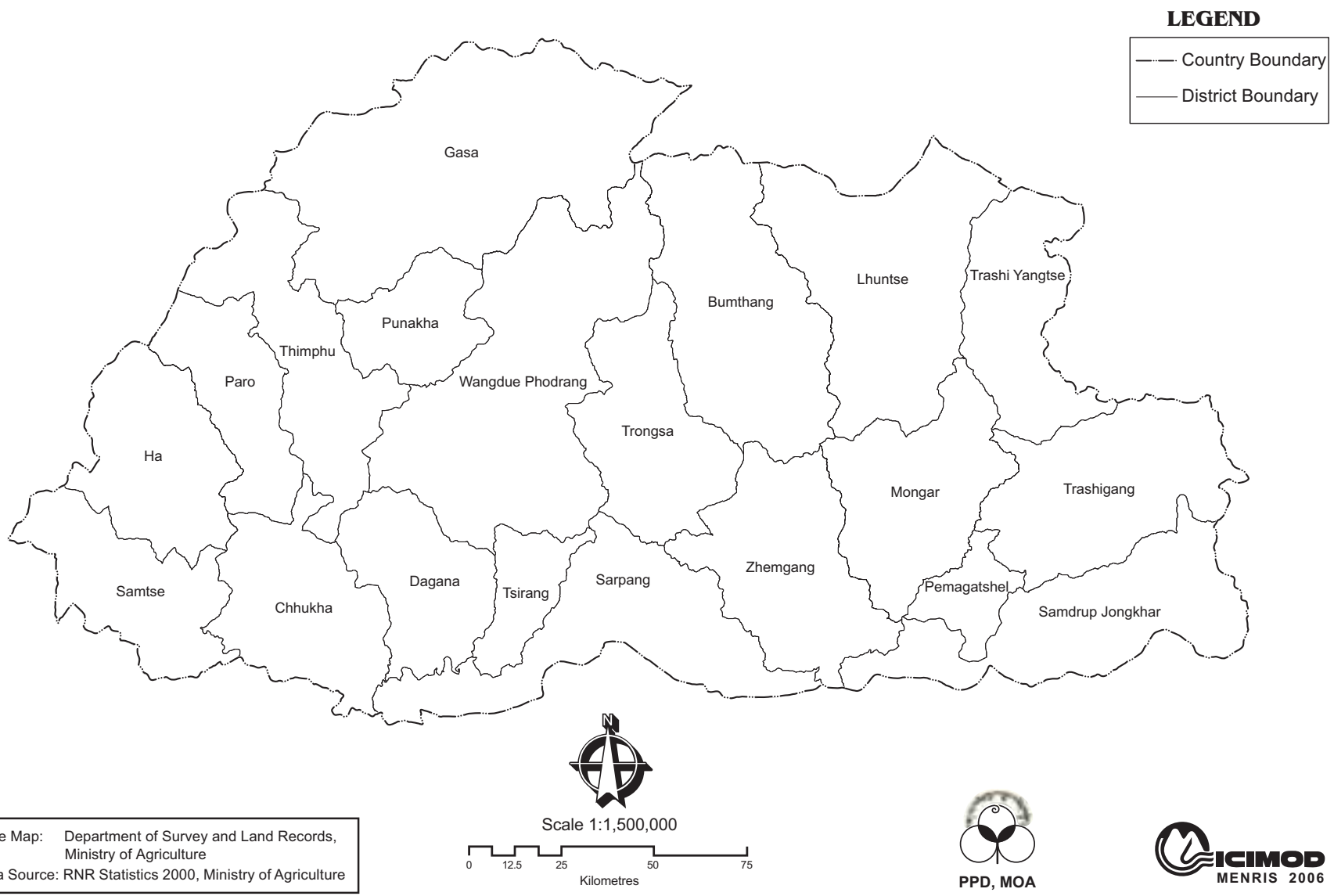
The maps illustrate useful district-wise information on various aspects of Bhutan's RNR and the farming community including agricultural production, availability of land for farming, sources of income, the amount of agricultural input used for farming, and the nature of constraints faced by farming households. The visual representation of the data by district is intended to make the comparison between districts easier and is intended to give the reader an overview of the country at a glance. These maps will be most useful in monitoring of current national plan programmes and their impacts, they can also be used in the 10th Five-Year planning by using the maps to indicate areas or districts where environmental problems exist or could emerge. This information constitutes the fundamental basis for understanding the RNR sector and the need for improved agricultural production and further development.

The comments and recommendations below were developed by the study team based on the shared experience and knowledge gained in the process of compiling the present document.

- This publication was prepared using the most comprehensive data available to date, which consist mainly of the data collected by the RNR Census 2000 conducted by the Ministry of Agriculture, RGoB. Since these figures are now some five years old, readers are cautioned to take into consideration the changes that may have taken place during this time. Notwithstanding this limitation, the document contains much valuable information and its preparation has been a useful learning exercise which will make it easier to produce subsequent updated versions. Since the Ministry of Agriculture has carried out annual sample surveys since 2000, it seems feasible that this document could be updated using this new data.

- This exercise was a useful on-the-job training method to provide experience to national staff in converting data into maps. It revealed the strength of RGoB's national expertise and technologies to conduct similar exercises in future. Exercises of this type should be conducted and the results published at regular intervals as a part of the sector's information.
- In a society that has only recently appreciated the use of maps as planning and management tools, it is recommended that the MoA should circulate this publication widely for public use and to ensure maximum benefits at all levels.
- Trend data is a valuable way to monitor and evaluate the various programmes and projects that have been put into place in the RNR sector. As more annual data becomes available, it can be used to carry out trend analysis for the RNR sector. Trend data can be presented in a form similar to that used here.
- As sufficient data exist to conduct and publish maps at district level, it is highly recommended that the sector should bring out the next publication at district level to disseminate information that can be used by policy makers and planners,
- Development in one sector is often contingent on change in other sectors; for this reason, it would be interesting to see the RNR sector and its linkages from an overall development perspective. In future, basic information on other sectors such as health, education, infrastructure, energy, and communication could also be presented in a similar map form together with the RNR data. Such a holistic compilation of the country's statistical data may eventually be useful to other sectors and may prompt them to use similar methods for planning and development.
- The release of the National Population and Housing Census data is imminent. This new data will be very valuable, especially when it is analysed together with the RNR data to help enrich our understanding of the manifold aspects of development. A new volume which would include this demographic data together with RNR data would be another useful tool for government planners and development practitioners.
- Finally a word of caution the assumption is made that the RNR census provided a full description of land used for agriculture and production across the country. However, as outlined in the introduction, for various reasons this first census may in fact give a somewhat incomplete view. Thus the values should be taken as indicative rather than exact, and more useful for comparative than precise assessment of the situation.

Administrative Map of Bhutan



Base Map: Department of Survey and Land Records, Ministry of Agriculture
Data Source: RNR Statistics 2000, Ministry of Agriculture

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