

**MINISTRY OF AGRICULTURE AND IRRIGATION
MINISTRY OF LIVESTOCK AND FISHERIES
MINISTRY OF COOPERATIVES**

**THE DEVELOPMENT STUDY
ON
SUSTAINABLE AGRICULTURAL
AND
RURAL DEVELOPMENT
FOR
POVERTY REDUCTION PROGRAMME
IN
THE CENTRAL DRY ZONE OF
THE UNION OF MYANMAR**

GIS ATLAS

AUGUST 2010

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
SANYU CONSULTANTS INC., TOKYO, JAPAN**

FOREWORD

This GIS ATLAS is a part of outputs from the Development Study on Sustainable Agricultural and Rural Development for Poverty Reduction Programme in the Central Dry Zone (CDZ) of the Union of Myanmar. The Study was commenced in May 2006 and carried out for a period of over 4 years in partnership with all those concerned officers of the Ministry of Agriculture and Irrigation, Ministry of Livestock and Fisheries, and Ministry of Cooperatives.

The CDZ extends within 3 divisions - Mandalay, Sagaing and Magway, covering an extensive area of 75,169 km². The population of the CDZ is estimated at 9,842,000 as of 2003 according to the population data recorded at relevant offices at township, giving a population density of 131 persons/km². The CDZ hereby has larger share of population rather than share of land area against whole Union and also against concerned entire 3 divisions, exemplified as that of the whole Union is 79 persons/km², and also that of the 3 divisions is 103 person/km². One of the reasons of relatively high population density may lie in the favorable living environment of the CDZ with larger portion of flat alluvial zone as compared to western, northern and eastern areas that accompany with mountainous areas.

The overall relief of the CDZ can be classified into river basins with fertile diluvial soils and fluvial deposit derived soils, alluvial plain extending along rivers in the CDZ, and then plateau zone with infertile soils over Bago Hills situated in between Ayeyarwady River and Sittang River. From land area point of view, plain occupies by far large portion, and an intensive farming is practiced making use of fertile soils along the grand Ayeyarwady River. As the topography shifts away from the rivers to the plain and then to the plateau, agricultural activities tend to become extensive.

From these facts, even though it is called Central “Dry” Zone, the CDZ should be interpreted as a drier area in its comparison with other areas in the Union where monsoon type climate predominates. Of course, at the very end of lingering dry season during November - next May, soils are dried up and wind erosion severely takes place. During this period, typical scenery in so-called semi-arid zone appears in the CDZ as well, but in contrast, in the rainy season falling in the period of June - October, paddy cropping, typical activity under monsoon climate, has long been practiced since prehistoric era in climatically favorable areas within the CDZ.

With above background, considerable quantities of data were collected from relevant offices and assembled, much of which was previously unavailable cross-cutting townships. The availability of this data and the desirability of presenting it in a spatially referenced framework led to a conclusion to produce a Geographical Information System (GIS) based digital maps in order to help development planners, practitioners, government policy makers and technocrats, etc. assist to make sound decision in their working horizon.

Special acknowledgement goes to the officers of Department of Agricultural Planning (DAP) and Myanma Agriculture Service (MAS) both at the Headquarters as well as at field level for the leading role of facilitating related field surveys as well as for their supports in collecting data and information included in this atlas. It is our sincere hope that this atlas will serve as a reference point and guide to those who wish to understand more clearly the situation of the CDZ.

CONTENTS

MAP 1: GEOGRAPHY AND DEMOGRAPHY

- Map 1.1 Districts and Townships in Central Dry Zone
- Map 1.2 Population Density and Population by Sex
- Map 1.3 Population Density and its Location (Urban and Rural 2003)
- Map 1.4 Population Density and its Age Structure (2003)
- Map 1.5 House Density and its Types (2005)
- Map 1.6 Number of Farm Household and its Farm Size Distribution

MAP 2: EMPLOYMENT INDICATORS

- Map 2.1 Employment Indicators- Distribution of Population by Agriculture and Non-Agriculture (2003)
- Map 2.2 Distribution of Employed Population by Occupation (2005)
- Map 2.3 Employment Indicators- Farmer (2005)
- Map 2.4 Employment Indicators- Casual Labor (2005)
- Map 2.5 Employment Indicators- Government Employee (2005)
- Map 2.6 Employment Indicators- Industrial Labor (2005)
- Map 2.7 Employment Indicators- Livestock Breeder (2005)
- Map 2.8 Employment Indicators- Other Labor (2005)

MAP 3: NATURAL CONDITION: CLIMATE, SOILS, AND LAND UTILIZATION

- Map 3.1 Climate, Precipitation 2001-2005 (inches)
- Map 3.2 Climate, Precipitation in inches (mm)
- Map 3.3 Soil Distribution- Catena of Savanna Soils on Slopes and Compact Soils in Depletion (Luvisol)
- Map 3.4 Soil Distribution- Compact Soils (Vertisol)
- Map 3.5 Soil Distribution- Light Forest Soils (Nitosol)
- Map 3.6 Soil Distribution- Meadow Alluvial Soils (Gleysol)
- Map 3.7 Soil Distribution- Meadow Carbonate Soils (Gleysol)
- Map 3.8 Soil Distribution- Other Soils
- Map 3.9 Soil Distribution- Primitive Crushed Stones Soils
- Map 3.10 Soil Distribution- Turfy Primitive Soils (Lithosol)
- Map 3.11 Soil Distribution- Yellow Brown Dry Forest and Indaing (Xanthic Ferralsol)
- Map 3.12 Land Utilization- Total Land Area by Land Type
- Map 3.13 Land Utilization- Le Land (Lowland)
- Map 3.14 Land Utilization- Yar Land (Upland)
- Map 3.15 Land Utilization- Kaing/Kyun Garden
- Map 3.16 Land Utilization- Total Cultivated Land (Le Land, Yar Land, Kaing/Kyun Garden)
- Map 3.17 Land Utilization- Waste Land
- Map 3.18 Land Utilization- Forest Area
- Map 3.19 Land Utilization- Uncultivable Land

MAP 4: HOUSEHOLD WITH ELECTRICITY AND BY HOUSING MATERIALS

- Map 4.1 Access to Electrification for Urban (2005)
- Map 4.2 Access to Electrification for Rural (2005)

Map 4.3	Rate of Households by Electric Power Sources- Main Power Line (2005)
Map 4.4	Rate of Households by Electric Power Sources- Biogas (2005)
Map 4.5	Rate of Households by Electric Power Sources- Rice Husk (2005)
Map 4.6	Rate of Households by Electric Power Sources- Own Generator (2005)
Map 4.7	Rate of Households by Electric Power Sources- Battery (2005)
Map 4.8	Rate of Households by Electric Power Sources- Candle (2005)
Map 4.9	Rate of Households by Type of Housing Materials- Bamboo (2005)
Map 4.10	Rate of Households by Type of Housing Materials- Wood (2005)
Map 4.11	Rate of Households by Type of Housing Materials- Brick (2005)

MAP 5: FARMER HOUSEHOLD BY FARM SIZE

Map 5.1	No. of Farmers by Farm Size (2003)
Map 5.2	No. of Farmers by Farm Size- Less than 5 Acres (2003)
Map 5.3	No. of Farmers by Farm Size- 5-10 Acres (2003)
Map 5.4	No. of Farmers by Farm Size- 10-20 Acres (2003)
Map 5.5	No. of Farmers by Farm Size- Greater than 20 Acres (2003)

MAP 6: AGRICULTURE: CROP PRODUCTION, SOWN AREA, YIELD, IRRIGATION, AND AGRO-INDUSTRY

Map 6.1	Crop Production- Annual Total Pigeon Pea (2005)
Map 6.2	Crop Production- Annual Total Chickpea (2005)
Map 6.3	Crop Production- Annual Total Green Gram (2005)
Map 6.4	Crop Production- Annual Total Soy Bean (2005)
Map 6.5	Crop Production- Annual Total Groundnut (2005)
Map 6.6	Crop Production- Annual Total Sesame (2005)
Map 6.7	Crop Production- Annual Total Sunflower (2005)
Map 6.8	Crop Production- Monsoon Paddy (2005)
Map 6.9	Crop Production- Summer Paddy (2005)
Map 6.10	Crop Production- Annual Total Maize (2005)
Map 6.11	Crop Production- Annual Total Sorghum (2005)
Map 6.12	Crop Production- Annual Total Onion (2005)
Map 6.13	Crop Production- Annual Total Chili (2005)
Map 6.14	Crop Production- Annual Total Potato (2005)
Map 6.15	Crop Production- Annual Total Toddy (2005)
Map 6.16	Crop Sown Area- Annual Total Pigeon Pea (2005)
Map 6.17	Crop Sown Area- Annual Total Chickpea (2005)
Map 6.18	Crop Sown Area- Annual Total Green Gram (2005)
Map 6.19	Crop Sown Area- Annual Total Soy Bean (2005)
Map 6.20	Crop Sown Area- Annual Total Groundnut (2005)
Map 6.21	Crop Sown Area- Annual Total Sesame (2005)
Map 6.22	Crop Sown Area- Annual Total Sunflower (2005)
Map 6.23	Crop Sown Area- Monsoon Paddy (2005)
Map 6.24	Crop Sown Area- Summer Paddy (2005)
Map 6.25	Crop Sown Area- Annual Total Maize (2005)
Map 6.26	Crop Sown Area- Annual Total Sorghum (2005)
Map 6.27	Crop Sown Area- Annual Total Onion (2005)

Map 6.28	Crop Sown Area- Annual Total Chili (2005)
Map 6.29	Crop Sown Area- Annual Total Potato (2005)
Map 6.30	Crop Sown Area- Annual Total Toddy (2005)
Map 6.31	Crop Yield- Annual Total Pigeon Pea (2005)
Map 6.32	Crop Yield- Annual Total Chickpea (2005)
Map 6.33	Crop Yield- Annual Total Green Gram (2005)
Map 6.34	Crop Yield- Annual Total Soy Bean (2005)
Map 6.35	Crop Yield- Annual Total Groundnut (2005)
Map 6.36	Crop Yield- Annual Total Sesame (2005)
Map 6.37	Crop Yield- Annual Total Sunflower (2005)
Map 6.38	Crop Yield- Monsoon Paddy (2005)
Map 6.39	Crop Yield- Summer Paddy (2005)
Map 6.40	Crop Yield- Annual Total Maize (2005)
Map 6.41	Crop Yield- Annual Total Sorghum (2005)
Map 6.42	Crop Yield- Annual Total Onion (2005)
Map 6.43	Crop Yield- Annual Total Chili (2005)
Map 6.44	Crop Yield- Annual Total Potato (2005)
Map 6.45	Crop Yield- Annual Total Toddy (2005)
Map 6.46	Irrigation by Reservoir System after 1988
Map 6.47	Irrigation by River Pumping System for Summer Crops (January to August 2007)
Map 6.48	Irrigation by River Pumping System for Monsoon Crops (January to August 2007)
Map 6.49	Agro-Industries by Type and Number- No. of Oil Crushing Mills (2005)
Map 6.50	Agro-Industries by Type and Number- No. of Cotton Ginning & Processing (2005)

MAP 7: LIVESTOCK: CATTLE, GOAT & SHEEP, CHICKEN, PIG, PRODUCTION, PROCESSING, AND PRICES

Map 7.1	Livestock- Total Cattle (2005)
Map 7.2	Livestock- Total Goat & Sheep (2005)
Map 7.3	Livestock- Total Chicken (2005)
Map 7.4	Livestock- Total Duck (2005)
Map 7.5	Livestock- Total Pig (2005)
Map 7.6	Livestock- Number of Households Raising Cattle (2005)
Map 7.7	Livestock- Number of Households Raising Goat & Sheep (2005)
Map 7.8	Livestock- Number of Households Raising Chicken (2005)
Map 7.9	Livestock- Number of Households Raising Duck (2005)
Map 7.10	Livestock- Number of Households Raising Pig (2005)
Map 7.11	Livestock- Grassland Area for Grazing Goat & Sheep (2005)
Map 7.12	Livestock- Meat Production (2005)
Map 7.13	Livestock- Milk Production (2005)
Map 7.14	Livestock- Egg Production (2005)
Map 7.15	Livestock- Number of Cattle Market (2005)
Map 7.16	Livestock- Number of Livestock Traders (2005)
Map 7.17	Livestock- Number of Slaughtered Animals (2005)
Map 7.18	Livestock- Number of Food Stuff Processing Plants (2005)
Map 7.19	Livestock- Number of Condensed Milk Plants (2005)
Map 7.20	Livestock- Unit Price of Live Goat & Sheep (2005)

Map 7.21	Livestock- Unit Price of Live Chicken (2005)
Map 7.22	Livestock- Unit Price of Live Duck (2005)
Map 7.23	Livestock- Unit Price of Live Pig (2005)

MAP 8: EDUCATION: LITERACY, ENROLMENT, GRADUATION, DROPOUT, FORMAL, AND NON-FORMAL

Map 8.1	Education Status- Literacy Rate (above 15 years old, 1999-2000 & 2005-2006)
Map 8.2	Education Status- Literacy Rate (above 15 years old, 2005-2006)
Map 8.3	Education Status- School Enrolment Rate by Type of School (2003)
Map 8.4	Education Status- Primary School Enrolment Rate (2003)
Map 8.5	Education Status- Middle School Enrolment Rate (2003)
Map 8.6	Education Status- High School Enrolment Rate (2003)
Map 8.7	Education Status- School Graduation Rates by Grade (2003)
Map 8.8	Education Status- Primary School Graduation Rate (2003)
Map 8.9	Education Status- Middle School Graduation Rate (2003)
Map 8.10	Education Status- High School Graduation Rate (2003)
Map 8.11	Education Status- School Dropouts Rates by Grade 1 (2003)
Map 8.12	Education Status- School Dropouts Rates by Grade 11 (2003)
Map 8.13	Education Status- School Dropouts Rates by Grade 111 (2003)
Map 8.14	Education Status- School Dropouts Rates by Grade IV (2003)
Map 8.15	Education Status- School Dropout Rates by Grade V (2003)
Map 8.16	Education Status- School Dropout Rates by Grade VI (2003)
Map 8.17	Education Status- School Dropout Rates by Grade VII (2003)
Map 8.18	Education Status- School Dropout Rates by Grade VIII (2003)
Map 8.19	Education Status- School Dropout Rates by Grade IX (2003)
Map 8.20	Education Status- School Dropout Rates by Grade X (2003)
Map 8.21	Education Status- School Dropout Rates by Grade XI (2003)
Map 8.22	Education Status- No. of Students and Its Types (Formal Education, 2003)
Map 8.23	Education Status- No. of Schools and Its Types (Formal Education, 2003)
Map 8.24	Education Status- No. of Teachers and Its Types (Formal Education, 2003)
Map 8.25	Education Status- Monastic Education (Non Formal Education, 2003)
Map 8.26	Education Status- No. of Monastic Students (Non Formal Education, 2005)
Map 8.27	Education Status- No. of Monastic Schools (Non Formal Education, 2005)
Map 8.28	Education Status- No. of Monastic Teachers (Non Formal Education, 2005)
Map 8.29	Education Status- No. of Night Schools (Non Formal Education, 2005)

MAP 9: HEALTH: BIRTH, DEATH, LIFE EXPECTANCY, MORTALITY, MALNUTRITION, AND MORBIDITY

Map 9.1	Health- Rates of Birth (2004)
Map 9.2	Health- Rates of Death (2004)
Map 9.3	Health- Life Expectancy Ratio by Sex (2004)
Map 9.4	Health- Infant Mortality Rate (2004-2005)
Map 9.5	Health- Under-five Mortality Rate (2004-2005)
Map 9.6	Health- Under-five Malnutrition Rate (2004-2005)
Map 9.7	Health- Maternal Mortality Rate (2004-2005)
Map 9.8	Health- Leading Cause Morbidity 1 (2004-2005)

Map 9.9	Health- Leading Cause Morbidity 2 (2004-2005)
Map 9.10	Health- Leading Cause Morbidity 3 (2004-2005)
Map 9.11	Health- Leading Cause Morbidity 4 (2004-2005)
Map 9.12	Health- Leading Cause Morbidity 5 (2004-2005)

SOURCE AND REFERENCE

- Map 1.1 to Map 1.3, Map 8.22 to Map 8.20, Map 9.1 to Map 9.3
Health Management Information System (HIMS), Ministry of Health
- Map 1.4, Map 9.4 to Map 12
HIMS & Township Peace and Development Council Township Profiles
- Map 1.5, Map 1.6
Division Peace Development Council Office Reports
- Map 2.1 to Map 2.8, Map 4.1, Map 4.2, Map 4.9 to Map 4.11
Township Peace and Development Council Township Profiles
- Map 3.1, Map 3.2
Township Peace and Development Council Township Profiles, Myanmar Agriculture Service
Township, Irrigation Department, Department of Meteorology and Hydrology
- Map 3.3 to Map 3.19, Map 6.49, Map 6.50
Land Use Division of Myanmar Agriculture Service
- Map 4.3 to Map 4.8
City Development Council
- Map 5.1 to Map 5.5
Township Peace and Development Council Township Profiles, Myanmar Agriculture Service
Township, Settlement and Land Record Department of Myanmar Agriculture Service
- Map 6.1 to Map 6.45
Myanmar Agriculture Service
- Map 6.46 to Map 6.48
Irrigation Department of Ministry of Agriculture and Irrigation
- Map 7.1 to Map 7.23
Livestock Breeding and Veterinary Department of Ministry of Livestock and Fisheries,
- Map 8.1, Map 8.2
Ministry of Education
- Map 8.3 to Map 8.21
Education Indicator, Ministry of Education

ACRONYMS AND ABBREVIATIONS

AED	Agricultural Extension Division
AMD	Agriculture Mechanization Department
ARCPA	Applied Research Center for Perennial Crops
BMI	Body Mass Index
CARI	Central Agriculture Research Institute
CARTC	Central Agriculture Research and Training Centre
CBM	Central Bank of Myanmar
CBO	Community Based Organization
CD	Cooperative Department
CID	Cottage Industry Department
CRDI	Credit for Rural Development Institution
CSO	Central Statistical Organization
DAP	Department of Agricultural Planning
DAR	Department of Agriculture Research
DOF	Department of Fisheries
DZMO	Dry Zone Micro-finance Organization
FAO	Food and Agriculture Organization
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
GOJ	Government of Japan
GOM	Government of Myanmar
GRDP	Gross Regional Domestic Product
HDI	Human Development Index
ID	Irrigation Department
ICDP	Integrated Community Development Project
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IMO	Indigenous Micro Organism (In Myanmar, it is called <i>dochakukin</i> as is Japanese)
IRRI	International Rice Research Institute
JICA	Japan International Cooperation Agency
LBVD	Livestock Breeding and Veterinary Department
LFDB	Livestock and Fisheries Development Bank
LUD	Land Use Division
MADB	Myanma Agricultural Development Bank
MAPT	Myanma Agricultural Produce Trading
MAS	Myanma Agriculture Service
MC	Ministry of Cooperatives
MCSE	Myanma Cotton and Sericulture Enterprise
MDG	Millennium Development Goal
MEIS	Myanmar Export and Import Service
MFI	Micro Finance Institution
MFR	Ministry of Finance and Revenue
MFTB	Myanma Foreign Trade Bank
MICB	Myanma Investment and Commercial Bank
MJI	Myanma Jute Industries

MOLF	Ministry of Livestock and Fisheries
MLFDB	Myanma Livestock and Fisheries Development Bank
MOAI	Ministry of Agriculture and Irrigation
MOF	Ministry of Forestry
MPCE	Myanma Perennial Crop Enterprise
MRTLCT	Myanma Rice Trading Leading Committee
MRTSC	Myanma Rice Trading Sub-Committee
MSE	Myanma Sugarcane Enterprise
NCD	Newcastle Disease
NGO	Non-Government Organization
NPD	National Project Director (the Chief Counterpart to the JICA Study)
NPK	Nitrogen, Phosphate, Potassium
ODA	Official Development Assistance
PDC	Peace and Development Council
PPD	Plant Protection Division
PPP	Purchasing Power Parity
PRA	Participatory Rural Appraisal
SAMB	State Agricultural Marketing Board
SD	Seed Division
SLRD	Settlement and Land Records Department
SPDC	State Peace and Development Council
TS	Township (the smallest administrative unit where government institutions are placed)
UMMB	Urea Molasses and Mineral Block
UNDP	United Nations Development Programme
VICO	Village Credit Organization
WFP	World Food Programme
WRUD	Water Resources Utilization Department
YAU	Yezin Agriculture University

FARMLAND TERMS IN MYANMAR

Le	Paddy land or wet land which can be used as paddy land
Yar	Upland
Kaing	Farmlands which appear in the flood lands in Ayeyarwady River as the water recedes
Kyun	Farmlands which appear on the alluvial sandbars in Ayeyarwady River as the water recedes

UNIT CONVERSION

1 basket	Paddy	20.9 kg
1 basket	Wheat	32.7 kg
1 basket	Maize (seed)	24.9 kg
1 basket	Sorghum	28.1 kg
1 basket	Sesame	24.5 kg
1 basket	Mustard	26.1 kg
1 basket	Sunflower	14.5 kg
1 basket	Groundnut	11.4 kg
1 basket	Butter Bean	31.3 kg

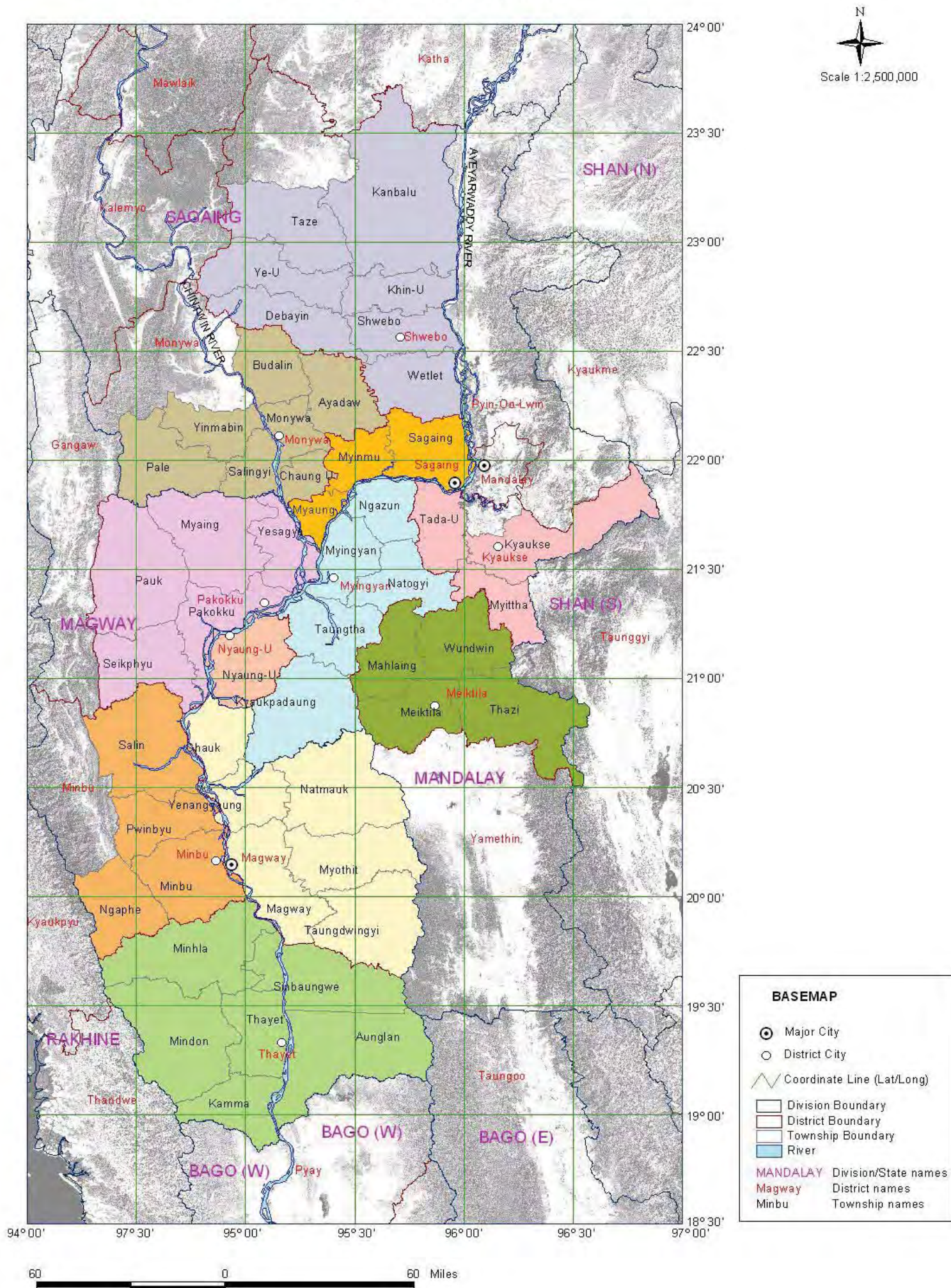
1 basket	Sultani	31.3 kg
1 basket	Sultapya	31.3 kg
1 basket	Chickpea	31.3 kg
1 basket	Pebyugalay	31.3 kg
1 basket	Pegyi	31.3 kg
1 basket	Pegyar	31.3 kg
1 basket	Pigeon Pea	32.7 kg
1 basket	Black Gram	32.7 kg
1 basket	Green Gram	32.7 kg
1 basket	Bocate	32.7 kg
1 basket	Soybean	32.7 kg
1 basket	Cowpea	32.7 kg
1 basket	Peyin	32.7 kg
1 basket	Sadawpea	32.7 kg
1 basket	Payazar	32.7 kg
1 basket	Pe-nauk	32.7 kg
1 basket	Other Pulses	31.7 kg
1 pyi		8 nohzibu
1 basket		16 pyi
1 viss		1.64 kg
1 lb (pound)		0.453 592 kg
1 inch (in.)		2.54 cm
1 feet (ft.)		30.5 cm
1 acre (ac)		0.405 ha
1 hectare (ha)		2.47 ac
1 ac-ft		1233.4 cum

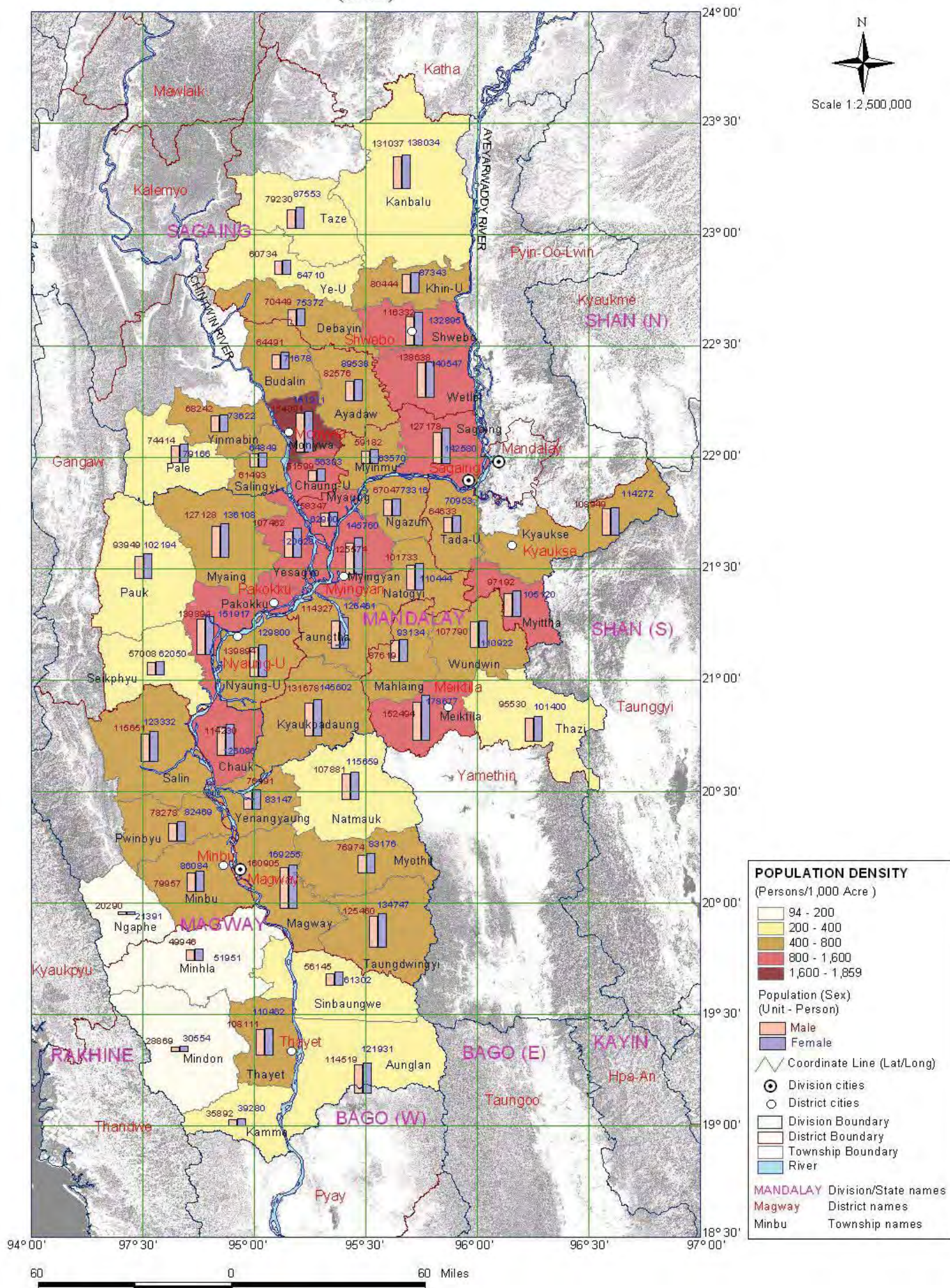
CURRENCY EQUIVALENTS (AS AT JUNE 2010)

1 US\$	=	450.99 Myanmar Kyats (TTB)
1 US\$	=	91.10 Japanese Yen (TTB)
1 Kyat	=	0.202 yen
1 US\$	=	980 Myanmar Kyats (Market Rate)
1 lakh	=	100,000 Kyats

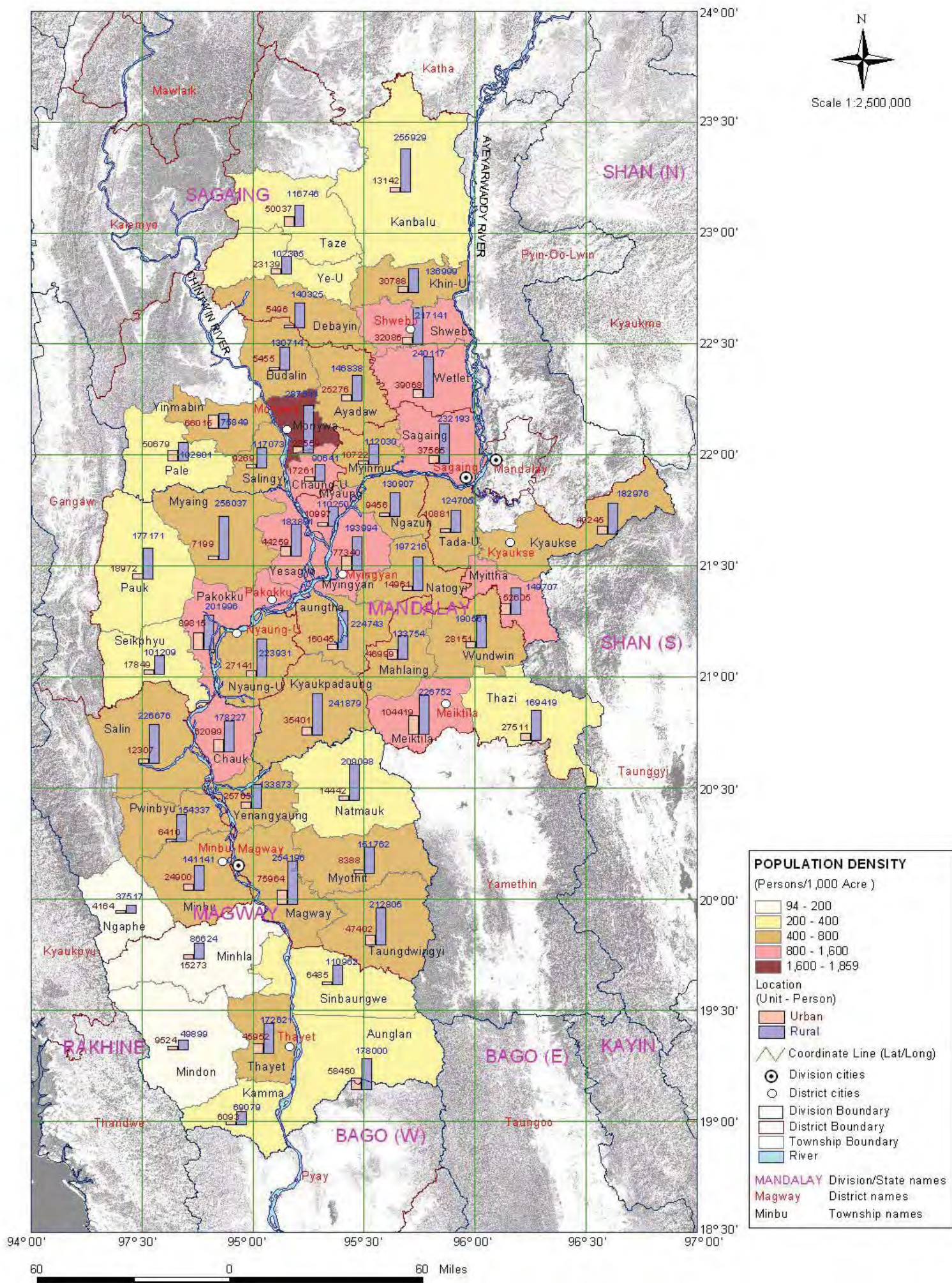
MAP 1.1

Districts and Townships in Central Dry Zone



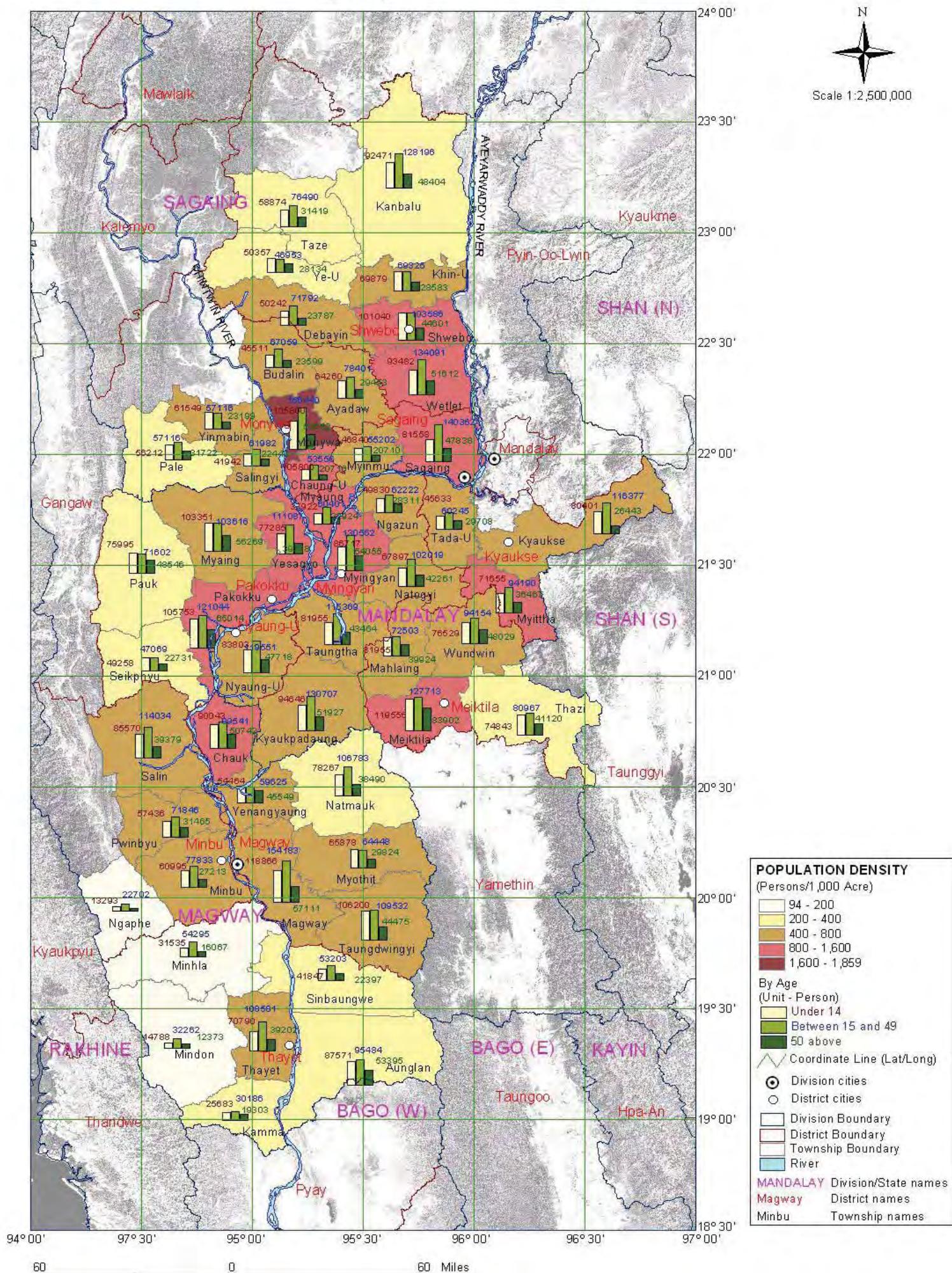


Population Density and its Location (Urban and Rural 2003)

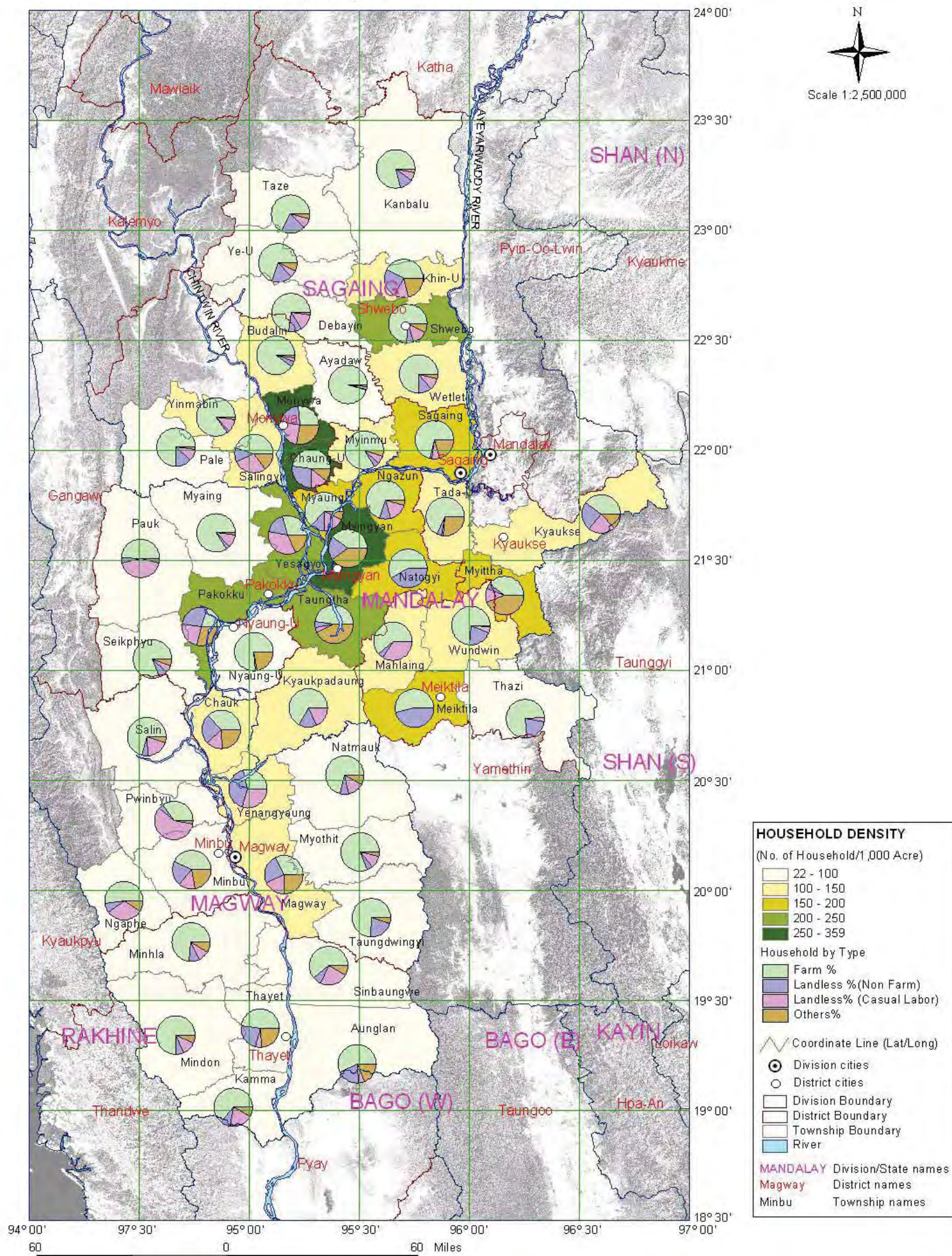


Population Density and its Age Structure (2003)

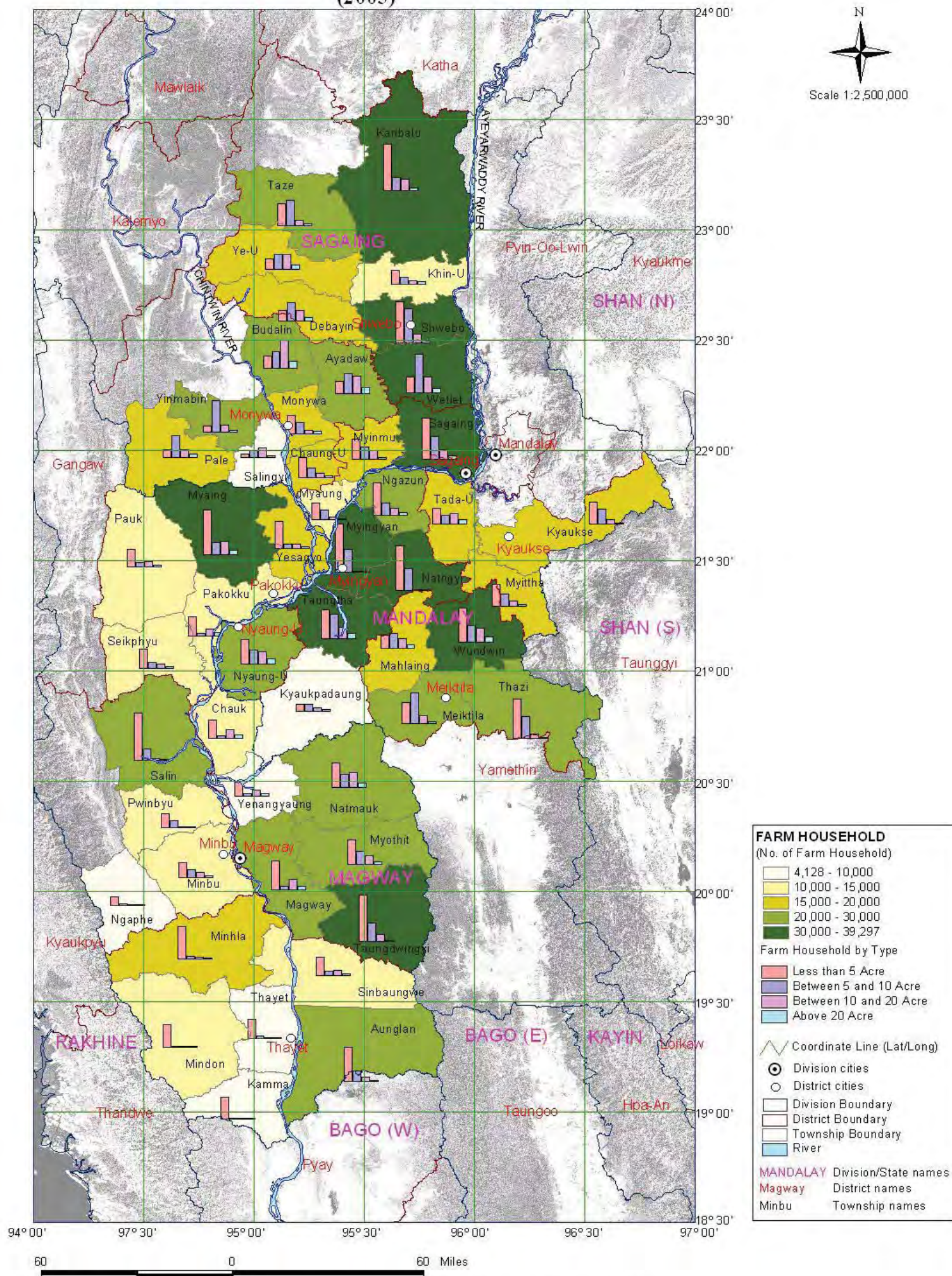
MAP 1.4



Household Density and its Types (2005)



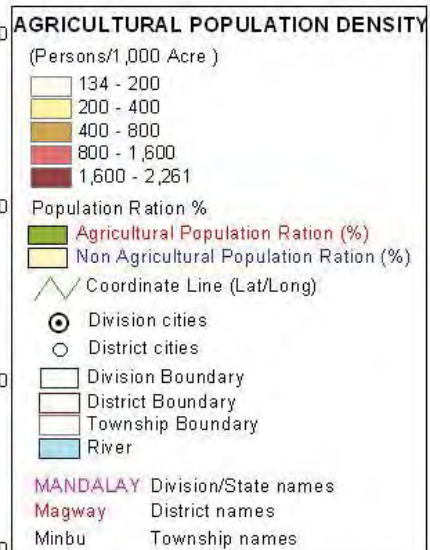
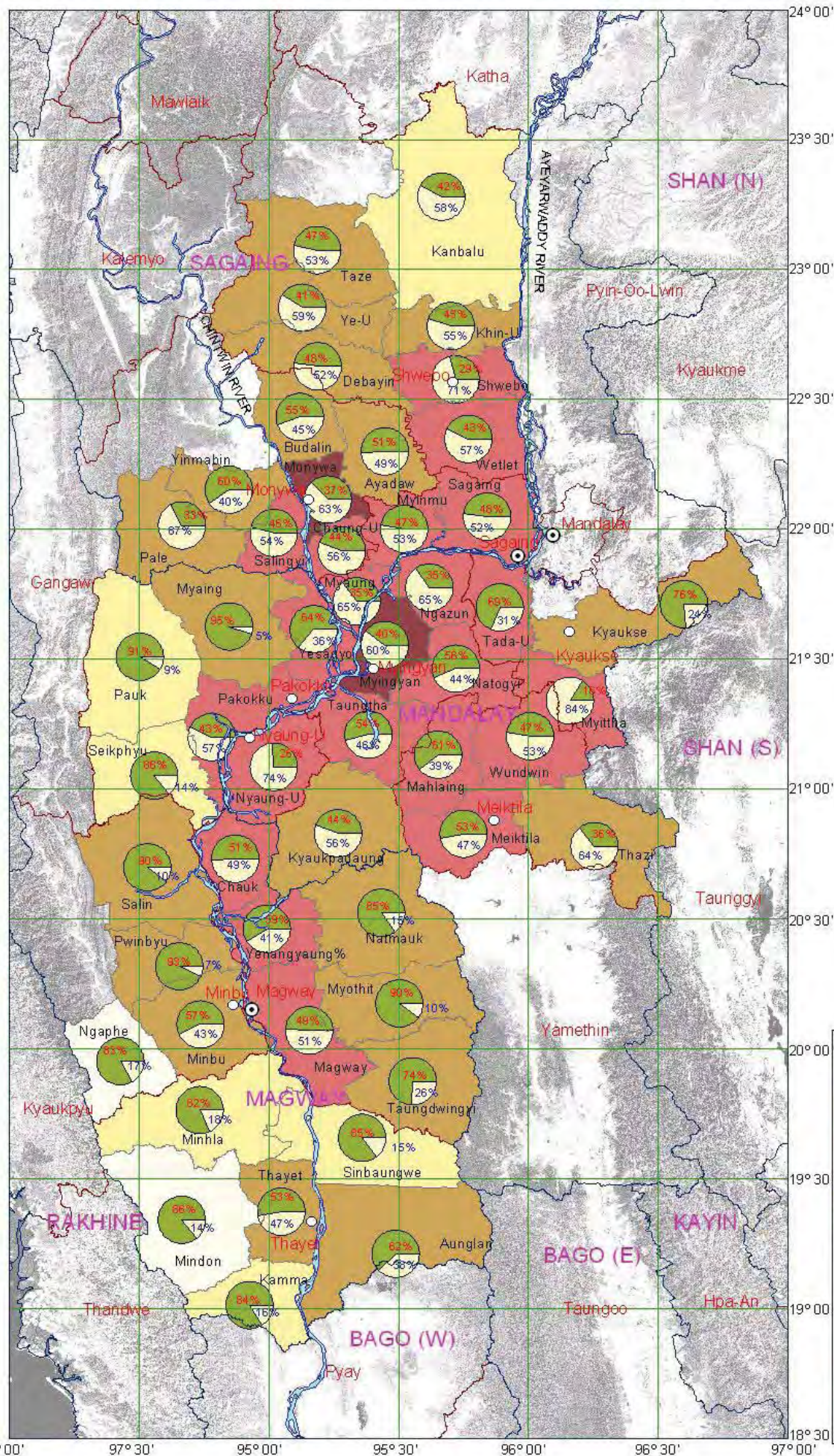
Number of Farm Household and its Farm Size Distribution (2005)



Employment Indicators Distribution of Population by Agriculture and Non-Agriculture (2004)

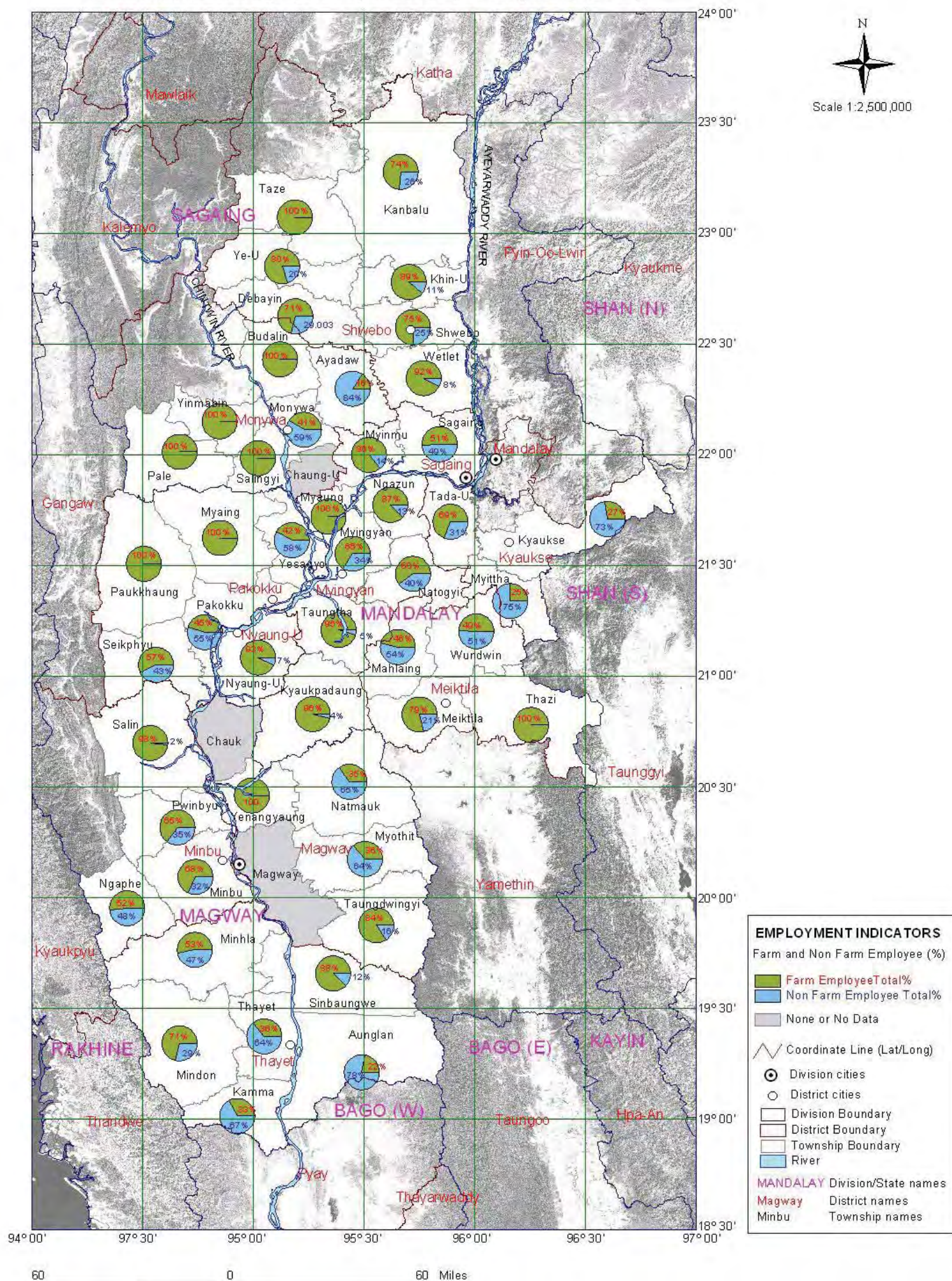


Scale 1:2,500,000

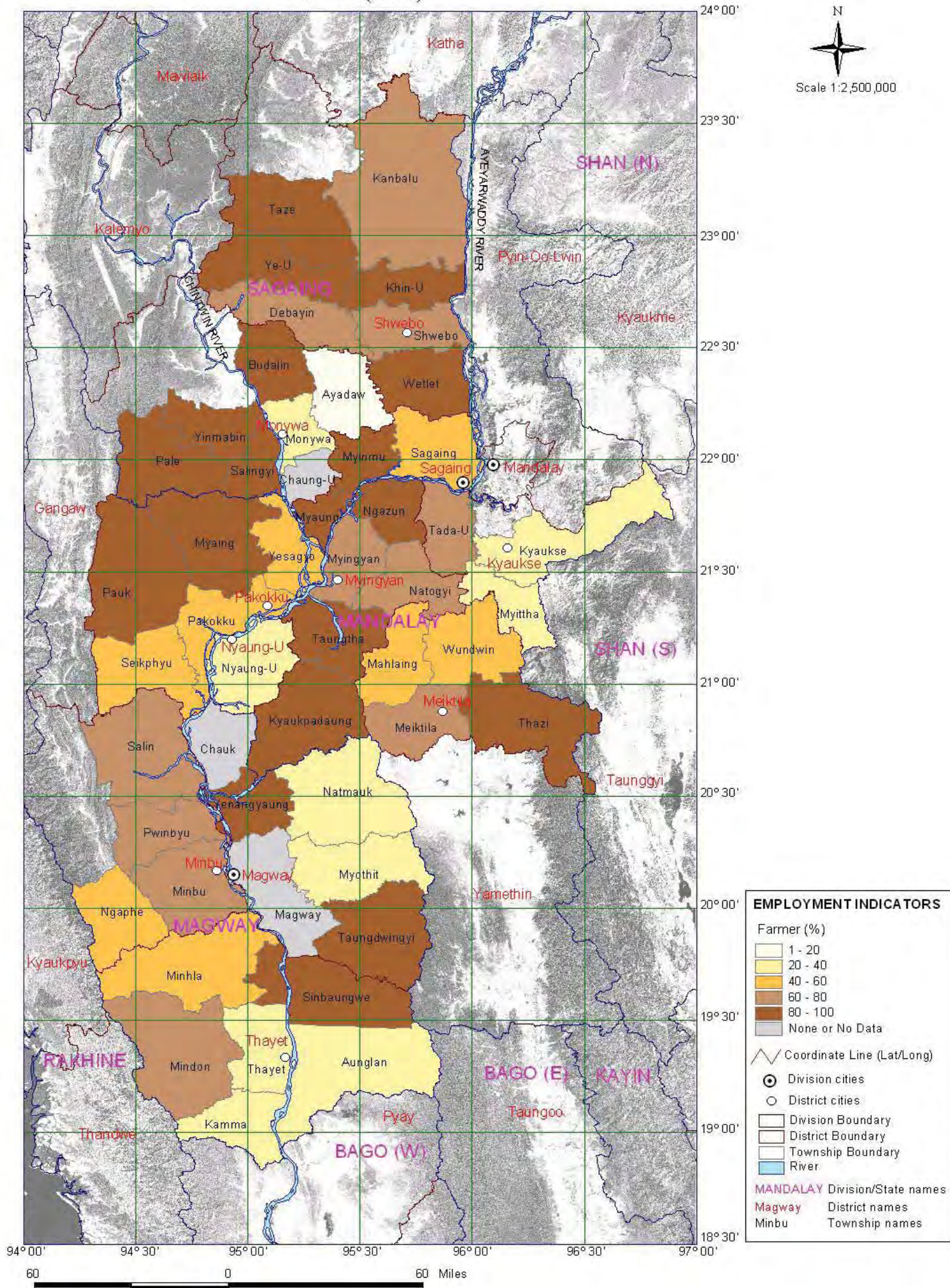


60 0 60 Miles

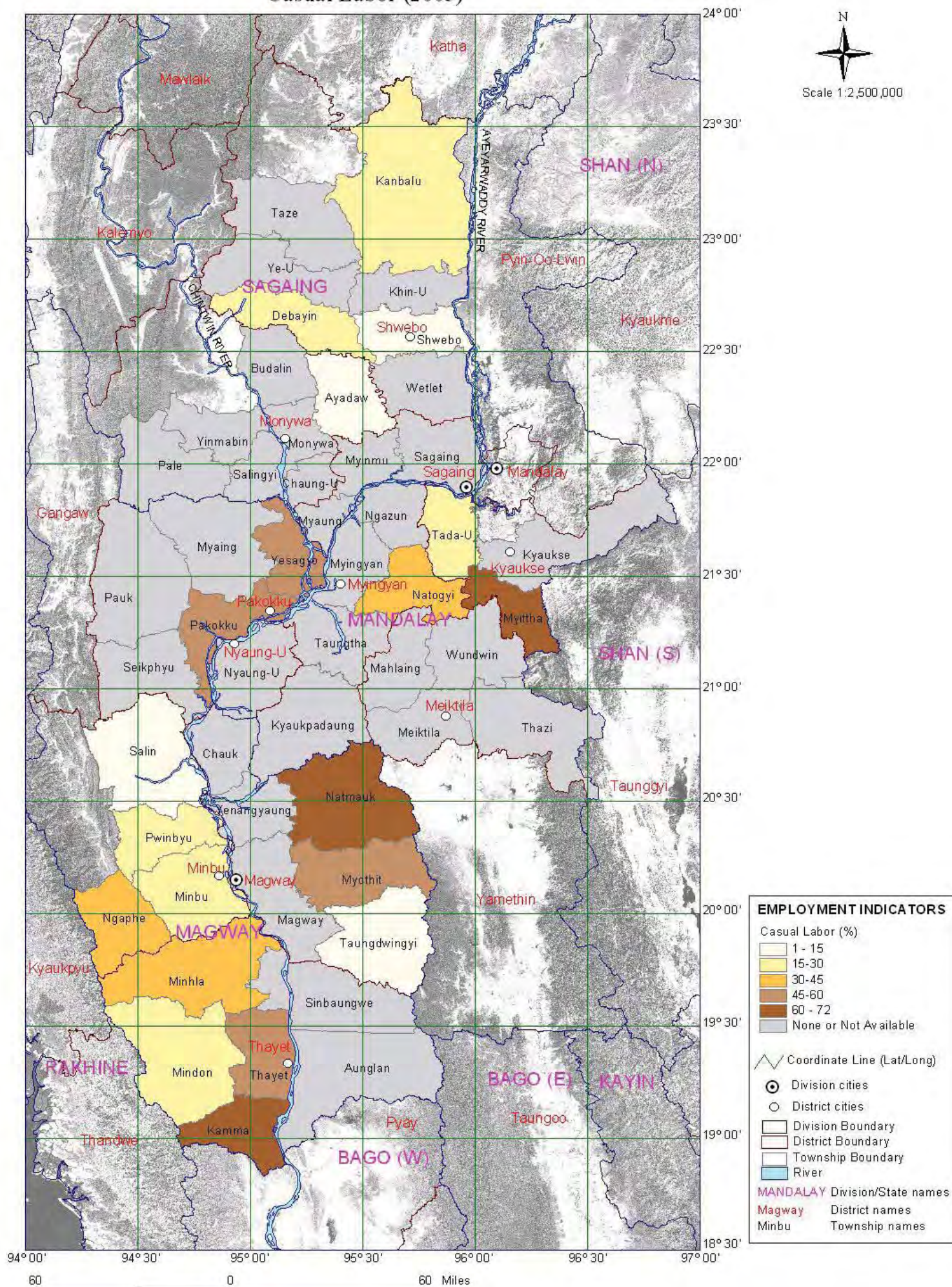
Distribution of Employed Population by Occupation (2005)



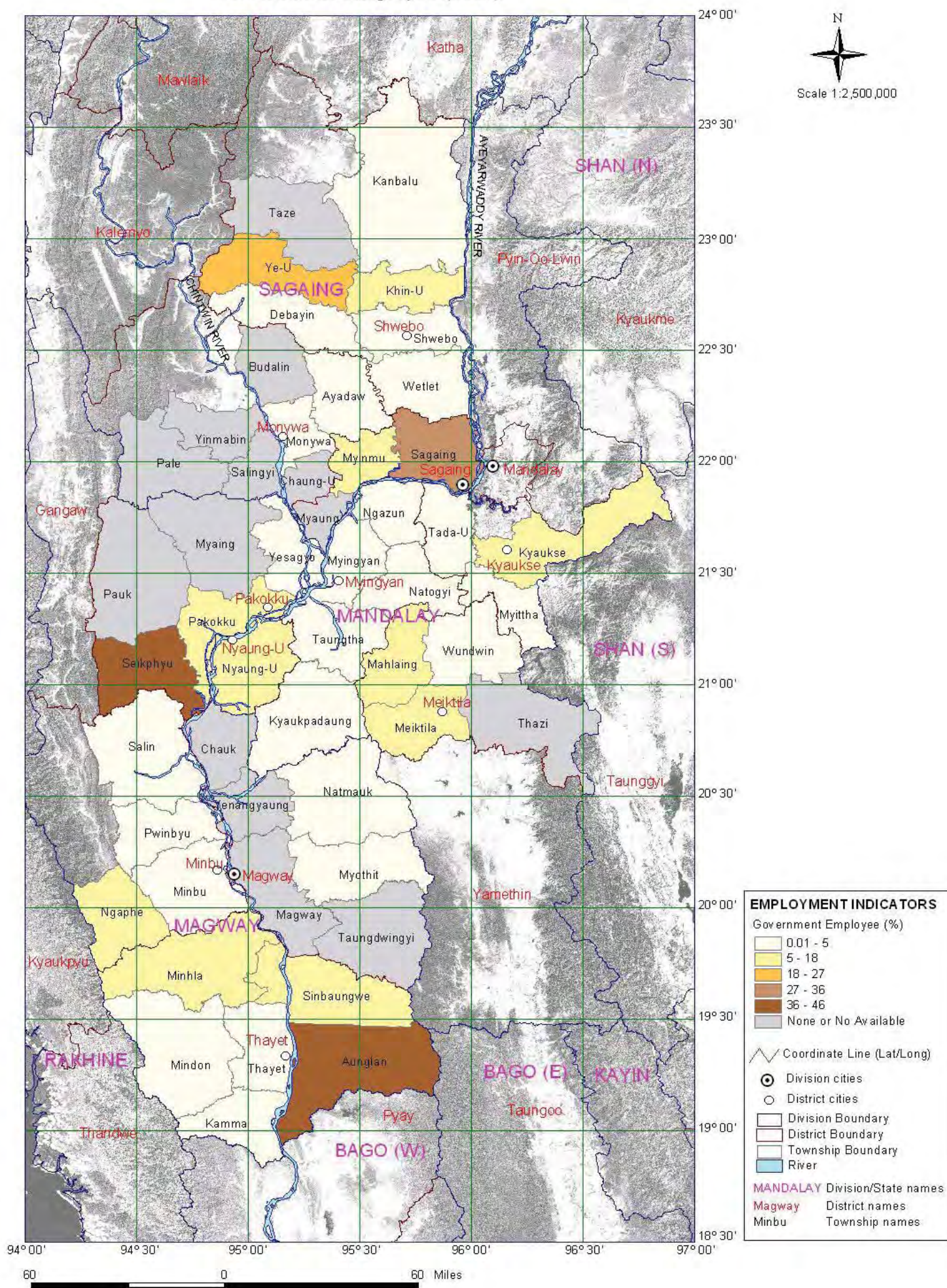
Employment Indicators Farmer (2005)



Employment Indicators Casual Labor (2005)



Employment Indicators Government Employee (2005)



Source: Township Profile, Township Peace and Development Council