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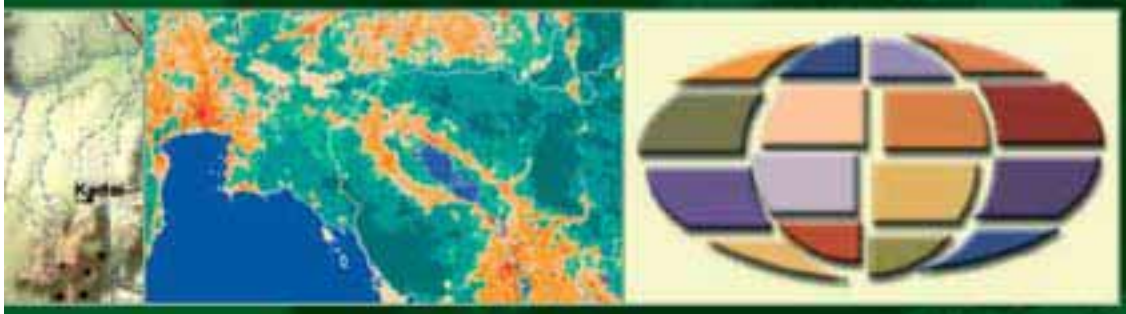
Wood-energy supply/demand scenarios in the context of poverty mapping

A WISDOM case study in Southeast Asia for the years 2000 and 2015



ENVIRONMENT AND NATURAL RESOURCES WORKING PAPER

[GEO-SPATIAL DATA AND INFORMATION] ENVIRONMENTAL MANAGEMENT ASSESSMENT AND MONITORING GLOBAL ENVIRONMENTAL CHANGE

POVERTY MAPPING
GEOGRAPHY OF POVERTY
GEOGRAFÍA DE LA POBREZA
GÉOGRAPHIE DE LA PAUVRETÉ

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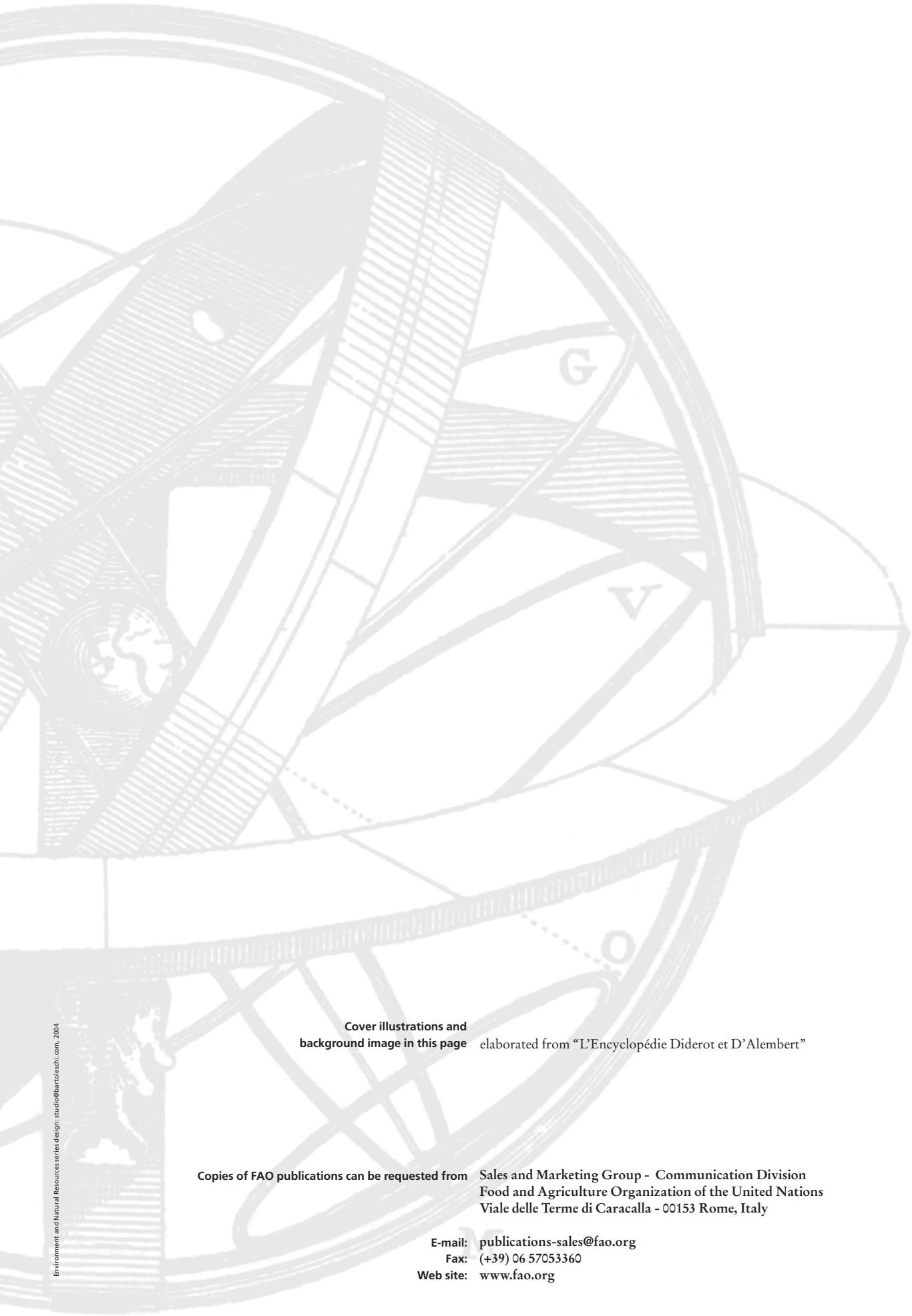

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Wood-energy supply/demand scenarios in the context of poverty mapping

A WISDOM case study in Southeast Asia for the years 2000 and 2015

Rudi Drigo

Environment and Natural Resources Service (SDRN)
Forest Product Service (FOPP)

Food and Agriculture Organization of the United Nations Rome, 2007

The conclusions given in this report are considered appropriate at the time of its preparation. They may be modified in the light of further knowledge gained.

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FOREWORD

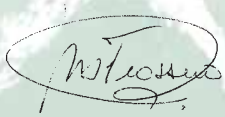
This publication provides policy-makers and project personnel with tools to assess present energy flows and future energy scenarios. It uses a geographic information system to generate and manage data independently of political boundaries, integrating and analysing relationships among socio-economic and environmental variable and facilitates the identification of priority areas and population that deserve greatest attention in efforts to attain the Millennium Development Goals (MDGs). It is also useful in identifying the relevant data needed to analyse poverty alleviation, health issues and wood energy community forest programmes.

Over the years the WISDOM methodology has proven to be a flexible tool for the integrating wood energy data from different sectors. Its application in the Southeast Asia region leads to the mapping of areas where poor socio-economic and subsistence energy supply conditions co-exist, providing an important new dimension to the mapping of poverty.

This study also sets the base for expanded work into other bioenergy sectors besides the world energy field, which can benefit from the GIS analytical environment, building upon the poverty mapping methodologies developed by FAO with support from the Government of Norway.

Future work should incorporate additional data and information on other biofuels, such as energy crops and agricultural and livestock residues, in order to develop and extend the analytical framework to reflect the broader bioenergy sector.

It is hoped this publication will stimulate further analysis related to this topic.



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ABSTRACT

Current (2000) and projected (2015) woodfuel consumption patterns and supply potentials in continental Southeast Asia are analysed and mapped applying the Woodfuel Integrated Supply/Demand Overview Mapping (WISDOM) methodology. Combined with poverty data, the study helps define areas where poor rural and suburban populations that depend primarily on woodfuels for their subsistence energy supply are likely to suffer severe shortages, adding an indicator to the mapping of extreme poverty and a new tool for poverty alleviation policies and forestry and energy development planning.

Integrating several cartographic layers with multi-source field data provides maps of woody biomass stocking and potential sustainable productivity in 2000 and 2015 at a spatial resolution of less than 1 km. Woody biomass consumption maps matching the resolution of supply maps, coupled with likely population distribution in 2015 and model projections of woodfuel consumption, give future consumption scenarios. Combining these yields balance maps of woodfuel deficit and surplus areas.

This study is a starting point for expanding work in the agro-energy sector, which can benefit from the approach, the GIS analytical environment, the additional thematic layers and the nexus with forestry, energy and poverty alleviation issues.

Wood-energy supply/demand scenarios in the context of poverty mapping. A WISDOM case study in Southeast Asia for the years 2000 and 2015

Prepared by Rudi Drigo

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ACRONYMS

30 arc-sec	30" x 30" latitude x longitude grid (approximately 0.9 x 0.9 km pixel size)
BAU	Business-as-usual [scenario]
BEF	Biomass Expansion Factor
BV	biomass of inventoried volume
Ch	charcoal [in Tables]
dbh	diameter at breast height
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO Statistical Databases
FF	Fuel Fraction
FIVIMS	Food Insecurity and Vulnerability Information and Mapping System
FOPP	Forest Product Service, Forest Products and Economic Division, FAO
FRA	Forest Resources Assessment (FAO Forestry Department Programme)
Fw	fuelwood [in Tables]
GEZ2000	Global Ecological Zoning of the FAO Forest Resources Assessment for year 2000
GFPOS	Global Forest Product Outlook Study
GIS	Geographical Information System
GLC 2000	Global Land Cover Map 2000
GLCN	Global Land Cover Network
HH	household(s) [in Tables]
ICIV	*Institut de la Carte Internationale de la Végétation*, Tolouse (now *Laboratoire d'Ecologie Terrestre*)
IUCN	International Union for the Conservation of Nature and Natural Resources
i-WESTAT	Interactive Wood Energy Statistics database (FAO)
JRC	Joint Research Centre of the European Commission
LandScan	Worldwide population database compiled on a 30" x 30" latitude x longitude grid of the Oak Ridge National Laboratory (ORNL) Global Population Project
LC	Land Cover
MAI	Mean Annual Increment
MDG	Millennium Development Goal(s)
MODIS	Moderate Resolution Imaging Spectroradiometer
Pixel	(from "picture element") The smallest unit of a raster map. In this study the pixel size corresponds usually to 30" x 30" latitude x longitude.
RWEDP	Regional Wood Energy Development Programme
SDRN	Environment and Natural Resources Service of FAO Sustainable Development Department
TREES II	Tropical Ecosystem Environment observation by Satellite, phase II (JRC Programme)
UBET	Unified Bioenergy Terminology
UNEP	United Nations Environment Programme
VCF	Vegetation Continuous Field
VEF	Volume Expansion Factor
VOB	volume over bark of trees >10 cm dbh
WCMC	World Conservation Monitoring Centre
WDod	Wood Density (oven-dry)
WFF	Woodfuel Fraction
WHO	World Health Organization
WISDOM	Woodfuel Integrated Supply/Demand Overview Mapping

SUMMARY

The scope of the study was to analyse current woodfuel consumption patterns and supply potentials in the countries of continental Southeast Asia and to map with highest possible resolution different wood energy situations as of 2000 and to project status for 2015, applying the Woodfuel Integrated Supply/Demand Overview Mapping (WISDOM) methodology. In combination with poverty data, the study contributed to the definition of the areas within the subregion where rural and suburban populations living under the poverty line and depending primarily on woodfuels for their subsistence energy supply, are likely to suffer severe shortages. Subsistence energy shortages due to insufficient access to woody biomass add a new important indicator to the mapping of extreme poverty and a new dimension to poverty alleviation policies and programmes.

The study area included Cambodia, Lao PDR, Malaysia, Myanmar, Thailand, Viet Nam and Yunnan Province of China.

The integration of several cartographic layers (land cover maps, ecological zoning, protected areas, etc.) with field data from a variety of sources allowed the creation of maps of woody biomass stocking and potential sustainable productivity at a spatial resolution of less than 1 km. Most recent information on changes in forest area and land cover permitted projection of potential 2015 resources, assuming no major changes in current land use trends.

Similarly, the integration of population distribution maps with fuelwood and charcoal consumption values by sector and by rural and urban areas resulting from the review of a wide variety of sources, allowed the creation of woody biomass consumption maps matching the resolution of supply maps. Similarly, newly developed maps of likely population distribution in 2015 and model projections of woodfuel consumption allowed the definition of future consumption scenarios.

The integration of woodfuel productivity and consumption maps allowed the creation of balance maps showing the areas of woodfuel deficit and surplus. The woodfuel balance was estimated within a defined distance that was assumed as the gathering horizon of poor rural and sub-urban households that cannot afford marketed woodfuels, imported from distance sources, or that live far from market centres. Therefore, a deficit woodfuel supply/demand condition does not necessarily indicate a subsistence energy shortage. It rather means that either these populations can afford marketed woodfuels or alternative fuels, or they are likely to suffer subsistence energy shortages. In this perspective, the links with poverty become highly relevant.

In order to enable combination with other socio-economic parameters, which were available only by administrative units, individual pixel-level values of woodfuel balance were aggregated at sub-national level for a total of 655 administrative units.

KEY FINDINGS OF THE 2000 BASELINE SCENARIO

Figure 1 shows the result of the woodfuel supply/demand balance analysis, providing both a general overview on a total area basis and an estimate for sparse rural populations, reflecting their reliance on local biomass resources for subsistence energy needs, unlike the dense agglomerations that depend primarily on marketed fuels.

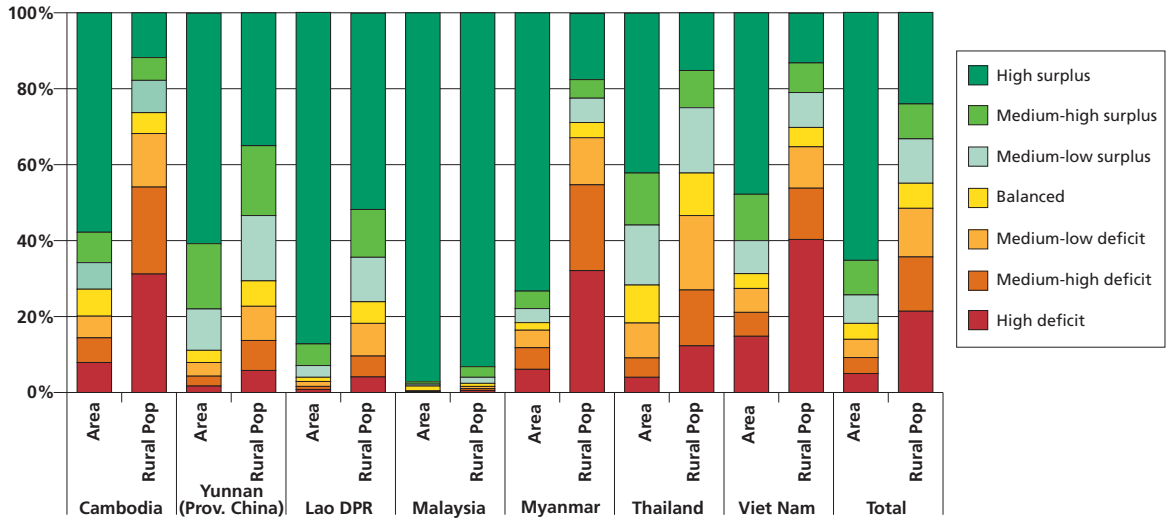
Some aspects deserve highlighting:

- According to the woodfuel supply/demand balance analysis the areas presenting more or less marked deficit conditions covered, in 2000, some 14 percent of the area of the subregion, with country values ranging between 0.4 for Malaysia and 27.4 for Viet Nam.

- From the demographic perspective, the results are far more striking. Besides localized high concentrations, such as rural settlements and urban areas that can be expected to be in high deficit, results showed that, overall, almost half of the sparse rural population (less than 2000 inhabitants per km²) live in deficit areas.
- Of these sparse rural populations, 35 percent – i.e. 45 million people – live in areas with acute deficit conditions, comprising 27 million people in high deficit conditions and 18 in medium-high deficit conditions.

FIGURE 1

Distribution by country area and by sparse rural population of woodfuel supply/demand balance categories for 2000



KEY FINDINGS OF THE 2015 SCENARIOS

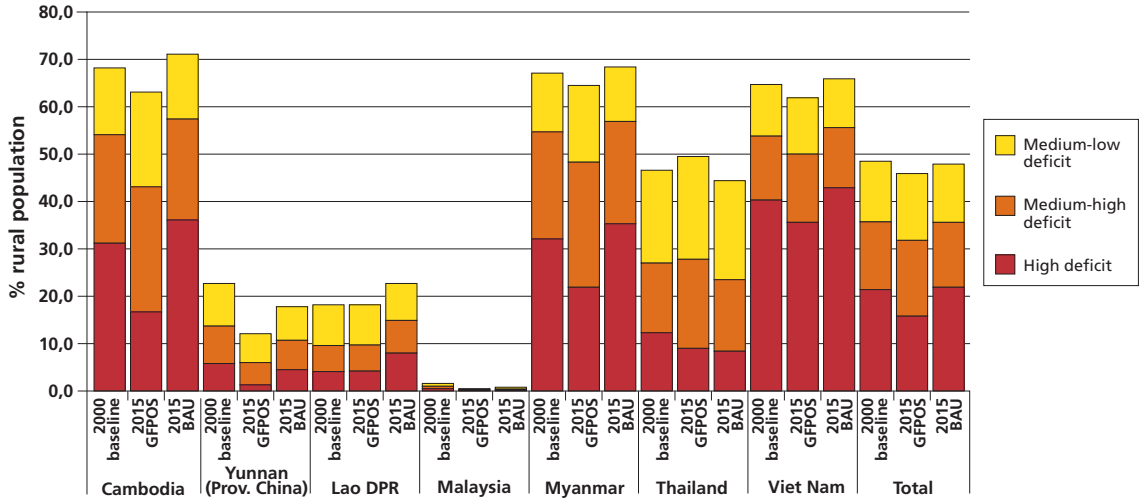
One of the most telling results of the analysis is the summary in Figure 2, which shows the distribution of sparse rural population in woodfuel-deficit areas as estimated for 2000 and as projected for 2015 based on two alternative scenarios. The following are worthy of note:

- According to the most likely scenario, the GFPOS-trend scenario, based on the consumption trends estimated in the FAO Global Forest Products Outlook Study (GFPOS) (FAO, 2001a), which assumes a general reduction in fuelwood consumption and a relative increase in charcoal consumption, 45.9 percent of the subregion's sparse rural population (56.8 million) will live in deficit conditions. Out of this population, over 39 million will face acute deficiencies (high to medium-high deficit areas). This represents a slight improvement with respect to the 2000 situation, but nevertheless it is clear evidence of how important and persistent the problem of woodfuel supply is likely to remain in the medium term for large segments of the population, especially rural and peri-urban poor.
- In the business-as-usual (BAU) scenario, which assumes constant per capita consumption rates, the sparse rural populations living in deficit areas will be very close to that estimated for year 2000, with over 59 million people living in areas with a negative supply/demand balance. Of these populations, 44 million will live in areas of acute deficiency.

- At the same time, it is estimated that a consistent fraction of the rural population lives in areas of high to medium-high surplus: 36 percent for the GFPOS-trend scenario and 34 percent for the BAU scenario. In these areas, the untapped (or unmanaged) sustainable production potential represents an accessible resource for poverty alleviation and socio-economic development.

FIGURE 2

Distribution of rural population by deficit woodfuel supply/demand balance categories in 2000 and in 2015 according to the GFPOS and BAU scenarios



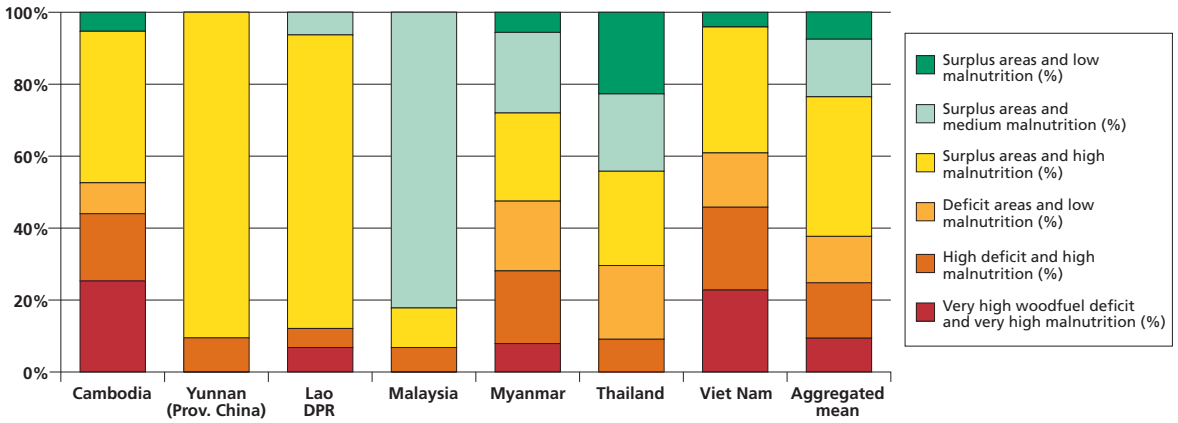
WOOD ENERGY AND POVERTY

Supply/demand balance maps depicting the situation in 2000 were combined with poverty-related indicators in order to group the population of the countries into categories determined by the combination of woodfuel availability and poverty. Due to lack of projected poverty parameters, this analysis was possible for only the 2000 data set. Results of this analysis (Figure 3) showed that, in 2000:

- Approximately one-quarter of the entire population of the subregion (rural and non-rural), i.e. some 66 million people, lived in concomitant conditions of poverty and woodfuel deficit.
- Almost one person in ten, i.e. some 25 million, lived in conditions that might be considered critical due to the interaction of worst conditions of woodfuel scarcity and poverty.
- Cambodia and Viet Nam were the countries appearing more vulnerable, with over 40 percent of the entire population facing malnutrition and woodfuel deficits, of which half faced critical conditions (concomitance of high to critical malnutrition and high to critical woodfuel deficit).
- Myanmar's situation appeared less critical, with some 28 percent of the population in the poverty/deficit zone, one-quarter of which faced critical conditions for both woodfuel supply and malnutrition.
- All other countries presented only pockets of poverty and deficit conditions, either due to better nutritional parameters (Thailand) or better biomass resources (Lao PDR, Malaysia, Yunnan).

FIGURE 3

Distribution of total country populations by woodfuel supply/demand balance categories and malnutrition status (estimates for 2000 baseline)



STRATEGIC PLANNING TOOL

WISDOM, and its various components, is a useful tool for strategic planning at regional, national and local policy levels. Its power is in its geographical and statistical data, which can support Geographical Information System (GIS) analysis for specific areas or can be combined with new thematic layers and thus assist strategic planning in new contexts and thematic perspectives. The maps and statistics included in the report are meant to describe the data and results considered to be of major relevance, but they far from exhaust the informative and analytical power of the underlying data set.

More than just a tool for wood energy specialists, the WISDOM environment supports the identification of vulnerable populations and ecosystems that require the attention of policy-makers. While designed for wood energy planning, the methodology can be applied to other sectors and serve for analysing alternative development scenarios in energy, agriculture, forestry and other macro-economic development plans.

The thematic layers produced in the study represent the beginning rather than the conclusion of an analytical process. They may, and hopefully will, support further level of analysis at both lower and higher geographical levels.

At lower levels, i.e. national and sub-national, they can serve as the basis for WISDOM analyses aimed at supporting and guiding policies on poverty alleviation within the perspectives of energy, forestry and rural development.

At higher levels, i.e. regional and global, they can provide qualified reference to regional and global wood energy mapping and contribute to poverty mapping in the framework of Millennium Development Goals (MDG) initiatives. In a wider context, the maps produced can provide useful references for other activities associated with international conventions, such as those on Climate Change, on Biological Diversity and on Desertification.

ACCURACY AND DATA RELIABILITY

Due to the lack of a single reliable data source on woody biomass and woodfuel consumption, this activity required the integration of information coming from a wide variety of sources, including data of undetermined reliability, and the assumption of subjective estimates to fill specific data gaps. Consequently, the maps produced in this study represent best approximations based on available data, to be used for the definition of priority zoning and strategic planning, rather than for operational planning, which requires reliable quantitative estimates. However, in spite of its approximation, this first definition of surplus and deficit areas provide a new and important insight on this sector and considerably circumscribes the areas requiring immediate attention and intervention, thus reducing the cost and enhancing the effectiveness of additional data collection and verification.

RECOMMENDATIONS

To improve on the accuracy of the analysis and at the same time to build on the knowledge developed in this study in relation to MDG, the following activities are recommended:

- Implement national WISDOM analyses, particularly in the geographical areas defined as higher priority in the present study.
- Improve supply scenarios at subregional level by
  - improving the estimation of woody biomass resources and sustainable productivity, with particular attention to the non-forest land uses that are important, but undocumented, sources of woodfuels;
  - undertaking Geographical Information System (GIS) studies in order to estimate physical accessibility of supply sources; and
  - assessing and mapping the production by forest and wood industries of residues suitable for energy use.
- Improve demand scenarios at subregional level, with particular attention to fuel substitution trends in different sectors and areas.
- Analyse interrelations between woodfuel scenarios and likely poverty and malnutrition situations in 2015, based on projected poverty-related socio-economic parameters, in order to define priority areas for action within the 2015 time frame for sustainable wood energy systems and poverty alleviation.
- In critical areas, measure and evaluate the interaction among woodfuel supplies, poverty levels, health and nutritional conditions.
- Take decisive multisectoral action (investigation and mitigation) in critical areas without awaiting further study results, since many of the results achieved appear adequate to identify urgent needs.

In addition, this study provides a starting point for expanding work in the agro-energy sector, which can benefit from the approach, the GIS analytical environment, the additional thematic layers and the nexus with forestry, energy and poverty alleviation issues.

It is therefore recommended that the WISDOM analytical framework be systematically enhanced to incorporate additional data and information on other biofuels, including energy crops and agricultural and livestock residues, in order to develop and extend the applications to reflect the broader bioenergy sector.