FAO/TCP/4453

LAO PEOPLE's DEMOCRATIC REPUBLIC

ENVIRONMENTAL POLICY PLANNING FOR SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT TO THE YEAR 2010 IN LAO PDR

(Volume I: Main Report)

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome December 1996

ACKNOWLEDGEMENTS

This report is the documentation of the joint efforts and labours put in by a group of national consultants positioned by the Government of Lao PDR through the Science, Technology and Environment Organization (STENO) and the international consultants fielded by the Food and Agriculture Organization of the United Nations under the TCP/LAO/4453 project. Essentially this volume, entitled 'Main Report' is a synthesis of the work carried out by six consultants in the areas of Resources, Agriculture and Livestock, Forestry, Social Dimensions, Legal/Land Tenure and Environmental Impact. The Mission Leader has drawn heavily upon the materials provided in the documentation of the work of those who participated in the mission, in shaping up this report on the framework set. Every effort has been made to capture the concepts, observations and findings presented in the respective areas of the consultancies. Articulation of the concepts and full reflection of the observations and analysis can be found in the documentation of the work done by the consultants which is set as annexures constituting Volume II of the mission report.

Given the short period of the mission, the members had to rely upon data and information on the work done by many agencies and individuals, national and international as well. All possible care has been taken in integrating the data from different sources. Yet some shortcoming must have crept to which the mission alone is responsible. The Mission gratefully acknowledges the support, intellectual and physical, extended to it by the various agencies and departments of the Lao PDR, international organizations and non-governmental organisation, visiting missions in fulfilling the commitments expected of mission. The Mission in particular wishes to place on record its grateful appreciation to the National Project Coordinator of the Project and Deputy Director of the STENO and his colleagues for extending the all possible cooperation in facilitating the work of the mission by providing the physical environment, and to the FAO Representative and the staff at the Representation for rendering all support services, but for which it would not have been possible toaccomplishwhat it has achieved.

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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
APB	Agricultural Promotion Bank
CPC	Committee on Planning and Cooperation
DOAE	Department of Agriculture and Extension
DOF	Department of Forestry
EAP	Environmental Action Plan
EMP	Environmental Management Plan
FAO	Food and Agriculture Organization of the United Nations
FIMC	Foreign Investment Management Committee
GDP	Gross Domestic Product
GOL	Government of Lao People's Democratic Republic
HYV	High Yielding Varieties
IPM	Integrated Pest Management
MAF	Ministry of Agriculture and Forestry
MOU	Memorandum of Understanding
NEM	New Economic Mechanism
NGO	Non Governmental Organizations
PAFSs	Provincial Agricultural and Forestry Services
PDR	People's Democratic Republic
PIP	Public Investment Programme
SARD	Sustainable Agriculture and Rural Development
SIDA	Swedish International Development Agency
STENO	Science Technology and Environment Organization
UNCED	United Nations Commission for Environment and Development
UNDP	United Nations Development Programme
WUG	Water user group (of irrigation projects)

Physical Measures

ha	Hectare
kg	Kilogram
km	kilometer
mm	millimeter
m	meter

CURRENCY EQUIVALENTS

As on **December 1995** US$1 = **940** kip

Fiscal year October 1-September 30

Agricultural year July-June

1. THE SETTING

1.1 Country richly endowed in natural resources

The Lao People's Democratic Republic (PDR) is richly endowed in natural resources. Much of the land receives moderate to high rainfall ranging from 1500 mm to 4000 mm per annum. Being located in the lower latitudes (14°-22° North latitude), the country enjoys tropical to subtropical climate with high incidence of sunshine which fosters high rates of photosynthetic activity. Soil in most parts of the country has reasonable depth. All these endow the country with high degree of biomass production potential. Close to one half of the geographic territory is under natural forests and two fifths of the land is under perennial vegetative cover. Only 4 per cent of the land is permanently under cultivation to which 3 per cent under shifting cultivation may also be added. The hydropower potential is estimated at 22000 mv of which only 200 mv have been utilised. The population of 4.5 million in 1992 (4.6 million in mid 1995) with a density of 19 persons per km^2 is small for a country with a geographic area of 236,800 km^2. Each Lao PDR citizen has access to over 5 hectares of land resource for sustenance which is one of the highest in the region[1].

1.2 Least developed status

Notwithstanding these apparently abundant resource endowments Lao PDR is one among the Least Developed Countries (LDCs) with a per capita nominal GDP of USS 335 (1994) or 240530 kip at the official exchange rate of 718 kip to a USS). Among the comity of 174 nations, the country is ranked 138 with the Human Development Index (HDI) of 0.460. The average life expectancy at birth of a Lao PDR citizen was just 51 years in 1992[2] with a crude birth rate of 45.2 and crude death rate of 15.2 per thousand population for 1992 (UNDP 1995a). Nation's food security is precarious. In normal years the production is enough to meet the basic requirements. But the consequence of aberrations in weather, floods as well as droughts whose visitations are more often than otherwise, render production levels highly fluctuating[3]. Limitations imposed by geography (land-locked country) and the restraints dictated by the history of the recent past, have failed in unleashing the productive forces and utilising the country's potentials. Apart from these, there are other constraints which are likely to perpetuate the low development status of the nation which should/are causing concerns.

1.3 Constraints perpetuating low development

First, country's population growth of 2.9 percent[4] with the prospect of doubling the population in 2015 AD[5] is one of the highest in the region. At the current rate of agricultural production[6] and manner of resource use and management, the sustainability of even the present low level of living standards, let alone the prospect of improvement, is in jeopardy[7] because much of the agronomically suitable lands (wetland paddies) has been used up and the communities, in desperation, are increasingly resorting to environmentally degrading resource management practices such as shifting cultivation and cultivation to vulnerable lands[8].

1.4 Heavily natural resource dependent economy

Second, country's economy is heavily dependent on the natural resource base. Almost two thirds of GDP is natural resource origin[9] so that two fifths of the exports[10]. Livelihood security for the vast majority of the population through employing 85 percent of the work force is found in the utilisation of natural resources for cropping, livestock rearing, fishing and forestry activities.

Third the population pyramid (See Section 2.9.1) is heavily skewed in favour of younger population age groups who will have to be supported with jobs for ensuring livelihood security. If other sectors of the economy does not achieve commensurate expansion and economic growth, the natural resource base of the country would have bear additional pressure, than the natural growth in population would have normally resulted.

1.5 Natural resources supported development

Given the backlog in development vis-a-vis its neighbours in the region, the constraints imposed by geography (land-locked country) and the opportunities denied through history, the country has to depend upon the natural resource base, at least in the immediate future, not only for ensuring livelihood security for its fast expanding population in the immediate future but also to build up the foundations for a leap into the 21st century. It will also provide the breathing time to stabilise population to the carrying capacity. The natural resource base of the Lao PDR has the potential in terms biomass production that can be transformed into various products of economic value irrespective of the form, be they crops, livestock, fish, timber, wood and industrial raw materials such as pulp, and to which may be added the enormous hydropower potential. The essential pre-requisite however, is to ensure the sustainable use of the natural resource base through scientific management and environmentally sound interventions.

1.6 Natural resource base under stress

Signs of stress on the natural resource base are already in evidence. Much of the terrain is unsuitable for cultivation due to fragile soils and steep slopes. Yet cultivation is being expanded on to these lands by the expanding population for sustenance especially subsistence food, predominantly rice but other crops as well, thereby denuding the natural vegetative cover and rendering such lands increasingly vulnerable to erosion. Decline in the fallow period of lands under shifting cultivation from 20-30 years to 6-10 years and even less which reduces the productivity of an otherwise sustainable practice, and thereby necessitating the opening up of vegetated lands is yet another symptom. The expanding need for revenue as well as foreign exchange is exerting increasing pressure on forest resources, forcing the system to extract wood resources nearly double than what is acknowledged as sustainable (Section 3.4.7)

1.7 Resource degradation engaging attention

These concerns are engaging the active consideration of the Government of Lao PDR especially after the commencement of the New Economic Mechanism as reflected in the pronouncements and initiatives of the recent times (See Section 6.1).

1.7.1 The new Constitution, adopted in 1991, made every citizen duty bound to protect the environment and natural resources by stating:

> All organizations and citizens must protect the environment and natural resources: land, underground resources, forests, fauna, water resources and atmosphere.

1.7.2 The 1993 Socioeconomic Development Plan went beyond the notion of environmental protection and stressed also the need for 'sustainable exploitation of natural resources for complementary development of agriculture, forestry, energy, industry trade, communication of transport sectors, while taking care not to degrade or deplete the rich natural assets of the country'.

1.8 Shifting the development base

The need for reducing the dependence on natural resources for economic development is found recognition in the Socioeconomic Development Plan to the Year 2000 (SDP 2000) adopted by the National Assembly in March 1993 while proposing 'to transform and diversify an economy largely based on natural resources while maintaining macroeconomic stability, pursuing economic growth and ensuring that the equitable distribution of the benefits significantly raises the living standards of all population groups'.

1.9 Environmental concerns gain momentum

The Government of Lao PDR for some years have been giving greater emphasis arresting the serious problems of deforestation and environmental degradation caused by shifting cultivation and uncontrolled logging. In recent times, other environmental issues have also been the subject of increasing concern: the need to conserve the country's rich biodiversity; halting degradation in watersheds already exploited for hydro-power and developing guidelines and regulations for watershed conservation in future large-scale hydro-power development; introducing regulatory procedures and laws to stem the growing pollution from largely foreign-controlled industries, including garment, forestry and agro-industries; and reducing food contamination. Strenuous efforts have been made to mobilise resources and international support in understanding the various dimensions of these concerns and identifying measures in mitigating the adverse impacts on the sustainability of the resource base.

1.10 Environmental reviews

1.10.1 The United Nations Conference on Environment and Development (UNCED) in its Country Report in 1992 attempted a comprehensive overview of the environmental management of the natural resources in the country[11]. This overview, against the backdrop of past development trends, resource endowments and their use, identified the environmental and social issues; reviewed the policies and strategies in natural resource management, institutional capability and programmes in natural resource development and environmental management; and indicated the planned environmental initiatives. The development potentials identified include the vast scope for hydroelectric power generation from abundant water resources, increased agricultural productivity through irrigation, increased animal

production to meet the demand in neighbouring countries, sustained development of forest industry through improved resource management and reforestation, export of non-wood products such as cardamom, benzoin, sticlac and other resins and mining new minerals for export. The critical development constraints identified are, the economic and social fragmentation due to physical isolation; subsistence level of farming; insufficient physical infrastructure; inadequate data base on resources, technologies, markets, and investment opportunities; limited domestic financial resources; lack of skilled man power; and sufficient institutional capacity to support a growing economy.

1.10.2 Lao PDR is a signatory to the Rio Declaration of Environment and Development of the Earth Summit and is committed to the implementation of Agenda 21 of the United Nations Programme of Action from Rio.

1.10.3 The World Bank in its Environmental Overview in 1993 identified and articulated the key environmental issues related to: forestry and forestry resources; biodiversity conservation; land resource managements; water resource management, industrial development, mining development and infrastructure development. Inter alia, it addressed the requirements for institutional strengthening including institutional capacity building and regulatory framework[12].

1.10.4 The Science, Technology and Environment Organization (STENO) of the Government of Lao PDR with World Bank assistance and in collaboration with the concerned sectoral ministries prepared an Environmental Action Plan (EAP) in 1993[13]. The EAP provided a broad institutional and policy framework to ensure resource conservation while promoting sustainable social and economic development. Implementation of the EAP will entail establishing appropriate institutional mechanisms and setting in motion the process for involving the government and society at large in incorporating environmental planning and management into wider social and economic development.

1.10.5 Given its mandate for environment matters STENO is to take the overall lead but concerned line ministries, particularly the Ministry of Agriculture and Forestry (MAF) as well as Ministries of Education, Trade, Industry and Handicrafts (which deals with forest-and agroindustries), and Public Health (which is responsible for food contamination problems), would take the initiatives in their relevant spheres of involvement. It is intended that STENO, in collaboration with the Committee for Planning and Cooperation (CPC) and relevant sectoral ministries, would further develop the individual components of the EAP with a view to incorporating precise components on environmental issues into the national development plan and the work programme of the sectoral ministries[14].

1.11 The project context

Most of the recent or on-going activities dealing with environmental and sustainable agriculture and rural development (SARD) issues have been sub-sectoral or have addressed limited problems, often in a piece-meal fashion. Only the EAP has a broad approach. However this is largely sectoral and does not address the interrelationships or possible conflicts and trade-offs between the different sectors or sub-sectors. The sections of EAP dealing with agriculture and forestry are brief and give greater emphasis to environmental conservation aspects rather than the promotion of sustainable production and natural resource use and management of rural communities. In general, environmental policy and strategy work does not deal adequately with agricultural problems while

agricultural policies and planning do not take sufficient account of environmental and sustainability considerations. The Government now gives priority to drawing up a comprehensive strategy for SARD that also takes into account environmental issues. The process of preparing such a strategy would involve identifying gaps and priorities, and designing specific proposals for action to remedy these gaps while complementing and building on existing achievements, knowledge and experience. It was felt that the development of such an EAP/SARD is timely not only in follow-up to the EAP but also because the sectoral ministries are in the process of further elaborating sectoral plans to put into effect the overall policy guidelines and targets in the SDP 2000. Since further work on these sectoral and subsectoral plans were still underway STENO underlined the need for urgent assistance in incorporating SARD considerations into the planning process at this stage, before being finalised.

1.12 The project

In view of FAO's experience in undertaking work in the area of SARD and its mandate for the Agriculture-related chapters of Agenda 21, the Government of Lao PDR requested assistance from FAO's Technical Cooperation Programme (TCP) to develop an Environmental Action Programme for Sustainable Agricultural and Rural Development EAP/SARD, elements of which would subsequently be incorporated into the national development plan. In response the FAO agreed to provide support under the project Environmental Policy and Planning for Sustainable Agriculture and Rural Development (TCP LAO/4453) in developing an Environmental Action Programme for Sustainable Agriculture and Rural development (EAP/SARD) to the year 2010 comprising of:

(i) an analysis of the policy, technical, socioeconomic, legal and institutional issues affecting the various agricultural sub-sectors, including intra-and inter-sectoral inter-relationships and possible conflicts and trade offs, with recommendations as appropriate; and

(ii) detailed environmental action programmes for key agricultural sub-sectors, taking account of sub-sectoral and inter-sectoral collaboration where appropriate, which will include an analysis of issues and proposals for concrete follow-up action including specific project ideas and allocation of government resources;

1.13 The output

This (draft) document entitled 'Environmental Action Programme for Sustainable Agriculture and Rural Development to the Year 2010 for Lao PDR' is the outcome of the joint efforts undertaken by a team composed of national experts assembled by the STENO on behalf of the Government of Lao PDR, and international experts fielded by the FAO undertaken during January to December 1995. This document integrates the observations, analyses, inferences, conclusions and recommendations contained in reports on land resources, agriculture including livestock, forestry, sociology/ anthropology, legal/land tenure dimensions, and environmental dimensions prepared by individual consultants. Review of the existing literature, extensive discussions with officials of the departments and agencies of the Government of Lao PDR, international agencies including multi-lateral and bilateral, NGOs national and international, engaged in research and development of the use and management of the natural resources and environment in the country, visits to related institutions and projects, and experience and knowledge of the individual experts constitute the information base for drafting these documents. The document is to be wetted by the participants at a National Workshop scheduled for early March 1996.

1.14 The structure of the document

The documentary outputs of the project is presented in two Volumes. The first volume constitute the main document entitled 'Environmental Policy Planning for Sustainable Agriculture and Rural Development to the Year 2010 for Lao PDR' This document is divided into seven sections. In Section 1, the development and policy context against which the project was designed is set out. An overview of the environmental resource base in Section 2, and their current use and management in Section 3 are presented. Macro economic as well as sectoral policies are reviewed and their implications to the sustainability of environmental resources and SARD are analysed in Section 4. In Section 5 the framework in developing a diagnostic approach for analysing the SARD issues with respect to the environmental resources is articulated. Applying the diagnostic approach evolved, the emerging potentials and constraints of the environmental resource base in the context of SARD in the medium term to the year 2010 AD are identified and possible strategies and mitigation interventions are indicated in Section 6. Finally in Section 7, interventions primarily on the part of the government through policies and enabling mechanisms for institutionalising them, and programmes for translating them into action, in promoting SARD are recommended. Volume two constitutes the documentation of the information gathered, observations made, conclusions drawn and actions recommended by of the individual consultants as laid out in Annexures 1-6.

2. ENVIRONMENTAL RESOURCE BASE

2.1 Location

Lao PDR is one of the three nations in the Indochina Peninsula constituting the upper left quarter lying within 22°30' and 20°21' North latitude and 100° 06' and the 107° 88' East longitude (See Map 1). It is a land locked country. The country is bordered on the north by the People's Republic of China for 416 km, on the east by the Socialist Republic of Vietnam for 1957 km, on the south by the Kingdom of Cambodia for 492 km, on the west by the Kingdom of Thailand for 1 730 km and on the north west by the Union of Myanmar for 230 km. The Annamite mountains on the east running north-south and the Mekong river on the west flowing north-south are the main natural boundaries. The Annamite mountain separates Lao PDR and Vietnam. The Mekong river runs through almost 1700 km on the west bordering Myanmar in the northern quarter, Thailand in the middle half and Cambodia in the southern quarter.

2.2 Area

Stretching more than 1 700 km from the north to south, and between 100 km and 400 km from the east to west, the Lao PDR constitutes a territory of 236 800 km^2. The country is delineated into 17 provinces[15] and one Special Region for administration and development planning, and further into 131 districts (1994). These provinces and the special region are grouped in to three regions, viz. Northern, Central and Southern, for development planning.

2.3 Climatic resources

2.3.1 Rainfall and seasons

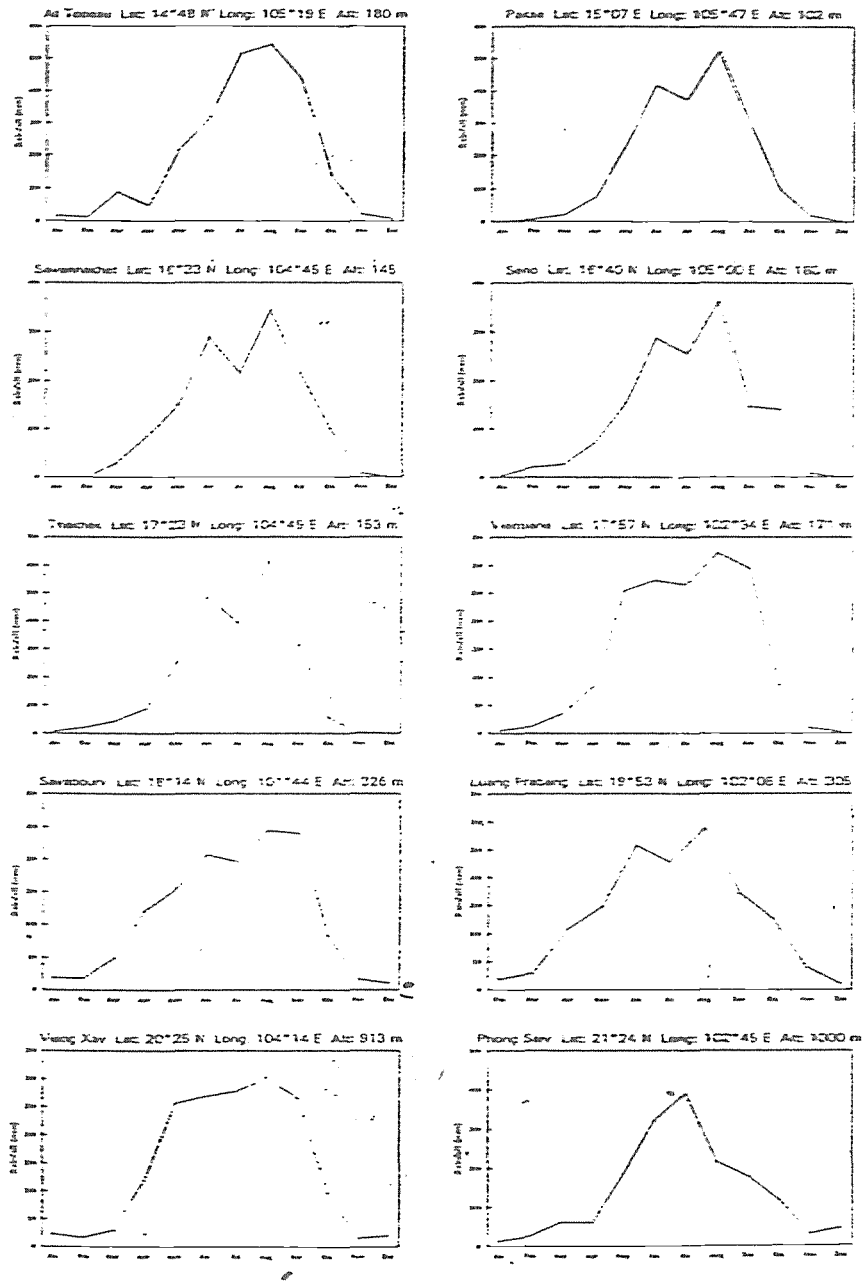
There are two main seasons determined by the rainfall, a wet-moist rainy period from May-October and a dry period from December to March.

Two rainy seasons with short intervals in between can be distinguished: the Southwest monsoon from May to late September and the Northeast monsoon from October to March. The main portion of the rainfall, about fourfifths, is concentrated in the period from May to October from the SW monsoon. Dry spells tend to occur in the monsoon rains in July. The rainfall is essentially monomodal, though many areas experience a slackening of the rains halfway through the monsoon in June (e.g. Sayabouly in the west) or July (e.g. Savannakhet and Champasak in the south) (See Figure .1). Mean annual rainfall ranges from about 1300 mm in the plains to over 3,000 mm in the highlands (See Map 2). There is a slight increase in annual rainfall from north to south in the country but its effect is minor compared to the effect of topography. Over the most parts of Lao, air currents from the Asian anticyclone are usually fresh and cool. In February-March very low clouds are associated with drizzling rains which usually lasts for two three days. As the land mass of South East Asia becomes increasingly warmer toward the month of April, convective activity and thunderstorms become frequent. They announce the arrival of the rainy season.

MAP 1 : LAO PEOPLE'S DEMOCRATIC REPUBLIC

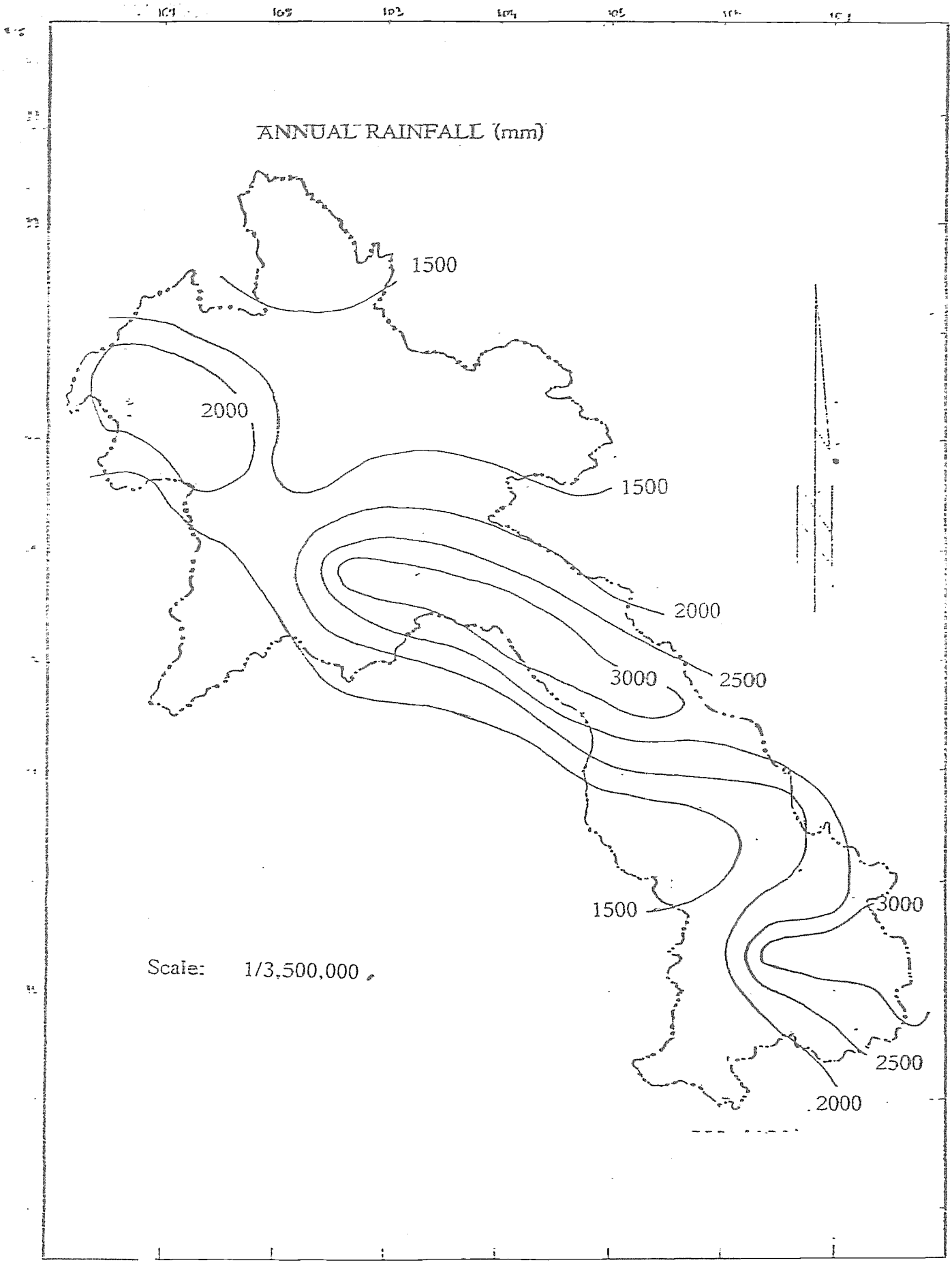
MAP NO. 3468 Rev. 2 UNITED NATIONS
OCTOBER 1990

FIGURE 1 : RAINFALL PATTERNS



- Rainfall patterns in the Lao PDR

MAP 2 : ANNUAL RAINFALL (mm)



2.3.2 Temperature

Mean annual temperature ranges from about 20°C in the highlands to between 25 and 27° C in the plains. Highest temperatures (mean monthly maxima of 30-35° C in the plains) are experienced before the beginning of the SW monsoon between March and June. Five thermal zones which have influence on the vegetation, have been identified based on altitude (See Table 2.1).

Table 2.1 Thermal zonation

Altitude range (m)	Annual mean (o^c)	Mean Maximum (o^c)	Mean Minimum (o^c)	January Mean minimum (o^c)
100-200	26.2-25.5	31.3-30.7	21.9-21.1	16.1-15.3
200-500	25.5-23.4	30.7-28.9	21.1-18.6	15.3-13.0
500-1000	23.4-19.9	28.9-26.0	18.6-14.5	13.0-09.1
500-1500	24.4-16.5	28.9-23.0	18.6-10.4	13.0-05.1
1500-2000	16.5-13.0	23.0-20.1	10.4-06.3	05.1-01.2

2.3.3 Climate

The climate experienced in the country is by and large tropical monsoon while subtropical monsoon with moderately cool winters in the higher elevations of the north. The pattern of the relief features and their orientation in relation to the principal monsoon currents are the main factors affecting climatic contrasts, which are noticeable even over small areas. Three major climatic conditions are experienced in the country. The tropical monsoon is preponderant in the south-east and center; tropical wet and dry type in the south-west and center-west areas; and subtropical wet and dry type in the northern part of the country.

2.3.4 Length of growing period

Length of growing period[16] is between 180 days in the southwest and more than 270 days in the eastern mountain range bordering Vietnam, and in parts of the northeast and the extreme north of the country (See Figures 2 and 3)

2.4 Physical resources

2.4.1 Drainage

The general slope orientation of the country is north-east to south-west thereby most of the rivers originating from the Annamate mountains in the east empty into the Mekong in the west. The high mountains along the eastern border are the source of most of the rivers in Lao PDR. They flow

FIGURE 2 : TYPES OF GROWING PERIODS

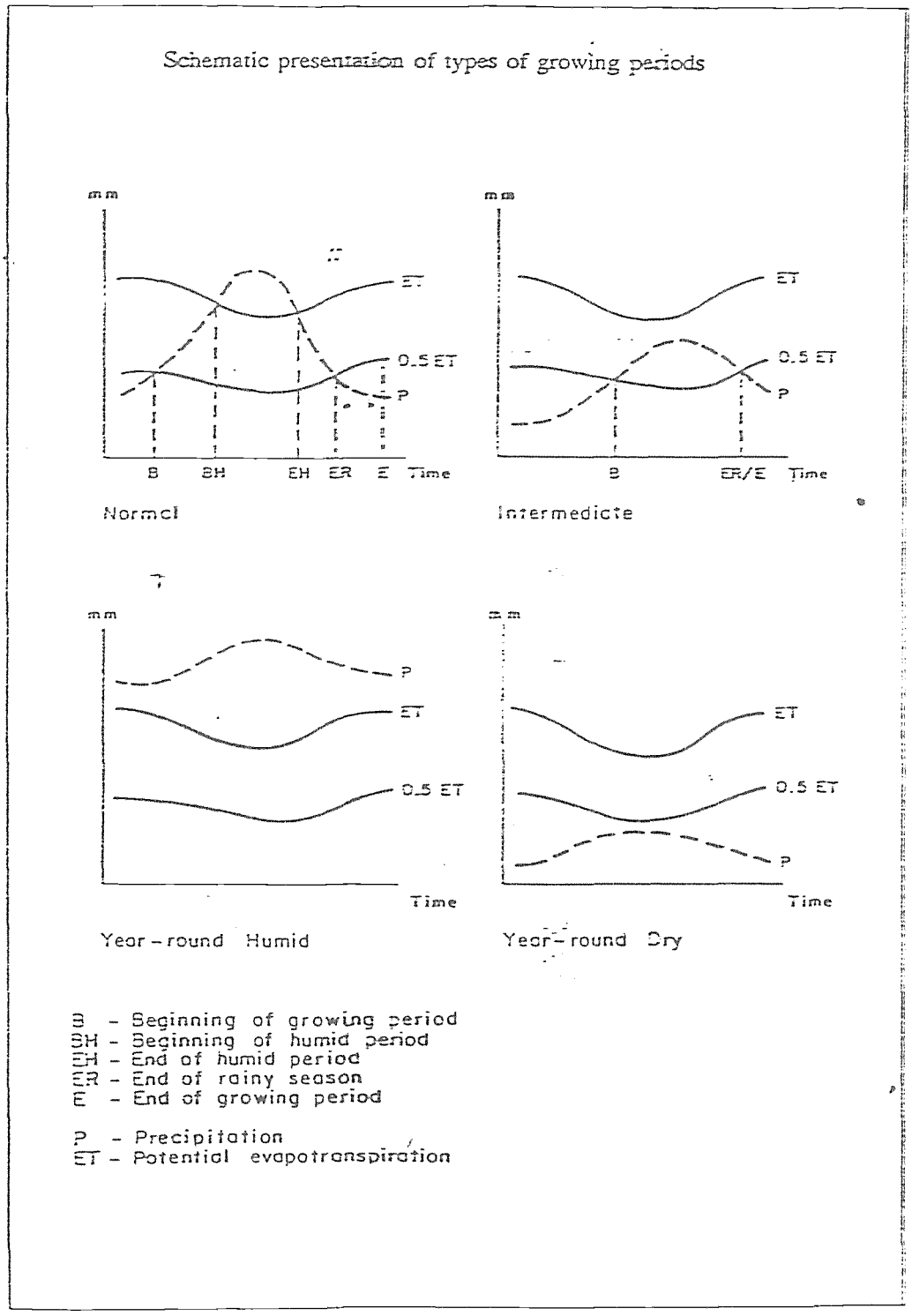
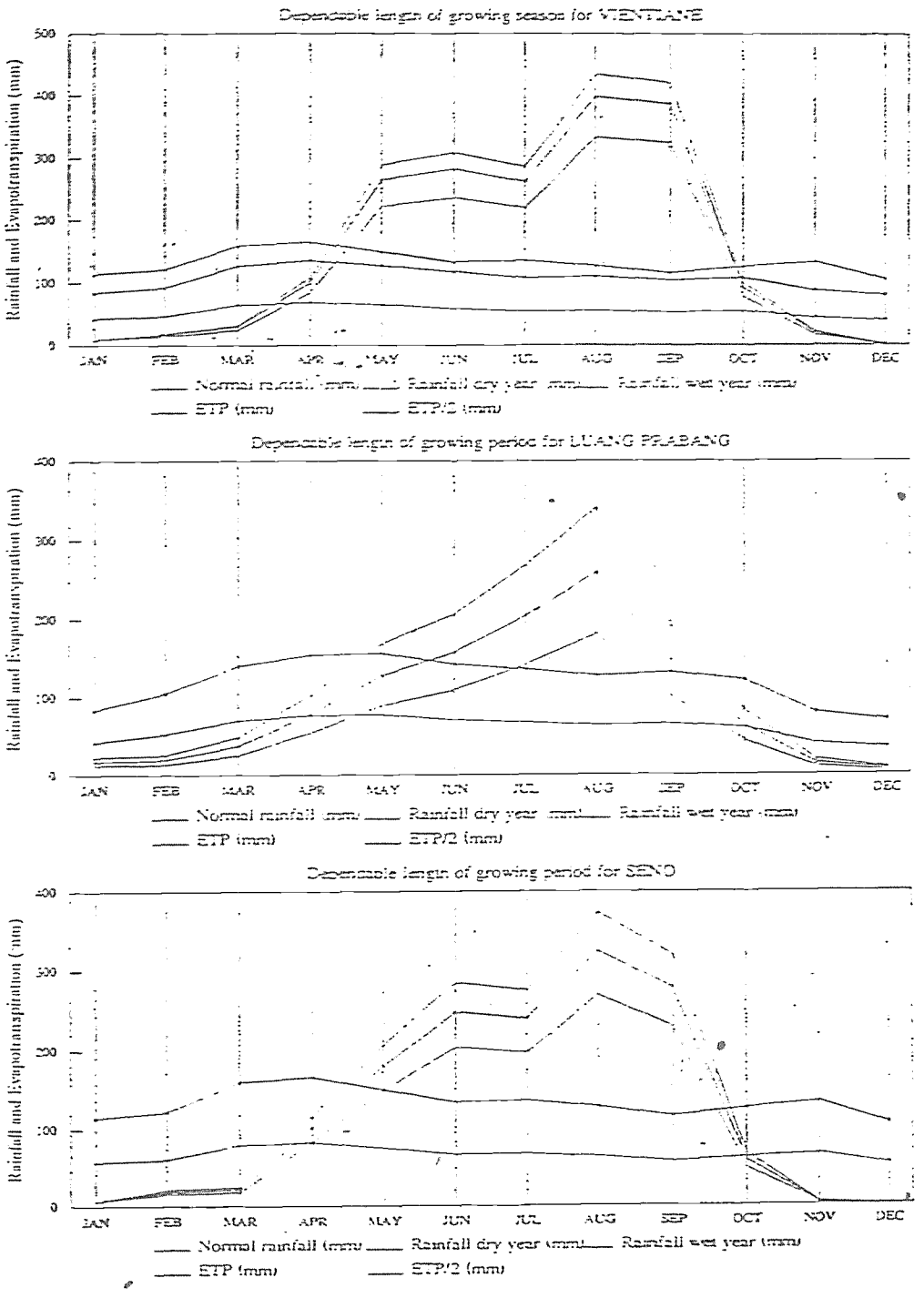


FIGURE 3 : DEPENDABLE LENGTH OF GROWING PERIODS



Dependable length of growing period for three stations

east-west and cross the country and empty in to the Mekong river. Nearly 90 percent of the Lao territory is drained by the Mekong river and her 14 tributaries. The remaining part on the north east constitute another watershed in the northeast. Lao PDR is one among the countries of the Mekong basin. Others are Thailand, Cambodia and Vietnam.

2.4.2 Altitude and Physiography

Mountains and plateaus cover more than four fifths of the country. About two thirds of the country is mountainous and highly dissected, with altitudes ranging from 200 to 2820 m above mean sea level (See Map 3). The narrow strips of land along the Mekong river and its tributaries and some of the flood plains falling within an altitude of 200-500 m are the only part of the country which is relatively flat and constitute country's most important land resource for agriculture[17]. The variations in altitude coupled with dissected topography engenders innumerable micro ecosystems fostering rich biodiversity both in flora and fauna, some of them unique and endemic to the country. The rigorous topography pose difficulties for transportation and communication rendering them costly but together with high rainfall form innumerable rivers and rivulets endowing the country with a vast potential for hydropower. The physiography also restricts the availability of agronomically suitable land especially with favourable slope, more so irrigable land to utilise the country's considerable water potential. The rigorous topography of the country is illustrated by the estimation of land under different slope classes.

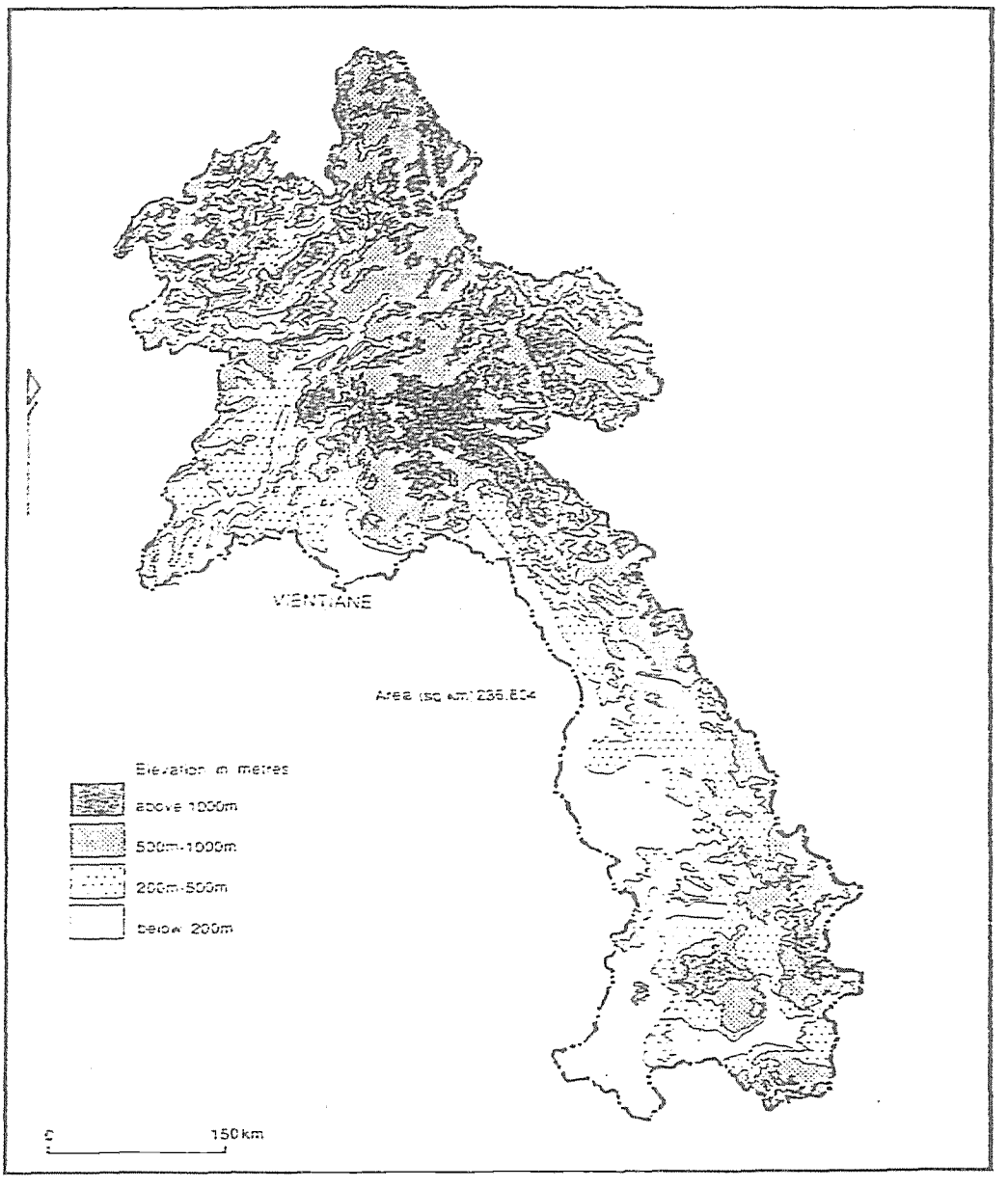
Slope class	Area (km^2)	Proportion (%)
Level to undulating (0-8%)	20 389	9
Rolling to hilly (8-30%)	81 848	35
Steeply dissected to mountainous (>30%)	128 326	56
Total	230 563	100

Physiographically four zones are distinguished. The mountainous north with rugged terrain and steep slopes of elevations over 1000 m soaring to 2800 m; the mountainous parts of the center and the south generally with moderate slopes lying within elevations between 500 m and 1000 m (and some peaks over 2000 m); the Bolaven plateau in the south; and the river plains along the Mekong and its tributaries.

2.4.3 Soils

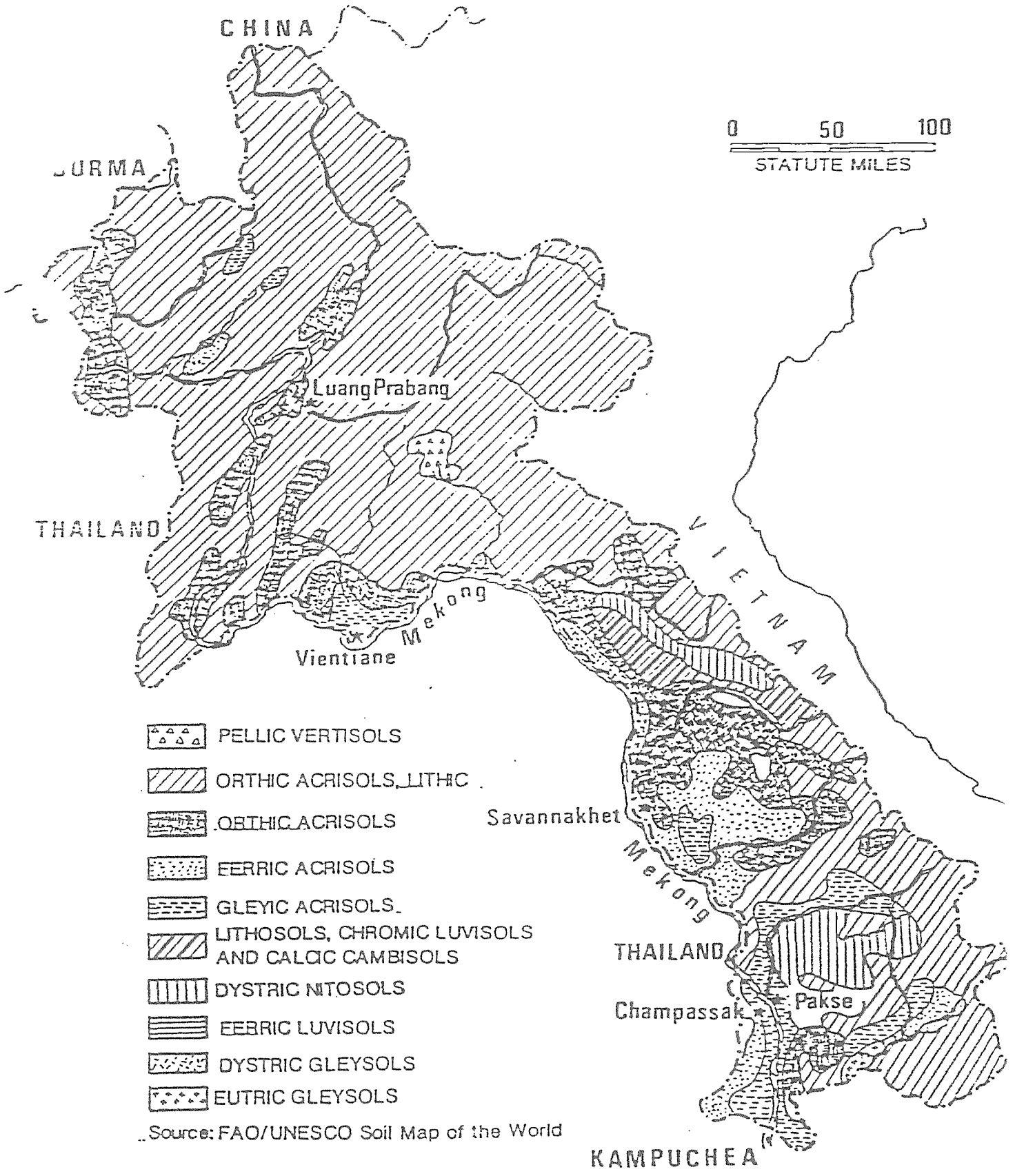
Acrisols covering nearly three quarters of the country dominate the soils in Lao PDR (See Map 4 and Table 2.2). They are well drained, medium textured soils developed on residual materials and old alluvial deposits occurring on steeply dissected mountain slopes, foot hills and rolling terraces. Steeper slopes remain under forest, while much of the rolling terrain is used for shifting cultivation, mainly upland/dryland rice. Locally shifting cultivation practices resulted in the development of a fire climax of anthropic savannah. Most of the Acrisols are physically in fairly good condition. They are chemically poor, being acidic, low in organic matter content and bases, and lacking in natural fertility. Most soils are 'moderately well' to 'well' drained but compactness of the underlying textural B horizon makes them

MAP 3 : ELEVATION



[Courtesy UNICEF, Vientiane. Reproduced from Children and Women in Lao People's Democratic Republic]

MAP 4 : SOILS OF LAO PDR



highly susceptible to erosion if exposed on slopes under the torrential rainfall regime. Annual food crops can be grown to a certain extent, but natural fertility limitations and erosion hazard on exposed slopes introduce a risk element. Slash and burn cultivation can generate good crop yields if the cropping period is restricted to a maximum of four years and a fallow period of minimum 10 years is pursued. Successful utilisation for annual food or cash crop production under a permanent agricultural system requires a relatively high standard of management, involving soil and water conservation measures, a rotation including nitrogen-fixing legumes, application of farm yard manure, crop residues, composted crop and kitchen waste, mineral fertilisers and soil amendments. Soil and terrain conditions are more suited for the cultivation of perennial crops (coffee, tea, fruits, rubber, oil palm) than for annual food cash crop production.

Table 2.2 Soils in Lao PDR grouped by major soil units

Soil unit	Area km²	Proportion (%)
Distric Glysols	3 360	1
Lithosols	21 675	10
Chromic Vertisols	1 229	1
Distric Cambisols	18 560	8
Calcic Cambisols	1 355	1
Ferralic Cambisols	3 431	2
Chromic Luvisols	1 355	1
Gleyic Luvisols	2 237	1
Orthic Acrisols	126 207	56
Ferric Acrisols	14 315	6
Humic Acrisols	15 725	7
Plinthic Acrisols	2 270	1
Gleyic Acrisols	4 421	2
Distric Nitosols	10 377	5
Total	226 517	100

Cambisols are the second largest soil types. Cambisols are less susceptible to water erosion and have better soil fertility characteristics compared to Acrisols.

Lithosols constituting one tenth of the soils, are shallow soils of the mountain crests. they are susceptible to erosion because of the steep slopes on which they occur. Their production potential for annual crops is negligible.

Soil texture

Top soil texture determines soil workability and is an important factor contributing to moisture and nutrient retention and resistant to erosion. Medium textured top soils are predominant ensuring good soil workability. Lowland soils are predominantly light textured which make them less suited for paddy cultivation.

Top soil texture	Area km²	Proportion (%)
Light texture	3 917	2
Medium texture	163 859	71
Heavy texture	62 787	27
Total	230 563	100

Slope

Slope is a prime indicator of susceptibility to water erosion. Surface irrigation suitability is confined to areas with slopes lower than 5 percent. Slopes steeper than 15 percent are not suitable for shifting cultivation. Without accompanying soil and water conservation practices and improvement in cultural practices annual crops should not be raised on lands with slopes greater than 15 percent. Perennials can be grown on slopes between 15 to 30 percent. Land suitable for cultivation is limited in Lao PDR as only one tenth of the land (20 389 km² or 11%) has slopes less than 8 percent. One third of the land (81 848 km² or 35%) is characterised as rolling to hilly indicated with slope ranging from 8-30 percent can be put to annual crops only with adequate conservation measures or to perennial crops. More than one half of the land (128 326 km² or 56%) are steeply dissected to mountainous with slopes great than 30 percent. Forest cover is the best guarantee for the conservation of such lands.

Soil depth

Soil depth determines the amount of nutrients available for plant growth, the possibilities for plant anchoring and moisture availability. Nearly three quarters of the soil in the country is deeper than 50 cm which is sufficient for moderate to good plant growth for most of the annual crops. Over two fifths of the soils is deeper than 100 cm making them suitable for perennial crop production. Only less than one tenth of the soil is shallower than 10 cm while one fifth has depth between 10-50 cm.

Soil depth class	Area km²	Proportion (%)
< 10 cm	21 675	9
10- 50 cm	41 851	18
50-100 cm	69 169	30
>100 cm	87 868	42
Total	230 563	99

Soil physical constraints

Only 15 percent of the soil is reckoned to be free from major physical constraints in the country. Over one half is too steep while one sixth is infertile. Other constraints to which subjected are shallowness, wetness and coarseness rendering crop production is not possible or uneconomic.

Constraint	Area km²	Proportion (%)
Too steep	128 326	56
Too shallow	11 084	5
Too wet	11 809	5
Too coarse	3 894	2
Vertic	1 797	1
Infertile	38 144	17
No major constraint	35 507	15
Total	230 561	101

Soil fertility/capability

Aluminium toxicity, soil acidity, potassium deficiency and phosphorus fixation are the main chemical factors limiting production potentials of the soils in the Lao PDR. Acute phosphorus and local potassium deficiencies is demonstrated in most moderately acid soils of the wetland rice paddies of the central and southern Lao. Predominant light textured wetland soils suffered from high water permeability. In the uplands physical constraints and moisture stress and available nitrogen and phosphorus are the limiting factor for rice production.

Fertility characteristics	Area km²	Proportion (%)
Hydromorphic soils	11 810	5
Strongly acid soils with Aluminium toxicity	150 882	65
Acid soils	151 118	65
Potassium deficiency	173 460	75
Phosphorus fixation	55 038	24
Alkaline soils	1 075	..
Cracking clay (Vertic) soils	1 797	1
Low nutrient retention capacity	50	..
Gravelly top soil	3 460	2

2.5 Agro-ecological Zones

Interventions based on the appreciation of the potentials and constraints global to Lao PDR would not be appropriate and certainly not sufficient considering the diversity in resource endowments arising from the abrupt variations in altitude and physiography at short spatial entities. Because the manifestation and magnitude of the potentials and constraints are primarily a function of the characteristics of the resource endowments. A system of identifying land resources based on homogeneous characteristics would facilitate focusing attention on the constraints and potentials and their quantification to design relevant and location specific interventions. One such system generally recognised is the 'agroecological zonation' . The project attempted to identify the major agroecological zones (AEZ) and as an approximation provisionally determined their spatial dimensions on the basis of information accessible to the project. As and when data accessibility improves the scheme could be refined further both in characterisation and quantification. AEZs are defined on the basis of the normal LGP, thermal zonation based on the relation between temperature and elevation, and available information on predominant land forms, soil erosion risk and present land use. The characteristics of the AEZs identified are summarised in Table 2.3, the delineation is presented in Map 5 and the spatial distribution is quantified in Table 2.4.

Table 2.3 : Agroecological zones in Lao PDR: Critical parameters

ZONE	Elevation (m)	Rainfall (mm)	LGP (days)	Slope (%)	Climate	Forest vegetation Evergreen	Deciduous
AEZ-1	100-200	1500-2000	180-120	Flat <8	Tropical Wet&Dry	Lower dry	Dry dipterocarp & upper mixed
AEZ-2	200-500	2000-3000	210-240	Rolling 08-30	Tropical Wet&Dry	Upper dry	Dry dipterocarp
AEZ-3	500-1000	2500-3000	240-270	Rolling 08-30	Tropical Monsoon	Upper dry Evergreen	Dry dipterocarp
AEZ-4	500-1500	2500-3000	240-270	Rolling <08	Subtropical Wet&Dry	Upper dry Evergreen	Dry dipterocarp
AEZ-5	500-1500	1500-2000	240-270	Mountainous 30-60	Subtropical Wet&Dry	Coniferous	
AEZ-6	1500-2000	1300-2500	270-300	Mountainous 30-60 & >	Subtropical Wet&Dry	Lower montane and coniferous	

2.5.1 AEZ 1 Southern Lowland Plain and Terrace Zone

Constituting much of the generally recognised lowlands comprising the plains and adjoining terraces, and the basins along the Mekong river this AEZ extends to 32000 km^2, almost one seventh of the country. Savannakhet and Champasak provinces account for two thirds of this zone. Almost the entire Vientiane municipality falls in this zone. Lying within an altitude range of 100-200 m and receiving 1500-200 mm annual rainfall this zone experience tropical wet and dry climate and has normal LGP range of 180-210 days. Soils on these plains are characterised as recent alluvial deposits which are acidic and shallow, with low organic matter and low fertility. The younger alluvial soils of the flood plains are more fertile than the older terrace soils, but they are often subject to wet season flooding. As this zone encompasses the major plains in the country much of the agronomically suitable land for annual crop production in the country is found in this zone. The land form is mainly plains with less than 8 percent, and the moisture availability is generally adequate during the main cropping season. Much of the wetland paddies are found in this zone. Hence this zone provide sustenance to more than one half of the population in the country and also support to one half of the livestock population.

Table 2.4 Distribution of AEZs by province (Area km²)

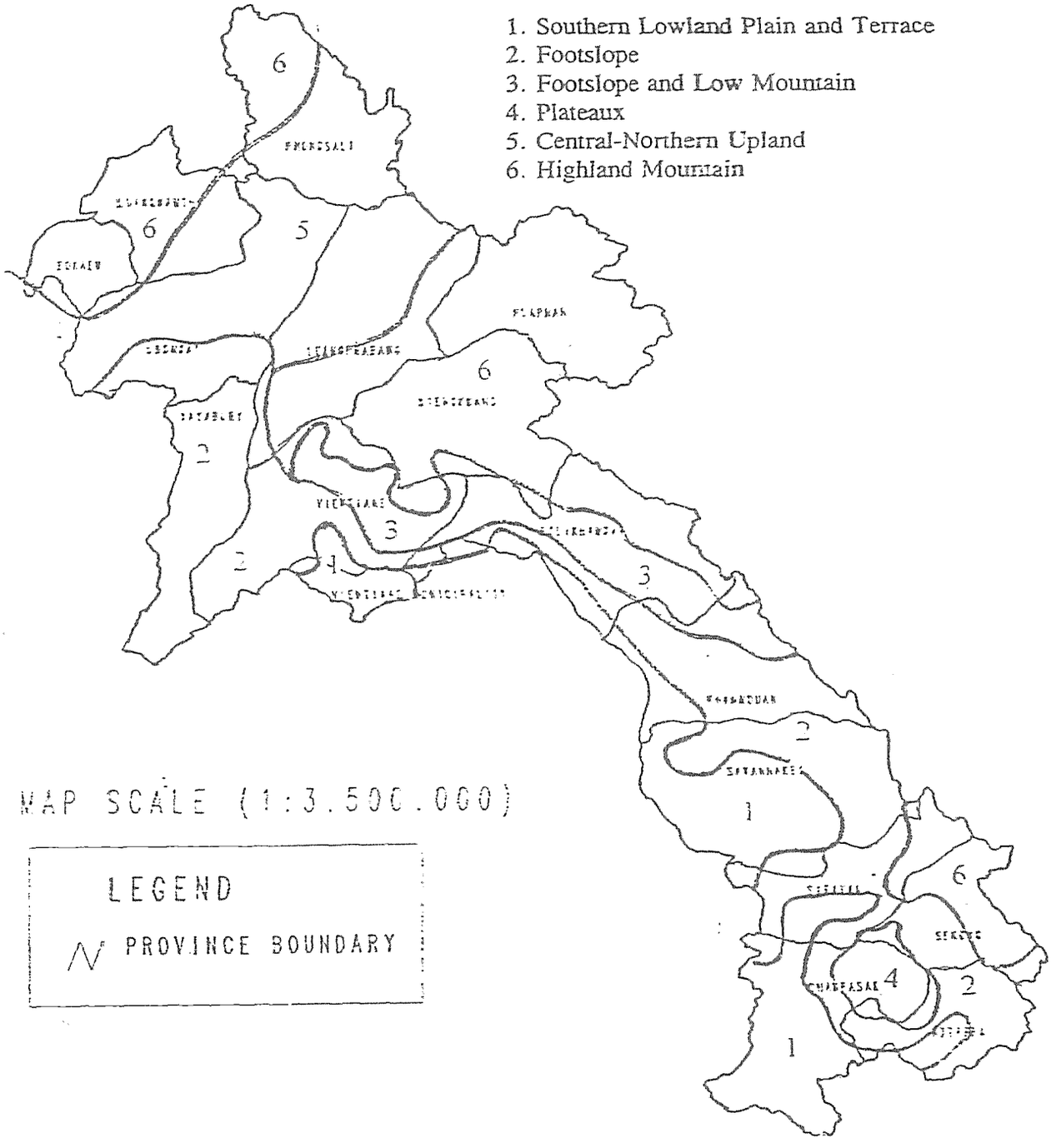
Province	AEZ-1	AEZ-2	AEZ-3	AEZ-4	AEZ-5	AEZ-6
01.Vientiane M.	2136	267	...	...	...	...
02.Phongsali	...	...	...	...	10147	5874
03.Louangnamtha	...	...	...	...	4273	6408
04.Oudomxai	...	5340	...	...	14953	534
05.Bokeo	...	...	...	...	....	5073
06.Louangphabang	...	801	...	...	10948	8278
07.Houaphan	...	...	...	...	...	17356
08.Xaignabouli	...	12283	...	...	...	...
09.Xiangkhoang	...	...	1068	...	...	16288
10.Vientiane	1068	9346	5073	...	...	2670
11.Bolikhamxai	1869	2136	8278	...	...	5073
12.Khammouan	1869	9346	2670	...	...	534
13.Savannakhet	11482	10414	...	...	...	...
14.Salavan	1869	5340	...	...	...	5073
15.Xekong	...	1602	....	534	...	...
16.Champasak	10147	3204	...	3738	...	...
17.Attapu	1602	6141	...	801	...	...
18.Special Region	...	5340	....	...	...	...
Lao PDR	32042	66221	17089	5073	40320	76100
Distribution (%)	(14)	(28)	(7)	(2)	(17)	(32)

Note: Area estimated mechanically using graphic squares. Hence arithmetically figures may not add up. Yet sufficient indicative of the proportions.

2.5.2 AEZ 2 Footslope Zone

As much of the land in this zone constitute the foot slopes, this zone is found in most of the provinces covering two seventh of the country extending to an area of over 66000 km². Located within the altitude range of 200-500 m and endowed with a rainfall ranging from 2000-3000 mm, tropical wet and dry climate with normal LGP of 210-240 days is experienced in this zone. Endowed with predominantly undulating to rolling topography of moderate to steep slopes (8-30%), the land is suitable mainly for dryland cultivation dependent on the rainfall. Lands in this AEZ is extensively subjected to shifting cultivation and as a consequence the evergreen dense forests is largely affected. Rehabilitation of the forest vegetation with an appropriate mix of dryland cropping and livestock rearing offers potential for supporting the increasing population.

MAP 5 : AGROECOLOGICAL ZONES IN LAO PDR



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DEPARTMENT OF FORESTRY MINISTRY OF AGRICULTURE & FORESTRY

2.5.3 AEZ 3 Footslope and Low Mountain Zone

Extending to over 17000 km^2 constituting one sixteenth of the total land in this country, this AEZ is relatively a small. Located in the altitude range between 500-1000 m and endowed with a rainfall of 2500-3000 mm, tropical monsoon climate with 240-270 days LGP is experienced. The predominantly rolling to mountainous land form with slopes exceeding 30% permit only dryland crops and livestock rearing. Shifting cultivation is practiced extensively affecting the natural upland forest vegetation.

2.5.4 AEZ 4 Plateaux (Mainly the Boloven) Zone

Though proportionately small of about two percent of the land extending to a little over 5000 km^2 this zone is mainly identified with the Bolaven plateau located in the north eastern quarter of Champasak province with small extensions to the Xekong and Attapu provinces. Tropical monsoon climate with LGP of 240-270 days is experienced as the altitude is within a range of 500-1500 m and the annual rainfall is in the range of 2500-3000 mm. Predominant rolling topography of slopes less than 8 percent, and endowed with well structured, less acidic soil of relatively good water retention and drainage capacity, provide opportunities for crop production. The savannah grassland vegetation can support extensive livestock grazing. The longer LGP in combination with deep soils foster perennial (tree) crops such as coffee, tea, cardamum etc.

2.5.5 AEZ 5 Central-Northern Upland Zone

This AEZ extend to over 40000 km^2 constituting one sixth of the country. Elevation ranging from 500-1500 m and an annual rainfall ranging from 1500-2000 mm generate subtropical wet and dry climatic conditions and LGP of 240-270 days. Mountainous topography dominant with slopes ranging from 30-60 and acidic and leached soils offer limited scope for crop production. Natural forest is largely in tact even though affected locally due to the practice of shifting cultivation.

2.5.6 AEZ 6 Highland Mountain Zone

The largest AEZ extending to 76000 km^2 and covering one third of the country it is one of the most extensive. Altitude of 1500-2000 m and over, and an annual precipitation ranging from 1300-2500 mm generates subtropical wet and dry climate with cooler dry season and longer LGP of 270-300 days. The mountainous land form with dominant slopes from 30-60 percent and above, combined with heavily leached and acidic soils renders agricultural production extremely difficult and the land vulnerable. Natural upland forest is largely in tact though locally disturbed due to shifting cultivation.

2.6 Bioresources

2.6.1 Natural forest vegetation

Natural forest vegetation (generally termed as 'current forests' in classification) extending to nearly 112 000 km^2 covered nearly one half of the territory of Lao PDR in 1988/89. There has been a steady decline in the natural forest coverage with the passage of time. It is reported that four decades ago much of the country was covered by natural forests which declined to 70 percent by 1970 and dwindled to 49 percent by 1982.

Table 2.5 Natural forest vegetation by class (1988/89)

Class	Extent (ha)	Proportion (%) of	
		Forest Vegetation	Land Area
Evergreen	1 279 000	11.45	5.40
Lower Dry Evergreen	85 000	0.76	0.36
Upper Dry Evergreen	1 061 300	9.50	4.48
Coniferous	132 700	1.19	0.56
Deciduous	9 678 000	86.01	40.57
Dry Dipterocarp	1 185 400	10.61	5.01
Lower Mixed Deciduous	897 000	7.67	3.61
Upper Mixed Deciduous	7 478 400	66.96	31.58
Gallery Forest	87 000	0.7	0.37
Mixed Coniferous-Broad leaf	281 300	2.5	1.19
Total	11 167 900	100.0	47.16

Source: Malyvanh, M., Swathvong, S., 1995

The natural forest vegetation in Lao PDR can be divided into two broad classes, viz. Evergreen and Deciduous. Altitude and species distribution determine the sub-classes within these two broad classes. Deciduous forests by far the largest class accounting for over four fifths and evergreens about one tenth of the natural forest vegetation in the country (See Table 2.5). The rest is a mix of the two.

Evergreen forest is an important forest type because it is a primary source of sawn timber, fuelwood and many commercial non-timber forest products. Evergreen forest is divided into three sub-classes:

1. Lower Dry Evergreen forests occurs on the fertile well drained moist alluvial soils that are below 200 meters above sea level; are typically very dense, two story forests with scattered large trees growing to heights of 35-40 meters. Major species are 'may nhang' (Dipterocarpus altus) and 'may khen hine' (Hopea ferrea). Because of the fertility of the soil, this land is often converted to agriculture. Rice paddies are often constructed or rice is grown under a regime of shifting cultivation.

2. Upper Dry Evergreen forests generally occurs between 200 and 1,000 meters, grows on soils which are shallow but have good moisture retention characteristics. The forests are similar to those of the Lower Dry Evergreen forests but the heights of the dominant trees are not as tall. Major species include 'may dou' (Pterocarpus pedatus) and 'may khen hine' (Hopea ferrea).

3. Conifer forests occur both above and below 1,000 meters, grow on poor soils, steep slopes and rocky ridges and is not only an important source of timber but also produce resin and turpentine. Dominate species are Pinus merkusi and Pinus khesva.

Deciduous forests are divided into three sub-classes.

1. Dry Dipterocarp forests occur both in the low land and hill areas and grow on poor soils, dry slopes and exposed ridges; are open with scattered trees reaching maximum heights of 20 meters. These forests have little commercial value and are the main source of firewood and charcoal. Major species include May Kong (Dipterocarpus tuberculatus), May Sat (Dipterocarpus obtusifolius), May Sabeng (Dipterocarpus intricatus) May Hang (Pentacme siamensis) and May Suak (Terminalia tomentosa).

2. Upper Mixed Deciduous forests develop on sandstone formations in the low lands and are characterized by the presence of Bamboo.

3. Lower Mixed Deciduous forests. Lower Mixed Deciduous Forests develop on alluvial soils in the lowlands after logging or cutting and burning for agriculture.

Lower Montane forests occur above 1,000 meters and are instrumental in protecting the higher altitudes of the watersheds of the nation. Dominate species in this type include Quercus and Castanopsis.

2.6.2 Grasslands

Next to forests, grassland is the natural vegetation occurring in Lao PDR. About 8 million hectares of land in the country, mostly in the plateaux and mountain areas in the north and east, constitute grasslands consisting of vegetation of variable nutritive value. In the central and southern regions open savannah type forests with an understorey of grasses are found. These herbaceous resources have potential to support livestock. With adequate management they can be made more productive.

2.6.3 Wetlands

There are no natural lakes in Lao PDR. However there are quite a number of wetland areas identified as swamps with a total extent of 35000 hectares. Some of them are sizeable such as Nongchand in Vientiane Municipality, That Luam/Salakham in Vientiane Prefecture, Nong Lack in Champasak Province, Nong Pheuang in Bokeo Province, Nong Luang in Savannakhet province and Nong Khaiock in Xekong Province. These wetlands meet with part of the subsistence needs of the people inhabiting in the neighbourhoods especially the protein needs through supplying fish. A variety

of wildlife: mammals, reptiles, amphibians, birds and other life forms, is supported by the wetlands in the country[18]

2.6.4 Wildlife

The diverse natural habitats in Lao PDR once supported a wide assortment of species of wildlife consisting of mammals, birds, reptiles, amphibians, insects, fish and other living organisms. Information available on species composition, range of habitats and populations is very limited. Of the more than 180 species of mammals listed, 20 are endemic to the Indochina region. Some of the larger mammals such as the elephant (Elephas maximus), tiger (Panthera tigris), leopard (Pantera pardus), two species of bear and four species of wild cattle, including the rare kouprey (Bos sauveli), are found in the country. Hardly any information available on reptiles and amphibians. More than 600 birds species are known to be present in the country, either as residents or migrants. Twenty-seven species are known to be endemic to the Indochina region, but the sooty babler (Stachyris herbeti) is found only in the central region of the country (UNDP 1991).

It is reported that there are indications to show that some species may have been reduced to very small numbers and may be even threatened or endangered. The following species are believed to be endangered: greater adjutant (Leptptilos dubius), white-shouldered ibis (Pseudibis davison), giant ibis (Thaumatibis gigantea), white-winged wood duck (Carinia scutulata) and the saurus crane (Grusantigone sharpii).

2.6.5 Biodiversity

Plant diversity is widespread in the country given the variegated natural resource endowments. The existence of innumerable microecosystems provide specific niches for the evolution of a variegated flora and fauna. The preservation of flora has been nurtured by the rich age-old tradition of the practice of herbal medicine by Buddhist monks and other practitioners which formed the backbone of the medical and healing system. Temples and monasteries have become repositories for preserving this rich heritage by growing them. In situ collections are maintained by these traditional institutions. It is reported that one such temple in Vientiane has a collection of over 1000 species. There is no systematic cataloguing or propagation except some initial attempts being made by the Public Health Ministry Research Institute in Medicinal Plants. Over a thousand indigenous varieties of rice are found in the country. Orchids and ferns is one set of flora unique to the country and have acquired economic value. Most of these are indiscriminately removed from the wild. The preservation of germ plasm of the cultivars is also lacking. There is no ex-situ conservation in zoological gardens, parks, arboreta or as private collections.

2.7 Water Resources

Apart from natural forest vegetation Lao PDR is richly endowed with water resources. Rainfall incidence in the range of 1500-4000 mm per annum generates considerable amount of water potential. The Mekong river, the third largest in Asia and the twelfth largest in the world (4 200 km)

and the tenth largest in terms of annual discharge, runs for some 1,700 km through Laos PDR, forming much of the western border with Myanmar and Thailand. Of the 475 000 million m^3 annually emptied into the South China by the Mekong river system, 88 percent comes from the Lower Mekong basin which constitutes 76 percent of the total catchment, representing 610,000 km^2. Most of Mekong's left bank tributaries (14 of them) lie within the Lao PDR which together drain 88 percent of the country (208,000 km^2). Although perennial wide variation between monsoon and dry weather flows is experienced. Measurements at Vientiane over a 73-year period from 1913 to 1986, indicate a low flow of 701 m^3 /second in 1956 and a peak flow of 26 000 m^3/second in 1966. Coordinated development and equitable sharing of the water resources among the riparian countries, namely the Lao PDR, Vietnam, Cambodia and Thailand, are the subject of study by the Interim Committee for Coordination of Investigations of the Lower Mekong Basin.

2.7.1 Hydropower

Hydropower is probably the most important natural resource endowment of Lao PDR with great potential for economic development. The high rainfall regime together with abrupt change in altitude to high elevations and rugged terrain create enormous hydropower potential. The most important attribute of the Mekong network of rivers in Lao PDR is the hydroelectric potential. In the Lao PDR the technical hydropower potential is estimated at nearly 22000 MW.

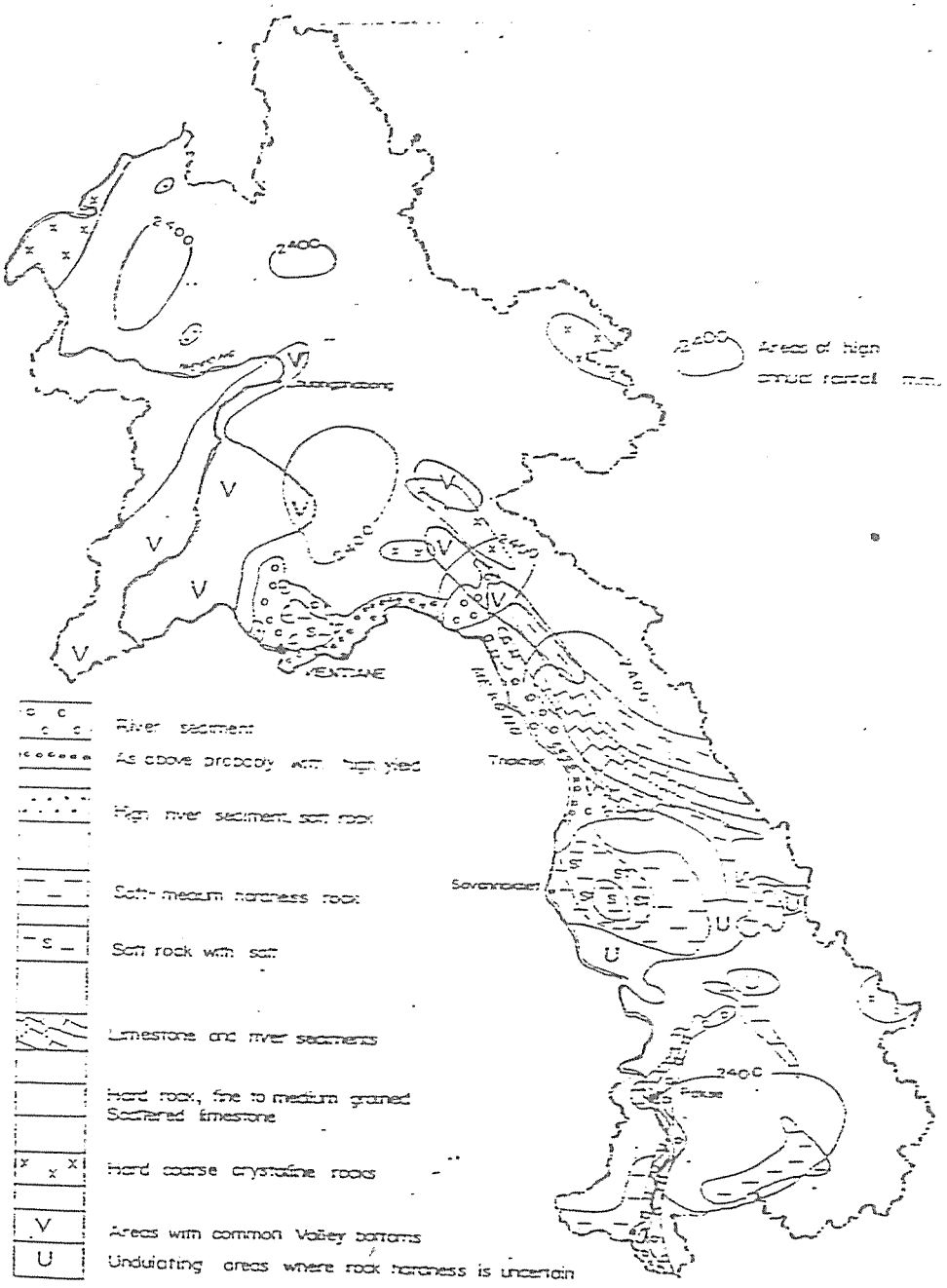
2.7.2 Groundwater

Information on groundwater resources is scarce[19]. Spatial variation in the characteristics of the groundwater resource including quantity, depth, quality and difficulty of extraction and accessibility are significant factors of its development. Areas of good accessibility are situated in the lowlands: in alluvial and erosional plains, river terraces, undulating landforms and valley-bottoms. Springs are found where the base of a permeable zone intersects a sloping land surface. They are common in limestone areas and fractured rocks in dissected landscapes. Mainly in the areas east of Savannakhet and north east of Vientiane Municipality saline groundwater (high in NaCl) tends to occur. Groundwater salinity in these areas may exceed 50,000 mg/l and values exceeding 3,000 mg/l are widespread. Limestone and dolomite will tend to produce hard water, but salinity is low. Areas underlain with red shales will tend to produce high iron containing water. Ground water potential is depicted in Map 6.

2.8 Mineral resources

Extensive mineral deposits are believed to exist in Lao PDR. Deposits of gemstones such as sapphire, zircon, amethyst, gold copper, iron ore and tin are known to exist in sizeable quantities in the country. The geographical distribution and extent of reserves on some of the known mineral deposits is summarised in Table 2.6. The extent is only indicative in the absence of detailed surveys. More geologic surveys are needed to identify location of deposits that would allow their exploitation in commercial quantities.

MAP 6 : GENERALISED GROUND WATER POTENTIAL



[Courtesy UNICEF, Vientiane. Reproduced from Children and Women in Lao People's Democratic Republic]

Table 2.6 Mineral resources of Lao PDR

Mineral	Location	Estimated potential
Potash	Vientiane plain	50 billion tons
Coal	Vientiane plain	8-15 million tons
	Other areas	Unknown
Iron ore	Vientiane plain	100 million tons
	Other areas	Unknown
Limestone	Vientiane plain	Large deposits
Gold	Many areas	Unknown
	Salakham-Nam Ou	Unknown
	Sekong river	20 kg panned per year
Silver, Lead, Zinc	Pha Louang	Unknown
Copper	N.E. of Nam Ngum	Unknown
Tin	Nam Phatene valley	134 000 tons of metal
	Houa Khong	Unknown
Bauxite	Boloven plateau	Unknown
	Vientiane plain	Unknown
Gemstone	Many areas	Unknown
Gypsum	Savannakhet	18 million tons

Source: UNCED Country Survey, Lao PDR (Sourced from Department of Geology and mines)

Gemstones, gold, coal and tin are estimated to have the high economic value. Only a few of them are mined. Those that are presently mined are tin, precious stones, gypsum, limestone, coal, gold, salt, clay sand and gravel. Export potential is hinged on the availability of high grade minerals. Economic utilisation depends upon the development of required infrastructure in handing and transport. Surveys are being carried out to inventorise the geological wealth and examine the costs and benefits of mining. Potential petroleum deposits are also being explored.

2.9 Human resources

2.9.1 Population

The latest Population Census conducted in March 1995 estimates that Lao PDR has a human population of 4.58 million comprised of 2.27 million males and 2.32 million females inhabiting in a little over 752 000 households spread over nearly 12 000 villages (ban), 133 districts (muong), and 17 provinces and 1 Special Region. A decade ago in 1985 the population of the country was 3.58 million persons consisting of 1.78 million males and 1.83 million females living in nearly 602 000 households (See Table 2.7). During this one decadal interval (1985-95) Lao PDR's

population registered a growth rate of 2.4 percent per annum resulting an increase in population density from 15.1 to 19.4 persons per km^2, an increase in the size of family from 5.96 to 6.09 persons per household and turning the sex ratio less favourable to women with a decline in the number of females from 1040 to 1022 per thousand males. Population expected to double in 29 years and by 2000 to grow to 5.2 million.

The population is predominantly rural even though the proportion of urban population has estimated to have been increasing steadily from 7.6 percent in 1960 to 23.5 percent in 1993. Majority of the population lives on the fertile plains along the Mekong river (See Map 7). Vientiane Municipality, and Savannakhet and Champasak provinces accounted for two fifths of the nations population although together they constitute only one sixth of the area[20].

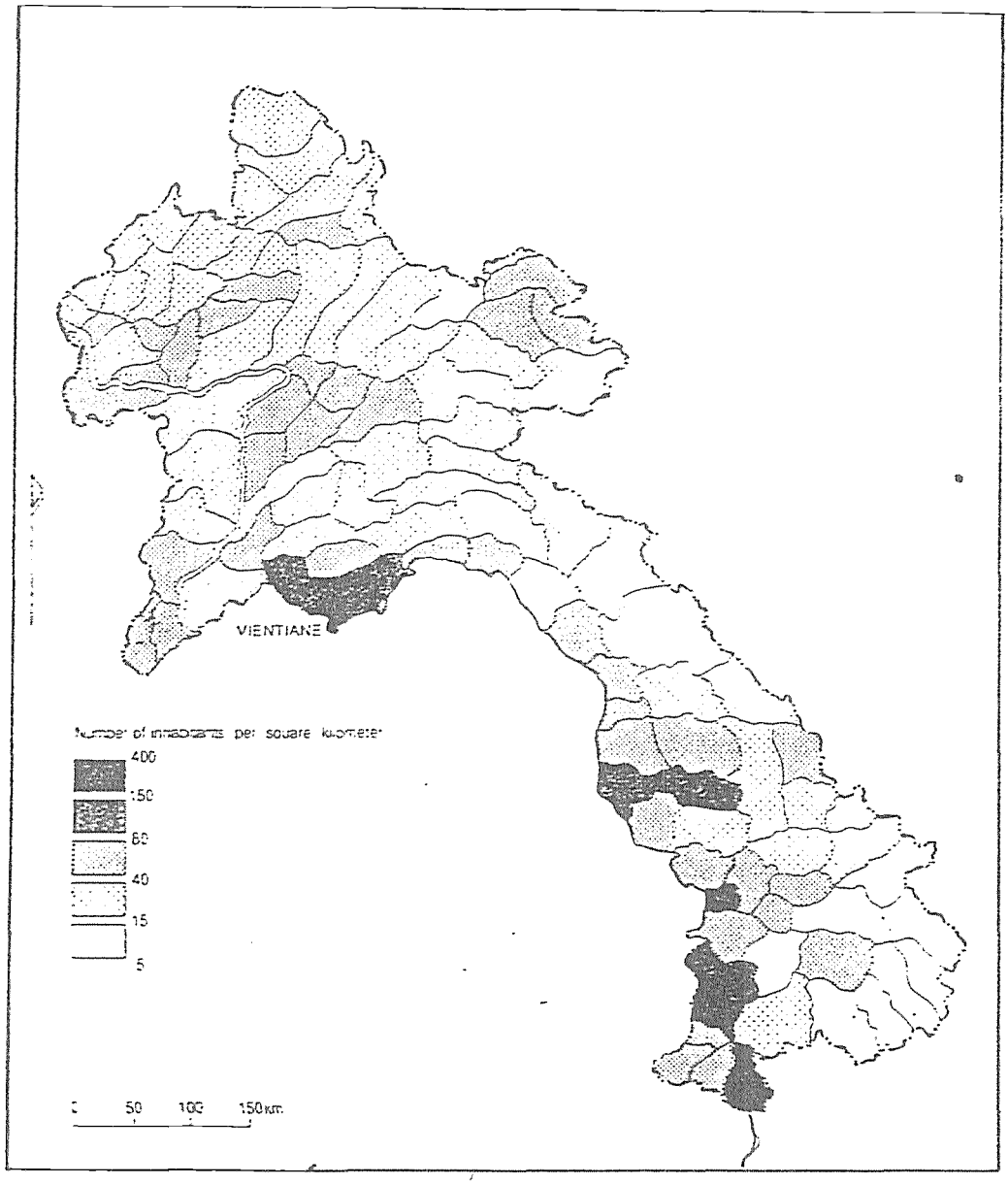
Average size of the family is large 6.1 in 1992. The average life span is low 51 years in 1992 (UNDP 1995a). Lao PDR's population is dominated by younger age groups (See Figure 4). In 1993 non-working age groups (0-14 years) constituted 45 percent of the population and working (economically active) age groups (15-64 years) nearly 52 percent giving a relatively higher dependency ratio (workers to non-workers) of 0.93. The extremely wider base of the population pyramid is also portentous of potentially larger population in the medium term future if no effective interventions are attempted. This skewed nature is likely to exacerbate with the concerted efforts in child care services is put underway to reduce the high infant mortality rates of 125 per and under five mortality rate 182 per 1000 live births in 1992 (UNDP 1995b). The overall sex ratio (male:female) is 1.04 indicating a higher proportion of females in the population. But a decomposition by age groups indicates that the proportion of females is less (0.93) in the 0-14 age group and higher (1.07) suggesting higher rates of female worker participation. The labour force is approximately 2.3 million (1993)and the labour in agriculture 85-90 %.

Table 2.7 Demographic characteristics of Lao PDR population

Characteristics	1995	1985
Population: Total	4 581 258	3 584 803
Male	2 265 327	1 757 115
Female	2 315 931	1 827 688
Geographic area (km^2)	236 800	236 800
Households	752 102	601 797
Villages	11 795	11 935
Districts	133	129
Province+Spl. Region+Vientiane Mun.	19	18
Population density: Persons/km^2	19.35	15.14
Sex ratio (females/1000 men)	1 022	1 040
Size of the household	6.1	5.96
Population per village	388	300
Households per village	64	50
Population per district	34 446	27 789
Households per district	5 655	4 665

Source: Census 1995 Lao PDR: Preliminary Report 1

MAP 7 : POPULATION DENSITY BY DISTRICTS



[Courtesy UNICEF, Vientiane. Reproduced from Children and Women in Lao People's Democratic Republic]

Source: Taillard 1989.

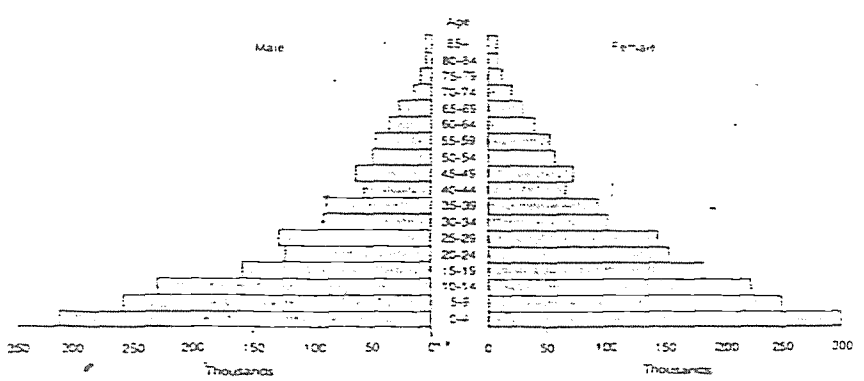
FIGURE 4 : POPULATION PYRAMID

Population by age and sex, 1985

	Total ('000)	Male ('000)	Female ('000)	Sex ratio
0-4	620 (17)	316	304	104
5-9	511 (14)	261	250	104
10-14	454 (13)	232	223	104
15-19	345 (10)	162	183	88
20-24	282 (8)	126	155	81
25-29	278 (8)	132	146	90
30-34	199 (6)	96	104	92
35-39	188 (5)	93	94	99
40-44	128 (4)	60	68	89
45-49	141 (4)	68	74	92
50-54	111 (3)	55	58	92
55-59	102 (3)	50	53	95
60-64	79 (2)	39	40	98
65-69	58 (2)	30	28	106
70-74	37 (1)	17	20	88
75-79	22 (1)	11	12	92
80-84	14 (0)	6	8	79
>85	13 (0)	5	8	71
TOTAL	3,585 (100)	1,757	1,828	

Note: Figures in brackets are percentages.
Source: Lao PDR. Population Census. 1985.

Lao PDR population pyramid, 1985



Source: Lao PDR. Population Census. 1985.

[Courtesy UNICEF, Vientiane. Reproduced from Children and Women in Lao People's Democratic Republic]

2.9.2 Work force

Labour force constituted 45 percent of the total population, 44 percent among males and 46 percent among females in 1985. Agriculture engaged 90 percent of the worker force of which 46 percent were males and 54 females. This sector employed 86 percent of the male, and 93 percent of the female, work force.

Defining work force as the population falling within the age group the labour force participation rate in 1990 was placed at 90 percent representing 42 percent of the population. Among the labour force women constituted 52 percent.

As per 1985 Population census there were a total of 1601535 workers of which 767034 (48%) were males and 834501 (52%) were females. The number of workers in agriculture were 1435740 (females 775300), in forestry 2699 (females 513). Lao PDR, Population Census 1985.

2.9.3 Ethnicity

Considerable ethnic diversity is seen in Lao PDR. Up to 68 ethnic groups inhabiting the country have been identified. Generally these ethnic groups are identified into three broad categories largely based on the habitat preference. They are:

Lao Loum who inhabit the lowland plains and the Mekong river valley, and constitute some two thirds of the total population (See Map 8).

Lao Theung who occupy the mountain slopes comprising about one fifth of the population, and who are thought to have been the first inhabitants of Laos.

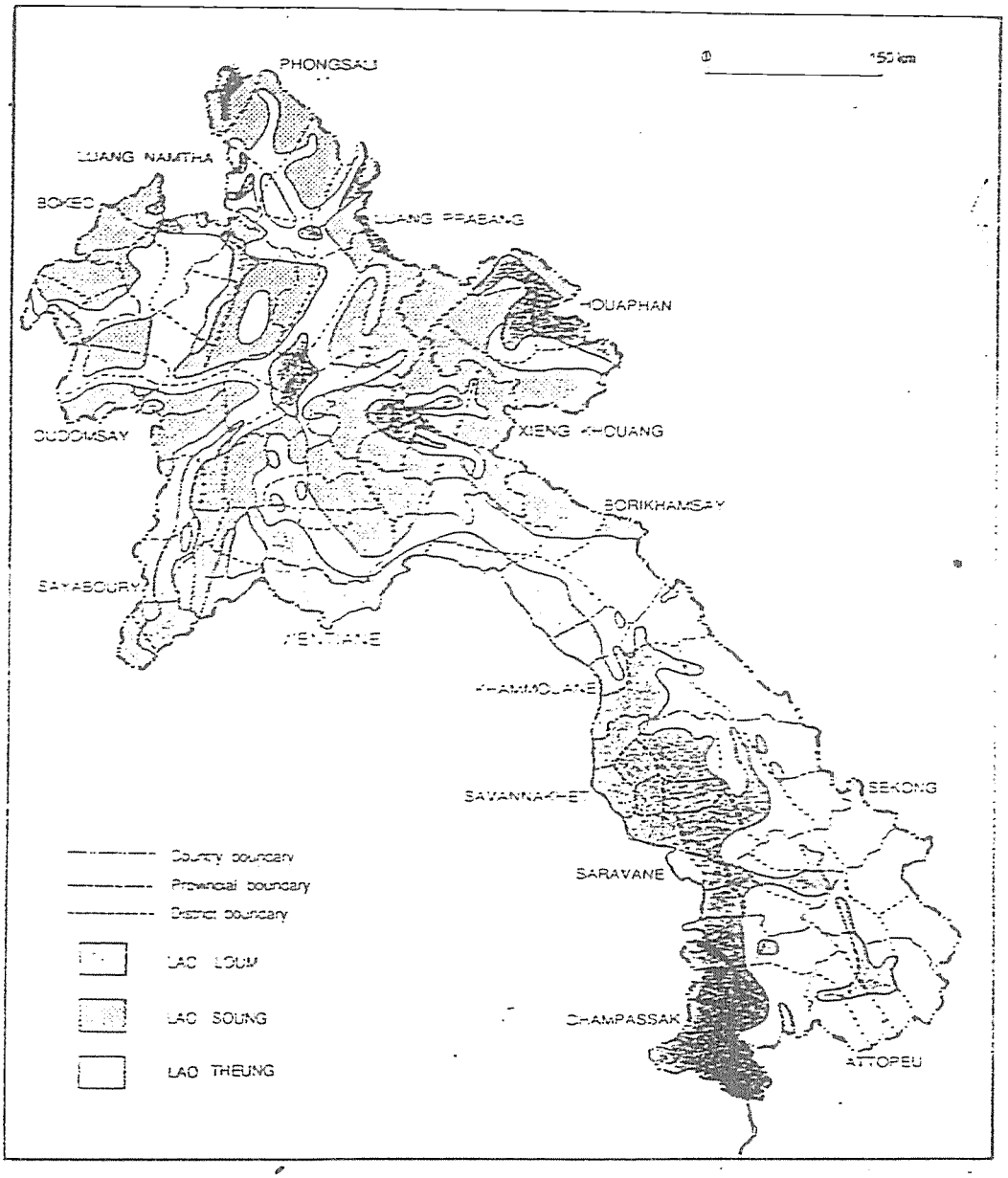
Lao Soung who occupy the mountainous areas of over 1000 meters constituting about a tenth of the local population, and who carry indigenous linguistic traditions in the remote and highly mobile settlements.

2.10 Women and development in Lao PDR

2.10.1 Gender division in rural labour

Gender based division of labour varies among ethnic groups and is linked to the social status of women, especially among Lao Loum. Division of labour appears to be somewhat more rigid for Lao Theung and Lao Soung groups, although the shortage of males sometimes forces some women to perform all tasks. In all stages of agricultural production women are involved. However, traditionally the division of labour by gender often allocates the most heavy and dangerous tasks to men, while tedious and time consuming activities (rice transplanting and weeding for instance) are expected to be carried out

MAP 8 : DISTRIBUTION OF ETHNIC GROUPS



[Courtesy UNICEF, Vientiane. Reproduced from Children and Women in Lao People's Democratic Republic]

Source: UNDP, 1990.

by women. Most of activities related to capital acquisition and maintenance (such as land marking and preparation in shifting cultivation, shelter construction and repair, buffalo and cattle rearing) are the responsibility of men. In all ethnic groups women are expected to take care of small animals (pigs and poultry) vegetable and spice gardens and the fruit trees. The sources of wealth controlled by women are small and more related to household consumption.

Handicrafts is an important source of off-farm income and means of value addition to time. Many Lao rural families are engaged in making various goods at household level with every one in the family participating. Women are responsible for cloth and mat making. Weaving and other handicraft activities requiring little strength are often the major occupations of older women. Wood, metal, gold and silver are usually worked by men.

2.10.2 Women in the rural economy

Participation in production and marketing provides Lao women opportunities to assert their identity and to experience self-fulfillment and some autonomy. More than one half (52 percent) of the active work force is comprised of women[21]. Agriculture, petty trading and manufacturing comprise the most common occupations for women, excluding the domestic activities. Agriculture sector employed 93 percent of the women work force. In agriculture including forestry women constituted 54 percent. Among the workers engaged in 'trade and material supply' 60 percent constituted women. In other areas of employment women's share ranged between one quarter to one third.

Apart from the involvement in the 'productive' activities women are primarily responsible for domestic activities related to household maintenance which include starting fire, carrying water, steaming and heating rice, cleaning the house, and feeding small animals and above all rice husking, the most exhaustive task considered by women. Traditional husking and winnowing of rice takes two to three hours per day and up to five hours for upland women who must also grind maize. All cooking (excluding rice preparation) occupies two to three hours. Water hauling usually requires one or two hours per day (unless the village has an improved source of water which is accessible only to one fifth of the households in the country). 'Other household tasks performed at least once a week include firewood collection (where men sometimes help in the cutting), foraging for wild foods, and doing the laundry. Washing cloths may require only a few hours per week. However getting fuelwood, shoots, roots, herbs or small animals in the forest or bush beyond the village requires many hours each week. Some times one or two days is necessary for this purpose, depending on the location of the resources. The receding forest renders access to forest resources increasingly (particularly in areas of high population density) requiring more time to be spent on fuelwood collection, the requirement of which is estimated at (0.5 to 2.0 cubic meters per capita per year).

2.10.3 Women's social role and position in society

The social role and position of women in Lao PDR is set as in many other societies by tradition which in turn vary with different major ethnic groups, between as well as among themselves. Limited anthropological studies suggest that the Lao Loum women with their matriarchal lineage and matrilocal residence enjoy a more egalitarian status than the other two groups who follow (some Lao Theung and most Lao Soung groups) patriarchal traditions in inheritance and patrilocal in residence.

In the Loa Loum households major family decisions are taken jointly by the couple under the guidance of the parents while the latter group major family decisions are made by men after some consultation with the women (UNICEF 1992).

The constitution of Lao, PDR affirms equality of sexes by stating that 'the men and the women are equal in rights in all political, economic, cultural, social and familial sectors'. However much headway seems need to be made to realise the equality envisioned in the Constitution to in the various spheres of life especially in formal organizations and spheres of influence. For instance, even though women members constituted 40 percent of the in the youth organisation (in 1989), the proportion decreased to 19 percent in the Lao Trade Union Federation and to 9 percent in the Lao People's Revolutionary Party. Yet another example is in the area of education. The disparity in education between men and women widens drastically with the increasing levels in education. In 1985, at the primary school level females constituted 44 percent, secondary level 37 percent and university and higher level 10 percent.

Lao women make crucial contributions to the development and sustenance of the nation. 'Both in their reproductive and productive roles', Lao women's 'lives are oriented towards the basic reproduction of society'. Women of Lao, in common with their counterparts in similarly placed societies, are fully occupied and work much longer than men to ensure the provision of basic needs to family members. 'Frequent child bearing and heavy, uninterrupted work in a difficult environment with limited food availability and little access to medical care leads to a vicious circle of poor health and more difficult work' which needs to be broken to realise sustainable agriculture and rural development.

3. RESOURCE USE AND MANAGEMENT

3.1 Land use and vegetation cover[22]

Land, one of the major environmental resources of Lao PDR, the other being water, is utilised in a variety of ways to derive sustenance and to provide livelihood security for the people inhabiting the territory of Lao PDR. Broadly land in the country could be distinguished into two categories. One, those lands on which the vegetation remain relatively 'undisturbed' even though utilised to derive benefits such as hunting and food gathering, which include 'current' forests, savannah and open woodlands, heath/scrub forest, and grasslands. The other category, 'disturbed' are those lands which have been subjected to human interference in varying degrees. Some recognised as 'unstocked' forests are those lands opened up for cultivation but reverted back to natural vegetation cover during the fallow period. On some lands the ecologically evolved natural vegetation has been altered beyond recognition such as bamboo forests or through extensive practices such as shifting cultivation, logging and grazing or intensive uses such as permanent agriculture.

An indication of the different uses to which land resource is put is provided by analysing the vegetative cover[23] , natural as well as man made. Natural forests generally identified as 'Current Forests'[24] have a crown density greater than 20 percent, by far still the largest land use and vegetation type in Lao PDR constituting 47 percent extending to 11188 thousand hectares (See Figure 5). 'Potential Forests' defined as forests with less than 20 percent crown density constitute 38% spread over 9049 thousand hectares is the next largest followed by 'Other Wooded Areas' accounting for 6% extending to 1444 thousand hectares. 'Permanent agricultural land' constitute less than 4 percent with an extent of 850 thousand hectares. 'Other uses' category include productively unusable areas are barren/rocky areas and urban areas, underused areas such as grasslands, swamps and other waterspreads accounting for over 5 percent extending to nearly 1269 thousand hectares. These are the various land use and vegetation type to which land in the country is broadly classified.

'Potential forests' constitute predominantly, of over three quarters 'Unstocked forests' which are recognised as forest vegetation developed after logging but with reduced regrowth of the understorey being subject to frequent forest fires and shifting cultivation; one sixth bamboo forests and the rest nearly 7% identified as 'ray' lands which have been under shifting cultivation just two years before. Savannah and open woodlands constituted two thirds and heath/scrub forest one third under the category.

Land under some form of natural vegetation cover constituted 91 percent of the land area in the country in 1989 while 'Permanent agricultural land' only less than 4 percent and rest 'Other land uses' 5 percent. Land under natural vegetation cover include 'Current Forests', 'Potential forests', 'Other wooded areas', Savannah and open woodlands, heath/scrub forest. Lands covered with relatively uninterfered/undisturbed natural vegetation (current forests, grasslands etc) even though utilised to derive benefits such as hunting and food gathering, constituted nearly 57 percent of the land area. While lands subjected to human interference (Potential forests and permanent agricultural land) accounted for a little over 41 percent. This includes 'bamboo forests' which has arisen on lands on which the ecologically evolved natural vegetation has been altered through extensive practices as shifting cultivation and consequent fallowing.

3.2 Changes in land use/vegetation cover[25]

Area under 'Current forest' declined by 0.8 percent (181100 ha) and 'Other wooded areas' by 0.6 percent (102200 ha) while the area under 'Potential forests' (which included shifting cultivation areas too) and 'Permanently agricultural land' increased by 0.9 percent (495200) and 0.5 percent (141100 ha) respectively between 1982 and 1989 (See Table 3.1). The area under natural vegetation declined by 283300 ha while area put permanently to agriculture increased by 141100 ha and shifting cultivation, increased by 495200 ha, almost four times the former, indicating increasing pressure on to secure sustenance by the communities.

Table 3.1 Changes in land-use and vegetation cover in Lao PDR (1982-1988)

Land use/ vegetation cover	1982		1988		Change
	Area (000) (ha)	%	Area (000) (ha)	%	%
Current forest	11006.9	47.8	11188.0	47.0	-0.8
Potential forest	8553.8	37.1	9049.0	38.0	0.9
Other wooded area	1546.5	6.7	1444.3	6.1	-0.6
Permanent agrl. land	708.4	3.1	849.5	3.6	0.5
Other non-forested land	1214.8	5.3	1269.4	5.3	0.0
Total	23030.8	100.0	23800.2	100.0	0.0

Source: Adapted from La-Swedish Forestry Programme, Department of Forestry and environment, 1992

The changes in the land use and vegetation affected differently in the various regions of the country during this period. The decline in 'Current forests' has been as much 2.4 percent in the Northern region while the loss was only 1.1 percent in the Southern region, and the area under this category increased in the Central region (See Table 3.2). In all regions the land put permanently to agriculture increased by 0.1 percent in the Northern region, 0.5 in the central region and 1.1 percent in the Southern region.

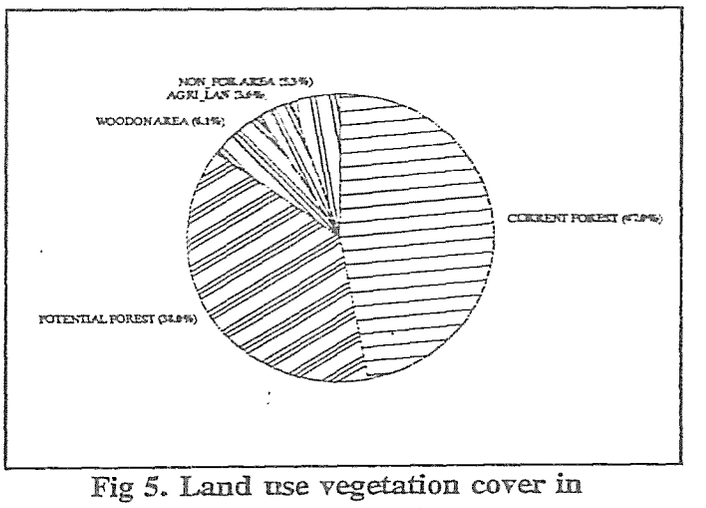


Fig 5. Land use vegetation cover in Lao PDR (1988)

3.2 Crop production (Agriculture)

3.2.1 Crop production in the economy

Even though crop production absorbs only a little over three percent of the territory, by far it is overwhelmingly important to the economy of the country in terms of GDP (32 percent of the total GDP and 55 percent of the agricultural GDP), employment by engaging 85 percent of the work force, and livelihood security for two thirds of the households, of foreign exchange with a modest

contribution through coffee exports (2 percent), apart from supplying almost all the food requirements necessitating imports of rice only to less than one percent of the rice production (ranging from 27000 to 64000 tons since late eighties (NEM). Sustained development of this subsector is critical especially in the short and medium term in reducing poverty, achieving a broad distribution of economic growth and containing rural-urban migration. This subsector will continue to play a very critical role, ensuring food for the nation and employment for the vast majority of the population, at least until the medium term future.

Table 3.2 Changes in land-use and vegetation cover by regions (1982-1989)

Land use/ vegetation cover	1982		1989		Change	
	Area (ha)	%	Area (ha)	%	Area(ha)	%
Lao PDR						
Current forest	11841300	50.0	11611040	49.0	-230260	-1.93
Potential forests	7705900	32.5	7842560	33.1	136660	1.12
Shifting cultvn.	590500	2.5	676930	2.9	86430	14.64
Other wooded area	1604600	6.8	1601780	6.8	-2820	-0.18
Permanent agrl.land	763600	3.2	770840	3.3	7240	0.95
Other non-frstd.land	1178600	5.0	1181370	5.0	2770	0.24
Total land	23684500	100.0	23684500	100.0		00.00
Northern Region						
Current forest	3522900	39.1	3450180	38.3	-72720	-2.06
Potential forests	4512900	50.1	4599730	51.1	86830	0.32
Shifting cultvn.	330400	3.7	316160	3.5	-14240	-4.31
Other wooded area	227100	2.5	227340	2.5	240	0.11
Permanent agrl. land	48900	0.5	48990	0.5	-10	0.02
Other non-frstd.land	361100	4.0	360990	4.0	-110	-0.03
Total land	9003300	100.0	9003300	100.0		00.00
Central Region						
Current forest	4176400	54.1	4067940	52.7	-108460	-2.60
Potential forests	1905000	24.7	1942380	25.2	37380	3.30
Shifting cultvn.	158500	2.1	221280	2.9	62780	39.61
Other wooded area	668500	8.7	671870	8.7	3370	0.50
Permanent agrl. land	249700	3.2	251820	3.3	2120	0.85
Other non-frstd.land	564300	7.3	567110	7.3	28100	0.50
Total land	7722400	100.0	7722400	100.0	0	0.00
Southern Region						
Current forest	4142000	59.5	4092920	58.8	-49080	-1.18
Potential forests	1288000	18.5	1300450	18.7	12450	2.98
Shifting cultvn.	101600	1.5	139490	2.0	37890	37.29
Other wooded area	709000	10.2	702570	10.1	-6430	-0.91
Permanent agrl. land	465000	6.7	470130	6.8	5130	1.10
Other non-frstd.land	253200	3.6	253270	3.6	70	0.03
Total land	6958800	100.0	6958800	100.0	0	0.00

Source: The First National Integrated Extension and Research Project (NIERP-I), Ministry of Agriculture and Forestry and Asian Development Bank (TANo. 1765-LAO) Final Report Volume III. (Sourced from Lao-Swedish Forestry Programme, Department of Forestry and environment, 1992)

3.2.2 Agricultural land use

Approximately 4.7 million ha (20 % of the land area) is regarded as suitable for agriculture. Most of this is situated in the south and central parts of the country adjacent to the Mekong river. About 0.85 million hectares of land recognised as 'permanently agricultural land' is currently under cultivation. Apparently land put to agriculture is only a fraction (3.4 percent) of the total land resource, and a small proportion (one sixth) of the stock of land regarded as suitable for agriculture. But lands reckoned to have put to agricultural uses include not only the 'permanently agricultural land' but also 'ray' lands (0.65 million hectares) which were under shifting cultivation only less than two years ago as well as 'unstocked forest' (6.8 million hectares) which at one time or other were put to/brought under shifting cultivation and currently meeting substantially the grazing needs of the nearly 2.2 million bovine (buffalo and cattle) population (See Table 3.3). Together, the land opened up for agriculture or used for agriculture at one time or other, attain a sizeable proportion of one third of the total stock of land resources in the country.

Table 3.3 Agricultural land use by regions (1989) ('000) ha

Types of agricultural land	Northern		Central		Southern		Lao PDR	
	1982	1989	1982	1989	1982	1989	1982	1989
Permanently agricultural land	51	57	234	296	423	497	709	849
Shifting cultivation (Ray)	352	365	144	155	101	106	598	626
Unstocked forest	4320	4473	1246	1340	935	979	6499	6791
All agril. land	4723	4895	1624	1791	1459	1581	7806	8266

Source: Adapted from Agricultural Sector Memorandum, World Bank

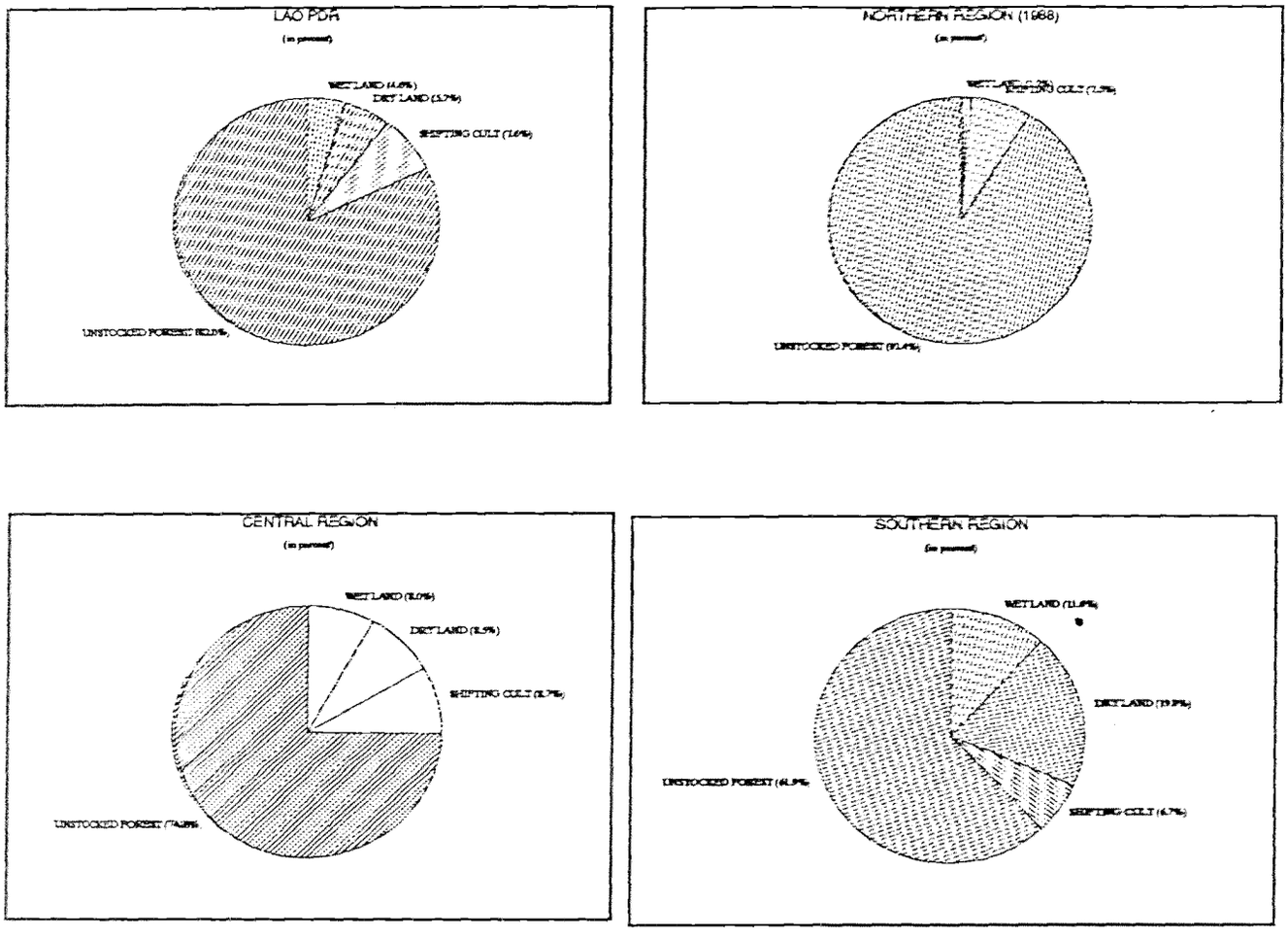
Land put to agricultural uses is on the increase though not as much as expansion in population (between 2.4 to 2.9% per annum). During the period of 7 years between 1982 and 1989 it is estimated that 'all agricultural lands' increased at the annual rate of 0.84 percent per annum, the Central Region registering the highest rate of 1.5 percent (See Table 3.4). Land permanently under agriculture had the highest annual growth of 2.8 percent, exceeding the population growth, and as high as 3.8 percent in the Central region, reflecting the pressure of increasing population for raising food. The other two categories had a slower pace of 0.67 for 'ray' lands and 0.64 percent for 'unstocked forests'. Again Central region registered the highest growth rates.

Table 3.4 Annual average rate of growth (%) of agricultural lands by regions (1982-89)

Types of agricultural land	Northern		Central		Southern		Lao PDR	
	Area	%	Area	%	Area	%	Area	%
Permanently agricultural land	857	1.68	8857	3.79	10571	2.46	20000	2.82
Shifting cultivation (Ray)	1857	0.53	1571	1.09	714	0.71	4000	0.67
Unstocked forest	21857	0.51	13429	1.08	6286	0.67	41714	0.64
All agril.land	24571	0.52	23857	1.47	17429	1.19	65714	0.84

Source: Derived from Table 3.3 above

Figure 6 : Agricultural Land use (1989)



3.2.3 Land use for crop production

Notwithstanding that one fifth of the land is suitable for crop production and nearly one third of the land has already been opened up for agricultural uses (6.8 million ha of unstocked forests, 0.85 million hectares of land permanently under agriculture and 0.63 million hectares of ray lands), at any given year the extent of land on which crops are cultivated (net cropped area) is only 0.71 million hectares and from which crops are harvested (gross cropped area) including shifting cultivation is only 0.73 million hectares of land (the average from 1990-1993 for which reliable data are available) with a cropping intensity of just 1.03 (See Table 3.5).

3.2.4 Land resource base of crop production

The cultivated land is almost equally divided between 'wetlands' (49 percent) and 'drylands' (51 percent)[26]. The predominance of the subsistence nature of the farm economy is indicated by the high proportion of land as much as 92 percent devoted to food crops and just only 8 percent to cash crops of which two thirds is accounted for by perennial crops such as coffee, tea and cardamom. On

Table 3.5 Area, production and yield of major crops in Lao PDR (Average of 1990-1993)

Crops	Area (ha)	Propn. %	Production (tons)	Yield tons/ha
Wetland rice	364 511	51	1 004 139	2.752
Irrigated rice	13 475	2	46 984	3.437
Dryland rice	217 206	30	323 660	1.479
Maize	32 534	5	60 957	1.874
Sweet potato	18 322	3	142 913	7.908
Mung bean	3 456	0	2 414	0.699
Soya bean	5 706	1	4 851	0.850
Pea nut	6 420	1	6 022	0.938
Cotton	7 658	1	5 241	0.684
Sugarcane	3 266	0	90 206	27.624
Tobacco	9 863	1	44 824	4.545
Vegetables	7 657	1	62 064	8.106
Sesame	8 021	1	4 442	0.554
Coffee	26 466	3	6 856	0.363
Tea	2 551	0	1 400	0.614
Cardamum	5 118	1	295	0.058
Gross cropped area	718 047	100	....	....
Net cropped area	709 592	99	....	....
Total rice	595 192	83	1 374 780	2.301
Total wetland crops	384 393	52	.....	....
Total dryland crops	312 196	48	.....	....
Seasonals/annuals	696 589	95	.....	....
Perennials	34 135	5	.....	....
Cash crops	67 193	8	.....	....
Food crops	667 786	92	....	.....

Propn. Proportion to the gross cropped area.
Source: Computed from data provided on area, production and yield in 'Agricultural Statistics Yearbook 1993, Ministry of Agriculture and Forestry, Lao PDR.

95 percent of the land seasonal and annual cropping is practised while perennial crops such as coffee, tea and cardamom are grown only on 5 percent (about 34000 hectares). Crops are grown predominantly under rainfed conditions, on wetland paddies and as well as drylands, as only 2 percent of the gross cropped area is entirely raised under irrigation, mostly irrigated rice (13500 ha) on wetland paddies during the dry season.

3.2.5 Major crops

Rice accounts for almost four fifths of the gross cropped area. All other seasonal and annual crops put together about one seventh and perennial crops just 4 percent gross cropped area. Maize grown on 4 percent of the cropped land is the next crop in coverage. Other crops grown include sweet potato, mung bean, soybean, and cash crops such as sesame, tobacco and cotton. Land devoted to pulses is relatively very small just 3 percent. Among the perennial crops coffee is the most important constituting three quarters and cardamum one quarter, of the land put to perennial crops. Small area is put under tea.

3.2.6 Crop area distribution

By far rice is the most wide spread crop grown both under wet and dry conditions although one half of the wet land paddy rice is grown in the provinces of the southern region and two thirds of all dryland rice (shifting cultivation) in the provinces of the northern region. Two thirds of the irrigated rice in the country is raised in the Central region and one half in the Vientiane Municipality alone. Other crops are very much localised. Three fifths of the maize (Oudomxai, Louangphabang and Houaphan together accounts one half), one half of soya bean (one fifth in Phongsali province), peanut (Phongsali, Louangphabang and Xaignabouli province together one half), three quarters of the cotton (one fifth in Xaignabouli), almost all sesame (three quarters by Oudomxai and Xaignabouli provinces) are grown in the provinces of the northern region. One half of the sweet potato (one quarter in Xekong province), almost all coffee (Champasak province accounts for two thirds), tea (Salavan three quarters), four fifths of the cardamum (Champasak and Salavan contributing one third each).

3.2.7 Crop outputs

Crop production is primarily oriented towards subsistence and hence the focus is on food production. The production basket consists of predominantly food grains and that too rice and some maize, roots as sweet potato, and vegetables, pulses as mung beans and soya beans, and oil seeds as peanut, and some cash and industrial crops such as sesame, cotton, tobacco and sugarcane, spices as chilies and cardamum and beverages as coffee and tea. On the average the country produces nearly 1 400 000 of rice (equivalent to 1 000 000 of milled rice), 61 000 tons of maize, 2500 tons of mung bean, 4900 tons of soya bean, 6000 tons of peanut, 4400 tons of sesame 143 000 tons of sweet potato. Main cash crops produced include 5200 tons of cotton, 90000 tons of sugarcane, 44800 tons of tobacco 6800 tons of coffee, 1400 tons of tea and 300 tons of cardamum. Rice is the staple for all parts of the nation. Maize constitutes a part of the diet of the population in the uplands. Rice, roots, vegetables, pulses and oil seeds are produced mainly for home consumption. Part of the maize is used as animal feed. Sesame is largely sold for cash. So too tobacco, coffee, tea and cardamum. Cotton is grown as raw material for making cloths (spinning and weaving) at the household level which is the main source of off-farm income and employment where it is practiced.

3.2.8 Crop yields

Crop yields are moderate to low. Average yield of rice is 2.3 tons per hectare (1.5 tons of milled rice). Rice yields vary between the low of 1.5 tons in the drylands, high of 3.4 tons under irrigation during dry season and around 2.8 tons in the wet land paddies during the rainy (main) season. Maize yield is 1.9 tons, that of mung bean 0.7 tons, soybean 0.85 tons, and peanut soybean 0.95. Sweet potato yield is around 8 tons, and vegetables 8.1 tons. Sugarcane yield is low at around 28 tons. Tobacco yield is modest at around 4.5 tons. For rainfed conditions yields 0.7 tons of mung bean, 0.85 tons of soybean, 0.95 tons of peanut, 0.55 tons of sesame and 0.7 tons of cotton are low. Coffee yielding 0.36 tons, tea 0.6 tons and cardamum 0.06 tons are very low and offer considerable opportunities for improvement.

3.2.9 Crop production management

Crops are grown predominantly under rainfed conditions. Rainfall for most parts of the country is reckoned to be sufficient for dry land agriculture but short of the requirements to maintain flooded conditions for paddy which is grown on the wetlands. The management of crops is described as 'low input/low output' system. Land is prepared by ploughing with buffalo in single harness on the wet land paddies, and by slash burn on the dry lands, transplanting and dry sowing, manual weeding and harvesting are the main operations done. Aftermath grazing on left over crop residue, dung and animal urine fallen while grazing, at times penning of cattle over night, are the main source of plant nutrient replenishment. Regular application of organic manure is seldom practiced. The ash after slash and burn is the main source of mineral nutrition for the drylands. Very little fertiliser is applied. The total consumption of chemical fertiliser is 4-5000 tons. Manual weeding is intense, especially for rice on the drylands under shifting cultivation. Under these management conditions crops yields can not but be low or at best moderate.

3.2.10 Rice production

Apart from being the principal staple, rice contributes two fifths of the GDP arising from agriculture sector. It is so fundamental to the household food security in Lao PDR, that it is grown wherever possible. Rice in Lao PDR is grown under three agronomic conditions viz. rainfed wetland paddies about two thirds, and dryland (shifting cultivation) nearly one third, and irrigated wetland in a small extent. Rice grown both on wetland paddies and drylands, is rainfed during the rainy season between June to November. During the dry season (December-March) soon after harvest, rice is grown on wetland paddies with irrigation. One half of the wetland rice is found in the southern region and one third in the central region. In contrast, over two thirds of the dryland rice is found in the northern region and less than one fifth in the Central region and the rest in the Southern region. Over two thirds of the irrigated rice and nearly one half in the Vientiane municipality and the rest is equally shared between the other two regions.

Wetland paddy rice accounts for two thirds of the area and contributes to three quarters of the production while dryland rice accounts for a third of the area but less than a quarter of the rice production (**See Table 3.6**). Irrigated rice accounts for two percent of the area and 3.5 percent of the production. These production capabilities are reflected in the yield variations between three rice environments.

The total rice production ranged from 1.0 million tons in 1988 to 1.6 million tons in 1994. The major rice producing provinces are Savannakhet , Champasak, Vientiane Municipality, Vientiane province and Salavan, which together account for on the average 55 percent to the total rice production.

The annual fluctuation in production in the country is high ranging from -19 to 40 percent. The fluctuation in area had a lower range of variation from -13 to +11 percent. The coefficient variation in yield is high with 9.4 for yield. But the highest was irrigated 13.5, wetland 12.6 and lowest for dryland 8.0. What is more interesting is that the coefficient of variation was not very different for the three rice land types with 7 percent, 12 percent and 16 percent for the wetland paddy, dryland and irrigated dry season rice areas.

Table 3.6 Area, production and yield of rice by ecosystems (Average 1990-93)

Region	Wetland Rice		Dryland rice		Total rice	
	Quantity	%	Quantity	%	Quantity	%
Area (hectares)						
Northern	52228	14	150605	69	202732	34
Central	143250	38	41045	19	184304	31
Southern	183171	48	27192	12	210362	35
Lao PDR	378556	100	218842	100	597398	100
Production (tons)						
Northern	143025	14	216763	67	359787	26
Central	391435	37	59178	18	450611	33
Southern	516663	49	47720	15	564382	41
Lao PDR	1051123	100	323660	100	1374780	100
Yield (tons/ha)		Ratio*		Ratio*		Ratio*
Northern	2.738	0.986	1.439	0.994	1.775	0.768
Central	2.733	0.984	1.442	0.975	2.445	1.062
Southern	2.821	1.016	1.755	1.187	2.683	1.166
Lao PDR	2.777	1.000	1.479	1.000	2.301	1.000

* To the national yield

Practically all the rice grown, on wetlands as well as drylands, are glutinous varieties (most preferred by the Lao people for palatability, nutrition, convenience) popularly known to outsiders as 'sticky' rice or 'sweet' rice. Most of these varieties are photosensitive and period bound (a major constraint against multiple cropping). To suit the micro agronomic conditions and to ensure availability of food over an extended period through early harvest, farmers chose more than one half of a dozen varieties with different maturing periods short, medium (proportionately larger), and long duration.

Rainfed wetland rice

The major focus in rice production planning is on the wetland paddies which are mostly available in the lowlands along the Mekong river and its tributaries and the adjoining terraces found in the provinces of the Southern and Central regions, and in the narrow valley bottoms in the hilly areas, especially in the Northern region. Moisture availability is better assured on the wetlands than on drylands. Being located in the lowest elevations in the toposequence, wetlands receive moisture not only from the in situ precipitation but also from the run off from the adjoining lands. In order to collect and store as much rain water as possible fields are bunded on all sides.

Wetland rice is transplanted in mid July on lands prepared by ploughing using animal power drawn by a single buffalo. Land preparation commences only after the rainy season is well set and sufficient water get accumulated in the bunded fields facilitating wet ploughing. Field is puddled before transplanting. Traditionally glutinous rice varieties are grown. Seed bed preparation starts with the rainy season in May-June and planting in late June to early July. Seedlings are raised on seed

beds. Rice is transplanted in hills of two to three seedlings at a spacing of 20 x 25 cm. Animal manure is used but not inorganic fertilisers and pesticides except by a few farmers. Weeding is done once or twice. No specific water management practices is followed. Most of the precipitation is retained within the bunds. Only the surplus run off is drained of as far as the natural system permits. Harvesting, threshing and winnowing is done mid October for early maturing rice varieties, November to early December for late maturing varieties. The crop is harvested by cutting close to the earheads leaving most (one half to two thirds) of the straw in the field. The harvest is transported to the village, threshed dry and stored in bins. The average yield is about 2.2 tons of paddy per hectare. Land is left to grazing by animals. Crop residue composted along with the droppings of dung and urine of the animals, and trampled over while grazing add some fertility to the soil. Towards the end of the dry season in some parts of the country, the field is burned along with the remaining crop residue which in addition to making available ash also destroys weed seeds and the eggs of pests and other pathogens.

Irrigated rice

A small proportion of the rice, not more than 2 percent, is grown during the dry season between November and February under irrigation on the wetland paddies following the main season wherever water supply can be augmented through diversion structures or lifting water through pumping as in river pumping schemes irrigated rice is grown. Though at present this practice is taken up only on a small proportion of the rice area irrigation offers an opportunity to augment rice area. The systems created so far can provide water to raise crops on 35000 hectares, but only one half of the such land dry season rice is cultivated. The average yield is about 3 tons/ha though under high input system (new varieties, fertiliser, pesticides) yields reach up to 3.5-4.0 tons per hectare.

Rainfed dryland rice and shifting cultivation

Wherever the terrain is rugged, undulating and mountainous as in the provinces of the Northern region, valley bottoms are too narrow to develop rice paddies. In such areas, rice cultivation is taken to the drylands on the slopes. Rice on the drylands is grown under shifting cultivation practicing **slash and burn** for land preparation. Land under natural vegetation is cleared of the wild growth by slashing and made ready for sowing after burning the dried weeds and twigs in February. This operation is done by men. Land is cleared collectively by the households inhabiting in the village or clans within a village, and shared equitably among the participating households. Cultivation is undertaken by individual households. The ash left after burning is the main source of fertility. With the onset of rains in June, holes are made to a depth of 4-5 cm 18 to 25 cm apart with thick sticks and 8-20 seeds are put on the holes. Sometimes seeds are covered but most often left open. Between 70 to 75 kg of seeds are required to cover one hectare. The entire family participates in this operation. Not only paddy, but often a mix of other grains especially maize, and pulses on border rows, are also sown. A variety of seeds especially of different duration are planted. Once the plants get established, weeding is done once invariably, and depending upon the intensity of infestation twice or even thrice. It is the most laborious operation and is done by women. The crop is harvested leaving much of the straw behind and the livestock is allowed to graze. After cultivating for one or two years the land is abandoned and another location is selected to come back to the same location after some years. Traditionally this rotation used to take over 30 years, but by the eighties in many parts of the country the period got reduced to 10 and in some extreme cases even less. Because long rotation and moving from one field to another the system is known as '**shifting cultivation**'. In the traditional long fallow rotation land is allowed to recuperate the fertility. With the shortening of the fallow the prospect of fertility building has lessened.

Slash and burn, and shifting cultivation

In common parlance **'slash and burn'** is coterminous with shifting cultivation. Often both terms are used interchangingly. While in the true operational sense **'slash and burn' is an agronomic management practice** or a method of land preparation such as hoeing or ploughing by using animal power or mechanical power. While **'shifting cultivation' is a land use practice** in which cultivation is moved from one location to another during different intervals, unlike under settled agriculture where the same land is used year after another or season after season with multiple cropping. This lack of clarity has drawn many misconceptions in the discussion on shifting cultivation. **All 'slash and burn' is not shifting cultivation while all shifting cultivation practice involve 'slash and burn'.** Land is prepared by slash and burn even on lands under 'permanent agriculture'. 'Shifting cultivation' or 'slash and burn' is not confined to rice alone. It is a dryland farming system where other crops such as maize, pulses such as mung bean, and cotton are grown. Hence 'slash and burn' in this document is referred to as only a method of land preparation.

Slash and burn in fact has many positive features of the conservation agronomy such as zero tillage where the land surface is least disturbed by placing seeds and fertiliser with seed drills by slicing and turning over. Slash and burn is a minimum tillage practice. The land surface is least disturbed as the land is never opened as in ploughing using animal power or mechanical power as in plough culture or by human power as in hoe culture. Seeds are placed in holes without disturbing the soil surface thereby rendering the sloppy lands less vulnerable to erosion.

Shifting cultivation is an ecologically sound agricultural practice as long as the fallow period between the periods of cultivation is sufficient to allow the land to recover. However, because of increasing population pressures in some areas, the average fallow period has been reduced to periods as short as 3 to 5 years. These periods are too short and the fertility of the soil diminishes with each rotation. Although much of the land subjected to shifting cultivation reverts to forest after several years, some remains unstocked thus reducing the nation's total forest area. In addition to the land converted by shifting cultivation, some forest land, even though not suited for intensive agriculture, is permanently converted to agriculture crops, because of increasing population pressure.

3.3 Livestock production

3.3.1 Livestock in the economy

Livestock rearing in the Lao PDR is traditionally a part of the subsistence agriculture, complementing and supplementing crop production. Livestock production in the economy of Lao PDR has greater significance than normally credited to it (providing draft power and main source of protein supply) and similarly placed countries and economies. First, livestock is the most important source of cash income for the rural households as much of the crop production is for subsistence[27], especially food. Second, it is the primary form of asset/capital accumulation especially with liquidity in the absence of a market for land[28]. Third, the livestock subsector accounts for two fifths of the agricultural GDP as against 55 percent of crop subsector. Fourth in recent years, live animal export has assumed as an importance source of foreign exchange earning[29]. Fifth, with 4.1 percent annual growth rate it is the fastest growing subsector[30] within the Agriculture sector of the economy especially after the initiatives under NEM. Sixth, it contributes substantially to the food supply as the

primary source of protein[31]. Seventh it is the single most important source of organic manure with potential that can fertilise every hectare of crop land with 4 tons of rich organic manure with nutrient content equivalent to 25-30 kg of urea[32].

3.3.2 Livestock population

Bovines (buffalo and cattle) are the most important economic animals reared by the rural households. The livestock population of Lao PDR (average of the two years 1991 and 1992) comprised of 1.12 million buffaloes, 0.94 million cattle (together 2.06 million heads of bovines), 0.13 million small ruminants of goats and sheep, 1.5 million pigs and 8.4 million poultry (See Table 3.7). Buffalo population is growing at an annual rate of 3 percent, cattle 6 percent, pigs 3 percent and poultry 6 percent (World Bank 1994b).

Table 3.7 Livestock population and meat supply in Lao PDR (Average of 1991-1992)

Livestock type	Population (Number)	Physical output (tons)	Meat supply (tons)
Buffaloes	1 115 000	40 154	7 615
Cattle	939 000	30 761	4 960
Goats & Sheep	130 000	999	...
Pigs	1 512 000	70 823	22 249
Poultry	8 467 000	12 131	6 928
Total	...	...	41 752
Fish	...	...	31 507
Total (Meat+Fish)	...	...	72 258

Source: Computed from Agricultural Statistics Yearbook 1993

3.3.3 Livestock products

Buffaloes are kept primarily for draught power and in addition, to produce manure. Animal ploughing is done only on wetland paddies for which buffalo is the primary source of draught power. Both male and female buffaloes are engaged in ploughing the land. When they become too old for ploughing they are slaughtered for meat. Cattle are not used for ploughing, but are however used for pulling carts in the plains. They are reared as source of income by selling for meat and as an asset that possess some liquidity on emergencies. Females, whether buffalo or cattle, are primarily kept for breeding and multiplication, rather than production of milk or milk products. These animals are also seen as a source of manure. Goats and sheep are reared for meat. Pigs and poultry are meant largely for home consumption and for sale. Meat and eggs are the products used from poultry. The physical output of all the livestock in the country is estimated at 155 thousand tons which supply 42 thousand tons of meat a year (World Bank 1994b).

3.3.4 Livestock management

Livestock rearing in Lao PDR is essentially a small holder enterprise. It is an adjunct to crop production. Animal rearing is well integrated into the lifestyle of the rural population. Livestock are widely distributed and its distribution closely follows that of the human population. On the average households in Lao PDR own two heads of buffalo, two heads of cattle, two pigs and twenty chicken while cultivating 1-2 hectares of land.

Livestock is raised under low input-low output production environment. Management of the herd is very traditional primarily depending upon the free range grazing for feed and with practically no inputs in animal health care, improved nutrition and breed. Management level is low and so too the productivity. Predominantly indigenous[33], these farm animals (buffalo, cattle, pig and poultry) are well adapted to the existing environment (utilisation of poor quality roughage, tolerance to parasites and tropical heat[34].

Free range grazing is the main feeding practice. Aftermath grazing on the cultivated fields and free range grazing on the pasture and woodlands, are the main sources of forage. Crop residue is not the primary source of feed. Soon after the harvest animals are let into the harvested field to graze on the left over straw and crop residue as much of the straw is left behind after harvest (Only part of the straw, about one third of the length along with the earhead, is cut while harvesting, leaving the rest in the field). In some areas in the lowlands a part of the straw is preserved for rainy season feeding. Such preserved straw is fed to buffalo which are used for ploughing. (In general buffaloes are cared relatively better than cattle, reflecting the greater value placed on the former, as it is the source of traction power for ploughing the field). During the dry season bovines are left free in the natural grazing land for the next six months (November-April) until the commencement of the rainy season. Animals graze by day and night during this time. They are gathered during the day time near the watering points within or in the neighbourhood of the grazing area. Before the onset of the rainy season animals are collected taken to the farm home. Animals are often kept below the owners house where the houses are built on stilts (which is the general housing structure) or in the fenced open spaces. In some parts of the country (the plateau) animals are kept in the pen during nights to collect the manure. Tending livestock is regarded as a low skilled activity and hence left to children and older members of the family who are unable to involve in activities demanding heavy labour. Women usually tend small animals such as pigs, goats and sheep, and poultry.

Cows are mated with bulls in the field. Castration of male is practiced, but only after the reaching sexual maturity to ensure strong, well muscled beast as they are used for draught. Castration is not a management tool. Castration of young stock is not practiced as it is believed that it retards muscular growth. Weaning of calves is not practiced as all the milk is left for the young ones to grow and help increase the stock.

High mortality rates among the animals is found due to epizootic diseases which are spread all over the country with intermittent out breaks. Major diseases found are Haemorrhagic septicemia, Anthrax, Black quarter and Foot and mouth.

3.3.5 Land use for livestock

It is difficult to quantify with some degree of precision the extent to which land in the country is put to livestock production[35]. Livestock feed resources primarily arise from free range grazing on natural vegetation. Natural grasslands cover about 8.1 million hectares 5 .3 million in the northern

mountainous areas, 0.4 plateau lands, and 2.4 million hectares savannah in the low land. The largest and extensively accessed source, and in fact that sustains the present livestock population, is the forage resource (patches of grass growth and herbage undergrowth) found in the 'unstocked forests' in and around human habitations covering 6.8 million hectares spread all over the country.

3.3.6 Livestock production systems[36]

The degree of integration with crop production in terms of supply of animal power and dependence on crop residue as a source of feed; the main purpose for which livestock are kept and hence the species composition especially whether preponderance is of buffalo or cattle among the bovine population or significance of feed lot/small animals such as pig and poultry; the sources of forage feed during different seasons and hence feeding practices; size of the livestock and hence the importance of livestock to the household economy, are some of the determinants in defining the livestock systems and distinguishing one system from the other, in Lao PDR. In the absence of a marketing network as a consequence of poor road communication and geographic isolation arising from difficult terrain conditions, the resource base is the critical determinant in evolving cropping systems and access to forage resources. Hence the livestock systems in Lao PDR are associated with the generally recognised three physiographic conditions viz. the lowland, the plateau and the upland. In the household economy of all these three regions, livestock is significant in terms of the source of cash income, means of capital/asset accumulation, and nutrition supply, although in varying degrees. Under all these three systems, buffalos, cattle, goats/sheep (none or sparsely), pigs and poultry are reared, although the size and composition vary. The cycle of seasonal weight gain and loss, depending upon the availability of forage, (the highest during end of rainy season and early dry season, and the lowest during the end of dry season and early rainy season) as a result of the wet and dry monsoonal climate, is also seen manifested in all the systems. Livestock is the principal form of capital accumulation and perhaps the only asset with liquidity to overcome emergencies and contingencies, number rather than productivity is important.

Lowland livestock system

Rainfed wetland paddy rice is the pivot of the cropping system in the lowlands. As wetland ploughing is the form of land preparation for which buffalo is the most suitable animal to supply traction, the livestock system is centered around buffalo and its proportion is higher in this system than in others. Rice is grown year after another on the same land. Hence fertility replenishment is required which is partly met with animal manure. Land preparation has to begin at a period of the year when the forage supply is scarce (being the end of the dry season land is denuded of all vegetation and the new growth is yet to set in), work animals need feed. Hence rice straw is conserved from the crop and preserved for stall-feeding. Because of the higher population densities, as the carrying capacity of the land in terms food production is higher, on the one hand the total land resource accessible per household is low, and on the other land put to cultivation is proportionately high. Consequently the size of pasture available is low and shortage of land for free range grazing is experienced, and hence livestock holding is relatively small. In order to meet the forage needs tethering of animals and 'cut and carry' system of gathering forage, are resorted to. Aftermath grazing on the harvested rice fields during the dry season is an important source of livestock forage. Combined with plentiful herbage on the drylands weight gain among animals is maximum during this time of the year. Under this system there is greater crop-livestock integration necessitated by the dependence of livestock for forage on crop residue and aftermath grazing, and in reverse on livestock to secure draught power for land preparation and manure to maintain soil fertility. The growth and development of both crop production and livestock rearing are mutually

dependent. Typically thus farm households in the lowland livestock system found to possess on the average 4.4 heads of cattle, 3.1 buffalo, 1.1 pigs and 10 poultry with the support of 1.8 hectares of cultivated land and 2.5 hectares of pasture per animal (Bounthong Bouahom 1993).

Plateau livestock system

With rolling topography despite higher rainfall, wetland paddy is scarce and opportunity for wetland paddy rice cultivation is limited. Rice grown under dryland conditions assumes significance. Slash and burn is the form of land preparation which does not require draught power. Traditionally cattle are not trained to be used for ploughing and buffalo is not suitable for dryland ploughing. Deep well drained soils and longer LGP foster perennial/tree crops (coffee, fruit trees etc.) which again does not demand draught animal power for cultivation. Thus there is less need for draught power and hence proportionately buffalo component in bovine population is low. Low population density facilitates access to larger extent of land. Size of livestock hence tend to be larger. These features of the plateau livestock system are found demonstrated in the study. Households in the plateau found on the average to possess livestock consisting of 9.9 heads of cattle, 2.2 buffalo, 1.5 pigs and 11 poultry. Such households had land holding of 0.96 ha and had access to 3.1 hectares of pasture per animal (Bounthong Bouahom 1993). Dependence on animal traction for land preparation is limited. Similarly crop residue either through stall feeding or aftermath grazing does not contribute significantly to the forage supply. Hence the degree of crop-livestock integration is much less and development of livestock production is independent of cropping.

3.3.6.3 Upland livestock system

The rugged terrain and lands with steep slopes limits the availability of wetland as the valleys are extremely narrow and far between. Sloppy land is brought under cultivation. Crop productivity is maintained through shifting cultivation. Most of the cultivated land is under shifting cultivation although some extent is put to permanent cultivation. Wide range of dryland crops apart from rice which still is dominant, such as maize and root crops are grown. Grain production is inadequate to meet family needs. Slash and burn is the method adopted for land preparation as shifting cultivation on mountain slopes is practiced. Draught power requirement is limited to the small area of wetland rice. Hence proportion of buffalo is smaller in the livestock population. Non-rice dryland crops such as maize and root crops support more feed lot animals. Average possession of livestock for a farm household found to consist of 7.2 heads of cattle, 2.7 buffalo, 3.5 pigs and 11 poultry which had the support 5.0 ha/head of pasture and 1.4 ha of cultivated land (Bounthong Bouahom 1993). Degree of crop-livestock integration is low as neither draught power is important in the cropping system not crop residue is significant in livestock forage. Development of both is mutually exclusive.

3.4 Forestry

3.4.1 Forestry in the national economy

Forests are one of the most important natural resources of Lao PDR. Even though its contribution to GDP is relatively small, less than three percent[37], forestry products (logs and wood products) accounted for over one third of all official exports[38] which is very critical at this stage of

Lao PDR's socioeconomic development and given the lack of export diversification, forest products exports will continue to make a major contribution towards total export earnings.

3.4.2 Land use for forestry

Forestry is one of the largest uses to which land is put in Lao PDR. The country has one of the highest ratios of forest land to total land area in Asia with 11.2 million hectares (1989) under natural forests known as 'Current Forests' and 9 million hectares of 'potential forests[39]', together constituting about 47 percent of the total land area of the country.

3.4.3 Major forest types and timber production

Among the current forests covering the forest areas of Lao PDR two fifths is recognised as 'high density forests')[4]. Current forests may broadly be distinguished into (1) **Mixed Deciduous** (75 percent) (2) **Dry Evergreen** (10 percent) and **Dry Dipterocarp** types (11 percent) and (3) **Coniferous and mixed coniferous** types (about 3 percent) (See **Table 3.8**). The Dry Evergreen Forest which is the primary source of commercial timber, covers only 10 percent of the current forest area but it supports 88 percent of the total timber volume produced (See Table 3.8). In contrast the mixed

Table 3.8 Natural forests by principal types

Forest type	Area (000 ha)	Proportion (%) to Total land	Proportion (%) to Current forest	Timber million (m^3)	Volume (%)
Mixed deciduous	8335.4	35.2	74.6	110.8	11.7
Dry evergreen	1146.3	4.5	10.3	832.6	87.7
Dry dipterocarp	1185.4	5.0	10.6	6.0	0.6
Sub total				949.4	100.0
Current forests	11167.9	100.0	100.0		
Total land	23680.0				

Source: Adapted from Malyvanh, M., Swathvong, S., 1995

deciduous forest types which cover 80 percent of the total forest area accounts for only 12 percent of the volume, and the Dry Dipterocarps with 12 percent of the forest area supports less than 1 percent.

3.4.4 Regional distribution of forests and timber production.

Although the area of current forest is distributed relatively evenly among the three regions, the volume distribution, in contrast, is disproportionate reflecting the physical characteristics of the land (See **Table 3.9**). The greatest volume of timber (42 percent) is generated in the Southern Region reflecting the relatively favourable conditions, flat land with deep rich soils. The Central Region contributes 32 percent while the Northern Region, with the mountainous terrain and relatively low volume mountain forest types accounts for only 26 percent.

Table 3.9 Natural Forest resources in Lao PDR by regions (1989)

Region	Total land Area (000 ha)	(%)	Current forests Area (000 ha)	(%)	Timber Volume (million (m^3)	(%)
Northern region	9820.9	41.5	3562.5	31.8	245.8	25.9
Central region	7228.7	30.5	3739.1	33.5	306.2	32.3
Southern region	6630.4	28.0	3886.4	34.7	397.4	41.9
Lao PDR	23680.0	100.0	11188.0	100.0	949.4	100.0

Source: Adapted from Lao-Swedish Forestry Programme, Department of Forestry 1992 and Malyvanh, M., Swathvong, S., 1995

3.4.5 Potential forests

Next to 'Current forests', largely synonymous with natural forests, there is another major use to which land in the country is put which is generally identified as 'potential forest'. This stock of land estimated at nearly 9 million hectares in 1989 (See Table 3.10) is very substantial amounting to almost four fifths of the area under 'Current forests'. Three quarters of the 'Potential forest' amounting to 6.8 million hectares has been identified as 'Unstocked forest' which has been under forest at one time or other but currently degraded either having been put under shifting cultivation or poor regeneration after logging or even subjected to forest fires. A small proportion of 7 percent is identified as 'ray' lands on which perennial vegetation is yet to get established as till two years ago shifting cultivation was being practised. Bamboo is established on one sixth of this stock of land.

Northern region has two thirds of the land under 'potential forests' in the country and within that four fifths is 'unstocked land', twice the other two regions combined reflecting higher proportion of land brought under shifting cultivation (Table 3.10). The distribution of 'potential forests' between 'bamboo', 'unstocked' and 'ray' are not significantly different in the various regions except that in the Northern region the proportion of 'bamboo' is only one half of those in the other two regions and correspondingly an increase is registered in the 'unstocked lands', the area opened up for shifting cultivation.

Table 3.10 'Potential Forests' in Lao PDR by class (1989)

Region	Bamboo[4] (000 ha)	(%)[1]	Unstocked (000 ha)	(%)[1]	Ray (000 ha)	(%)[1]	Potential F. (000 ha)	(%)[2]
Northern	781.8	13.9	4473.0	79.6	365.0	6.5	5619.8	62.8
Central	515.8	25.7	1340.0	66.6	155.0	7.7	2010.8	22.5
Southern	333.5	23.5	979.0	69.0	106.0	7.5	1418.5	15.9
Lao PDR	1524.3	17.0	6799.7	76.0	625.0	7.0	8949.0	37.8
Lao PDR[3]	1524.3	6.4	6799.7	28.7	625.0	2.6	8949.0	37.8

[1] Proportion to Potential Forests within the region.
[2] Distribution of Potential forests between regions.
[3] Proportion to total land.
[4] Residual of Potential Forests less Ray less Unstocked.

Source: Adapted from Lao-Swedish Forestry Programme, Department of Forestry and Environment, 1992; and from Table 6.5, pp. (World Bank, 1994b)

3.4.6 Forest products

Forests of Lao PDR produce a multitude of timber and non timber products. Industrial timber and local construction material apart, other important commercial forest products include stick lac, benzoin, cardamon, rattan, bamboo and pine resin. It is estimated that approximately 150 additional non timber products are harvested from the forest for rural household consumption. Some are processed and exported.

3.4.7 Forest product industries

Forests in Lao PDR provide raw materials for its forest product industries which produce for both domestic consumption and export. Harvesting firms and sawmills dominate the industry (Table 3.11). The industry has built up a capacity nearly two and one half times the allowable cut[40].

Table 3.11 Forest product industry in Lao PDR

Industry	Number	Capacity (meters^3)
Logging	50-60	
Resaw	14	
Flooring & Parquet	7	
Plywood Mill	1	40 000
Furniture	386	
Charcoal	244	5 170
Wood Energy	310	18 900
Sawmills	116	1 424 500
Total	1 070	1 488 570

Source: (Lao 1994, Amin 1994, Malyvanh, Swathvong, 1995)

3.4.8 Production and consumption of forest products

Commercial timber

The total volume of forest resources in Lao is approximately 1,200 million m^3. The sustainable rate of timber extraction is estimated to be an annual harvest[41] of 288,000 m^3. This rate, which was accepted by the Tropical Forestry Action Plan (TFAP), is the basis for recent logging quotas. Log harvests have increased steadily over the past 40 years, averaging about 75 000 cubic meters during the 1960's; 140,000 m^3 during the 1970's, 270 000 m^3 during the 1980's and during the second half to significantly higher than 300 000 m^3 exceeding the accepted sustainable harvest. In recent years the log production quotas have been stabilised at 275 000 m^3, close to the permissible harvest. In addition to the official log production quotas, illegal harvests are estimated to be between 100 000 m^3 and 150 000 m^3 per year (STENO 1993). Thus total commercial timber harvest (official and unofficial as well) is approximately 425 000 m^3 per year, or about 150 percent of the sustainable rate of timber extraction[42].

Wood for local construction, and fuelwood

The forests of Lao are also a source of wood for local construction and fuelwood as well. Approximately 100,000 m^3 are cut each year to meet the non-fuel timber needs of local communities within or adjacent to forest areas. Wood harvested for fuel is approximately 4 million m^3. However these additional harvests are concentrated in scattered stands, the under story and natural mortality. Hence, although the volumes harvested are significant, the effect on the forest resource is not considered a threat to forest conservation on this account (World Bank, 1993). The annual removal of wood may thus be summarised in m^3:

Logging	250 000- 300 000
Illegal logging	100 000- 150 000
Wastage (40% of removals)	140 000- 180 000
Subsistence farmer domestic use	100 000
Fuelwood (1 m per person)	3 500 000-4 000 000
Total	**4 090 000-4 630 000**

Source: Environmental Action Plan, Organization for Science, Technology and Environment November 5, 1995

3.4.9 Shifting cultivation

The practice of shifting cultivation places a demand on land under forest vegetation. It is generally agreed that shifting cultivators clear between 100 000 and 300 000 hectares a year[43]. Assuming a fallow period which averaged 5.5 years, the area affected is 2 150 000 hectares. It is estimated that about 300 000 families practice shifting cultivation. An additional 100 000 families plant some crops on upland slopes for food, barter, emergency or cash crops using slash and burn cultivation.

Shifting cultivation (dryland rice as a proxy) is concentrated in the northern region which accounted for 69 percent of the total dryland rice. But considering the relatively larger proportion of the geographic area, mountainous and rugged terrain, and lower proportion of wetlands suitable for rice production it is only a natural outcome.

Changes in shifting cultivation area

The annually cultivated area under shifting cultivation increased by 73 percent (250 200 hectares) from 352 500 hectares in 1981-82 to 610 700 hectares in 1988-89, at an annual rate of 37 000 hectares per year. This trend is confirmed by field observations[44]. However the increase in fallow areas has been 5.7 % (229 900 hectares) only, from 4024 100 hectares to 4 254 000 hectares at an annual average rate of 33 000 hectares. Based on these observations, it is estimated that 4 864 000 hectares representing 20.5 percent of the national territory have been opened up for practicing shifting cultivation systems with an average fallow period of 8 years till 1988-89 (against 12 in 1981-1982).

3.4.10 Forest fires

Fires also destroy forest land. Apart from natural causes, fires are used by farmers not only to clear land for agriculture but to promote the production of grass for grazing. Approximately 100 000 hectares are burned each year to improve grazing. These fires often burn beyond the intended area, destroying regeneration and damaging established forests. It is estimated that uncontrolled fires burn about 40 000 hectares of forest each year (Chazee 1994).

3.5 Aquaculture/Fisheries

3.5.1 Aquaculture resources

Water resources suitable for aquaculture include the Mekong river and its tributaries, lakes, reservoirs (natural and manmade, innumerable ponds, bunded paddy fields and swamps. The multitude of aquatic ecosystems provide habitats for 203 indigenous species of fish. With 90 percent of the Lao PDR territory falling in the Mekong basin covering 1800 km of Laotian stretch, its 14 tributaries and 25-30 perennial water courses traditionally the Mekong system has been a major source of fish supply contributing to nearly three quarters of the fish produced in the country (See Table 3.12). Due to overfishing this principal source of fish supply is reportedly declining (20 percent in a decade Csavas 1984).

3.5.2 Changes in aquatic resources over time

During 1988-1993 period pond area increased to 9000 and bunded paddy fields to 41 800 hectares and swamps declined to 1000 hectares. Total area figure still remains the same at 739 000 hectares. Reservoirs built for generating hydroelectric power, Nam Ngum the largest spread over 37 000 hectares and the smaller ones namely Nam Souang, Nam Houm, Nam Tan, Selbam, Nam Dong, Man Moun together add another 20000 to manmade potential. The productivity of these resources are also reportedly declining[45] due to uncontrolled overfishing and use of destructive fishing methods on one hand, and large scale capture of brood fishes during the spawning season. Swamps and flooded lowland areas is another source though insignificant at present. Due to reclamation for other productive purposes including human habitation this resource is reportedly declining (1500-2000 ha in 1983 to 1200 ha in 1988). Wetland paddy fields, both rainfed wetlands and irrigated lands, has been a traditional source of fish and other edible aquatic animals which on the average is estimated to yield about 16 kg per hectare. Rice cum fish culture has gained momentum in recent times with interventions in technology, extension and infrastructure support. Ponds of various sizes scattered all through the country (including bomb craters) estimated to cover 6000 ha of waterspread is another resource with potential for intensive aquaculture. One tenth of this resource has been brought under scientific management yielding 1200 kg of fish per hectare.

3.5.3 Fish production

Fish production from various aquatic resources in 1993 is estimated at 30000 tons of which capture fisheries produced 19240 tons and aquaculture contributed 10760 tons. Fish produced

Table 3.12 Aquaculture resources and production in Lao PDR (1988)

Resource	Area (ha) 1988	1993	Yield kg/ha 1988	1993	Production 1988 Tons	(%)	1993 Tons	(%)
Pond fish culture	6000	9000	305	450	1830	6.8	4050	13.5
Intensive	600		1250		750			
Extensive	5400		200		1080			
Rice fields	416000	418000	11	16	4400	16.0	6688	22.3
Irrigated	16000		25		400			
Rainfed	400000		10		4000			
Swamps	1200	1000	30	22	36	0.1	22	0.1
Reservoirs	57000	57000	20	22	1140	4.2	1240	4.1
Nam Ngum	37000		20		740			
Others	20000		20		400			
Rivers	254000	254000	78	71	20000	72.9	18000	60.0
Mekong	200000							
Tributaries	54000							
Total	739000	739000			27421		30000	

Source: 1988-Status of Aquaculture in Lao PDR S.B.Singh.
1993-Khamphet Roger, Deputy Director of Fisheries Division, Department of Livestock and Veterinary services, Ministry of Agriculture and Forestry, Lao PDR. Communication to FAO Representative, Lao PDR, 06 May 1994.

resources (the river systems and the manmade reservoirs) put to capture fisheries which constitute the bulk of the supply of fish call for urgent interventions in terms of judicious management and conservation. Through imaginative development culture fishery resources, wetland paddies and ponds which remain largely underutilised or unutilised, can contribute significantly to improve rural household income and mitigate the deficiencies of animal protein in the diet[46].

3.5.4 Aquaculture systems

Two major aquaculture systems practiced in Lao PDR are the 'rice cum fish culture' and the 'integrated polyculture', the former a traditional practice and the latter, a recently developed system. Both are being fostered in the country. In addition the system of cage culture is being developed to increase the productivity of aquaculture in the reservoirs.

Rice cum fish culture system

Some fish usually breed in rainfed wetland paddies, but yields are low at 30 kg per hectare. Fish yields are very uncertain and depend heavily on rainfall distribution and could be lower than 30 kg per hectare usually caught without any seeding. Good water control is a basic pre-requisite to rice cum fish culture. Under improved management rice fields which have assured water supply either from irrigation or perennial streams are suited for practicing rice cum fish culture. Small trenches are constructed inside or adjacent to the rice field from which the fingerlings or growing fish enter into the rice field. Common carp, tilapia, Puntius spp. Trichogaster spp. and various locally available species are grown. Under warmer climate even mrigal, silver carp and big head carp are added in small numbers. Water depth in the field is maintained at varying levels between 10 and 15 cm. Duration of the culture ranges from 90-120 days. Supplementary feeding is minimal. It has been proved that yield under rice cum fish culture can be increased from 50-150 to 100-600 kg per hectare per year. The possibility of a taking two crops, a purely fish crop in addition to the existing rice cum fish culture, has also been developed. Fish confer the benefits of stirring up the mud in flooded paddy, thus increasing the availability of fertilizers, and of controlling various insects by eating their larvae. In terms of income the monetary value of 600 kg of fish is almost equivalent to that of ten tons of rice.

Integrated polyculture system

Stocking an appropriate mix of fingerlings and feeding are the two management interventions required for integrated polyculture system. The system is practiced in old or newly dug out ponds where controlled water supply is assured. Ponds are dried, limed and manured. Common carp, Indian carp (rohu and mrigal), Chinese carp (silver/bighead) and local species depending on availability are stocked. Nile tilapia is also used. Fish fingerlings are stocked at a density 3000-5000 per hectare with a ratio 2:2:4 of surface, column and bottom feeders respectively; plus some grass carp if available. The pond is manured regularly and the fish are fed with rice bran. To facilitate manuring livestock such as pigs, duck and poultry are housed over the pond embankments with the house partly stretching over the pond. In the small family ponds, common carp and tilapia are grown, manured with pig dung/chicken droppings and fed mostly with rice bran and kitchen wastes. Yields obtained varied from 50-800 to 200-2000 kg per hectare per year. Increasingly pond fish culture becoming accepted as the ponds also serve as the water storage for livestock and agriculture.

3.6 Farming systems[47]

Generally on the basis of physiographic features, two farming systems viz. the lowland and upland are differentiated in Lao PDR: to which a third viz. the plateau, sometimes seen added because of the distinctive features and potentials. Farming systems in Lao PDR can further be distinguished primarily on the basis of management for which the following criteria could be used: extent of rainfed wetland rice cultivation, extent and nature of shifting cultivation, size and composition of the livestock, and the degree and extent of crop-livestock integration in the rural household economy. All these factors are basically related to the characteristics of the land and water resource endowments, and in turn to the physiography of the land. It is necessary to combine the elements of total resource use, production diversification, topographic/altitude situation and the essential agronomic condition in identifying and characterising farming systems. Combining both

physiography and management practices and reflecting product combination or mix, five farming systems could be distinguished in Lao PDR.

3.6.1 Lowland wetland farming system[48]

[Specification: Lowland rainfed wetland rice-large ruminant (buffalo-cattle) farming system]

Dominance of wetland paddy rice cultivation (constituting about four fifths of the cultivated land) on level, bunded fields and preparing land by wet ploughing using buffalo for traction are the distinctive features of the lowland rainfed wetland farming system. Land is permanently put to cultivation and cropping is done annually. Originally natural vegetation consisted of lowland forests which has been removed for cultivation. Secondary forests are used for grazing livestock. Production is rainfed dependent on south west monsoon using the rain water retained in the bunded fields. Glutinous, traditional photoperiod-sensitive varieties are used. Farming families practicing this system do raise crops other than rice on drylands (one fifth of the cultivated land) dependent on rains using slash and burn or hoeing by hand and not ploughing, as the method of land preparation. They also use pasture available in the surrounding environs of the habitat for grazing the livestock. Bovines constitute the most important segment of the livestock population. Buffalo proportion among the bovines is relatively higher as wet ploughing is the dominant form of land preparation. Cattle are reared as a source of cash income and asset. The proportion of land put to cultivation is higher. Hence there is scarcity of forage that can be secured through free-ranging. Crop residue and aftermath grazing of the wetlands are important sources of forage. Livestock manure is the main source for soil nutrient replenishment. Because of the mutual dependence of the crop and livestock production activities, the degree of crop-livestock integration in the system is greater and strong.

This farming system is prevalent in the lowland plains and terraces which occur along the Mekong river and flood plains, fans and valleys of its tributaries, inhabited predominantly by the Lao Loung ethnic group covering about one fifth of the country and supporting one half of the population. This farming system is predominant in the Southern Lowland Plains and Terraces AEZ-1 although found practiced in other AEZs especially in the Foot Slope AEZ, also. Lying in the altitude range of 200-500 m tropical wet and dry climate is experienced. Annual rainfall ranges from 1500-2000 mm falling mostly in the period of May-September (75%) Rainfall though high is variable both by location and time. Short dry period during the growing season in June causing moisture stress. The flood plains comprise low humid grey soils and recent alluvia. On the higher terraces the soils are formed in old alluvium and mainly consists of mainly podsol and laterite. The land is generally suited for to a wide range of crops.

3.6.2 Lowland irrigated farming system

[Specification: Lowland irrigated wetland-large ruminant (buffalo-cattle) farming system]

This farming system is an intensification of the rainfed wetland farming system. Wherever water supply to raise a rice crop is available, second rice is cultivated on the wetland paddies during the dry season. This is the only environment in which there has been significant adoption of

improved varieties. Improved varieties cover 90 percent of the irrigated rice which extent to about 15000 hectares at present. The main improved varieties used are the Thai glutinous variety RD16 covering 90 percent and the Vietnamese non-glutinous variety CR203, former preferred for its grain quality though the latter is higher yielding (and also susceptible to brown plant hopper attack). There is also greater use of fertilisers and pesticides. Yields under irrigation are higher and stable than yields obtained under rainfed conditions. (3.5 tons for the former and 2.6 for the latter). The potential of this farming is not fully exploited as the irrigation potential created is about 35 000 hectares. Lack of photo-insensitive varieties and the socially accepted tradition of unrestrained aftermath grazing right, are likely to act as major constraints in fully utilising this potential (See paragraph 5.2.2 for a comprehensive discussion).

3.6.3 Upland farming system

Shifting cultivation, of moving cultivation periodically from one location to another and returning to the previous location after a lapse of time, using slash and burn as the method of land preparation, and livestock rearing by free-range grazing are the distinctive features of this farming system. Cultivation is done on slopes of varying intensity, under rainfed dryland conditions including rice. There is greater crop diversification, though rice is still the dominant crop, with maize, pulses and root crops. Next to rice maize is the important crop. Glutinous varieties of rice are preferred. Varieties are selected for their palatability and aroma. Productivity of land is maintained through long fallow rotation. The rotation period is decreasing under pressure with the increase in population. If valley bottoms are available farmers do practice rainfed wetland rice cultivation which however constitute relatively a smaller proportion of the cultivated land. Livestock holding size is larger as there is greater access to pasture and contributes a larger share to the household economy. Ruminants entirely depend upon the free ranging of environs in the neigbourhood of the habitation and the lands under ray. Aftermath grazing on the harvested fields also contribute but not critical as in the lowland systems. Animals are not used for traction except for the wetlands. Composition of bovines is dominated by cattle. The level of crop-livestock integration is low or almost absent. The proportion of buffalo is low (Buffalos are kept to meet the needs of wetland rice cultivation apart from as an asset or capital). More feedlot/small animals especially pig are found in the livestock composition. This system is found practiced in a wide variety of rainfall regimes and altitude where the topography is hilly and mountainous. Ethnic group identified as Lao Theung and Lao Soung are the dominant inhabitants in the areas practicing this farming system.

Sedentary shifting cultivation

[Specification: **Upland rainfed dryland -large ruminant (cattle-buffalo) shifting cultivation with sedentary/stationery habitation]**

The predominant shifting cultivation practice is in which the cultivation is moved from one location to another but the habitation of the community or the village remain permanent at one location. Other characteristics remain the same as described in section 3.4.3. This system is found practiced in the agroecological zones of the lower altitude characterised as the Footslopes (AEZ-2), the Footslope and Mountains (AEZ-3), the Plateau (AEZ-4) and in the Central-Northern uplands AEZ-5. predominantly in altitude range 500-1500 m.

Migratory shifting cultivation

[Specification: **Upland rainfed dryland -large ruminant (cattle-buffalo) shifting cultivation with migrating/nomadic habitation]**

In the higher altitudes and isolated mountainous areas, communities practice shifting cultivation not only move cultivation from one location to another, but also move the habitation to the location where adequate land is found for cultivation. This practice is more prevalent in the Highland Mountain zone AEZ-6) among the remote, isolated communities.

3.6.4 Plateau farming system

[Specification: Plateau rainfed dryland-perennial crop large ruminant (cattle) farming system]

The practice of growing perennial/tree crops such as coffee and cardamom and larger livestock holdings are the significant features that distinguish the farming system practiced in the plateaus from the upland farming system. Longer LGP and deep and well drained soils fosters the growth of perennial crops. Coffee is an important crop. Primarily crops are grown under rainfed dryland conditions using 'slash and burn' as the means of land preparation, the perennial crops including. Rice and other annual crops are raised on shifting cultivation lands. The rolling topography with milder slopes does not permit wetland paddy formations. Hence wetland rice growing is limited. The livestock holding sizes are larger than the lowlands (and also uplands also) as the area endowed with richer grazing resources (grasslands) and the very availability of larger extent of land for foraging. Livestock are reared under free-range grazing. Proportion of buffalo among bovines is low as very little of land is under wetland rice and slash and burn is the means of land preparation. Crop livestock integration is low as neither land preparation is dependent on animal draught nor livestock feeding is based on crop residue. Cash income from perennial crops and livestock. The areas under this farming system is coterminus with the Plateau agroecological zone (AEZ-4). Lao Soung and Lao Theun are the major ethnic groups inhabiting this area.

3.7 Water resources (use and management)

The rich endowment of water resources which is one of the most important potential that can usher in economic development and prosperity is currently being underutilised partly due to inherent physical disabilities and partly due to dearth of capital and technology. Knowledge on the immense water resources of the country is scanty. Some information is available on the surface water potential while knowledge on the ground water potential is scanty. The principal uses to which water resources of the country currently used are irrigation, hydropower generation, transportation, and fisheries, apart from drinking water for human and livestock populations. Briefly the current status of these major uses other than fisheries which has already been reviewed, are discussed below.

3.7.1 Irrigation

Plentiful supplies of water are found in the country but its limited availability in the dry season prevents optimum use of the arable land. Rice is the principal crop grown in the country that requires irrigation support. More than 98 percent of the rice grown in Lao PDR is rainfed. Although

there is considerable scope for increasing agricultural productivity through irrigation[49], the infrastructure is poorly developed and maintained. At present only one crop is taken from the wetland paddies that too during the main rainy season. During the rest of the year this potential land resource remain unutilised as there is not enough moisture to raise another crop.

Rice is the only crop irrigated. Out of the 364 500 hectares of wetland paddy rice only 13 500 hectares of land is cultivated with irrigation support. Storing and diverting surface water across streams and rivulets through simple structures is the primary means adopted traditionally for providing irrigation. Lifting water by pumping from rivers is the main means adopted under modern irrigation systems.

Year	Area (ha)	Prop. wetland	Production (tons)	Yield (tons/ha)
1990	12047	3.01	40992	3.40
1991	13325	4.13	43722	3.28
1992	15507	3.96	55300	3.57
1993	13022	3.72	45576	3.50
Average	**13475**	**3.71**	**46398**	**3.44**

Irrigated rice accounts for less than 2 percent of the rice area (gross cropped area) but contributes to 4 percent of the production. It is during this season that much of the modern inputs such as improved seeds, fertilisers and pesticides are used. The average yield from irrigated land than the main season rice crop from the wetlands. Almost one half of all irrigated land is in the Vientiane municipality (about one sixth of the wetland) and distantly followed by Savannakhet province with 13 percent. Other provinces where lands receive irrigation of some significance are Louangphabang province (800 hectares) and Vientiane Province (750 hectares, Khammouan and Xaignabouli provinces 550 hectares each.

So far the irrigation potential created is estimated at 35000 hectares. However only less than one half the potential is currently being utilised. Substantial investment has been made in large scale public sector-managed irrigation schemes but returns on investment and productivity have not been commensurating for a variety of reasons. Small-scale units managed by farmer groups are found to be more successful.

3.7.2 Groundwater

Supplying safe drinking water to rural areas is the only use to which any significant quantity of water from this source is being put currently. Preliminary information available on ground water resources is reported to have significant potential rural water supply development in the country (UNICEF 1991).

3.7.3 Hydropower

Hydroelectric potential of the water resources of Lao PDR offers one of the biggest opportunity for economic develop through internal use and export. The technical hydropower potential of the country is placed at 22000 mw of which only 198 mw have been utilised so far. The largest hydroelectric facility is at Nam Ngum which has an installed capacity of 150 mw. Currently about 800 Gwh are generated annually. The second largest power plant in the country, the Xeset power station in the south has been commissioned in 1991. The Xeset power station with an installed capacity of 45 mw, and an annual generating capacity of 150 Gwh. Consumption within the country is relatively small. The combined capacity of these two power stations constitutes only one hundredth of the hydropower potential in the country. Plans are underway to construct a number of new hydroelectric power plants. Almost four fifths of the hydropower generated in the country is exported to Thailand.

3.7.4 River transportation

Much of the land is mountainous and the terrain is very rugged. Hence it very difficult to develop land transport systems. Whatever road transport system developed is largely confined to the plains and a net work is being developed linking the major towns (provincial capitals) in the interior (**See Map 9**). The interiors Rivers provide an important means of transport in Lao PDR. In some parts of the country river transportation is the only means of travel. Historically, habitations developed along the rivers and other waterways to facilitate communication and access to water for human and livestock consumption as much of the country is mountainous and of rugged terrain. Much of the Mekong river along the border with Thailand is navigable except for certain stretches of the river with rapids and falls. Total obstruction is the Khong falls (5 km long). The Khemmarat and Kanheup rapids between Savannakhet and Pakse are passable by small vessels during two three months of the tear. During July to February the section between Vientiane and Louangphabang is navigable by larger boats. Navigation is also restricted to smaller vessels of five to ten tons during the dry season because of reduced water levels. In addition, the tributaries totalling a stretch of 3000 km provide transportation for goods and passengers in small three to five ton boats and canoes.

3.8 Economic development

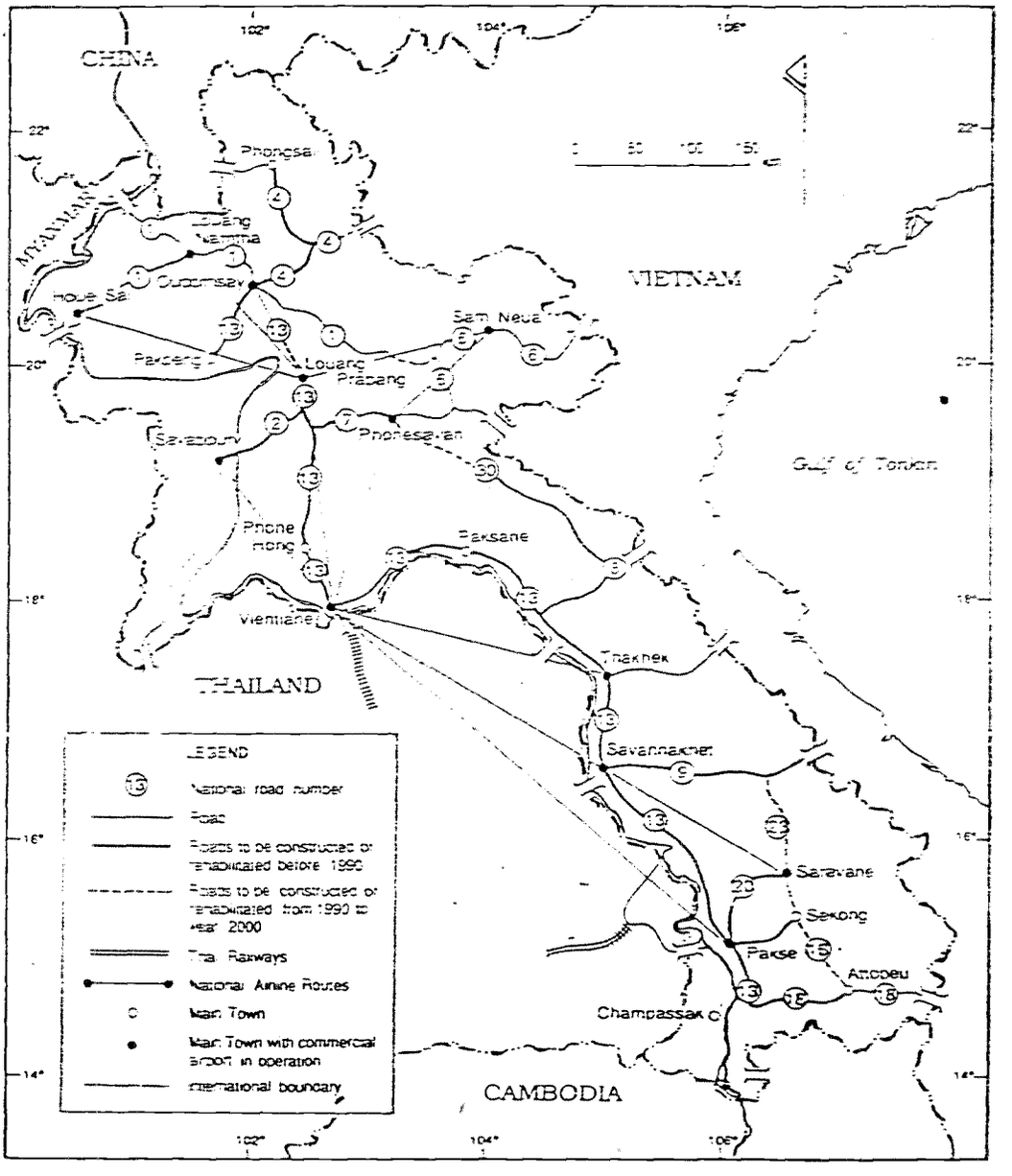
3.8.1 Characteristics of the national economy

Some of the principal characteristics of the national economy of Lao PDR which have significant relevance to economic development are:

Low per capita of income of US$ 335 in 1994 which is generally recognised as an understatement of the living standards because of the non-representation of the non-monetised segment of the economy in the income data especially with respect to the rural sector, where subsistence farming is the main occupation.

Relative low income disparity with a Gini coefficient (income distribution) of 0.32 largely because of the equity in the ownership of cultivated land as a result of the land reforms, and the traditional communal ownership of other land resources

MAP 9 : NATIONAL TRANSPORTATION NETWORK



[Courtesy UNICEF, Vientiane. Reproduced from **Children and Women in Lao People's Democratic Republic**]

Dominance of the agriculture sector in the national economy as this sector accounted for 56 percent of total value added in 1994, and covering a wide range of activities from subsistence production to agriculture related industries; despite over-dependence the share of agriculture GDP declining from 59 percent in 1992 to 56 percent in 1994.

Expanding industrial sector under the NEM adopted in 1986, there has been considerable expansion in the output of the industrial sector particularly manufacturing.

Dependence on agriculture as the principal source of employment and livelihood security with as much as about 80 percent of the population is considered engaged in agriculture, broadly defined to include livestock, fisheries and forestry in addition to cropping;

Dominance of rice in agriculture as 600 000 hectares or four fifths of the approximately 737000 of land under cultivation is devoted to rice cultivation and a third of the rice is grown on drylands;

Predominance of rainfed agriculture with only less than 2 percent or 14000 hectares of the rice is irrigated and hence the food security is precarious especially of those families dependent on rice for food on the drylands (three fifths of the population dependent of dryland for rice do not produce enough to cover their own needs and lack of rice for about three months of the year, during which time they eat maize, cassava, taro, and other rice substitutes).

Significance of livestock in the household economy being the principal exchangeable asset and source of cash income rural families have sizeable livestock holdings which include buffalo and cattle, as well as pigs, sheep, goats, poultry, and other animals.

3.8.2 Macroeconomic performance

The Lao PDR's economy registered 6.3 percent annual average growth of GDP at constant 1990 prices during 1990 to 1994 which is considered quite respectable even when compared to the economic growth performance of countries in the dynamic Southeast Asian sub-region (UNDP 1995b). This growth was achieved in an environment of stable domestic prices and exchange rates. Inflation was gradually brought down from a record 75.5 percent in 1989 to single digit levels until December 1994. The parallel market exchange rate remained stable within the range of Kip 698 too Kip 726 (buying) to the US dollar since October 1989 and until December 1994. The budget deficit was brought down to 7.7 percent of the GDP, financed largely through liquidity expansion at an average annual rate of almost 50 percent since 1992. The balance of payment (BOP) current account deficit (excluding official transfers) was also brought down to 6.3% of GDP in 1993. Mainly due to sustained inflow of external assistance and increased inflow of direct foreign investment since 1993, the gradual build-up of international reserves continued, reaching $158.2 million by end of 1994, equivalent to 3.5 months of imports. Despite an increase in the debt stock, due to its highly concessional terms the external debt service burden of the country has remained manageable at around 4.5% of exports. One salient feature of the debt burden is that all of the disbursed and outstanding debts of the Lao PDR acquired so far were from official bilateral and multilateral sources.

Since the beginning of 1995 there has been a slide back in some aspects of the economy. Inflationary rate has crossed the single digit levels. The budget deficit has exceeded 10 percent of the GDP. Current account deficit in BOP jumped to 14.4 percent, mainly due to increasing import

requirements. Export base still continue to be thin. The dependence on official developmental assistance continue to be substantial. Urban unemployment in 1994 is placed at 5.6 percent of the labour force. The per capita income estimated at $335 in 1994 is still one of the lowest in the world and Lao PDR continues to be one of the least developed countries (UNDP 1995b).

3.8.3 Political and administrative organization

The Constitution of Lao PDR adopted in 1991 provides for the separation of legislative, executive and judicial powers. Political power ultimately resides with the people who exercise such power through a directly elected National Assembly for a fiver-year term. Apart from legislative work, the key functions of the National Assembly include the approval of annual state budget, and the medium-term national development plan and public investment programme. The constitution further defines the authorities and structure of the state and the fundamental rights of the citizens. It also provides a legal frame for a market-based economic system. The Head of the State is the President, and the main organ of the Government is the Prime Minister's Office headed by the Prime Minister. The Government is composed of eighteen members including heads of ministries, Bank of the Lao PDR, and Committee for Planning and Cooperation (CPC). The President of the CPC is concurrently the Deputy Prime Minister.

Administrative structure extends from the national level to the levels of provinces (the Vientiane Municipality, 17 provinces and one Special Region), districts (133) and villages (11795). The province is administered by a Governor. Divisions of responsibilities within the provincial and district administrations are similar to those at the central level, covering the same fields as the central ministries except in the areas of national defense, foreign affairs and police.

The leading role of Lao People's Revolutionary Party (LPRP), the only political party is explicitly recognised in the Constitution. The Central Committee headed by an Executive Committee guides the Party. The Party organizational network extends downward to the district and village levels, in parallel with the government administrative structure.

The current assembly was elected in December 1992, and its fiver-year term commenced in January 1993. Among the important legislations it has passed which are vital to the functioning of the market economy are: revised foreign investment law, budget organic law, taxation law, and the law on business operations.

3.8.4 Economic and development management system

In 1986, the Fourth Party Congress adopted a package of reforms intended to transform the economy from a central command system to one which is market based and characterised by decentralised economic decision making, with the private sector playing an active role. The new economic management system emerging from the implementation of the economic reform package is referred to as the New Economic Mechanism (NEM) in the Lao PDR. Adoption of NEM was subsequently confirmed by the Fifth Party Congress in 1991. An economic system anchored on market principles is now enshrined in the Lao PDR constitution.

A system of indicative macroeconomic planning, medium-term public investment programming, and annual budgeting has been adopted as an instrument for development management. CPC in cooperation with the sectoral ministries and local government units, has drafted the country's development plan up to the year 2000, and the accompanying medium-term public investment programme. They will be presented to the National Assembly in September 1995 for consideration and approval, along with the annual state budget and plan. At the session of the National Assembly in September 1994, the Deputy Prime Minister and Concurrently President CPC presented the country's seven priority programmes up to the year 2000, as follows: food production, stabilisation/reduction of shifting cultivation, commercial production, rural development, human resources development, expansion of foreign economic relations, and infrastructure development.

In line with the NEM reform programme, the administrative reforms include further delineation of the responsibilities of the Party from those of the State and structuring of the civil service to correspond with the implementation requirements of the NEM reforms.

Decree 68 providing for the Fundamental Centralisation of State Finance, Budget and Treasury, promulgated in August 1991, has reformed the administration from horizontal to vertical management, placing fiscal collection and budgetary allocation under the ministerial purview.

3.9 Human resource development

3.9.1 Human development

The Human Development Index (HDI) for Lao, PDR estimated in 1992 is 0.420 which ranks 138 among the comity of 174 nations (UNDP1995a). Life expectancy at 51 years is still one of the lowest in the world. Infant mortality and under five mortality rates are 125 and 182 per thousand live births, respectively. Maternal mortality rate is estimated at more than 500 per one hundred thousand live births. Only a little over one third of the rural population has access to safe drinking water and less than a quarter to sanitation facilities. Access to modern health care services is limited to 12 percent. Vast majority (58 percent) is dependent on pharmacies, some on traditional healers (17 percent) and the rest (13) received no care World Bank 1995). The change in sex ratio[50] reducing the proportion of women in the population observed between the last two population census deserve concern that it could be an indication of a possible deterioration in the biophysical status of women in the country.

3.9.2 Human capital formation

The mean years of schooling in Lao PDR is only 2.9 years. Enrollment rates in the primary school is 60 (rural areas 54 and urban areas 78) and the lower secondary level dropping drastically to 15 (rural areas 11 and urban areas 26). Only one half of the adult population is literate. Under the conditions prevailing in the country, of the six out of seven children born alive who will likely to survive beyond their fifth birth day, three will likely be chronically malnourished, and only four will enroll in the primary schools UNDP 1995b).

3.9.3 Incidence of poverty

It is estimated that in 1992-93 a quarter of the population in the country did not have the annual income of Kip 8558 to buy enough food to meet their basic food energy requirement (2100 calories per person per day) defined as food poverty (See Table 3.13). Such people were as much as over a quarter of the population in rural areas while their proportion was less than a tenth in the urban part of the country. Among the regions, the southern region had nearly a third of the population who were below the food poverty threshold while in the other two regions their proportion was less than one fifth.

If the income threshold is raised to Kip 11,472 per person per month to include essential non-food expenditure (poverty line), estimates show that 46 percent of the Lao population during 1992-93 lived in poverty (See Table 3.13). By the same reckoning, incidence of poverty among the rural population was found to be 53 percent while for the urban population it was only 24 percent. Southern region exhibited higher incidence with 60 percent below poverty threshold and for the rural population as much as 66 percent. Consistently incidence of poverty was higher in the rural areas of the country, and in the south both rural and urban, among the regions.

Table 3.13 Incidence of poverty by region and sector in Lao PDR (1992-93)

Region	Head count ratio			Poverty gap index		
	Rural	Urban	Total	Rural	Urban	Total
Food poverty line*						
0.045	0.003	0.038				
Central	0.216	0.112	0.184	0.042	0.015	0.034
Southern	0.373	0.006	0.310	0.098	0.001	0.081
Lao PDR	0.260	0.076	0.216	0.055	0.010	0.044
Poverty line**						
Northern	0.527	0.160	0.464	0.129	0.025	0.111
Central	0.469	0.257	0.404	0.118	0.060	0.100
Southern	0.662	0.288	0.598	0.224	0.017	0.188
Lao PDR	0.530	0.239	0.461	0.144	0.045	0.121

* Annual income of Kip 8558 per person sufficient to 2100 calories of food per person per day.

** Annual income of Kip 11472 per person in addition to food include non-food expenditures.

Source: Adapted from Table A pp. iii, 'Social Development Assessment, Lao PDR. Report No. 13992-LA, World Bank, August 15, 1995.

3.9.4 Incidence of income disparity

The poorest one tenth of the population accounted for only 4.2 percent of the total consumption, while the richest one tenth consumed 26 percent. Inequalities in income distribution in Lao PDR is relatively low as the Gini Coefficient, a broad measure of the equality in income

distribution, estimated for Lao PDR is 0.32 which compares favourably with 0.34 for Vietnam and 0.32 for Indonesia, both are among the high equality nations in the world (World Bank 1995). Apart from being a low income agricultural economy, the traditional communal ownership of land, and the egalitarian land distribution effected in the recent past must have contributed in bringing about greater equality in income distribution. Land holding in Lao PDR is nearly universal. On the average each family owns 1.4 hectares of cultivable land. The lowest one fifth in income distribution owned 1.29 hectares while the highest one fifth income group owned only 1.72 hectares (World Bank 1995).

3.9.5 Food security

Food security of the nation through self-sufficiency is one of the dominant concerns in development planning of Lao PDR as seen reflected in the development policies and programmes pursued hitherto in the country and currently being formulated for the immediate future. The nature and quantitative dimensions of food security are briefly summarised in **Table 3.14.**

Availability of food

Estimates on the availability of food from internal sources for a given year is primarily dependent on the production of foodgrains (basically rice) in the previous year. The net viability however is determined by the quantity retained as seed for raising the crop in the following year (3-5% of the production), conversion efficiency of paddy into rice (60-66%), extent of loss and wastage (10-15%). To the extent food is imported (commercial as well as food aid) availability also varies. Supply from previous year's carry over would be neutralised as the same to be carried forwards to the next year.

Food production in the country fluctuated between 1.22 to 1.58 million tons during the five year period from 1990 to 1994. Almost the entire rice grown, whether on wetlands or drylands, is rainfed and hence production is primarily dependent on the incidence of rainfall. In years of poor rainfall the aggregate production of rice declined to around 1.22 million tons as in 1991 and 1993 while in normal years production revolved around 1.50 million tons as in 1990, 1992 and 1994. Thus the difference between the years of sub-normal and normal rainfall is around 20 percent. There has always been some import of rice in to the country through official channels by way of commercial imports (around 14000 tons in 1994 but varied from 7000 in 1985 to 42000 tons in 1989) and food aid (about 15000 tons I 1994). In addition there could be some informal exchange between the deficit northern provinces bordering Thailand. Reverse is also possible in the rice surplus provinces of the Central region.

Requirement

Aggregate requirement is a function of the population numbers and the food energy needs. Population in the country is reckoned growing at an annual rate of 2.9 percent from 4140 thousand in 1990 to 4709 thousand in 1995.

Food energy requirement is estimated variously based on the preferred assumptions on climate and the activities pursued, age and sex composition of the population, food composition and incomes. One of the most recent FAO investigation 'Diagnostic de la situation nutritionalle et consommation alimentaire as Laos' of October 1994 estimated the average energy requirement per day per person at 2328 Kcal. For a similar population, living and working under comparable climatic conditions,

Table 3.14 Food security status in Lao PDR (1991-1995)

No	Indicators	Unit	1990	1991	1992	1993	1994	1995
1	Paddy Production	tons	1491495	1223374	1502360	1250630	1577000	
2	Population	000	4140	4248	4360	4474	4590	
3	Paddy output less seed 1	tons	1446750	1186673	1457289	1213111	1529690	
4	Rice (converted)	tons	896985	735737	903519	752129	948408	
5	**Net availability**							
A	Loss & wastage 10% [2]	tons	743097	789347	647449	795097	661874	8345
B	Loss & wastage 15% [2]	tons	700875	744498	610662	749921	624276	7871
6	**Annual requirement**							
	At 180 kg per capita	tons	745200	764640	784800	805320	826200	8476
	At 162 kg per capita	tons	670680	688176	706320	724788	743580	7628
	At 146 kg per capita	tons	604440	620208	636560	653204	670140	6875
7	Net availability(per capita)							
	Loss & wastage 10%	kg	180	186	149	178	144	17
	Loss & wastage 15%	kg	169	175	140	168	136	16
8	**Food security status (5A)**							
A	At 180 kg per capita	%	0	+3	-17	-1	-20	-
	At 162 kg per capita	%	+11	+15	-8	+10	-11	+
	At 146 kg per capita	%	+23	+27	+2	+22	-1	+
B	**Food security status (5B)**							
	At 180 kg per capita	%	-6	-3	-22	-7	-24	
	At 162 kg per capita	%	+5	+8	-14	+4	-16	-
	At 146 kg per capita	%	+16	+20	-4	+15	-7	-

[1] Less seeds 3% [2] Other uses 2%

8A Net availability at 10% loss and wastage 8B Net availability at 15% loss and wastage

180 kg /annum/caput 2328 Kcal of food energy/capita/day , 75% cereal of which rice contributing 100%

162 kg /anum/caput 2328 Kcal of food energy/capita/day , 75% cereal of which rice contributing 90%

162 kg /anum/caput 2100 Kcal of food energy/capita/day , 75% cereal of which rice contributing 100%

162 kg /anum/caput 2100 Kcal of food energy/capita/day , 75% cereal of which rice contributing 90%

Source: Combining Tables 3 and 4 presented in ' **Requirement and availability of rice for food use, Lao PDR: Methodological aspect and preliminary findings, 1995'**. Mathema, P.R., Chief Technical Advisor/Food Security Programming Expert, FAO, GCPS/RAS/140/TTA(LAO)

in the neighbouring country of Vietnam, the food energy requirement estimated is 2100 Kcal per person per day. Translation of energy requirement in terms food and especially rice again depends upon various assumptions on the share of cereals to the total food energy (generally reckoned at 75%) and the proportion of rice among cereals. Based on the various assumptions the requirement of rice per capita per year is estimated at 180 kg, 162 kg and 146 kg (See Foot Notes given in Table 3.14)

Food security status

Considering the predominance of rice in the food basket and the preference of the non-rural population for this food grain the deficit/surplus situation of rice in the country is a good indicator

of the food security status for any given year. Planning for food security could be attempted on this plank. The various estimates based on various assumptions are presented as an illustration. As the estimates given in Table 3.14 demonstrate, these assumptions make significant changes in the food security scenario and hence in deciding policies and programmes for sustainable agricultural and rural development, in terms of the policy for food-self-sufficiency, whether national or regional or on resource allocation (land and capital) for development, rice versus other crops.

For instance, if the most liberal estimate on requirement of 180 kg of rice per capita per year, and at very low efficiency of conservation, in no year the country is in balance and the deficit can be as high as one fifth to one quarter of the availability from internal sources. Requirement at this level is very generous from the fact that with the highest ever production of 1.58 million of rice in 1995, an year generally reckoned to be comfortable, the food balance estimate arrived is negative. Even if food were available, stocks would not have been bought over due to lack of adequate purchasing power. On the other hand at other levels of requirement, even under low conservation, the situation is positive. Hence the middle figure of 162 kg per capita per year seems adequate. At that level deficiency in rice is around 10 per cent of the requirements even in years of sub-normal rainfall. Even though globally the food situation is balanced only four provinces viz. Saravanh (50%), Champassak (22%) and Savannakhet (13%) and Oudomsy(33%), have significant amounts of surplus while 9 out of 18 provinces especially those in the Northern region, largely on account of absence of suitable lands for rice cultivation due to the hilly and mountainous terrain, are food deficit. Even though Vientiane Municipality is well endowed with nearly one half of the irrigated rice in the country, is deficit largely on account of the high proportion of urban population to be fed.

4. POLICIES AND PROGRAMMES: IMPLICATIONS TO ENVIRONMENT AND SARD

4.1 Macro development policy environment

The use and management of the environmental resources in Lao PDR as it has evolved to the present have been largely shaped by the macro policy environment related to economic development, institutions and infrastructure designed and executed by the government over time. The most basic and pervasive among these in recent times is the economic liberalisation policy embodied in the New Economic Mechanism (NEM) which was initiated in 1986.

4.1.1 New Economic Mechanism (NEM)

The NEM seeks to achieve two main goals: one, stabilisation of the economy, and two, transition from central planning to market-based growth strategy. This policy initiative apart from providing the frame-work for promoting the private sector, including foreign investment, redefines the role of public sector. Accordingly, while withdrawing from direct involvement in commodity production and marketing activities, the public sector is to concentrate on providing a conducive macroeconomic and legal environment for the development of agricultural, industrial and service sectors as well as services which are unlikely to attract private investors, such as social infrastructure including education and health, agricultural research and extension, natural resource conservation, etc.,(UNDP 1995b). Interventions under this policy design included decontrol of prices and distribution of goods and services; elimination of subsidies; establishment of a market determined exchange rate; reform of the tax and tariff system; enactment of a new Central Bank Law; refinements in money and administrative authority for economic, financial and development management.

4.1.2 Socioeconomic Development Plan to the Year 2000 (SDP 2000)

The objectives, policies and investment envisaged under the Medium Term Plan to the Year 2000 (1996-2000) (MTP) is another economic development initiative of significance to the sustainability of the environmental resources. The overall objective of the MTP is to realise the transformation from a primary products-based economy to a commodity economy by focussing on eight areas viz. achieving food self-sufficiency; increasing exports from the agriculture sector (cash crops, livestock, forest products); phasing out and eliminate shifting cultivation by the year 2000; achieving a large installed capacity of hydroelectric power; improving the level of human resources development; expanding the transportation infrastructure network; and improving the level of rural development.

The instrumentalities of policies designed under NEM, and the programmes and investment envisaged under MTP in realising the objectives of economic and social development will have profound implications to the sustainability of the environmental resources and thereby the livelihood security of the people of Lao PDR. The impact of these initiatives and some of the major concerns emerging, are discussed to provide the necessary underpinnings of the conclusions and recommendations made.

4.2 Economic liberalisation policy

Over the last decade NEM has had significant impact and success, including reduction in inflation, stabilisation of the exchange rate of the kip (national currency), vigorous increase in foreign investment, and a high rate of growth in exports. In combination these factors have led to a robust average real growth in GDP of around 8 percent. The relatively strong economic performance has in turn led to increasing investor and consumer confidence in the economy, repatriation of capital back to the country, greater demand for the kip as transaction currency (despite the continuing general free use of baht and US dollars for commercial transactions), and low urban unemployment. The performance of the economy as a result of these measures is summarised below.

Indicator	1989	1990	1991	1992	1993	1994
Real GDP growth (%)	...	6.7	4.0	7.0	5.9	8.1
Inflation (%)	75.9	17.7	10.4	6.0	9.0	6.7
Official exchange rate (buying Kip/US$)	...	695	711	715	716	718
Approved foreign investment (US$m)	...	90	127	116	133	387
Fiscal budget deficit (% of GDP)	16.0	13.4	10.6	11.7	7.7	11.1
Current account deficit (% of GDP)	18.0	11.8	11.3	8.8	6.3	14.4
Debt service ratio (debt service payments as % of exports)	...	10.3	11.2	6.3	4.6	4.5

4.3 Fiscal and monetary policy

The cautious fiscal and monetary policies enabled the GOL to reduce fiscal deficit, one third through improved revenue collection and two thirds through reduced fiscal expenditure. Concurrently, GOL also limited the expansion of credit. As a consequence the rate of inflation was brought to single digit level, assisted the recovery of agricultural production and fostered strong growth in manufacturing (the garment industry in particular) and construction, Exports have surged strongly, with a 400% increase in deliveries to overseas markets with convertible currencies, and a concurrent cessation in trade with states under the former Soviet Union enabling to reduce the current account deficit to 6.3% in 1993. However this good performance was reversed in 1995 with increasing import requirements of the liberalised market economy (hindered by a narrow export base) pushed the current account deficit up sharply in 1994 and induced economic destabilisation. Inflation again increased to two digit levels resulting in the devaluation of the kip by 28 percent.

4.4 Investment policy

NEM has dramatically reoriented investment climate in LAO PDR, from one led by centrally planned fiscal policy to the current primacy of foreign development investment (FDI). Public investment for capital projects was slashed from 15% of GDP in 1989 to 7% in 1992/93. A large portion of this reduction was brought about by eliminating inappropriate government investment in production sectors. Lesser portions of the capital cuts were for infrastructure and social sectors, as well as maintenance outlays affecting adversely the services rendered by the government including transport with implications immediately to the economy and education and health in the long run.

Adoption of the Law on Foreign Investment in 1989 has led to a major influx of foreign investment. FDI is now the primary engine of growth in the economy. Much of the realised investment up till now has been in manufacturing (garments and motorcycle assembly industries). By 1994, 30 percent of the $500 million of investment licenses issued since 1988 had been realised. Half of the investment has been wholly foreign owned, and half as joint-ventures. Currently, some 632 projects have been approved worth a total of $5.6 billion. Investment is heavily oriented toward the hydroelectricity sector (76%), with hotels/tourism coming a distant second (7%), and mining (mainly coal/lignite) third (6%).

Installed capacity in power generation by the year 2000 is expected to be 1,500 mw. Hydropower schemes are economically viable due to the favourable natural resource endowments of Lao PDR for hydropower production (steep relief and abundant rainfall) and the high demand of the Thai market for electricity. Apart from the benefits realised from electricity sales, these hydropower projects will rapidly expand construction and related sectors. The heavy emphasis on hydroelectricity development as the prime economic engine means that economic development of Lao PDR over the next few decades could be accompanied by significant environmental degradation if a strong environmental policy is not adopted and enforced.

Service sector expansion is expected to be mainly in the areas of trade, finance and tourism. The tourism industry in particular has a significant potential, given the high quality of Lao PDR's cultural heritage and natural endowments in riverine and forested mountain scenery.

Projected average annual growth rates over the coming decade (1993-2003) are 11 percent for industry and 7.4 percent for services. In contrast, the agriculture sector (crops, forestry, fisheries) is expected to grow by a more modest 4.1 percent which will result in reducing its share in GDP from 56 to 45 percent while that of industry and services will be increased from 24 to 26 percent and 17 to 26 percent respectively. The lower projected growth rate of agriculture is partly due to a more limited potential for expansion and investment, which is mainly in the areas of non-traditional dryland cash crops (coffee, maize, sugar cane, cotton), agribusiness to improve yields, livestock, sustainable forest harvesting and management and hydrodam reservoir fisheries. [Investment in the agriculture sector is more dependant on domestic sources and external donor assistance, than on FDI because of the low potential for profit, subsistence consumption orientation, domestic market supply and only limited export. Moreover, to achieve this modest expansion, large investment in rural infrastructure, expansion of markets, and development of export opportunities will be required].

The public investment program (PIP) is mainly financed by foreign donors, as GOL resources are very limited. The priority area for investment under MTP is transportation infrastructure. Lao PDR

occupies a central (crossroads) position for surface land-based transport in the Southeast Asian region. Two main regional roads (Thailand/Lao PDR/China and Thailand/Lao PDR/Vietnam) are being planned to take advantage of this geographical endowment :

A secondary focus of PIP is rural electrification which is be carried out through improving the exiting distribution network, purchase and exchange from cross boarder sources, constructing low capacity hydroelectric installations, and developing micro hydro systems.

4.5 Trade Policy

Export development is the principal thrust of GOL trade policy which is promoted through two central measures viz. removal of all quantitative restrictions on imports and reduction of export taxes. Exports of Lao PDR are dominated by wood products (32 percent) and garments (19 percent). Electricity export is still small (8 percent). The GOL policy is to promote hydroelectricity exports, while concurrently developing new manufacturing-based export industries which take advantage of low cost labour. Towards the latter end, expansion of non-traditional export industries has been stimulated by two specific measures: viz. import duty exemption and liberal foreign investment regulations. In addition to these specific measures, overall sound economic management aimed at maintaining low inflation and modest government borrowing have helped to build investor confidence and export price competitiveness. A notable success of this policy has been the growth of the garment export industry. With heavy investments proposed over the next two decades, export trade is likely to become dominated by hydroelectricity sales.

Consumption goods account for one half and investment goods a quarter of the imports. Import trade policy is significantly poorer in performance than that for exports. Non-uniform (12 different rates) and highly dispersed (5 to 100 percent) tariff-rates and inadequacies in product valuation standards are attributed to as some of the weaknesses of the system which result in generation of revenue below the potential. There are also several significant non-tariff barriers to trade which include the practice of negotiating special agreements between private trading companies and GOL that confer tax-free status on trade in particular products; trade licensing system which is mainly for registration purposes, and the government joint-venture monopoly for transport of exports transiting through Bangkok.

4.6 Employment policy

The depletion of skilled workers during the decade prior to the NEM has left behind a work force dependent overwhelmingly on agriculture for employment, with low skills, low literacy and low life expectancy, of young age structure, and expanding faster in urban areas(6 percent) than rural areas (3 percent). Women form 51% of labour force, and dominate in numbers in agriculture, trade, health and social services. Entry of women into urban labour force is increasing due to expansion of manufacturing and services. Unemployment and underemployment in the agriculture sector varies in severity from region to region. GOL enacted a labour law in 1990 which charges the Ministry of Labour (MOL) with responsibility for the formulation of policy in the following three general areas: employment (including manpower planning, training, labour market policy formulation); worker protection (covering labour standards, occupational safety and health standards, working conditions,

social security schemes); and labour relations including collective bargaining (collective bargaining, consultation and cooperation among industrial relations actors, settlement of labour disputes). Market forces are dominant factors setting wage rates and labour allocation in the private sector, but are less effective in the large civil service and state enterprise sectors. Since 1988, GOL policy of reducing public spending and decentralising government operations has resulted in a 15 percent decrease in government employment. Lay-offs in state enterprises have however been minimal. Public sector employees have generally been able to find employment in the expanding manufacturing and service sectors. Because of an increasing shortage of skilled labour, university graduates and technicians easily find jobs. The shortage in skilled labour is expected to worsen as FDI increases employment demand in industry, manufacturing and services. Real incomes have increased in the private sector but have probably lagged behind inflation in the public sector.

4.7 Agriculture policies and programmes

4.7.1 Policy interventions

The transition to a market economy has been accompanied by major policy interventions by GOL in the agriculture sector since 1987. More important among them are:

Removal of state marketing board and official distribution network (resulting in exclusively free market determination of prices);

Abolition of implicit consumption subsidies built into below-market prices for producers and consumers;

Transformation of land tax from flat rate to land yield basis, and reduction of rate scale to low level monetary terms (rather than commodity terms);

Granting to individual farmers long-term guarantees to the use, transfer and inheritance of land (i.e. holding of land titles, although land ownership remains with the state);

Ending of discrimination against individual farmers in favour of cooperatives and state farms, by allowing access to modern inputs, credit and agricultural support;

Participation in cooperatives was made voluntary, and incentives for participation were removed;

Cooperatives and state farms were made autonomous and exposed to competition from individual farmers and private companies;

Privatisation of agricultural state enterprises.

These measures, along with macroeconomic policies of exchange rates setting near market rates, tight monetary and fiscal policy and liberalising trade have resulted in a dramatic increase in the agricultural terms of trade by 40 percent and a recovery of the sector. This also has led to increased international support and public investment expenditure in agriculture, greater availability of foreign exchange for importing agricultural inputs and essential consumer goods, and some improvement in FDI to the agriculture sector. Notwithstanding these positive developments a break-through in agriculture is yet to be realised. This sector still constrained by some of the legacies of the past, to mention a few, such as:

Over-investment in low return, under-utilised, capital- intensive irrigation schemes;

Government involvement in direct trading of agricultural inputs;

Segmented and inefficient commodity markets;

Underdeveloped and controlled markets for labour, land and capital;

Macroeconomic and agricultural policies that have made agriculture unattractive to foreign investors.

Removal of these restraints is urgently required to unleash the productive forces in agriculture.

Apart from these overall impact these measures have implications in shaping and evolving the development environment in agriculture. The critical ones are:

Food imports and exports: GOL agricultural policy is strongly focused on food self-sufficiency (= food security). Given the political sensitivity of food production and agricultural employment in Lao PDR as is in most of the developing countries the hesitancy is understandable. Accordingly, agriculture policy is supportive of the domestic producer, and rice, the basic staple, is only imported during years of shortage (caused by either drought or flood damage). Large surpluses of staple foods are rarely produced, so export of food is currently not an issue. Intensification of agricultural production on arable land has not yet reached the point of serious degradation of the natural resource base, and prevailing economic policies do not appear to be excessively promoting intensive use of external inputs for export crops, or unsustainable cropping practices for food self-sufficiency.

Subsidies: Subsidised credit at a low rate of interest from the agriculture bank is only available for qualifying ethnic groups in remote locations. No other explicit subsidies are operated in the agriculture sector. In general there are no subsidies or protection of import substitution industries to stimulate economic development which might act against the interests or sustainability of the agriculture sector or distort the rural economy.

Prices: At present there are no direct price controls on rice or other agricultural commodities. However, for certain major economic goods (such as gasoline, electricity, water) price increases are to be approved by GOL before they can be applied.

Taxation: Prior to liberalisation, GOL extracted a fairly large tax from the agriculture sector, usually in kind. The current policy however is to enforce a fairly low land tax but in kip, based on land type (home construction site; home garden; rice fields). Agricultural inputs such as machinery, seed and fertiliser are import tax exempt. There do not appear to be any explicit or implicit taxes on the agriculture sector designed to provide cheap food for urban populations.

Land titling: While the urban and lowland populations generally holds title to plots of land and can freely sell the titles, the large proportion of the scattered rural population has no land title and can exercise only use rights over land. Use right exclusive to individual households is confined to land under crops the wetland paddies and homesteads, while usufruct rights on the rest of the land are

enjoyed by the entire community. Lack of ownership results in negative land use practices (poor soil and vegetation conservation, deforestation and shifting cultivation). Rural land titling is presently being implemented on a pilot project basis. Results are encouraging, with a cessation of shifting cultivation and recovery of forest on such areas. GOL intent to carry out land titling throughout the country.

Shifting cultivation: GOL are publicly committed to phasing out and terminating shifting cultivation practices by the year 2000. This will be accomplished by resettlement of hillside populations on lowland sites and provision of credit and other support to carry out other agricultural activities such as livestock grazing. Agroforestry is another option. A nation-wide census is currently being carried out on the prevalence of shifting cultivation, and the data will be used to formulate operational plans for the phasing out.

Terracing: A terracing pilot project near Luangphabang has proved to be very successful and GOL are interested to initiate terracing more widely, to replace shifting cultivation on slopes. Terracing is also not socially disruptive of upland tribal communities, compared to resettlement to lowland.

Reclamation of barren lands: GOL policy is to bring badly eroded hill slopes (resulting shifting) back into productive use. This involves interplanting of hardy cash crops such as pineapple and cassava with trees such as eucalyptus and fruit along slope contours. This system results in micro-terracing of the hillside, cessation of soil erosion, and increase of grass and herbal ground cover between planted rows. Adjacent valleys can be dammed to form fish ponds. Sale of crops, wood and fish can provide substantial incomes from previously degraded hillsides and valleys.

Rice Varieties: GOL policy is to promote high yield varieties (HYV), which can yield 5-6 tons/hectare compared to local varieties which yield about 2-3 tons/hectare. HYVs however require more fertiliser and improved pest management. Consumer preference is for 'sticky' (glutinous) rice, so it is not clear if the introduction of HYV will be successful.

Pest management: Efforts are under way to reduce the use of pesticides and introduce Integrated Pest Management (IPM) systems. This would rely more on use of biopesticides from plant sources and birds and other animals as pest control agents.

Green fertiliser: DOAE is promoting the use of green manure crops as a substitute for chemical fertiliser. Green manures as a source plant nutrient is cheaper and also more environment friendly.

Mechanisation: The general policy to increase mechanisation in agriculture, particularly replacing buffalo ploughing with tractors during the dry season. Mechanisation would facilitate bring more area undercultivation as it would remove the basic constraint in land preparation. Besides, it would considerably reduce the drudgery of farm work and there by discourage migration to urban areas. It would at the same time place increasing demand on capital investment in agriculture and greater allocation of foreign exchange for the import of fuel and machinery.

4.7.2 Development strategies

GOL currently have six strategies for agricultural development which aim at promoting integrated rural development and improving living conditions of rural families:

1. Achieving food self-sufficiency (mainly by increasing rice production);

2. Increasing the production of cash crops (i.e. soybean, maize, sugarcane, tobacco, fruit, coffee, vegetables, cotton) and livestock for export;

3. Reducing and eliminating shifting cultivation by the year 2000 (by resettlement of upland farmers and by terracing);

4. Expanding the use of irrigation to allow dry season cropping;

5. Strengthening the seed multiplication stations;

6. Improving professional skills through training of technical officers of the Department of Agriculture and Extension (DOAE).

4.8 Livestock policy

Livestock subsector in the country is developing more rapidly than other subsctors of agriculture in response to general economic liberalisation and market opportunities. GOL policy is to promote further market development and encourage private investment (and FDI) in this subsector. To assist this development GOL policy intervention will be in two areas:

Disease control to reduce significant losses that are now prevalent; and

Breeding stock improvement.

Improvement of veterinary services and emphasis on animal management including husbandry, nutrition and genetic reproduction are the strategies envisaged.

4.9 Fishery policy

The fisheries subsector is viewed by the GOL as having an important role to play in the overall policy of food self-sufficiency. GOL policy for the development of this subsector is to fully develop fisheries potential in hydrodam and irrigation reservoirs, and to promote improved pond aquaculture. Strategies envisaged include:

1. Promotion of aquaculture of indigenous and selected exotic species in pond and rice fields and in support construction of hatcheries;

2. Environmental management for the sustainable use of river, reservoir and wetland capture fisheries;

3. Supporting research on aquatic resources, particularly the Mekong River; and

4. Promotion of post harvest technology and improving marketing

4.10 Forestry policy and programmes

4.10.1 Policies

Within the confines of the broad national policy of increasing the utilisation of natural resources for economic development while preserving the environment, the forest policy enunciated by the GOL seeks:

1. to preserve existing forests from further degeneration, along with the expansion of forested land areas so as to bring about and maintain the natural equilibrium in the country; and

2. to rationalize the utilization of the forests to the maximum and in the most efficient way, by applying environmentally and sustainable forest management practices as to safeguard both their protection and supply functions.

The strategy proposed to implement the policy has three elements:

-Protection of the existing forest.
-Rational utilization of the existing forest.
-Expansion of forest cover.

These strategies are being translated into action by

Introducing a general nation-wide ban on logging except in the reservoir areas of hydrodams, roads, electricity lines and designated forestry production areas under forest management plans;

Reaffirming not only to preserve the forested area of 47% and but also to increase to 60% in the future; and

Declaring 18 forest areas, constituting a quarter of the forested area and one tenth of the national territory as protected areas.

4.10.2 Development programmes

The primary means by which the government is achieving the goals outlined in the policy is by implementing the programmes and projects developed under the Tropical Forest Action Plan (TFAP) in 1990 and approved by the GOL in 1991 as the National Forest Action Plan (NFAP). TFAP is a comprehensive national assessment of the forest resources, depletion trends, national objectives and aspirations and the physical, social and resource constraints that limit the achievement of these goals. This plan identified programs and projects which could enhance the sustainable use of the country's

forest resources. In pursuance of the NFAP six support programmes involving over US$ 157 million were designed and their implementation has commenced. Briefly these programmes are described.

Development process support for: (1) establishing an appropriate organization responsible for the sector to develop, (2) strengthening legal functions appropriate to development, and (3) to improve donor coordination and cost effective development. The Coordination Unit established has improved the capacity of the DOF to assist development assistance agencies.

Institutional strengthening and human resource development seeks to transform the institutional frame work within the forestry subsector to that which is appropriate to meet current demands. Components include institutional development, legislative framework development, and manpower planning and training. Achievements under this programme include: (1) the implementation of procedures within DOF to improve financial management and monitoring, (2) the development of a legal framework to support the forest industry development and the cooperation of rural communities in the management of forest resources, (3) the drafting of a manpower plan which identified staff upgrading to the year 2000, and (4) the implementation of training programmes to meet identified needs.

Development of sustainable alternatives to shifting cultivation attempts to reduce shifting cultivation through improving the utilization of the lowlands, promoting the integrated development of the uplands, promoting suitable farmland technologies for the uplands and collecting and analysing socio-economic information on shifting cultivation. Activities include irrigation projects and research into lowland rice production.

Protection of watersheds tries to improve watershed management so as to ensure a better quality of life for people and better operational conditions for the hydropower industry. The programme has two components: (1) to identify and priories critical watersheds and (2) to invest in the protection of water catchment areas. Activities include collaboration by DOF on several studies in the Nam Ngum watershed.

Sustained use of natural forests aims at developing management principles which insure rational use of the natural forest. Activities include a Nationwide Reconnaissance Survey in 1992 which provided information on land use, forest cover and forest types. A national forest inventory has been initiated which is expected to be completed by 1997.

Plantation forest development envisages the rehabilitation and reforesting unstocked or degraded areas to provide roundwood for forest industry. Activities include feasibility studies on plantation forests, feasibility studies of potential forestry industries which could be based on tree plantations, investments in tree plantations, and investment in tree plantation based forest industries.

The National Forest Action Plan has made significant progress through the implementation of these programmes and thereby established the basic framework for developing the sustainable use of nation's forest resources.

4.10.3 Fostering private initiatives in tree planting

In addition to the measures taken to manage the natural forests, the GOL have taken have significant initiatives in fostering the expansion of forest wealth through creating opportunities for growing timber crops by individuals and communities. First, articles under the Decree 169 promulgated in 1993 permits villages, groups or individuals to establish private forest plantations on government land, granting legal support to treat such enterprises as private property which can be managed, used, transferred and inherited with freedom to market the produce. Second, Article 12 of the same decree enables to grant the right to undertake the actual management of forests and forest land to the villagers, collective organizations, individuals or jurisdical entities facilitating the direct involvement of the communities in development and implementation of forest management plans through joint forest management contracts. Third, in further support, tree planting enterprises are given tax incentives. There is no land tax on land planted with fast growing trees (eg. eucaplytus) for the first seven years, and slow growing trees (eg. teak) for the first ten years.

4.10.4 Rationalising forest industry

The forestry industry is undergoing a process of rationalisation. Until recently, numerous small logging companies operated freely throughout Lao PDR with little regard for environmental management or damage mitigation. Under the new rationalised system, only three large state companies run by the military have been authorised by GOL to carry out felling operations for the northern, central and southern parts of the country, respectively. These 'mother companies' can in turn sell logs to the numerous small sawmills that exist at negotiated prices. However the mother companies can also carry out all other sectoral activities (skidding, transport, processing, export), thus competing with the private sector. In practice only surplus logs might be available for sale to private sawmills. The mother companies are responsible for forest management activities. Under this system, the activities of the three mother companies can be closely monitored by GOL, and more efficient use of logs and better forest management is anticipated. Distortions in the system could also be crept in. In their respective areas, these enterprises have virtual monopoly in logging, skidding and related activities. In its wake the deficiencies of monopolies such as dictated price, over capitalisation and hence high costs of production, inefficient utlisation of resources, etc. can be manifested, unless timely corrective interventions are made.

4.10.5 Designated protected areas

Management of protected areas is proposed to be carried out according to IUCN guidelines which stress participation of local communities in utilisation, management and sharing in benefits. Protected areas will be surrounded by buffer zones.

4.11 Environmental impacts of economic policies

Economic and other development policies can affect positively and negatively the sustainability of environmental resources. The impacts manifested are identifiable and measurable in terms of deforestation, denudation of vegetation including grass and undergrowth cover, soil loss through erosion, soil quality deterioration such as alkalinisation and salination as well as nutrient depletion, decline in water quality, depletion in water supply especially ground water, loss of biodiversity and

genetic heritage, depletion in fish stock, etc. to mention a few of the most important ones. In the context of Lao PDR, denudation of vegetation especially deforestation and consequent soil erosion are often highlighted as they are the most visible signs of environmental impact.

4.11.1 Forest resources

In the past, forest products have been the principal source of foreign revenue for the Lao PDR economy. This has led to large-scale and unsustainable logging practices throughout the country. Shifting cultivation, to some extent an indirect result of GOL policy in the agriculture sector, has caused additional deforestation. Forest products still account for about one third of exports. GOL policy is now to improve forest management, sharply delimit the areas that can be logged, eliminate shifting cultivation entirely by the year 2000 and to reduce forestry's share of total exports by developing the hydroelectricity sector. Clearing of reservoir basin areas is however leading to even more deforestation, and irrecoverable loss of designated forest lands by basin flooding. Moreover, the pace of hydrodam planning, feasibility study and construction is generally slow, implying that the expected switch to electricity sales as the main source of export earnings will not happen quickly. Clearly, forestry products are likely to remain the largest single source of export earnings for some time to come. If sustainable forestry practices are not rapidly implemented, further degradation of the forestry resource is likely to take place in the coming decade.

4.11.2 Land resources

The policy of food self-sufficiency, rice in particular, has a marked impact on environment and sustainability. The rice self-sufficiency policy results in a large proportion of the agricultural capital budget (43 percent in 1993) being allocated to irrigation, a low return investment compared to other opportunities such as animal production. Lack of a nationally integrated market for rice and low profitability of rice production reduces the incentive for farmers to grow rice. Under-utilisation of irrigation schemes has been the result, and shortage of investment capital for the non-rice producing subsectors of agriculture. Lacking support for more profitable agricultural activities on arable land, some farmers continue to carry out shifting cultivation, while others graze cattle on forested lands. Irrigation is non-sustainable economically if intended for a crop with poor markets and low profitability.

4.11.3 Water resources

Impacts on water resources of GOL policies have been fairly severe though indirect. Deforestation caused by forestry exports and inappropriate agricultural policies tend to increase soil erosion and sedimentation of wetlands and rivers. This will also likely endanger some of the planned hydroelectric developments. There is also evidence of a gradual decline in rainfall in upland areas which may be related to deforestation. The marked increase in flash flooding which some tributary basins experience almost certainly is the result of deforestation.

The impacts of hydroelectric dams at present can only be gauged by Nam Ngum. A severe acidification of discharge water occurred after dam closure, with pH 4-5 being recorded in the Nam

Ngum river downstream. This was due to the leaching of nutrients and deoxygenation (lack of tree clearing in the reservoir basin has also been cited as causing acidification). It is not known if this had an impact on irrigation schemes downstream.

Inappropriate timing of spillway flood releases at Nam Ngum in order to create vacant shortage capacity in anticipation of monsoon rains has resulted in heavy downstream flooding of agricultural land, loss of human life, loss of livestock and damage to homes and infrastructure. Anxiety to maintain the water level high and the delay to decrease the head to turbine (which would decrease electricity production and thus export sales) could result in late flood releases.

The food self-sufficiency policy has resulted in enhanced irrigation capacity and drawl of water from the river system. This has increased the consumptive use of river water, but the degree to which this threatens critical flow volumes needed to maintain ecological integrity of the riverine habitat during the dry season is not clear. Salinisation of ground water is occurring at the tail end of some irrigation schemes.

4.11.4 Fishery resources

Economic policies that have induced deforestation and sedimentation have affected fish habitat. The hydrodam policy is likely to create significant new fisheries potentials in the reservoirs, but dams will block spawning migrations of fish coming from the Mekong river. It is not clear if losses in mainstream Mekong production will be compensated by gains in reservoir fisheries. The potential for installing fish bypass structures at hydrodams needs to be evaluated.

4.11.5 Biodiversity

The botanical resources of Lao PDR are rich in diversity and to some extent unique, especially the tropical high mountain species. Large wildlife resources were also plentiful in the past, but have been severely reduced in part by habitat loss due to deforestation. Lack of cover also makes hunting of large game easier. Forest cover may improve if the effective forest management is carried out. However, there is a high risk of loss of both floral and faunal biodiversity due to hydrodam construction.

4.12 Constraints on environmental protection

4.12.1 Economic factors

GOL are becoming increasingly concerned with the potential negative impacts of certain types of development projects and rural practices (especially hydroelectric dams, logging, and shifting cultivation on the environment as well as the negative feed-back effects that environmental degradation can have on the sustainability of economic development. As a consequence all proponents of major development project are obliged now to carry out environmental impact assessments (EIAs)

which are reviewed by GOL. Environmental management plans (EMPs) which define mitigation measures are also required. User group management responsibility has been relegated within a rationalised logging industry. Steps are being taken to phase out and terminate shifting cultivation. The threat that deforestation and soil erosion pose to hydro electricity facilities is clearly recognised, and the need to maintain high quality watershed to feed reservoirs is being highlighted. The economic losses that accompany inefficient logging practices, and the unsustainability of logging without reforestation and other silviculture practices are becoming unacceptable to GOL.

Despite these important advances in introducing environmental concerns into the planning and economic management processes, it is still widely acknowledged that the main thrust of economic development (i.e. hydropower) poses severe environmental problems, as well as in some cases social problems of resettlement and loss of livelihood. A tension will continue to exist between the need for economic growth and the need for environmental conservation.

Some economic factors exacerbate environmental degradation. Devaluation and cuts in GOL budget have resulted in scarcity of funds for a host of activities, ranging from agricultural research and extension services, to protected areas management, forest conservation and flood relief. The largest economic constraint on environmental management continues to be inadequate funding.

4.12.2 Institutional factors

The Foreign Investment Management Committee (FIMC) is now the principal GOL agency responsible for evaluation and approval of FDI development projects. All concerned ministries, including STENO, are represented in FIMC decision-making bodies. Environmental concerns are discussed in this forum. Clear institutional responsibility for environmental planning and management has however not yet been achieved. Some line agencies have environmental planning units, while others do not. STENO as yet does not have a strong enough legal mandate to carry out all environmental planning tasks. Environmental staff in STENO and line ministries are not adequately trained for the tasks they face, and have insufficient experience. There is a lack of skilled labour for crop production in the provinces. By and large the technical and professional exposure of the field level extension staff are low. Some districts do not have even that support.

4.13 Legal frame-work for SARD

An appropriate legal frame-work provides the enabling mechanism to translate the policies and programmes for the sustainable use and management of the environmental resources by setting the frame of reference that defines the rights and responsibilities and legitimacy of all the actors involved, the individuals, the households, the community and the government.

For development to be sustainable, legal frameworks should:

- embody a commitment to sustainability in law, policy and agency mandates;

- be capable of effective and realistic implementation, monitoring and enforcement;

- provide for local community participation, cross-sectoral and decentralized decision making;

- ensure transparency of political decision making processes (accountability, information access, publicity);

- identify interests which justify government action and those which limit government discretion; and

- be characterized by equity, efficiency and resilience.

4.13.1 Natural resource management legislative framework

The Lao PDR depends upon its natural resources and utilisation for its population's food and employment. Its first priority should therefore be to ensure that its individual natural resource management laws are appropriate and promote SARD. Sound natural resource management laws will ensure equitable access to the resource and environmentally-sound management of the resource for its sustainable use in the future.

Traditionally natural resources have been owned and managed by the community in Lao PDR. Individuals had no ownership rights but enjoyed usufruct rights which are inheritable but not exchangeable. The use (all types of cultivation, grazing, extraction of forest vegetation, etc.) and management of the resources, were governed by the accumulated customary law evolved from generation to generation. The norms of behaviour, rights and responsibilities had ensured equitable access, and enabled to sustain the resource base for centuries.

Natural resource management legislation in Lao PDR exists for land, forests, wildlife and protected areas. There is no legislation at all for water or fish although significant aspects of each may be regulated from the international level by the agreements among riparian countries of the Mekong River. However, the existing Decrees (there are no laws) on land, forests, wildlife and protected areas are so general that the responsible institutions have difficulty in implementing them. In addition, the implementing legislation may be on a trial basis and inapplicable to parts of the organic decree.

Most natural resource management is occurring at the village level through the use of contracts and agreements, especially under externally-financed projects. There is limited or no higher level authority for these contracts and none of them has any binding effect on the central Government authority. It is possible ,for instance, for hydropower development schemes to be approved for national forest reserves without any consultation with affected villages and despite approved land use plans within those villages.

The GOL are in the process of drafting land, water and forest laws for adoption by the National Assembly in February 1996. The Ministry of Justice is coordinating this process through working groups. The Ministry of Industry's Department of Energy is responsible for chairing the water law drafting committee; the Ministry of Agriculture's Department of Forestry for chairing the forest law drafting committee; and the Ministry of Finance's Department of Lands and Housing Management for chairing the land law drafting committee. These drafts are under various stages of completion.

4.13.2 Existing legal support to resource use and management

Land

Under the Constitution, land is the property of the national community (Art. 15) although the State ensures the right of use, transfer and succession in conformity with applicable laws. The Constitution recognizes property in general as occupation, usage and transfer rights and protects the right of property and the right of succession of assets belonging to organizations and individuals (Art. 15).

The existing Prime Ministerial Decrees on Land and Land Tax establish a system of land use rights.

Under Art. 24, male and female citizens have equal political, economic, cultural, social and family rights. Decree No. 99/PM on Land and Decree No. 50/PM on Land Tax refer to individuals or organizations who lawfully possess or use land. However, the implementing guidelines for Decree No. 50/PM on Land Tax refer to families and taxpayers. This focus on families is consistent with the government's policy to promote the family or household as the production unit and with the Ministry of Agriculture and Forestry's land allocation process which completes contracts with the family (head of household)

This implementation permits the head of a household rather than the land owner, user or possessor to obtain formal legal title to the land. Implementation of this formal legislation by male-dominated Government departments, such as the Department of Lands and Housing Management in the Ministry of Finance, may disenfranchise women of their traditional inheritance land rights in certain ethnic groups. Land titling teams have contact with traditionally male 'heads of household'. Overlaying a new, rigid, inequitable legislative framework does not promote SARD efficiently, especially considerations of equity.

Forests

Forest legislation is based on Decree No. 169/PM on the Management and Use of Forests and Forested Lands. To implement Decree No. 169/PM on the Management and Use of Forests and Forested Land, one externally-financed project has enabled villages to establish village enterprises with whom forest resource management contracts are made. Villages are themselves legal entities under the Constitution and under Decree No. 102/PM on the Organization and Administration of Villages.

Unless natural resource management contracts are monitored and subject to environmental conditions from an overall legal and regulatory framework, they may promote inefficiency in SARD.

The role of the military in developing the forest resources of the Lao PDR is a potential constraint on SARD. In many Decrees and Laws, defense is always exempted from the legal obligations.

Penalties should be prescribed for violations of management plans and the Government to declare intention to enforce the contract.

Water

Loss of small-scale hydropower to the Ministry of Industry is a major constraint to the development of SARD since it removes energy projects from the sphere of influence of the line ministry with primary responsibility for agriculture.

Fish

The only legislation related to fisheries and fishing is Decree No. 118/CCM on the Management and Protection of Wild Animals, Fisheries and on Hunting and Fishing (5 October 1989). The Ministry of Justice has proposed that a law on wild animals be drafted for enactment in the period from 1997-2000.

Protected areas and biodiversity

Existing Decree No. 164/PM on the Establishment of National Forest Reserves is so general that it cannot be implemented effectively. The Decree provides some minimal level of protection to what are termed within the Government "National Biodiversity Conservation Areas". The three main purposes of forest reserves listed in the Decree are consistent with SARD: sustainable preservation of species and water sources, preservation of natural environment's balance; and preservation of natural sceneries for multiple purposes. However, the Decree provides no substantive management guidelines for these areas. The Ministry of Agriculture and Forestry is delegated general authority to issue regulations on the management of reserve forests and, in coordination with provincial authorities, to direct and organize the implementation of detailed allotment plans (Art. 6).

Seven restrictions are placed on activities within the reserves (Art. 4). There are no substantive requirements regarding situations when such activities are forbidden and when not. For example, the Government may authorize surveys, mining, dike-building, other schemes and roads (Art. 4.3). If National Forest Reserves are intended to preserve the wealth and biodiversity of the Lao PDR, then there should be a higher standard for Government approval of activities in those reserves where biodiversity could be most threatened. In-situ conservation is not only consistent with the Lao PDR's future obligations under the Convention on Biological Diversity but also necessary for SARD. Protected areas provisions might be included in the draft forests law to be enacted in February 1996.

Animals

The draft prepared under FAO: TCP/LAO/4454 does not provide adequate legal basis for the draft Ministerial Provisions and Recommendations on the Preservation and Development of Animal Species.

Plants

Existing legislation regulates phytosanitary measures in the Lao PDR. The potential impact on SARD of the removal of import taxes on artificial agricultural chemicals appears not to have been considered in the Prime Minister's decision.

Although at least one externally assisted project is collecting rice germ plasm according to the principles of the International Code of Conduct on Plant Germplasm Collecting, there is no legal authority for protection, preservation and development of plant genetic resources or the protection of plant breeders' rights. Many plant genetic resources in the Lao PDR are associated with non-timber forest products. The Department of Agriculture and Extension intends to study and recommend possible legislation on this issue. At least one private sector representative has also encouraged STENO to introduce bioaccess legislation. These two processes should be coordinated to protect the national heritage of the Lao people and ensure that private and Government efforts to make plant genetic resources financially sustainable do not result in their inadvertent destruction or the loss of the property rights of the Lao people in these resources.

With the Lao PDR's future accession to the Convention on Biodiversity, the Government should place priority on in-situ conservation of genetic resources as well as indigenous communities.

The February 1996 session of the National Assembly is scheduled to enact amendments to the Penal Code which will criminalise the growing of opium. Alternative cash and food crops as well as rural employment alternatives should be available to ensure that criminalising opium-growing is effective.

4.13.3 Overall agricultural sector legislation

There is no direct legislation regulating the agricultural sector overall. The Constitution refers indirectly to the agricultural sector when, under Art. 13, it promotes the relentless development of production and circulation of commodities, the conversion of the subsistence economy to the market economy, and the upgrading of the Lao people's material and spiritual living conditions. Financial legislation directly affecting the agricultural sector does exist: Decree No. 92/PM on the Establishment of the Agricultural Promotion Bank (1993) and Decree No. 50/PM on Land Tax (1993). A draft Food Law is scheduled for finalization in 1996. There is also the Resolution on Rural Development, adopted on 31 March 1994 by the Executive Committee of the Central Committee of the Lao People's Revolutionary Party. An additional National Rural Development Policy Framework is being drafted by the National Committee on Rural Development. To promote SARD, this legislation should focus less on production increases per se and more on farmers and microenterprises which use natural resources in a sustainable manner.

Agricultural Promotion Bank Decree

Decree No. 92/PM establishes the Agricultural Promotion Bank as a development bank to finance, in money and in agricultural material, the production of foods and domestic consumer goods and export-oriented production while gradually developing the agricultural sector (Art. 1). The Bank does not "necessarily" have a profit objective (Art. 1). The Ministry of Finance holds 80% of the Bank's capital; the remaining 20% may be purchased by the economic sector, including farmers and the general public (Arts. 3-4). The State budget encourages reduced lending rates and guaranteed minimum prices of major agricultural products which are considered targets so that the farmers need

not be concerned with the marketing of their production (Art. 5). The Agricultural Promotion Bank does not appear to use land documents as collateral for loans.

The regulations on credit of the Agricultural Promotion Bank were available only in Lao. It is recommended that they be evaluated to determine whether they facilitate and support group credit schemes and whether they result in increased access to farm credit. If not, they would, for example, promote liquidation of forest resources to meet capital needs and restrict the investment capital available to establish SARD-friendly investments such as forest plantations.

Land Tax Decree

Decree No. 50/PM on Land Tax abrogated the agricultural produce tax and land tax regimes previously established. Decree No. 50 is SARD-friendly in its resource-based fiscal regulation; however, some of the Decree's details constrain SARD.

The connection between taxes and soil quality promotes agroecological zoning and SARD. Agricultural land tax is imposed upon lowland fields, irrigated fields and orchards based on their location (in plains or mountains) and on soil quality. Lowland fields are classified as double (irrigation for single or double season) or single season. Taxes increase relative to productivity in a single season. Upland fields for plains or mountains are further classified as fixed upland fields, rotation upland fields and other types of upland fields (in order of ascending land tax) (Art. 6(3)). The highest land taxes are assessed on "other types of upland fields" in the plains. Orchards of long-term industrial trees are subject to marginally higher taxes than long-term fruit trees. While the Decree punishes rotation fields with higher taxes, its lower rates in the mountain areas promote new clearance of mountain areas.

In addition, exemption from land tax is provided for families cultivating lowland or upland fields with an average paddy yield per capita of 150 kg/year, victims of natural disasters or pests (this includes damage to shifting cultivation fields), newly cleared fields in mountainous areas (for 5 years), newly cleared fields in the plains (3 years) and long-term industrial tree and fruit tree orchards (for 2-5 years depending on the growth rate of the planted trees) (Art. 7 (agricultural land) (4-8)). These land tax exemptions directly promote forest clearance and shifting cultivation. The periods of land tax exemption encourage shorter fallow periods than can be sustained and are not sufficient to encourage returns from longer-term investments (10-15 years for commercially-valuable trees). The amounts of land tax also do not compensate for the loss of environmental services provided by forests. Lower taxes imposed on orchards which are farther away from village areas and are in the mountains promote loss of in-situ primary forests.

In addition, under Art. 12, as early as 13 March 1996, the State could be obligated to take away the right of use over any land which has not been declared under the tenure of any organization or individual. This is relevant to the Government's ongoing land registration and land titling program since formal titles (permanent or provisional) are issued only after payment of land tax. The Land Tax unit of each district is obligated to maintain a land tax register and issue certificates for declared areas of use (Art. 9). Licenses, transfer and assignments of rights of land tenure and use must be declared and recorded on the Land Register (Art. 11).

Draft Food Law

The Minister of Justice has proposed that a law on food and medicines be drafted for enactment in the period from 1997-2000.

4.13.4 Resolution on Rural Development (31 March 1994)

The Resolution on Rural Development which, as a Government Resolution overrides any Prime Minister's Orders or instructions at the ministerial, provincial, municipal or district levels, sees implementation by drawing up rural development plans at the national level, starting from the grassroots (bottom up). The Government's stated policy is to orient itself toward community-based resource management. The Resolution notes that rural development includes the strategic measures of shifting into the grassroots and strengthening grassroots building in all areas.

The Resolution also refers to the need to establish an organization responsible for rural development activities, as resolved long ago. A National Committee on Rural Development at the central level has been established and is drafting the National Rural Development Policy Framework for adoption by the National Assembly in 1996.

4.13.5 Overall environmental protection legislation

The Constitution requires all organizations and individuals to safeguard the environment and natural resources existing on the surface and under the land, forests, animals, water sources and air (Art. 17). The State is also obligated to protect antiques and sites of worship of national value (Art. 20). The Lao PDR is a party to the 1972 UNESCO Convention for the Protection of World Cultural and Natural Heritage. It expects to become a party to the Convention on Biological Diversity in 1996.

There are no laws or Prime Ministerial Decrees on overall environmental protection in the Lao PDR. There is a Government coordinating office for environmental matters, STENO, established under Prime Ministerial Decree No. 63 in 1993. Based on STENO's proposals, Prime Ministerial Decrees have also been promulgated, establishing standards and quality of goods, serving some consumer protection functions, as well as uniform measurements throughout the Lao PDR. Some public health and safety functions are advanced by these decrees.

For factories using a certain horsepower, there are regulations under a Decree from the Ministry of Industry and Handicraft which regulate waste water discharge as well as licensing. This Decree applies to some agroindustries but not others. It only applies to industries which are under the Ministry's jurisdiction. Therefore, the Ministry of Agriculture and Forestry has jurisdiction over all wood-based industries. It seems that there is no regulation specifically regulating waste water discharge or other environmental management of these wood-based industries. Small-scale or microenterprises, such as those proposed to be promoted for SARD in the Lao PDR, are not currently regulated at the central Government level although some provincial or district level registration and licensing requirements from the Ministry of Commerce may be required. The Ministry of Industry and Handicraft is studying how best to regulate these microenterprises but its concern is primarily on urban wastes, not sustainable rural development.

5. DIAGNOSTIC APPROACH

5.1 Human intervention and biomass production

While atmosphere, land and water constitute the basic components of the environment, solar energy, air, land and water are the primary environmental resources that produce the primary life sustaining biomass. Human activity or intervention with the environmental resources sets the pace of the process of biomass production. While the permutations and combinations of environmental resource endowments determine the type of biomass product, the skill attainments (technology) of the society, set the pace (accelerated or decelerated) of the process and hence the quantum of biomass output is enhanced or reduced per unit of time.

SOLAR ENERGY + AIR + LAND + WATER
——————————= BIOMASS [crops, trees, animals, etc.]
[With/without human activity]

Left to itself (zero human intervention) the nature evolves into an ecology with a well defined biological community of plants and animals in consonant with the climate (temperature regime determined by sunlight and altitude, and moisture regime by rainfall and topography) and soil (the plant nutrients and microbial activity) as found in the natural forests or marshes or grasslands.

5.2 Environmental resources that concern SARD in Lao PDR

Of the four resource endowments of the environment, solar energy and air, do not pose any limitation for biomass production in Lao PDR being located in the tropical/subtropical zone. While, land and water being spatially finite, their supply is limited. Air and sunlight being free and abundant, their utilization does not demand much concern. (At present with few industries, low level of urbanization and low automobile density, air pollution may not be a problem locally). Primary concern has to be focused, therefore on the sustainability of the relatively limited resources viz. land and water from which the vast majority of the population in the country draw sustenance. Land in much of this discussion subsumes water also, unless specifically mentioned or highlighted as in its use for irrigation or hydropower generation. Natural vegetation including forests and grasslands although a product of land and water, in this discussion is treated distinctively as a resource to have greater clarity. Generally natural vegetation (not only trees but shrubs and grasses too, spatially not only forests but also woodlands and grasslands) has acquired an identity of its own being used and managed differently to draw livelihood security by the population. Human intervention in quantity (population) and quality (skills and technology, institutions and infrastructure) through use and management of these resources is critical in the sustainability of these resources for ensuring livelihood security. The subject matter in the ensuing discussions is therefore is centered around the **sustainability concerns of the three environmental resources viz. land, water and natural vegetation, in the context of the human resources** for agriculture and rural development.

5.3 Biomass production for livelihood security

In their effort to ensure livelihood security, rural households in Lao PDR as in most of the developing countries where small scale farming predominate, transform both environmental and

human resources into biomass in its various forms, directly as output of crops (cereals, pulses, oilseeds, vegetables, fruits, etc.) or trees (fuel and timber) or indirectly through grass or herbage as live animals (cattle, buffaloes, goats, sheep, pigs, rabbits or birds (chicken or duck) or fish, and products of animal origin as meat, milk, egg, skin etc.

5.4 Intensity of resource use and biomass production

The intensity of resource use for biomass production and utilisation varies[51] in Lao PDR, largely depending upon the characteristics of the resource endowments. Utilisation of natural forests to supplement the family food basket especially during lean periods through extractive processes such as hunting animals and birds using traps and other contraptions for capture; gathering of wild roots, herbs and honey; fishing in the waterspreads and wetlands; and extraction of bamboo for handicrafts, are practiced by Lao households inhabiting under almost all ecosystems and resource endowments. Hunting (animals and birds), fishing and food gathering are the least intensive forms of human intervention in utilising the biomass, and the least intensive form of biomass production. Over one half of the land resources especially under natural vegetation and bamboo in Lao PDR is put to very low intensive use such as hunting and food gathering (**See Table 5.1**).

Herding, that of utilising domesticated animals to convert biomass into useful products requires higher skills and hence is a more intensive form of biomass production and utilisation than hunting. Livestock rearing based on free-range grazing on the grasslands, wood lands and forests is widely practiced in almost all ecosystems even though there are variations in the degree of grazing, herd composition by species, dependency of the livestock on feed sources endangering the very survival of the species that are hunted and fished and type of herbage. Over one third of the land resource in the country is subjected to herding, fully as in grasslands and partially as in unstocked forests and other wooded areas. Only less than one twentieth or five percent of the land (arable land including drylands and wet rice paddies) to hoeing (on drylands for perennial crops) and to ploughing (for wet cultivation of rice in the paddies) demonstrate the progression in the acquisition and use of skills and thereby intensification of biomass production. Again, in various combinations these practices are seen employed by people under all ecosystems and resource endowments. Shifting cultivation is more dominant in the uplands while ploughing for wet cultivation of rice in the paddies is the principal practice in the lowlands. As communities in Lao PDR change from slash and burn systems to mechanised (draught power and lifting water) high energy input (inorganic chemical fertilisers) agriculture, through rained dryland including shifting cultivation, rainfed wet land and irrigated farming, they progressively move from lower levels to higher of intensification in resource use and application of skills. Intensification of resource use not only in terms of space (land) but in terms of time as is achieved in multiple cropping[52] .

5.5 Access to resources

Households in Lao PDR have access to a variety of land resources by virtue of the law predicated and rights customarily sanctioned (**See Figure 7**). Even though the individual households do not own (exchange by sale or inheritance) land but have access to it through usufruct. At the level of present population (1992) households in Lao PDR on the average have access to the usufruct of 35 ha of land and the water contained in it [**See Table 5.2**]. Of which leaving 1.4 hectares of land unutilisable for biomass production being rocky, built-up and urban areas etc., the rest can be put to the biomass production of some form or other. At the core of the land resource to which the

Table 5.1 Use by intensity of resource use in Lao PDR

Land use intensity/ biomass source	Total land		Per village	Per house hold	Per caput
	(%)	Area (ha)	(ha)	(ha)	(ha)
1. Very low intensity					
Current forests	47.16	11167900	936	16.3	2.56
Bamboo	6.44	1524300	128	2.2	0.35
2. Low intensity					
Savannah open woodlands	3.49	910200	76	1.3	0.21
Grass lands	3.49	826900	67	1.2	0.19
Unstocked forest	28.72	6799700	570	9.9	1.56
3. Moderate intensity					
Ray	2.64	625000	52	0.9	0.14
Dry land	1.91	451600	38	0.7	0.10
Perennial crops	0.14	34140	3	0.0	0.01
Rice paddy	1.53	363260	30	0.5	0.08
4. Unutilisable for Biomass					
Heath scrub	2.26	534200	45	0.8	0.12
Swamps	0.15	35100	3	0.1	0.01
Waterspread	0.89	210100	18	0.3	0.05
Urban areas	0.36	84500	7	0.1	0.02
Barren, rocky etc	0.48	113000	10	0.2	0.03
Extraction (1)	53.60	12692200	1063	18.5	2.91
Herding/cultivation(2)	36.05	8536800	715	12.5	1.96
Shifting cultivation(2/3)	2.64	625000	82	0.9	0.14
Dryland cultivation(3)	2.05	485740	52	0.7	0.11
Wetland cultivation(3)	1.53	363260	41	0.5	0.08
Wastelands (4)	4.13	976900	30	1.3	0.22
Total	**100.00**	**23679900**	**1984**	**34.6**	**5.43**

1. The land use/vegetation classes presented in Table 3.1 are grouped into intensity gradation.
2. 1992 population of 4.36 million in a geographic area of 23680000 hectares involving 685 230 households inhabiting 11935 village of 129 districts. Land use data refer to 1988/89, the latest available. Hence the per capita/household/ village land figures are marginally higher than actually for 1992. Yet the data is illustrative

households have access is the 0.5 hectare of wetland paddies where the family grow rice, and the adjacent 0.7 hectare of dryland where dry land crops, seasonal as well as perennial, are raised. These constitute the primary land resource put 'permanently' to agriculture, used with moderate intensity (cropping once in a year) for raising the staple rice and other food crops for subsistence and the crops for cash through sale. Except selling, households can enjoy unrestricted use including inheritance of the right to use this land resource. The rest of the land are 'commons'. But in order to ensure livelihood security households within a given community can exercise access to the 'commons' belonging to that community through usufruct rights. This access is primarily exercised through

FIGURE 7 : PER HOUSEHOLD ACCESS TO LAND AND VEGETATION

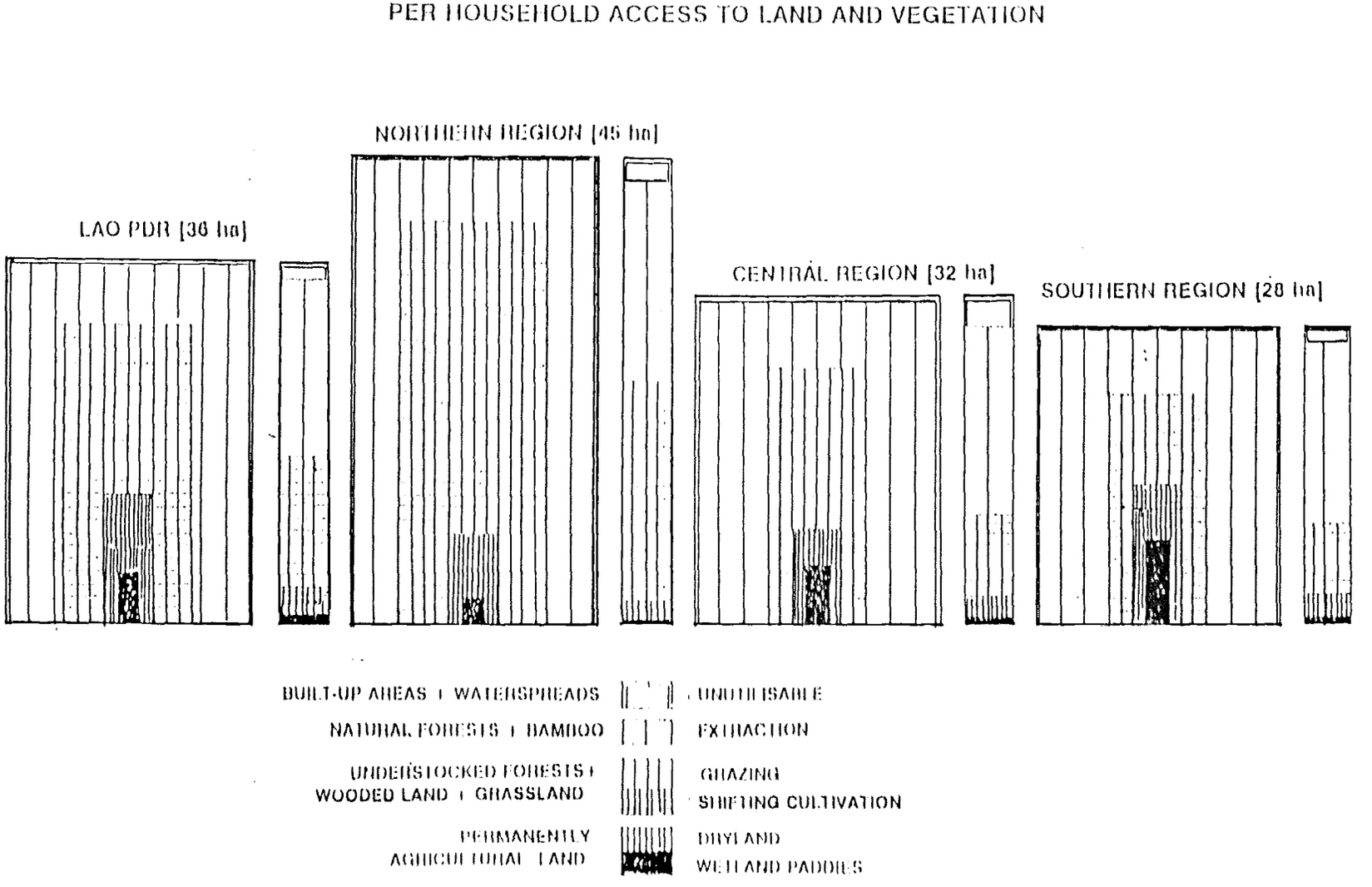


FIGURE 7 : PER HOUSEHOLD ACCESS TO LAND AND VEGETATION

Table 5.2 : Landuse-vegetation summary - Lao PDR					
Land use/vegetation	Area (ha)	Proportion (%)	Per village (ha)	Per house hold (ha)	Per caput (ha)
Lao PDR					
Natural forests + bamboo	12692200	53.60	1063	18.5	2.91
Unstocked forests+grasslands	8536800	36.05	715	12.5	1.96
Shifting Cultivation (Ray)	625000	2.64	52	0.9	0.14
Dryland cultivation	485739	2.0	41	0.7	0.11
Wetland Paddies	363261	1.53	30	0.5	0.08
Wastelands	976900	4.13	82	1.4	0.22
Total	23679900	100.00	1984	34.6	5.43
Northern Region					
Natural forests + bamboo	4344300	43.79	844	19.6	3.06
Unstocked forests+grasslands	4735500	47.73	920	21.3	3.33
Shifting Cultivation (Ray)	365000	3.68	71	1.6	0.26
Dryland cultivation	8913	0.09	2	0.0	0.01
Wetland Paddies	48087	0.48	9	0.2	0.03
Wastelands	419300	4.23	81	1.9	0.30
Total	9921100	100.00	1927	44.7	6.98
Central Region					
Natural forests + bamboo	4254900	58.86	1390	18.7	2.99
Unstocked forests+grasslands	1933800	26.75	632	8.5	1.36
Shifting Cultivation (Ray)	155000	2.14	51	0.7	0.11
Dryland cultivation	161522	2.23	53	0.1	0.11
Wetland Paddies	134478	1.86	44	0.6	0.09
Wastelands	589000	8.15	192	2.6	0.41
Total	7228700	100.00	2361	31.7	5.09
Southern Region					
Natural forests + bamboo	4219800	63.46	1133	17.9	2.76
Unstocked forests+grasslands	1567000	23.56	421	6.7	1.02
Shifting Cultivation (Ray)	106000	1.59	28	0.5	0.07
Dryland cultivation	315304	4.74	85	1.3	0.21
Wetland Paddies	180696	2.72	49	0.8	0.12
Wastelands	261100	3.93	70	1.1	0.17
Total	6649900	100.00	1786	8.3	4.35

grazing livestock, practicing shifting cultivation to raise dryland crops including rice, extraction of wood for fuel and timber, and hunting and food gathering. An household on the average, in addition to the nearly one hectare of land put to shifting cultivation, has access to the usufruct of 12.5 hectares of commons identified as 'unstocked forests' which has been evolved as a result of the long rotation fallow practiced under shifting cultivation. This is also the reserve land for shifting cultivation and when not under crops is used for livestock grazing (free range grazing). Again households within a given community have relatively unrestricted usufruct right to graze the livestock on these long rotation fallows, even though the quantity and quality of herbage is low. Fuelwood required are also secured from this land. They also extract 'minor forest products' including raw materials for handicrafts and small timber, making farm implements and for housing. Protection of the watershed is dependent on the vegetation cover of these lands. Together with access to 'grasslands' to the extent of 1.1 hectares, the 'unstocked forests', enable the households support 2.1 heads of bovines, the principal asset with some liquidity in times of financial crisis and emergencies (food shortage due to the natural calamities such as floods and drought or incidence of illness or expenses connected with social obligations and religious ceremonies). On the outer periphery and farthest end, is the 'natural forest' to the extent of 18.5 hectares which the rural households use to supplement the diet through hunting and food gathering, securing raw materials for handicrafts (especially bamboo of various kinds) and some grazing during the dry months and timber though limited to own house building. It is also the vegetation that protect the watershed. Through timber extraction, the State derives substantial revenue and earns significant foreign exchange though wood product export.

The extent nature and proportion of the various types of land resources accessible to the households depend up on the resource endowment as reflected in the different ecosystems or agroecological zones[53]. Households in the Northern region have access to a larger extent of total land, as much as 45 hectares, as against 32 hectares in the Central region and 28 hectares in the Southern region. (See Figure 7 which is drawn to scale to enable comparisons possible, both in magnitude and characteristics of land. But as the qualities of the land vary (physiography, rainfall, etc.) the uses to which land resources can be put also vary, and in turn the differences in access. The Northern region being mountainous and highly dissected, land available for wetland rice is only 0.2 hectares per households as against 0.6 hectares in the Central region and 0.8 hectares in the Southern region. Households in the South have access to more land suitable for dryland crops (1.3 hectares) but households in the North have practically no sedentary agricultural land for dryland crops. All the dryland crops in the Northern region are grown under shifting cultivation. As shifting cultivation is a dominant form of access to arable land on account of difficult terrain, considerable extent of land is opened up under this practice. Hence the extent of land accessible under 'unstocked forests' is higher than 'natural forests' with 21 hectares and 20 hectares respectively. In contrast households in the Central region have twice and in the Southern region has three times access to land under 'natural forests' than the 'unstocked forests'. It also reflects that proportionately more land in the Northern region has been opened up for shifting cultivation

5.6 Sustainability context

Two critical developmental contexts emerge for the sustainable use and management of the environmental resources in Lao PDR.

Firstly, the vast majority of the population depend upon activities based on natural resources (land and water) such as agriculture, animal husbandry and forestry, for sustenance, and yet such dependence result only in low levels of livelihood security despite the apparent 'abundance' in resource endowments; and

Secondly, the fast expanding population also has to depend heavily upon these very resources for sustenance for some time to come, at least in the medium term.

The dependence on natural resources for the entire food energy, for livelihood security of over fourfifths of the households through employment of over 90 percent of the work force, contributions to foreign exchange earnings, etc., are unlikely to change dramatically in the immediate future 5-10 years (except perhaps in foreign exchange earnings) as the development of other sectors that could ensure livelihood security such as industrial development. Further, Lao PDR has an added handicap. Being a late comer into the field in relation to its neighbours who have already acquired a headstart in the very same opportunities where Lao PDR has advantage. Hence the country has to make much leeway in these areas to become competitive. In the mean time there is the likelihood of the increase in population putting heavy pressure on the resource base.

5.7 Rich resource endowment-low incomes paradox

The characterisation and quantification of the environmental resources in Section 2 and the subsequent discussion on the current status of use and management in Section 3 , have thrown some light in explaining the paradox of 'apparent abundance' in basic environmental resources (sunlight, air, land and water) and low incomes of the population. Two major conclusions emerge: First the uneven distribution of land and water in space and time which renders biomass production less conducive and in turn results in the failure in realising the full utilisation of the potentials. Lands with conducive terrain for arable farming is concentrated in six plains and thus confining the opportunities for food production to these small expanses of land, which exposes much of the remaining sensitive lands vulnerable to management. Though the incidence of rainfall is heavy (1500 to 4000 mm), biomass production is restrained due to the incidence of a unimodal rainfall pattern which on the one hand generates excessive moisture regimes (including water logging) and on the other renders inadequate moisture for plant growth. Second, the fragility of the resource base renders land highly vulnerable to degradation. Being hilly and mountainous the land scape is highly undulating. Nearly three fifths of the country is too steep to withstand surface disturbance. Coupled with high intense rainfall and undulating terrain, the land surface is rendered highly fragile requiring careful husbandry. In addition, both these factors, cause the depletion of plant nutrients. Only 15 percent of the land in the country is free from major constraints to arable use.

5.8 Strains on resources under demographic pressure

The population of the country is likely to increase from the 1995 level of 4.58 million to 6.73 million in 2010[54]. The demand on environmental resources is formidable just to feed this population, let alone finding employment and other basic necessaries for sustenance. In normal years of rainfall as in 1991 and 1993 production of food grains within the country would ensure the supply of 180 kg of rice which is considered adequate to meet the demand arising from purchasing power and meeting three quarters of the food energy requirement through cereals. To secure this much food, the country in 1992 had per caput 1600 m2 of land consisting of 830 m2 of wetland paddy, 500 m2 of dry land and in addition the support of 1600 m2 of land under shifting cultivation (See Table 5.3). By 2010 the per caput the food crop area would have reduced by one third to 1030 m2 reducing the output also by one third unless the productivity of the wetland rice paddies and dryland under other food crops is increased by one half to maintain the same level of food energy availability (the possible effect of income increase is not considered). It is generally recognised that expansion of wetland paddies has

reached the limits in the country. If no increase in productivity is accomplished, area under food production would have to be extended either to the drylands under sedentary cultivation or to shifting cultivation, both would enhance vulnerability to degradation (Soil erosion on the drylands, and loss of natural vegetation in addition to soil erosion, due to increase in shifting cultivation). The issue at stake is not only that of ensuring food energy for the rural households, but also generating adequate employment and sources of income to meet other basic necessaries. During this period the gross cropped are per male worker would be reduced from 0.71 to 0.46 hectares and per female worker from 0.63 to 0.41 hectares accentuating underemployment and reduction in incomes. In order to make up the loss in income, adjoining land resources such as the unstocked forests and natural forests would be put under pressure. Availability of these resources also would decline: area under 'current forests' from 10.9 to 7.1 hectares per male worker, and 9.7 to 6.3 hectares per female worker, resulting in the intensification of extraction of the 'minor forest' products as well as hunting and food gathering. Similarly the availability of the 'unstocked forest' is expected to decline from 7.4 to 4.8 hectares per male worker and 6.5 to 4.2 hectares per female worker. The direct effect would be increased pressure on fuelwood availability and accessibility.

Table 5.3 Availability of land resources in 1992 and 2010

	Indicators	Percaput		Per male worker		Per female worker	
		1992	2010	1992	2010	1992	2010
	Land use (ha)						
1	Current forest	2.66	1.72	10.89	7.05	9.66	6.25
2	Other woods	0.37	0.24	1.50	0.47	1.33	0.86
3	Potential forests	1.80	1.16	7.35	4.76	6.52	4.22
4	Shifting cultivation	0.16	0.10	0.63	0.41	0.56	0.36
5	Permanently agrl. land	0.18	0.11	0.72	0.47	0.64	0.42
6	Total land	5.43	3.52	22.21	14.38	19.69	12.75
	Cropping (ha)						
1	Net wetland rice	0.083	0.054	0.341	0.221	0.291	0.189
2	Net dryland rice	0.050	0.032	0.204	0.132	0.181	0.117
3	Gross rice area	0.136	0.088	0.557	0.361	0.494	0.320
4	Food crop area	0.160	0.103	0.652	0.422	0.578	0.375
6	Net cropped area	0.169	0.109	0.690	0.447	0.612	0.396
	Livestock (no.)						
1	Buffalo	0.255	0.255	1.041	1.041	0.923	0.923
2	Cattle	0.215	0.215	0.881	0.881	0.781	0.781

Yet another major concurrent impact on the resource base would be the pressure exerted by the livestock, especially the bovine stock which is the main source of cash income and capital asset for the rural households. At present the per caput availability at bovines is 0.47 heads which is supported by 2.2 hectares of 'potential forests and other wooded areas', the main source of forage. Even though the per caput bovine population is not envisaged to increase, the one third increase in absolute numbers would reduce the land available for forage per caput to 1.4 hectares[55]. The result would be decline in area for forage resources from 4.6 hectares to 3.0 hectares per head of bovine (See Table 5.4). Already the forage resources are short of requirement of the present bovine population. The increase in stock numbers would lead to further intensification of foraging resulting in deterioration of the grazing lands through overgrazing and even in the slower the regeneration of forests through destruction of the undergrowth (denudation by grazing as well as suppression by trampling). However the availability of animal power would increase, so also the manure. The availability of work buffalo per hectare of net wetland paddy would increase from 1.3 to 2.0 heads and the area to be covered by a work buffalo would be reduced from 0.79 to 0.51 hectares. Thus the demographic pressure on its own is likely to increase the extent and degree of degradation of the land resources and reduce even further the current levels of livelihood security.

Table 5.4 Land resource availability for livestock 1992 and 2010

	Indicators	1992	2010
	Livestock population (000)		
1	Buffalos	1110.4	1714.5
2	Cattle	939.3	1450.3
3	Bovine Total	249.7	3164.8
	Land use/bovine (ha)		
1	Current forests	5.66	3.67
2	other woods	0.78	0.51
3	Potential forests	3.88	2.48
4	Shifting cultivation	0.33	0.21
5	Permanently agrl. land	0.38	3.24
6	Total land	11.55	7.48
	Cropland/bovine		
1	Net wetland rice	0.170	0.111
2	Net dryland rice	0.106	0.069
3	Gross rice area	0.290	0.189
4	Gross food crop area	0.339	0.220
5	Net wetland/work buffalo	0.788	0.510
	Bovine/human resource		
1	Total population	0.255	0.255
2	Total work force	0.904	0.904
3	Male work force	1.041	1.041
4	Work buffalo/male worker	0.416	0.416

5.9 Concerns for SARD

> "Sustainable development is the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable". [FAO Council, November 1988, Document CL94/6].

Such a perspective on sustainable agriculture and rural development (SARD) has significant implications to the management and conservation of the environmental resource base in the context of Lao PDR where the livelihood security of the vast majority of the population is dependent on the utilisation of the biomass generated, both in quality and quality, from land, water, and natural vegetation. Sustainability in practical terms means, when used over time while producing goods and services, should not diminish the productivity of the resource per unit, and/or should not require more resources to produce the same unit of output. Sustainability concerns therefore demand that the stock of resources maintained and enhanced, and not diminished. The capital is retained, while only the interest is used for sustenance. Operationally, by maintaining soil fertility through preserving the fertile top soil (or preventing the depletion of fertility and arresting the erosion of top soil that occur in the upland rainfed cultivation), and preventing waterlogging and development of alkalinity and salinity through controlled irrigation, the stock of land is maintained; by limiting the utilisation of ground water to what is recharged annually through the infiltration of rainfall, the ground water regime is maintained, and by limiting the bovine population to the annual forage yield of the grasslands and restricting logging and other forms of wood extraction to the annual sustainable yield of timber, the stock of natural vegetation is conserved and its biodiversity is preserved

5.10 Approach to sustainable resource use and management

The sustainability concern that the policies and programmes designed for resource utilisation and management, while producing goods and services should promote the use of environmental resources that would not only sustain the current benefits and productivity, but also improve upon, in order to meet the increasing and multiple needs of the present and the future populations as well, requires changes in the approach to the environmental resource use and management .

Firstly the focus of concern in the development policies and programmes should shift from **commodities/products** (production of so many hundreds of thousand tones of rice or maize or milk or beef or cubic meters of timber or fuelwood) to **resources** because the rural households ensure livelihood security by putting resources, biophysical as well as human, to multiple uses. In the former the objective is to maximise the output of a specific commodity or product per unit of resource (land or water) irrespective of the potentials or characteristics of the given resource endowment. In contrast the objective sought in the latter as pursued by the rural households, is that of maximising the total benefits measured in terms of biomass and value, irrespective of the type of commodity, for a set natural resource endowments of a given configuration (agroecosystem). The choice of the product is to be determined by the inherent production capability, cost effectiveness and

market demand. The approach to sustainable utilisation is 'resource-driven and market-driven as well and not commodity-driven.

Secondly, it is not only the resources owned or possessed by the rural households that ensure livelihood security for them, but also those to which they have command as the access to the usufruct of the common property resources (grazing land for grazing, forest land for fuelwood and timber, waterspreads for fishing). The resource use is not confined to crops but to all forms of biomass dependent outputs (crops, livestock, trees and forest products). As that of the households, the resource use of the community may transcend beyond the immediate environs to cover one or several watersheds. This would call for a **holistic systems approach** to resource use and management (See Figure 8).

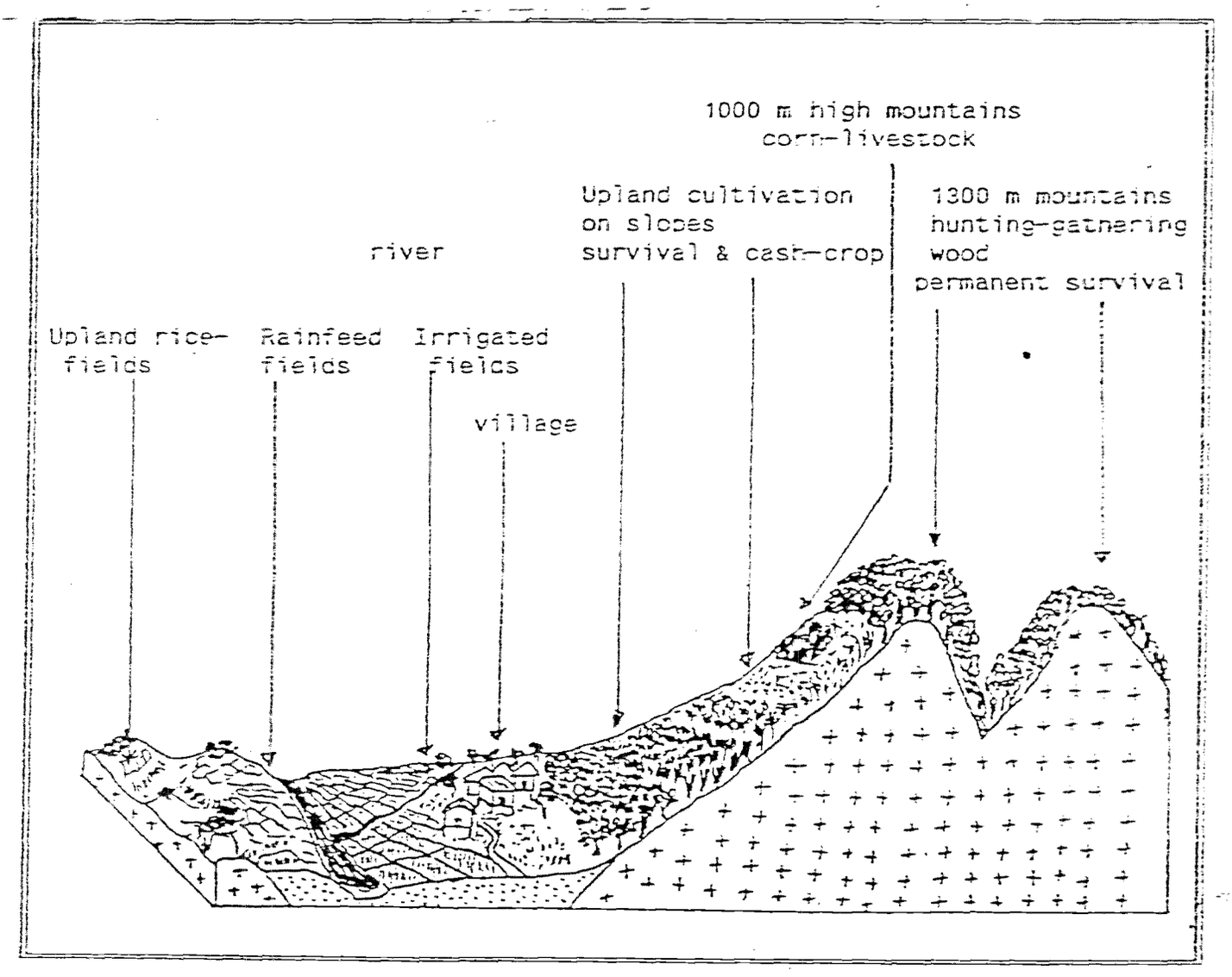
Thirdly, the implications and perceptions as well, of the benefits arising from policies and programmes vary at different levels of decision making. Interests of the actors at different levels need not necessarily converge but at times are divergent, and not always harmonious but often are conflicting. At the micro level of the farm household, the lowest and the finite decision making unit, policies and programmes are assessed on the basis of maximising benefits accruing to the household. At the meso level the community perceives the impact beyond the individual farm household to the aggregate of the resources in the immediate neighbourhood of the habitation, spatially the village or the watershed. The objective of the household is to maximise the benefit accruing to it (as increasing stock numbers in a common grazing land) while the community seeks to maximise the benefit to the whole social entity with emphasis on equity and sustainability through restraints (limiting stock numbers to the carrying capacity of the common grazing land, for instance). If restrictions are imposed there is clash of interests between the community and the individual household. With no restraints, deterioration of the resource base sets in, unless concurrent efforts are made to raise the consciousness of the individual households to converge with the interests of the community through **mechanisms for participation.** Third at the macro level of the region, nation and beyond, the trade off between various options determine whether policies and programmes evolved would foster or facilitate adoption and replication.

Fourthly, the sustainability concern that resource use should help not only maintain the present livelihood security but also enhance the quality of life of the existing as well of the future populations who are likely to be dependent on natural resources demands that policies and programmes should be **pro-active** rather than **reactive** by focusing on **the utilisation of production potentials** rather than **arresting deterioration of resources** and at **potentials of the resources apart from constraints.** When translated, then the starting point of enquiry is not from the end of **manifestations or problems** (shifting cultivation, soil erosion, decline in productivity, denudation of natural vegetation, etc.) but from **capabilities and potentials** of environmental resources with which the country is endowed leading to the identification of interventions - technological, institutional, infrastructural and legal - to ensure sustainability.

5.11 Diagnostic frame

The problems of the sustainability of the environmental resources in Lao PDR are known, certainly at the macro level. There might be divergence in the perceptions, and the causes. nature, extent and intensity of the manifestations vary, which in turn depend upon the nature and

FIGURE 8 : TRANSECT OF A VILLAGE RESOURCE BASE



[Courtesy Laurant Chazee: Reproduced from **Shifting cultivation in Laos-Present Systems and Their Future.** Vientiane, January 1994]

characteristics of the resource endowments, the patterns of resource use evolved over time (technology and skill attainments, and traditions of the communities) and the intensity of resource use (demographic pressure). The resource base of Lao PDR is highly heterogenous. So is the technology and skill attainments, the extent of exposure or isolation and the intensity of resource use. Policies and programmes to be relevant and realistic, therefore should reflect the variations and divergences and would have to be tailored to the specific situations as is understood. Against the setting of the approaches to sustainability concerns elucidated in the preceding paragraph, the potentials and constraints for the sustainable use and management of the environmental resources (land, water and natural vegetation) under each of the major uses to which currently they are put (wetland rice paddies, dryland, shifting cultivation, under/unstocked forest, grasslands and natural forests) are identified and characterised. Strategies and interventions for mitigation required, starts of with technology and processes. They have been proposed wherever currently known and available, and in others the needed further research and investigation have been identified. The environmental impact of the suggested interventions are considered. The facilitating mechanism in terms of infrastructure, institutions and support services, required to translate the suggested technologies and processes are then proposed at the farm/households covering classes and gender, and community. Enabling mechanisms, primarily Governmental interventions in terms of policies related to development, economy, administration, technology, institutions and infrastructure which are to be reinforced and institutionalised with legal support/personality are proposed. Some policy interventions discussed are applicable at the macro level to all the environmental resources and not specific any resource or system of use. Finally a set of programmes to translate the policies into action are also proposed.

6. POTENTIALS AND CONSTRAINTS, AND STRATEGIES AND INTERVENTIONS

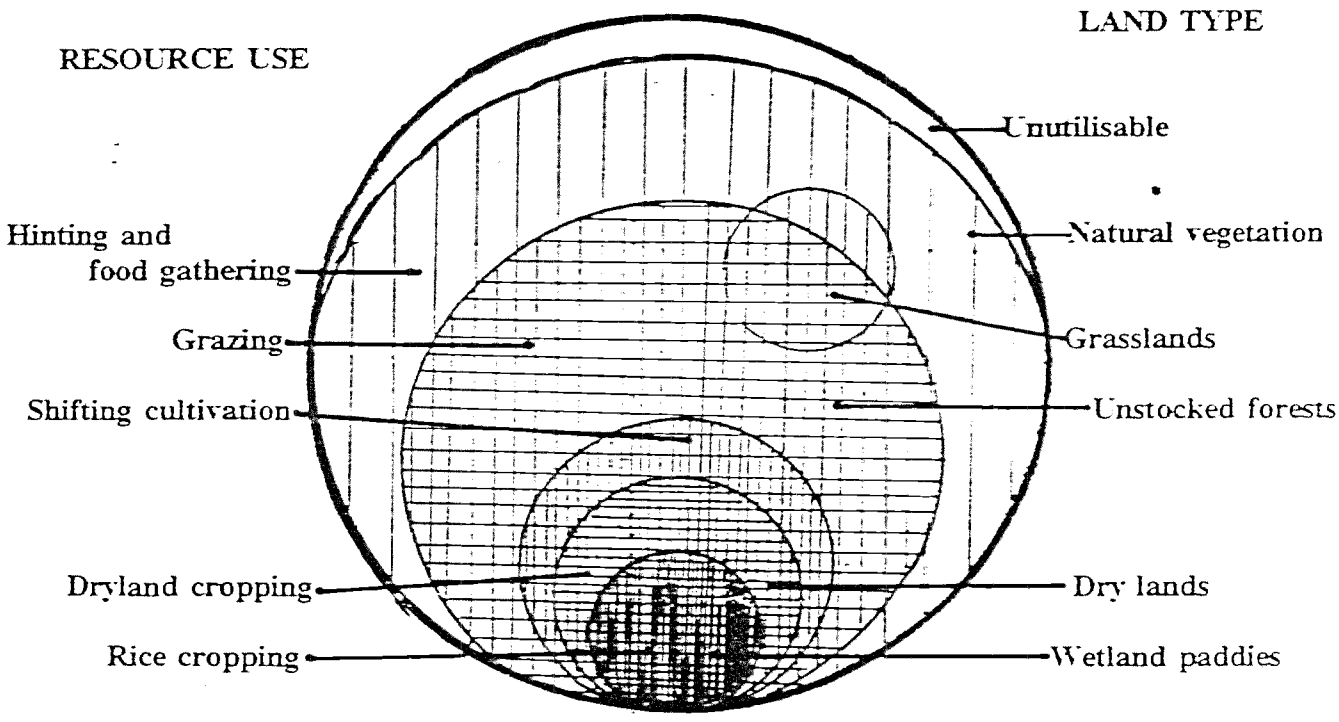
6.1 Land resources

In the foregoing discussion it has been demonstrated that in order to ensure livelihood security, the rural households in Lao PDR, exercise two types of access to land resources: **possessionary** rights on the permanently agricultural land which is under their exclusive management, and **usufruct** rights on the rest of the land which is managed by the village community and the state. On the basis of use and natural vegetation coverage, various land resource types were identified and characterised. To facilitate focussed discussion on the sustainability concerns, the following types of land resources are considered viz. the **permanently agricultural land** comprised of the **wetland paddies** and the adjoining **drylands** (which the individual households possess and exercise the right to use, and are responsible for management in its entirety) and lands put under **shifting cultivation, unstocked forests, grasslands, and natural forests** (on which the households exercise usufruct rights and distinguished on the basis of the type of use and natural vegetation cover). **Figure 9** lays out the types of land resources identified illustrating the spatial dimensions and interrelationships. In addition, **waterspreads**, natural as well as human-made, as part of the water resources and **conservation areas** as part of biodiversity preservation, have also been brought under this purview.

6.2 Wetland paddies

Wetland paddies although constitutes only less than one twenty fifth (3.5-4.0 percent) of the land resource in the country, it is the most important arable land resource on which the rural households depend upon for food supply, employment, and part of the livestock forage (aftermath grazing during the dry season). In fact the rural household economy especially of the lowlands revolves around this unit of land. Endowed with flat topography, deep soils and better moisture regimes (relatively within a given location) being located in the lowest elevation in the toposequence constituting either the naturally occurring depressions or converted valley bottoms with human effort, wetland paddies is agronomically the most suitable land in the country for arable farming. Cultivated during the rainy season (the main cropping season in the country) rice is the sole crop grown. Despite the apparent favourable agronomic environment the productivity of these lands is low, varying between 2.5 to 3.5 tons of paddy (1.5 to 2.0 tons of milled rice) per hectare. Rice being the staple accounting for over three quarters to fourfifths of the food energy of the households in the country, increase in rice productivity is seen as the key to ensuring food security, at the household as well as at the national level. Therefore, the entire effort (research, extension, capital investment in agriculture as for irrigation, etc.) in agricultural development is concentrated on rice production and that too from the wetlands which is considered the most suitable for rice production. It is generally believed that almost all lands suitable for wetland rice have already been brought under wetland paddies. Persistence of low input/output technology, low adoption of available improved technology, preference of farmers for a low yielding glutinous ('sticky') rice varieties in contrast to high yielding non-glutinous varieties, lack of infrastructure such as markets and roads, low price, poor support services, near total dependence of rainfall and lack of irrigation are some of the major reasons attributed to the low productivity of rice grown on wetland paddies. Increasing the yield of rice from wetland paddies dictated by the imperatives of ensuring food security at the macro level apart, it needs appreciation that increasing the total productivity of wetland paddies is critical, not only for ensuring household food security but for improving the very livelihood security of the rural

FIGURE 9 : SYSTEM OF RESOURCE USE AND ACCESS



households. Wetland paddies is the most important land resource to which farmers have full access (the other being the adjoining drylands), the land least vulnerable to the vagaries of nature, and above all the main opportunity for employment (rather reducing under-employment). At present wetland paddies is underutilised. Just one crop is taken from the vast majority of the wetland lands. Apart from the main rainy season some land (2 percent) is put under irrigated rice and the rest under vegetables especially in areas close to the urban centres during the dry season. The cropping intensity of wetland paddies is only 104 percent. Endowed with ample sunshine and no limitations of temperature (low) even in high altitude (1500 m and above), the dry season following the rainy season is very ideal for crop production, not only rice but several other crops. Inadequate moisture is widely attributed as the limiting factor which needs reconsideration as over one half of the irrigation capacity built-up in the country remains unutilised. Wetland paddies suffer from several constraints, some are inherent, while others demand a drastically different perception in finding out mitigation remedies. Issues need to be seen in the context of increasing the total productivity of wetland paddies, both during the main rainy season and the rest of the year, that is multiple cropping as well, and not that of rice yield alone.

6.2.1 Increasing the productivity of main season rice

Firstly, it should be realised that wetland paddies is not the most suitable land for rice production. In fact only one tenth of the wetlands is considered favourable to rice production[56]. The rest is subjected to various constraints: one tenth submergence-prone, one fifth drought-prone, and three fifths both drought-prone and submergence-prone. Wetland paddies by virtue of their location in the toposequence is the least risky land for crop production (near flat or relatively milder slopes in a spatial entity where one third of the land has slopes between 8-30 percent and one half above 30 percent, and endowed with soil moisture over a longer period). But the very virtue of a favourable topolocation also engenders a disadvantage that of poor drainage, both internal and surface. During the rainy season water get collected and stagnated, and the land become water-logged. The only crop that can be grown under such an agronomic environment is rice and hence traditionally rice is the preferred crop on these lands.

Secondly, wetland paddies is comprised of clusters of bunded fields which serve not only the surface to grow the crop but also as temporary (seasonal) reservoirs for the storage of water to maintain the moisture regime through the crop life. The topography being relatively plain, except for the valley bottom wetlands in the hilly and mountainous areas, natural surface drainage system does not exist. Neither drainage network is developed because all the water collected from the precipitation need to be stored to tide over the months when evapotranspiration is more than the precipitation. Even though the total rainfall is reasonable (1500-2000 mm and above) for rice production in most of the areas where wetland paddies dominate, its incidence is uneven (concentrated during 2-3 months, See Figure 1) and hence the rainfall is inadequate to meet the minimum water requirement of 200 mm per month during critical periods of plant growth. Lack of efficient drainage has two major implications which often seen overlooked in the discussions in increasing rice production. One, high yielding modern rice varieties require efficient water management systems (timely addition as well as removal) to ensure the moisture regimes at different stages of plant growth in creating the right physiological conditions for the full expression of the genetic potential. Green revolution areas in rice the world over are found in semiarid regions where rice is grown under irrigation, (nature itself ensures water control), unlike rise production under rainfed conditions, medium as well as high rainfall. Second, high yield is also a response to increased availability of plant nutrients. Without adequate supply of nutrients high yielding varieties

are unable to give full expression in terms of higher yields. In the absence of adequate drainage it is physically not possible to provide higher levels of nutrients let alone secure increased efficiency of nutrients applied (leeching of soluble plant nutrients). Except phosphatic fertilisers and the basal doze of nitrogen which could be applied along with preparatory tillage, further applications of fertilisers are difficult as water control is not possible.

Thirdly, basic accessibility to plant nutrients is constrained due to poor infrastructure. At present the demand for plant nutrient is largely met from the animal dung collected and applied consciously or supplied by animals while grazing (especially the after-math grazing during the dry season soon after the harvest) and the crop residue from the left over straw. Most of the wetland paddy soils are deficient in phosphorus and nitrogen. In a rain dependent system of cultivation it may not be possible always to grow green manure crops in situ and incorporate them into the soil to augment nitrogen supply due to inadequate moisture and the invasion such a practice would make into the limited growing period under rainfed rice production. Even the very growth of green manure crops is hampered in the absence of a minimum amount of phosphorus application[57]. Even if the supply of nitrogen is ensured from sources within the farm, the supply of phosphorus nutrient is to be secured outside the farm. Apart from the fact that all fertilisers are to be imported, it is not possible to argument the supply of plant nutrients dependent on off-farm sources, in the absence of adequate road net-work to reach commodities within reasonable access.

Fourthly, the improved technology currently available for wetland rice production is modelled after the 'favourable' one tenth of the wetland which may not fill in technology gaps in the disparate agronomic conditions obtaining in the rest of the nine tenth of the wetlands subjected to various types of stress (The fact that myriads of micro environmental conditions exist in Lao PDR, apart). The focus of improved technology is understandably on transplanted rice on puddled fields which is the most dominant system of wetland rice production practiced in the country. Radically different systems of rice production from wetlands, suited to different environmental conditions, especially with built-in flexibility to adapt to different moisture conditions need to be developed. For instance dry sowing of rice soon after the onset of monsoon and leaving the crop to adjust to the increasing incidence of submergence is one widely adopted practice in some parts of high rainfall tropical monsoon areas of India. The system is capable of both overcoming the interim short period of drought between the pre-monsoon and main monsoon showers as well as increasing levels of water during the monsoon period. Apart from testing and developing such technologies new systems of land preparation also need to be developed. A major constraint is likely to be the unsuitability of the total dependence of wooden spiked tooth harrow harnessed to a single buffalo for land preparation in the wetlands of the country. (The constraint of land preparation is considered fully in the subsequent discussion on dryland management).

Fifthly, the shift from the traditional apparently low yielding glutinous varieties, 'sticky rice', to high yielding non-glutinous varieties as a solution to augmenting rice production is unlikely to be economically attractive. The market for increased rice production is domestic and not external. The internal market price for glutinous varieties is one quarter to one third lower than non-glutinous 'ordinary rice' varieties[58] which in itself is a 'strange phenomena'[59] besides that they are preferred for valid reasons other than mere palatability such as longer 'pot' life facilitating reduction in cooking times (once instead of thrice a day). Being flanked on either side by two major cheap rice exporting countries (Thailand and Vietnam ranking second and third in the world) non-glutinous varieties of Lao rice might find it difficult to compete price-wise. Hence increased production has to content with the domestic market which is relatively small being confined to the urban population as

majority of the households are rice producers. What is required is to increase the returns from glutinous rice through the aggressive promotion of glutinous rice exploiting its virtues in terms of keeping quality, aroma, by creating a 'niche' in the international market which at present is ruled over by very few types[60]. Further the low input/low input syndrome can also be turned into a virtue by exploiting the increasing preference for 'green' products by adding 'green rice'[61]

Sixthly, returns from the 'main season rice' on the wetland paddies have to be seen not only in terms of increase in the yield of rice, but other means also such as concurrent fish production. The system of rearing fish in wetland paddies during the 'main season rice' is widely practiced in Lao PDR which need to be intensified for which technologies are available at present. What is required is extending support services such as making available the necessary inputs especially fish fingerlings (which does not require much external support). Market permitting, fish culture in low productive lands such as water-logged wetland paddies is economically an attractive proposition. Even with moderate intensity, a proven 600 kg yield per hectare is equivalent to 10 tons of paddy in terms of value (Swithun Goodbody 1995).

The inherent constraints of wetland paddies for rice production, the total dependence on rainfall, absence of control on water regimes, widely varying agronomic environment during the crop season, all compels farmers to stick to the low input/low output syndrome of rice production in Lao PDR during the main season. Environment-specific management systems (not restricted to variety-focus) for rice production from the wetlands during the 'main season' is a pre-requisite to bring about quantum jumps in 'main season' rice production in the country. In the absence of such basic technologies, tinkering with macro policies alone would not be of much help in the march towards food security.

6.2.2 Dry season rice and multiple cropping on wetland paddies

The months following the rainy season, but for inadequate moisture availability, are agronomically favourable for crop production in the wetland paddies, not only for rice but other crops as well. The most favourable factor is that the land is free from poor drainage and water-logging and thus more amenable to water control. The topography permits growing crops under dryland management practices. Utilisation of wetlands during the dry season is significant not only to the economy of rural households but also to the sustainability of other land resources. Rural households would gain directly from an additional crop production activity during this period as it would provide employment for the under-utilised family labour, and enable greater utilisation of the animal power[62]. More importantly, the pressure exerted on dry lands could be reduced. Because, given the limitations for expanding the extent of wetland paddies, cultivation is extended to more vulnerable (soil erosion in slope lands) areas such as drylands and lands under shifting cultivation, in order to satisfy the urge for increasing food availability. Multiple cropping including raising a second crop of rice is however beset with quite a few constraints.

First and foremost, is overcoming the shortage of moisture availability, although that is not the only one. Augmenting water supply through irrigation is the obvious possibility. The traditional diversion structures (diverting water from streams, rivulets and other water courses) may not be effective as most of the water courses would be dry by then. Lifting water from sources such as perennial rivers is the main means of providing irrigation apart from the hydro dams. As the experience of the past goes by these projects are capital intensive and less efficient. One option is

the utilisation of ground water by digging shallow wells and lifting water by small pumpsets, initially run with diesel and later with electricity as the distribution network expands (Further discussed in the context of water resources development). A decentralised system of irrigation based on shallow dug wells (even tube wells with larger capacities) and tanks (mini reservoirs) would increase water use efficiency as they could be managed by individual farmers or small groups of farmers who will have full control over water delivery. Another option is that of adopting water harvesting techniques such as building tanks on the drylands at appropriate sites for collecting surplus run off during the rainy season which would enable to provide a couple of critical life saving irrigation during dry season. These small water reservoirs could be used as another opportunity for fish production. A much less capital intensive option is squeezing in an additional low moisture demanding crop during the growing period succeeding the main season rice crop. Raising a medium duration rice crop under dry sowing (as practiced under shifting cultivation) soon after the onset of the rainy season as indicated already would enable to harvest the 'main season rice' early and thereby save a couple of weeks leaving some period of moisture availability on the land. The harvest could be followed immediately with a short/medium duration crop such as pulses, oil seeds (sesamum) or a grain crop such as maize or sorghum (grains from both could be used for raising pigs and poultry and stalks as fodder for the cattle). In the Northern region with relatively higher altitude even wheat is a possibility as cool temperatures prevailing during this period is favourable to this corp[63] experienced during the growing period of the crop). Land preparation for rice under dry conditions and competition for limited family labour (activities connected with the sowing of the dryland crops are also to be undertaken during this time) are the two problems to be overcome. Photo periodism of the rice varieties may not be a limitation as farmers are already using short and medium photosensitive varieties for the main season rice.

Second constraint to dry season rice production is the photoperiodism of the existing traditional varieties which are sensitive to day length period. Though not widely available and limited in numbers (RD16 a glutinous variety from Thailand and CR203 a non-glutinous variety from Vietnam), some varieties have been evolved already and are used extensively in the irrigated areas. More varieties incorporating photo insensitivity and traditional glutinous and other preferred qualities suited different agronomic conditions need to be evolved.

Thirdly, land preparation soon after the harvest might pose a problem as the fields are stubble ridden. Usually major part of the straw (from two thirds to three quarters) are left uncut in the field while harvesting rice. The stubble is left for grazing and whatever remains is either incorporated by trampling by the grazing stock or burned before the beginning of the land preparation of the subsequent main season rice production. The capacity of the single harness buffalo to overcome this problem need further studies.

Fourthly, maintaining the status of plant nutrients in the soil which is under stress even under a single crop need to be attended to, when multiple cropping is resorted not only for the second crop but also for the traditional main season crop itself. Although introduction of pulse crops may partly make up the depletion in nitrogen, but phosphorus nutrient for which the soil is deficient already, would have to be supplemented.

Fifthly, apart from these constraints related to technology there is a major social problem. Aftermath grazing on the left over straw and grass and weeds grown, is a major source of livestock forage during the dry season especially in the lowland agroecological zone where livestock numbers

per unit area is more while access to grazing resources (woodlands and unstocked forests) is relatively low. Further, other avenues for grazing the livestock, such as the weeds and stubble on the dry lands, under growth in the wooded areas, and grasslands become exhausted soon after the rainy season. Aftermath grazing on the wetlands takes the livestock through the rest of the dry season. Further, aftermath grazing on the harvested wetland paddies is an socially accepted practice irrespective of the ownership or possessionary rights. Unless cultivated areas are protected with fencing which is expensive or socially prevented by collective action (social fencing) raising a dry season crop is likely to be at the cost of livestock production and social harmony or adding to the cost for fencing which is not insubstantial even with local materials such as bamboo.

6.2.3 Alternative cropping systems

Another possibility of increasing the productivity of wetland paddies, especially on lands prone to various abiotic stresses (drought-proneness for instance) is the introduction of alternate crops. Candidate crops are cotton and sugarcane. In the absence of extensive market[64] in both cases production should be vertically integrated with processing and product conversion[65] (Cotton with spinning and sugarcane with sugar production).

6.2.4 Irrigation and water management

Irrigation development is very basic to improving the productivity of wetland paddies apart from overcoming the limitations such as difficulties in land preparation, lack of photo insensitive varieties and communal aftermath grazing by livestock. Efficient distribution of water and the maintenance of the system are the two important concerns afflicting the irrigation systems in the country. Lack of field channels to take water to the fields prevents the full utilisation of the potentials created in the command area. Seepage from unlined channels apart from reducing water availability also creates waterlogging. Consequently, the emergence of alkalinity and salinity problems in some irrigated areas, is incipient even though not fully manifested.

6.3 Drylands

The second major land resource available to rural households is the dryland often adjoining the wetland paddies or close to the habitation. Quite often it is an extension of the homesteads. Increasing the productivity of dryland equally deserve attention and support as it will improve substantially the household economy both with food and cash, and in turn will also lessen the pressure on the environmentally vulnerable practice of shifting cultivation, especially in the Lowland and the Footslope and Low Mountain zones which are under pressure from expanding population. Development of drylands therefore is another key strategy in the sustainability of the resource base. Dry lands have only moderate slopes ranging from 8-16 percent. Crops grown on drylands include food crops such as maize, pulses, sasamum and cash crops such as cotton and tobacco, and various kinds of fruit trees mostly for home consumption such as mango, coconut, tamarind, jack fruit, and scattering of bamboo, fuelwood and timber trees. In the plateaus perennial crops such as coffee and cardamum are also grown on the drylands. In addition to cropping, drylands also provide some forage during the rainy season when almost the entire wetland paddies is closed to grazing as rice is standing on the fields. Productivity of the crops grown on drylands is low. It is also possible that the

cropping intensity is also low. Under similar agronomic conditions (rainfall, slope, soil, and latitude) land is used more productively in many other developing countries (India for instance) by growing crops such as dryland rice, maize, sorghum, groundnut, cotton, tobacco, chilies, and perennial crops such as cashewnut and rubber apart from fruit trees such as banana, pine apple, mango, guava and jack fruit. All these crops (except rubber and cashewnut) are already grown in Lao PDR and farmers are familiar with the production processes. Apart from poor infrastructure such as absence of road network for transport and hence access to market there are certain production constraints which militate against increasing the productivity of drylands.

6.3.1 Land tilling

The most important constraint seems to be the inability to accomplish timely land preparation to plant the seasonal and annual crops on the drylands. Land preparation in the drylands is by 'slash and burn' (not shifting cultivation as clarified earlier) under which stubble, weeds and such unwanted growth are cut, collected in heaps and burned. Some times hoeing is practiced. Crops are sown by dibbling seeds in holes made with thick sticks. Limited family labour has to compete with the more important rice crop. To overcome the shortage of moisture and shorter growing period[66] sowing and planting has to be done as quickly as possible soon after the commencement of the rainfall season which is a universal problem in dryland farming. Farmers in other parts of the world partly overcome this problem of ensuring larger area coverage in the shortest time by resorting to ploughing the drylands with animal power or mechanical power. Farmers in Lao PDR are familiar with wetland ploughing but not with dryland ploughing. Land for rice planting is done by puddling which can be achieved only when the soil is flush with water either from rains or irrigation. For ploughing wetlands single harness buffalo is used. The implement used for puddling is a toothed harrow of wooden spikes which can work only under wet conditions and not when the soil is dry. In animal ploughing for drylands even though basically wooden ploughs are used in other countries, the ploughs are tipped with a replaceable shear made out of iron which is capable of penetrating the moist (but not wet) soil. Animal in single harness do provide enough draught power to plough the drylands as practiced in countries such as China. But cattle is trained whether in single harness (China) or double (India as well as mountainous countries such as Bhutan, Nepal and Ethiopia) cattle is used to provide the draught power. But in Lao PDR only buffalo and not cattle is used and that too only for wetland ploughing. The suitability of buffalo for dryland ploughing, whether in single harness or double harness, need to be investigated or else cattle (male and female) need to be trained for ploughing to which farmers are not familiar. Moreover new ploughs would have to be designed or adapted and tested and get widely adopted by farmers. The other alternative is going in mechanical ploughing by power tillers (walking tractors) which are getting increasingly popular in the country. The switch over from animal to mechanical power for traction opens up new sets of issues which are discussed under crop-livestock integration later (See paragraph 5.3.4).

6.3.2 Moisture conservation

Moisture availability is the most critical factor in dryland cultivation especially at the initial stages of crop establishment. Apart from the uncertainties of the onset of the initial rains enabling land preparation and planting, surviving the interim drought to ensure adequate plant population established is very crucial in dryland farming in Lao PDR. Moisture conservation therefore becomes very critical to the success of dryland cultivation. Apart from measures to capture as much rainfall as possible, placement of seeds as in dibbling as against broadcasting ensures greater gemination

and uniform plant population establishment. Dibbling in of seeds in holes made out of thick sticks (some times tipped with iron) as practiced for sowing grains in the shifting cultivation areas drylands (See paragraph 3.2.10), do serve the objective but is slow, and places greater demand on scarce labour resulting in smaller coverage in area. Placement of seeds on furrows made out of animal drawn ploughs and covering subsequently with a plank or using seed drills[67] for the purpose can ensure sufficient area coverage at shorter period. Land preparation by ploughing coupled with planting seeds with seed drills can make cropping a viable proposition and in turn bring in intensification to another stock of relatively more agronomically suitable and less environmental risk-prone lands in the country.

6.3.3 Farm forestry and biofences

In an integrated system of land use involving wetland paddies, drylands and shifting cultivation (stabilisation or elimination) family labour availability particularly at the beginning of the rainy season when land preparation and planting for all the crops occur simultaneously, sequencing of operations are important to even out work force. Further, vagaries of the weather impose many uncertainties in production, and income. One strategy to achieve both the distribution of available family labour optimally and minimise the uncertainties of yield could be bringing in perennial trees and grass (crops, fruits, trees for timber and fodder, fodder grasses and bamboos) with which rural households in Lao PDR are familiar. What is intended is active promotion of perennial plants of economic and social value through integration into the dryland farming systems as part of the intensification of land utilisation. It is in short farm forestry in its broad sense involving all perennial plants and not just trees for fodder, fuelwood and timber. Determined by the market opportunities, consistent with agronomic conditions climate, soil and slope, it should be an appropriate mix off medium (3-5 years) and longer duration perennial plants including grasses for livestock fodder, fruits such as banana, pine apple, mango, peach and multi-purpose trees such as jack tree (fruit fodder and timber), tamarind, valuable timber such as teak and raw materials such as bamboo for household handicrafts and conservation of soil. Fencing the homesteads and drylands to keep away animal and wildlife trespassing is a familiar feature of the farms in Lao PDR. Currently a variety of plants are used which if replaced with trees of economic value with bamboo and teak for instance, and planted systematically as a biofence, apart from affording protection desired, would also help build lasting assets with practically no effort (planting and annual pruning) and little investment (largely limited to the cost of initial planting materials) are ideal plants for building biofences at the farm boundaries). The inclusion of timber of commercial value in farm forestry and biofence are essential as it is an asset with liquidity (an alternative to livestock) which in times of emergency could be used for raising money (by pledging or sale) (See paragraph 7.1.10). Adapting farm forestry to suit the market potentials and requirements of the farm households should be attractive to the farm households and does not need much capital investment either on their part or of the government.

6.3.4 Livestock-crop integration

Livestock's eminent place in the household economy of the rural Lao PDR as the principal asset (as still land has not granted the legal sanction as an asset that commands a market in exchange, though use right is inheritable), means of cash income, source of draught power as well as manure for the most important crop rice, and supplement to the food energy supply, have made animal rearing an integration part of the farming systems practiced in all parts of the country, even though the extent of these contributions and hence the species composition vary depending upon the resource

endowments and market opportunities (Refer to paragraph 3.3.11). But it management and resource utilisation pattern as evolved to the present times, is unlikely to foster the sustainability of the resource base. Resource dependence and utilisation pattern vary between the biomass dependent ruminants such as buffalo, cattle, goats and sheep on the one hand, and the other the grain/feed dependent livestock pigs and poultry. Both groups face different sets of issues. Hence the sustainability concerns differ between the two categories. The grain/feed dependent species can be fostered and need to be encouraged only to the extent that they contribute both to the nutrition and income of the households through foraging and scavenging, and utilising damaged and unfit grains for human consumption. Rather than leaving to the market forces to play, fostering them with state support in a food energy deficit (or precariously balanced) situation as is prevailing currently in Lao PDR, is uneconomic and wasteful[68] as it can impinge upon the limited grain supply for human consumption. The expansion of biomass dependant ruminant enterprises, primarily buffalo and cattle, entails significant implications to the resource base, land as well as natural vegetation, and more importantly its sustainability. The concerns involved deserve some digression.

Balancing livestock numbers with biomass output

Given the expanding market for livestock products, both domestic and external, and the potential for augmenting household cash incomes and asset with liquidity, and for earning foreign exchange through export, the temptation is to foster this activity as the engine of growth of the rural economy citing the relatively high animal:land ratio (See Table 4.4). It is partly reflected in the growth rates achieved in recent times (5.7 percent annual growth rate for this subsector during 1986-92 in contrast to 1.7 of rice, 3.5 of total agriculture and negative 9.3 of forestry) as well as in the strategies advocated for development of the country, especially of the agriculture sector. Often it is not recognised that ruminants are not producers, but consumers of biomass. Biomass is finite at a given period of time (season or year). The need for a balance between biomass production and livestock population is vital for the sustainability of the productivity of the resources on which biomass is produced. Currently ruminant production in the country is dependent on foraging the biomass produced naturally (except the small proportion of straw left over in the fields after harvest) primarily the under growth and the grass found in patches of open grounds in the 'unstocked forests', and the weed growth on the drylands to a limited extent. These are the most widespread forage sources and accessible to most of the households in the country. The other is the grasslands found in specific locations especially on plateau formations in the country. Currently there is not enough information of the quality and quantity of forage output and the animal carrying capacity. Free ranging is the main grazing practice except tethering during the main season rice growing period especially in the Lowlands. Animals are let lose for months and collected back only at the beginning of the rainy season. Granting that the incidence of contagious diseases and parasitic infestations take a heavy toll, the growth in numbers have been keeping in step with increase in human population. Herd sizes are not large indicating that some sort of a balance is struck between the biomass production capability and the stock numbers. Nor do the relatively poor physical health of the livestock in general is an indication of the abundance of the forage.

Increasing marginal output by early slaughter

The value system and the role of ruminants in the economy do not foster the productive utilisation of even the limited herbage available. Draught power, manure and meat are the main products secured from the ruminants. Meat is not the first but the end product, and is incidental

rather than the main output. Hence numbers rather than output of meat per animal is important. Further the primacy of the ruminant in the rural household economy is not as much cash as an asset with liquidity, to tide over contingent financial emergencies. Again, number becomes important. Harvest by slaughter is not by choice but dictated by the need to liquidate an asset. The result can be increase in the number of stock rather than slaughter. The result is dominance of adult animals whose productivity in terms of meat output per unit of feed it is low unlike stocks of growing age group. Which means more pressure on the limited herbage. With increase in numbers, grazing will turn more intense which in turn will lead to overgrazing, denudation of herbage coverage, and soil erosion.

Integration and not addition of livestock rearing

Apart from crop residue, animal manure is the primary means of maintenance of soil fertility and increase the productivity of land. The other option is application of fertilisers which are not accessible to a significant proportion of the farms due to poor road network besides the institutional constraints such as lack of credit. Availability of animal power is also necessary for intensification of land use through multiple cropping. Crop-livestock integration is therefore very vital to the sustainability of all the farming systems in the country where cropping is the central component. Inclusion of ruminant rearing as an activity or increasing the existing numbers dependent on herbage from the common land ('unstocked forests' for instance) will not lead to integration but only addition. It will only further aggravate the delicate balance in carrying capacity. In contrast, ruminant rearing based upon the crop residue (feeding of straw for instance) or through cultivated fodder especially drylands, will make the two enterprises mutually dependent and the resulting synergy will lead to increased income (conversion of an unutilisable product viz. crop residue into a useful product, the meat) and productivity (through enhanced supply of animal manure). Introduction of fodder grass as well as perennials in the dryland systems offers an opportunity. Utilisation of grasslands through fostering cattle ranching is another opportunity for livestock production in the plateau farming systems of the country which is discussed later (See paragraph 5.5).

6.3.5 Mechanical power for the farms

It has been argued earlier that availability of adequate draught power especially for dry ploughing is a major limitation in the intensification of arable land use in the country (Refer to paragraphs 5.2.1.4 and 5.3.1). (Dry sowing of rice as an alternative to transplanting, ploughing the land soon after harvest to raise an additional crop utilising the residual moisture, and expansion of cultivation to the dry lands). The underutilised animal power is a potential source of farm power. Buffalos are utilised only for a couple months in the year. Cattle are totally not used for ploughing. But attendant limitations such as the inability of the main draught animal buffalo for dryland ploughing, unfamiliarity of using cattle as a draught animal and lack of appropriate implements stand in the way of utilising this potential (Refer to paragraph 5.3.1). While striving to realise the animal power potential to the maximum, the option of using mechanical power has to be explored as intensification of arable land use is a very critical strategy, not only for improving the livelihood security of the rural households but also to ensure the sustainability of other land resources, especially arresting the expansion of shifting cultivation. The option of promoting the use of mechanical power especially power tillers or 'walking tractors' of 5-10 horse power has many advantages. First, it provides enough draught power for dry ploughing whether in the wetland paddies or drylands. Second, it would help bring more area under sowing at the shortest time so that

the limited growing period can be used fully. Third, the same power source can be used for lifting water. In combination with dug wells more land can be brought under irrigation and thus increase area under multiple cropping. Fourth, it will also improve the transportation capabilities in the rural areas. Fifth, relieving animals from ploughing would obviate the need for keeping them over longer periods thereby encouraging their slaughter at younger age which in turn help increase the productivity of limited roughage. Finally it would help achieve a very important social function of transforming farming as an economically viable occupation by relieving the drudgery of tropical farming. Removing the drudgery of farming is a critical technological intervention to decelerate if not prevent the migration of rural people to urban areas and the aggravation of social problems associate with. It is more so to reduce the flight of the schooled from rural areas[69]. Fostering mechanical power need not result in the elimination of ruminants from the system. On the contrary they can be used as a converter of the biomass generated from crop residue and as a supplier of organic manure for improving soil fertility. Some of the often quoted negative effects on farm employment and rural equity are unlikely to have serious implications in Lao PDR. Because firstly there exists a fair degree of equity in access to land. Secondly farm work is dependent almost entirely on family labour or at best supplemented with exchange labour in contrast to hired labour, thereby reducing employment opportunities to any specific economic strata of the community. Initially focus could be on areas endowed with road communication so that the servicing facilities could be created and in the lowlands where the terrain permits the use of mechanical power.

6.3.6 Plant nutrition management

Intensification through multiple cropping and expansion of cultivation to drylands would place heavy demand on the nutrition reserves in the soil. Extensive farming as in shifting cultivation depends heavily on natural recuperation of soil fertility. Intensification besides manifesting initial deficiencies, puts additional burden on the reserves through depletion. Balanced nutrition is basic to the technical and economic efficiencies and hence sustainability of the resource base. Integrated nutrition management systems tailored to the specific agronomic conditions comprising the elements of conservation of existing supply of animal manure, increased supply of animal manure through subjecting the entire crop residue passes through animal cycle, crop rotations, incorporating green manure crops grown in situ as well as green leaf tree lopping, composting of biomass wastes, and supplementation with lower doses of chemical fertilisers could minimise the dependence on chemical fertilisers to meet the increasing demand on soil nutrient as a consequence of intensification.

6.3.7 Plant pest and disease management

In its trail, intensification, especially multiple cropping with the same crops, can bring about increase in the incidence of different or the same pests and diseases. The tendency is to resort to chemical control and sometimes a cocktail of chemicals with attendant residual effect and indiscriminate destruction of predators and other useful insects. Integrated pest and disease management systems involving natural predators, mechanical devices, crop rotations, catch crops, botanical pesticides, limiting the application of chemical only beyond the threshold levels would help minimise the loss of crops on this score. 'Slash and burn' land preparation has some positive impact through the destruction of the pests at dormant stages (eggs and nymphs) and the seeds of weeds. These measures to control pests and diseases together with plant nutrition management suggested above, will not only minimise the dependence on external inputs and cash, but also help preserve the 'green' character, a distinctive feature of farm products of the country which is worthy of preserving, not only for reasons of health and aesthetics but also for economics (See paragraph 7.2.1.3).

6.4 Unstocked forests and wooded lands

The second largest stock of land accounting for a third of the land resource of the country, identified as 'potential forests' is classified into two types: the 'ray' lands and 'unstocked forests' based on the current use and supporting vegetation. The former constituting nearly a tenth of this land category is subjected to shifting cultivation in recent times (less than two years) and the recovery of natural vegetation is yet to set in. The latter accounting for 90 percent, is in various stages of recovery of its natural vegetation depending upon the length of the rotation fallow, and at present is largely used for grazing livestock (in fact the main source of forage for the livestock) and access to forest products, mainly fuelwood.

Though rural households have no possessionary rights on 'unstocked forests' and wooded lands, they enjoy usufruct rights on this stock of land. Benefits derived from land through shifting cultivation and the utilisation of biomass on it through grazing, contribute significantly to the livelihood security of the rural households of Lao PDR in general, and those of the Northern region in particular which accounts for two thirds of this category of land. The community through its representatives exercise control over the management (allocation of land to the individual households for shifting cultivation for instance) of the land and vegetation. Customarily the usufruct right is confined to the members of the community and not outside, in areas falling within its territorial jurisdiction. Once forested, the vegetation cover on this type of land evolved to the present, has been the result of the practice of shifting cultivation. Part of this stock of land belongs to the timber harvested areas.

The 'unstocked forest' land, is also the most environmentally disturbed land resource. Hence its conservation through the rejuvenation and restoration of the natural vegetation is very vital for the sustainability of the resource base and development of the rural economy. Scientific management of this stock of resource would ensure sustainable livelihood security for the rural households who are dependant on it. Strategies and programmes are to be developed for increasing the biomass output sustainably and value addition to the biomass produced. As it is the most exposed area for human contact through opening up for shifting cultivation, grazing, extraction, the involvement of the local communities for its conservation are very critical. Strategically, if shifting cultivation is stabilised to what is currently being cultivated annually which is actually the capacity of the community to deal with given the labour availability, it should be possible to conserve this resource. Based on the type of vegetation (tree growth and grass) which also a function of the slope and soil depth and accessibility the strategies could be designed. The possibilities include grazing management, perennial crops, community forestry for timber, fuelwood, raw materials, and conservation. Management can be through biomass harvests rather than cultivation. Much of the area should be left for regeneration rather than production.

Major uses to which currently this resource is put are shifting cultivation, grazing, and extraction of fuelwood, timber for construction, food through hunting and gathering. The vegetation cover provides protection to the watershed commanded by it.

6.4.1 Shifting cultivation

Shifting cultivation tops the agenda of environmental concerns in the country, and is next only to food production among the seven national priority programmes for the medium term Socioeconomic Development Plan to the Year 2000. The objective is to eliminate this practice by

the year 2000[70]. There is some evidence of the setting in of a deceleration in the area put under shifting cultivation[71].In order to design policies and programmes that would lead to the realization of the objective of eliminating shifting cultivation, it is necessary to have an understanding and appreciation of the causes and motivation for the persistence of this practice which is proving unsustainable not only environmentally[72] but also economically[73].

Firstly, lands brought under shifting cultivation is the main means of food production for the households engaged in it. Food production is the primary objective of this practice. Rice accounting for four fifths of the cropped area is the principal crop grown under shifting cultivation, followed by maize in about a tenth of the land. In the absence of other types of suitable land for rice production such as basins and valley bottoms, as the topography is highly undulating[74], rural households inhabiting these areas are compelled to resort to this practice to generate the required food energy. They seek out for lands within accessibility. Because of the difficult terrain, the road communication is also extremely poor. These communities are isolated and hence they opt for self-sufficiency in food for survival. Accessing these communities to food availability is a major incentive to abandon this practice. Putting in position a public distribution system by opening up grain outlets at the nearest roadhead where motorised transport could reach is a key intervention. Habitations within one or two days of walking distance are likely to be attracted to purchase food if reasonably priced.

Secondly, not only that food is made available but also it should be accessible. Unless sufficient income is generated the households would not be able to buy food. There should be alternative income generating activities. Experience in other countries has demonstrated that introduction of such income generation activities has encouraged communities to move away from shifting cultivation[75] as they themselves desire so since the practice itself is an hazardous endeavor being highly labour demanding. In the absence of road transportation, the products chosen should have high unit value and should be least bulky. Identifying appropriate products is very critical. In the mid altitude areas (500-1000 m) coffee and cardamom are good options. Livestock rearing is another possibility which currently being practiced[76]. Cattle rearing is a significant part of the household economy of the communities engaged in shifting cultivation and they depend for forage on the unstocked forests. Whether the available forage can support additional stocks on free ranging needs consideration. Grazing pressure adversely affects the vegetation recovery and hence bringing back the natural vegetation is likely to be slowed down.

Thirdly, improvements in the very productivity of the lands which have already been opened up would render it unnecessary to open up new lands to cultivate. Generally households move to new lands after one or two years of continuous cultivation because of the decline in productivity arising from the loss of soil fertility (nutrient depletion and soil loss) in the absence of any fertility building practice through nutrient conservation or supplementation. Being a highly labour intensive activity decline in productivity results in negative marginal returns to labour (the production is not adequate to meet the effort put in for one unit of labour). Moreover increase in weed infestation following continuous cultivation add significantly to the labour requirement especially female labour[77]. Opening up of new lands despite the additional labour required for land clearance give greater return to labour per unit that the low production from the existing lands. Shifting cultivation is basically a dryland farming system. Both depend totally on rainfall. The essential agronomic practices are similar: slash and burn for land preparation, dry sowing, weeding, etc. What is environmentally unsustainable and hence its continuance discouraged by the community at large, is that the vegetation, trees and more importantly the undergrowth[78] is destroyed leading to degradation of land and water resources. Dryland farming systems that conserves soil and water, and thereby maintain productivity are found

sustainable the world over. Therefore adoption of improved dryland farming practices as discussed earlier can help stabilise and ultimately eliminate shifting cultivation. The elements that could be included are:

Introduction of labour saving technologies. Land clearance and weeding are the two labour demanding activities under shifting cultivation. As weed control is the most labour absorbing operation introduction of chemical weedicides can make a significant dent into the labour demand for the system. If weedicides chosen are biodegradable, arising environmental concerns can be minimised. Reducing the drudgery of weeding crops is a relief to rural women which is next only to unburdening women's workload that rice mills replace hand pounding. The amount of labour saved through this single intervention is significant which could be used for alternative production activities such as hand looms, stall-fed livestock rearing based on cultivated fodder, etc. bringing additional income to the household.

Yield improvements in dryland rice production: Management practices that would improve the productivity of dryland rice itself is a key intervention that would render extension of land for rice production unnecessary. The management improvements proposed for dryland management are equally relevant under shifting cultivation. Ensuring plant population density through good and uniform generation is one such measure. Already dibbling in holes made with sticks is an established practice. Placement of seeds in furrows taken with animal ploughing can help save labour. Introduction of seed drills for both placement seeds and fertilisers can on the one hand save labour, and on the other enable to place seeds at appropriate depth according to moisture availability which in turn facilitate uniform germination and crop stand. Crop rotations with appropriate leguminous crops, supplementation of plant nutrients through low levels of fertilisers, and placement of compost and farm yard manure along with the seeds can help build soil fertility. Soil and water conservation measures tailored to the slope conditions to reduce risks arising from moisture stress should be an integral part of the management[79]. Promotion of crops that add value through processing (cotton for spinning and weaving, sorghum for poultry production, fodder for livestock) would help augment household incomes.

Fourth, stabilising shifting cultivation rather than elimination might be a more pragmatic and viable approach. The choice should be dictated by the vulnerability to degradation (slopes and depth of soil) and demographic pressure. Areas with steeper slopes should be abandoned. Closing the area to all human interference including grazing will allow the nature to restore its vegetation[80], while less vulnerable should be stabilised. Investment programme for stabilising and rehabilitating shifting cultivation lands are to be designed. It should have two components. Support for permanent improvements and conservation measures including planting of trees. Second support to the households till the plants start giving returns which should be in the form of off-season employment.

6.4.2 Grazing in unstocked forests

Next to shifting cultivation, livestock grazing is the major benefit which the rural households derive from the 'unstocked forests' and woodlands. The biomass harvested through grazing, and converted and accumulated in the form of ruminant livestock is the primary asset of the rural households. Sale proceeds from livestock is the major source of cash income. Hence the sustainable use and management of the grazing resources of 'unstocked forests' and woodlands is very vital for ensuring the livelihood security of the rural households in the country. The undergrowth and the patches of grass found in the 'unstocked forests' in the vicinity of the habitation is the main source

of forage for the ruminant livestock reared by the households. Animals are grazed on these lands all through the year in varying degrees. In the upland zones unstocked forest is the only source both during the rainy and dry seasons for livestock forage in the absence of wetland paddies. In contrast aftermath grazing on the wetland paddies is a significant source of forage especially during the dry season in the low land zone. Much of the grazing during the rainy season is provided by the 'unstocked forests' and woodlands as wetland paddies and drylands are under cropping.

Free range grazing (See Section 3.3.4) is the practice followed. Expansion of livestock rearing is generally considered an opportunity. But this needs some caution. By and large unstocked forests has substantial tree coverage. Regeneration and canopy formation are slow. The undergrowth is poor. The forage output is likely to be low and the quality very diverse. Livestock carry capacity of these lands are not known. To what extent livestock grazing is hampering the regeneration and restoration needs investigation and assessment before adopting a policy of encouraging livestock rearing to utilise productively the biomass in the unstocked forests and woodlands in the country. Areas where grass vegetation predominate livestock rearing should be encouraged. Preservation of the vegetation through conservation and management is also important for maintaining the productivity of the arable lands as the 'unstocked forests' and woodlands constitute an integral part of the watershed covering the drylands and wetland paddies. An integrated vegetation management system involving the 'unstocked forests' and woodlands, the drylands and the wetland paddies is critical for the sustainability of the resource base that ensures livelihood security for the rural households.

6.4.3 Perennial crop plantations

Increasing the income and employment potential of some part of the 'unstocked forests' and woodlands especially those lying relatively within easy access from the village habitation would discourage the village communities from pursuing the current exploitative utilisation from this stock of land resource. Indirectly it will help restoration of vegetation naturally as the land will be subjected less biomass dependent activities such as grazing. Developing plantations of perennial crops is one option. The advantage of planting perennial crops is that once planted they put less demand on the limited family labour. Cashewnut, rubber, cardamom and coffee are the possible candidate crops. These products have demand in the international market. The potential output being relatively small, products from Lao can still find opportunities in the international market. Cashewnut should be a suitable crop in the low rainfall parts of the lowlands as it can withstand longer dry periods. Light textured soils found in these parts are particularly suited to this crop.. Cashewnut does not require much maintenance and the harvests come in the dry season (February-April) and hence may not interfere with other farm activities. Lands in the high rainfall areas of the low lands in the Southern region should be suitable for rubber cultivation. Cardamom could be the choice for the Footslope mountain zone in the country while coffee could be developed in the plateau zone. The country has some experience in the production the latter two crops.

6.4.4 Community forest plantations

Encouraging communities to establish tree plantations of appropriate species consistent with the market demand and resource endowments, for timber, fuelwood (commercial such as charcoal making) and raw materials (eucalyptus for pulp) under the management of the individual households is another opportunity for utilising more productively the 'unstocked forests' and woodlands and

thereby generate more income and employment. The expansion of urban population places increasing demand on fuelwood. Hence fuelwood should find a place in the community forestry in areas close to the urban centres. Country has accumulated considerable experience in this area which need to be aggressively pursued.

6.4.5 Utilisation of bamboo vegetation

Bamboo (collectively covering a variety of species) plays a very important role in the everyday life and economy of the rural households in Lao PDR. Rural communities have developed many skills in its utilisation from house construction to making household utility articles such as baskets for a variety of purposes, various contraptions for trapping animals and fish, to attractive handicrafts for sale. Bamboo with its colonising disposition is one of the plant species that naturally get established on lands left for fallowing for regeneration after shifting cultivation or timber harvests and wood extraction. Although the land is not turned into 'timber-rich forest', bamboo growth is an excellent conservation measure both in retaining soil and holding precipitation with its fibrous root system. Apart from its current utilisation for making various household articles and artifacts for sale, bamboo holds two major potentials. Bamboo with its long fibre can form the basis of a pulp industry for paper manufacturing. Secondly it can be used to make strong, durable and attractive particle boards for buildings as wall partitions, doors and ceilings[81]. Country's rich endowment in bamboo has to be seen and developed into an opportunity. Its expansion should be fostered in the 'unstocked forests' and woodlands with low potential for tree growth.

6.4.6 Non-timber forest products

'Unstocked forests' and woodlands is a repository[82] of several useful natural and biological products (other than forage, fuelwood, timber and bamboo described above) which the rural families collect for household consumption and to augment income through sale. Collectively known as 'non-timber forest products' or 'minor products', this group of products include over 150 identified items in the country. Apart from some of the more commercially marketed products such as sticlac, benzoin, cardamom, rattan, bamboo and pine resin, and lesser ones such as oil seeds, essential oils and medicinal plants, this group includes a host of products which supplement rural diets such as honey, mushrooms, fruits, nuts, tubers, roots, leaves and wildlife. Hunting and food gathering form forests is particularly critical during stress conditions of drought or floods which occur about once every five years. Many of these products are collected during winter months, when rural households have difficulties in finding other productive work. It is generally believed that collection and marketing of these products are a substantial source of employment and income for the rural households even though little data are available on the resource base and its contribution to the socioeconomic well-being of local communities. Collection systems are often random, indiscriminate and wasteful, without regard to quality and sustainability. Non-timber forest products must be managed and their harvests be limited to sustainable production in order to ensure a continuous flow of production and in turn and thereby this activity continue to provide the rural households with an important source of supplemental income. In order to discourage exploitative extraction, the producers should be accessed to a greater share of the sales proceeds through increased marketing efficiency. Further, expansion of production of some of these products such as medicinal plants, oil seeds etc. which have good market potential, has to be sought through cultivation by incorporating in the dryland farming system or utilising the forest floors as is done in the case of cardamom.

6.5 Grasslands

Natural grasslands estimated to extend over 0.8 million hectares constituting about 3.5 percent of the stock of land resource in the country. It is a significant biomass resource, based on which productive livestock enterprises can be developed if the herbage is sustainably managed through limiting stocks to carrying capacity and improving the pasture. The demand for beef in the neighbouring countries of Thailand and Vietnam offers potential markets. Apart from the natural grasslands as ecologically evolved, grasslands as secondary growth arising from forest fires[83], natural or deliberate, to develop grass for livestock grazing, are also found in the country. The productivity of these grasslands is also to be improved for discouraging the communities from further intrusions into the forest vegetation cover.

6.6 Natural (current) forests

Unlike other stocks of land resources, an average rural households' access to natural forests, the largest single natural resource of the country covering only a little less than one half of the nation's territory, is indirect and largely confined to grazing ruminant livestock, collection of non-timber forest products, and foraging for food through gathering and hunting. It is one of the natural resource endowment of the country which is exposed to least human interference, except the areas where logging is done for timber extraction. However in some parts of the country, natural forests are subjected to human intervention through shifting cultivation[84] and forest fires. To the nation's economy the direct contribution of natural forests in terms of revenue to the government, earnings in foreign exchange and source of raw materials for the wood based industry, the largest industry in the country, is very significant. Such contributions of natural forests to economy of the country are likely to continue for some time to come at least in the medium term future. That apart, contribution of natural forests in terms of the watershed protection it affords to the conservation of the land and water resources is very basic to the sustainability of the resource base of the country. The forests of Lao PDR produce a multitude of timber and non-timber products. In order to ensure that natural forests continue to make its due contribution to the nations economy it is imperative to sustain a continuous flow of forest products (timber as well as non-timber) for which this resource must be managed and harvests be limited to sustainable production. Some of the critical constraints and the interventions required to mitigate them are described.

6.6.1 Unsustainable harvests

The Tropical Forestry Action Plan (TFAP) prepared in 1990 and adopted in 1991 estimated the sustainable rate of timber extraction to be an annual harvest of 288 000 cubic meters. Based on this recommendation official log production quotas have been stabilised at around 275 000 cubic meters per year. Notwithstanding that the officially sanctioned harvests are within the sustainable limit, it appears that the total resource depletion exceeds volumes which can not be sustained due to various pressures in the economy. First, the wood industry capacity built up over the years is around 1489 thousand cubic meters which is five and one half times the current allowable cut[85]. It will take some time to decommission such huge capacity. Efforts are underway to bring production capacity on par with allowable cut through reducing the number of saw mills. Secondly in addition to log production quotas, illegal harvests are estimated to be between 100000 and 150000 cubic meters per year (STENO 1994). Thirdly, the forests of Lao PDR are also a source of timber for local

construction and fuelwood. About 100000 cubic meters are cut each year to meet the non fuel timber needs of local communities within and adjacent to forest areas. Besides, wood harvested for fuel is estimated at 4 million cubic meters. These additional harvests (over and above log production) are spread over scattered stands, the under story and natural mortality, the effect on the forest resources is not considered a threat, although the volumes harvested are significant.

6.6.2 Deforestation

Sustainable yields are based on the assumption that forest will regenerate after harvest and continue to produce timber at current rates. But deforestation destabilises this balance. Deforestation which is reducing the forest area (covering both 'natural' and 'unstocked' forests) in the country is estimated at 64000 hectares. Major causes of deforestation are the failure of forest land to regenerate after harvests, shifting cultivation and forest fire. Approximately 30000 hectares are harvested annually and some of this area does not regenerate because of poor logging practices. Some of the harvest is unregulated logging which is destructive because as a rule illegal loggers do not use conservation logging techniques, nor are they concerned about regeneration. Shifting cultivators are believed to clear between 100000 and 300000 hectares a year. It has been demonstrated in the earlier part of this discussion that there are indications of decline in shifting cultivation. It was suggested that a viable approach is to stabilise shifting cultivation to less vulnerable lands and increase the productivity of the existing land resources thereby discourage the expansion of this practice to newer areas (See paragraph 5.4.1). Fires destroy forest cover. Approximately 100000 hectares are burned each year to improve grazing.

6.6.3 Lack of production forest management plans

Sustainable forest management requires an appropriate consideration of immediate benefits (harvesting mature trees) and future benefits (assured by investments in regeneration and tending). The activities that should take place to perpetually sustain production is outlined in the management plan. Tropical forest management is very complex. Species composition differs by region, site quality, and slope. Each forest is unique and although forest management principles are the same, management has to be site specific. To sustainably manage the forest resources of Lao PDR, all forests should be divided into management units and management plans should be developed for each unit. The management plan should include marking rules, harvesting techniques and regeneration plans, and monitoring schedules (including pre and post harvesting inspections assuring regeneration and stand tending operations between harvests) to insure that the components of the plan are being implemented.

The first step in managing tropical forests is to delineate the production forest or the forest on which the primary objective is to grow commercial timber. All the productive forests in Lao PDR have been delineated[86]. The second step is to divide the production forest into management units and to develop management plans for each unit. In Lao PDR many production forests do not have management plans. Due to a lack of plans there is a tendency to over exploit accessible areas and to use expedient and less expensive harvesting techniques which damage the remaining stand and destroys regeneration.

6.6.4 Developing harvesting techniques and marking rules

The primary tropical forest management activity is harvesting. Only appropriate harvesting will assure that the forests will supply a continuous flow of resources for future generations. If tree harvesting is light and non selective, like natural mortality, the forest will regenerate itself and the original species composition will remain constant. If selective harvesting concentrates on the few marketable species, such as has been the case in Lao PDR, the forest composition will gravitate towards the production of non market species. Over harvesting, on the other hand, often opens the canopy excessively, which suppresses the natural regeneration of desirable species and promotes weeds and bamboo. Appropriate techniques must be defined and followed. Due to the lack of harvesting prescriptions and enforcement, forest resources have been destroyed.

The forest management plan identifies the time at which harvesting should take place in each management unit on the basis of the management objective. But the plan does not identify the specific trees to be felled. The trees to be felled have to be identified by the local forester and this is the most critical exercise in a forest management programme. If the appropriate trees are marked the forest will continue to produce a perpetual flow of products. Marking that is not appropriate will result in "high-grading" the forest which leads to a substantial reduction in the volume and value of the trees available for the next harvest and perhaps the elimination of one or more of the high value commercial species from the stand as only more valuable trees are harvested. Thus marking rules are a critical part of developing a management plan.

In Lao PDR the most often used method is the 'selective system' which consists of conducting an inventory, marking mature trees for felling and leaving a residual of advanced growth for the next cutting cycle, usually after 30 years. To successfully manage a forest using a 'selective system' rules must be developed for marking the trees to harvest. These rules have to be developed for each forest type in each stand to be harvested. The more complex the forest stand, the more complex the marking rules. As the forestry situation varies dramatically from one logging area to another, a separate prescription for selecting trees to be harvested must be developed for each logging area. The experience gained in developing marking rules suited to some logging areas in the country could be used as a guide for developing marking rules for other logging areas on a site specific basis, taking into consideration potential products and anticipated markets.

6.6.5 Maximising returns from non-timber forest products.

It has been observed that the share of the final price realized by the rural resident who gathers and or harvest these products is small. There are many reasons including lack of information on the markets, poor access to market, indifferent quality. Vast majority of these products are often collected and exported out of the region and even the nation in their raw unfinished form. By exporting raw materials and unfinished products, the region is not able to fully capitalize on these forest resources to create jobs and raise incomes. Thus there is an opportunity for value added processing prior to marketing. In addition to gathering non-timber forest products from natural sources, some products can actually be produced by local farmers. For instance, medicinal plants, lemon grass.

6.6.6 Increasing returns from logging

At present the quality of the logs delivered to the mills is often poor. Logs are split, checked and infested with borers. The poor quality is due to a number of factors: poor planning, bad weather, limited hauling season and poor roads. Poor planning is a dominate factor. It has been estimated that one half of the volume of the timber harvested is left in the forest at the harvest site. This not only is a waste of resources but results in lost royalty revenue for the government, deprives sawmills of raw materials that they need to run their mills at capacity, reduces employment and increases the demand for additional harvests of the forest resource. By improving efficiency and quality control in forest product harvesting, transportation and distribution the returns from logging can be substantially improved.

6.6.7 Rationalisation of wood industry

The excess processing capacity built up in the wood industry, far exceeding the sustainable harvest of timber from the forests of the country, is one of the major reasons for the inability of the system to contain extraction to allowable cuts. The industry need to be rationalised on the basis of efficiency. The inefficient ones should be moved out. One of the viable and feasible approach is to provide a level field for the market forces to play it out through systems such as open and competitive bidding and auctions instead of the present system of allocations. Efficiency factors such as skills in sawing, market ability, willingness to accept a lower profit, etc., would decide the survival of the units. Such a strategy would demand greater skills on the effective conduct of auction, access to market information, determination of minimum price etc on the part of the foresters. Apart from weeding out the inefficient units the process would also help full utilisation of the logs including the rejects and augment revenue to the exchequer.

6.7 Conservation Forests and biodiversity

Lao PDR by decree has declared 18 locations covering 2.8 million hectares as 'Conservation Forests' for the preservation and conservation of biodiversity in the flora and fauna, some of which are unique and endemic to the country. The declared protected areas constitute one fifth of the natural forests and one tenth of the country. Given the significant dependence of the local populace on the resources of these protected areas especially in supplementing the food basket through hunting and food gathering, the flora and fauna are vulnerable. Grazing of livestock could also be a cause for concern in the preservation of the ruminant fauna, as the foraging animals could be carriers of major contagious and infectious diseases and parasites that afflict ruminants. The key strategy in preserving the rich flora and fauna and biodiversity, is to ensure the total involvement of the communities and populations dependent on the protected areas through developing a stake in the preservation of this heritage of the nation. This stake has to be built up through strong economic links. First reduce the dependence of the population on these resources for subsistence, especially food supply. Focusing the strategies suggested for the development of the 'unstocked' and 'natural forests' are applicable. What is required to extend priority to the protected areas in implementing the strategies. Second, demarcate and delineate protected areas into 'core' and 'buffer' zones to contain human activity within the bounds of the 'buffer' zone (a cordon sanitaire). Opportunities for income and employment should be increased in this area through intensification of the biomass production and conversion. Third, developing ecotourism in these areas would further the employment and

income opportunities dependent on the buffer zones. Fourth, marshes with unique flora and fauna in the country should be brought under protected areas to preserve the biodiversity. Fifth equally important is the preservation found among cultivated plants especially rice, both of the wetlands and uplands as many unique characteristics (glutinous, aroma, drought tolerance etc) could be used for future development. Sixth traditional knowledge on the properties of various plants, especially of medicinal value, has to be given the required legal personality to safeguard their future utilisation in the context of the new Intellectual Property Rights (IPR) regime, internationally recognised.

6.8 Water resources

Moderate to high rainfall incidence endow the country with rich water resources. But the undulating topography and the sharp and abrupt changes in altitude impose constraints as well as endow potentials in utilising the water resources especially the surface water for development. On the one hand the rich surface water potential can not be used for supporting agricultural development through irrigation because of the relatively low proportion of irrigable land (land with slopes suitable for irrigation) in the command area which renders irrigation investment costly per unit of land. On the other the country is endowed with rich hydro power potential.

6.8.1 Hydropower development

Hydropower is one of the few resources the country is endowed with for its economic development in the absence of proven deposits of major minerals and oil. Its export can ensure a steady inflow of foreign exchange as well as revenue for the government which could be ploughed back for the development of other sectors of the economy. Apart from being environmentally clean and cost effective in relation to other sources, the location of the country close to power-deficit food surplus countries, make hydropower a strategic resource[87] for the economic development of Lao PDR.

6.8.2 Trade offs in hydropower development

But hydro power development has important implications to the sustainability of the land and vegetation resources of the country. First the reservoir formed behind the dam would lead to submergence of a significant extent of land accompanied by a sudden and permanent depletion of prime forests which occupy the valley floors and lower slopes. The submergence also displaces permanently and deprives of livelihood for the human populations inhabiting the land which get submerged. Second the economic activities generated by development would result an influx of population suddenly during the construction period and at a slower pace subsequently attracted by new opportunities such as tourism, fishing etc. which would place a heavy demand on resource land for housing and farming, vegetation for grazing and fuelwood. Often many systems are unable withstand this sudden onslaught on resources. A trade off between the benefits and losses on all accounts would have to be struck in developing hydropower. With a conscious approach it should be possible to minimise the adverse impacts through built-in safeguards. Even though such safeguards may increase the costs, in the long run in terms of human welfare and environmental benefits such measures would prove cheaper. The cost advantages bestowed upon Lao PDR by nature's bounty should enable compensate itself these additional 'burdens' on hydropower development.

6.8.3 Hydropower for rural prosperity

Development of hydropower in Lao PDR has to be seen not only as an opportunity for earning foreign exchange through export but also as a key resource economic development. Apart from profiting from the opportunities for power intensive industries (producing aluminium from bauxite for instance) the hydropower should be used as an instrument for achieving rural prosperity through triggering development in rural areas. Irrigation development using hydropower offers great potential in the country. The limitations of surface water development for irrigation has been indicated in the early part of this discussion. But most of the areas where wetland rice is the dominant crop as in the basins and valley bottom in the Lowlands are also endowed with ground water. Hydropower is a cheap source of energy for lifting water. Combining hydropower with ground water potential (through dug wells as well as tube wells) can usher in the intensification of agriculture and rural prosperity through industrialisation apart from other attendant benefits of rural electrification. Mechanism such as a mandatory allocation from capital investment for power distribution and setting aside a part of the revenue from the sale of generated power can ensure distribution of power for rural development

6.8.4 Orienting irrigation management

Hydropower development apart from energy generation also enriches the down stream water courses with a perennial supply of water. This supply of water could be used for irrigation through lift pumps (with the cheap power it should be economic to run). Irrigation systems from tail waters of hydropower production should be designed to make full use of the water potentials created. The perennial supply of water enables to practice more productive use of water by growing crops all through the year especially during the dry months when the photosynthetic activity is maximum. Annual crops such as sugarcane and perennial fruit crops are opportunities. Cropping patterns have to be designed keeping the focus on utilising the potentials of the dry summer months rather than the supplementary water needs of the rainy season.

6.8.5 Mini and micro hydropower projects

The sparse and scattered habitation in the upland zones in the country would make distribution of electric power expensive (unit cost). Development of mini and micro power hydropower units minimizes the need for long haulage transmission links to carry power to these areas. The dissected topography and high rainfall would provide considerable opportunities in these parts of the country for hydropower development through small and tiny units, a strategy pursued vigorously in many countries with similar resource endowments.

6.8.6 Aquaculture in hydropower reservoirs

Development of aquaculture especially fisheries is one of the a spill over benefit of hydropower development. It provides employment and income and food supplement as well. Through appropriate management, technology for augmenting production as well as regulated harvest, it should be possible to ensure sustainable yields from these water resource potential.

6.8.7 Management of waterspreads

Waterspreads formed by the rivers is a major source fish in the country. Over-catching in these waters is believed to have resulted in the setting in reduction or stagnation in production. Management through restraints in harvesting and enriching the waters with fish fingerlings are the measures required in sustaining yield levels.

6.9 Minerals for agricultural use

High grade guano and appreciable quantities of gypsum (>60 %), limestone ($CaCO_3$) (>50 % CaO), dolomitic limestone ($(Ca,Mg)CO_3$), sylvite (KCl) (>30 % K_2O), carnellite (MgCl) and halite (NaCl) are available in the country. Rock phosphate deposits are also likely present, but further exploration is needed in order to determine minable quantities.

In view of the abundance of phosphorus fixing, phosphorus poor, potassium deficient, acidic and aluminum toxic soils in the country these minerals can contribute substantially to improve the soil production potential. Gypsum can be used on calcium deficient soils replacing aluminum and hydrogen on the exchange complex (gypsum does not improve the soil reaction but has the advantage of being highly soluble, thus improving also subsoil conditions, allowing deeper rooting and reducing moisture stress during the frequent dry spells in the monsoon season). Limestone and dolomitic limestone not only reduce or eliminate aluminum toxicity (by its precipitation in less acid soil conditions) but also improve phosphorus availability (superphosphate precipitates as aluminum phosphate in the presence of exchangeable aluminum). Dolomitic limestone has the advantage of presenting a more favourable Ca/Mg ratio than dolomite and limestone. Deep incorporation of dolomite and limestone into the soil by ploughing is advisable because of the limited solubility of these products. Rock phosphate as a supplement to the feed of local cattle increases their life weight by 20 % (life weight of adult local cattle is between 150 and 200 kg). Lickstones of sodium, potassium and magnesium chlorides could further improve the performance of the local cattle breeds.

Mineral exploitation on a commercial basis for agricultural purposes has not started yet. A closer examination of the chemical (associated impurities, e.g. heavy metals in rock phosphate and sodium content in sylvite) and physical (solubility of rock phosphate) properties after pulverisation and testing in fertilizer trials of the various mineral resources is advisable before any large scale distribution to farmers can be considered.

Commercial exploitation of limestone and gypsum is already taking place for the cement industry. Annually 200 000 tones of gypsum are mined, at present the needs of the cement industry do not exceed 40 000 tones. The remaining amount is exported. Halite containing brine is used for small scale industrial processing of kitchen salt (evaporation of brine by heating with wood).

An organic fertilizer is produced by a local company from composting of mainly pig and cattle manure with rice straw. Inclusion of biopesticides (inter alia parts of the neem tree) makes the product effective for pest control. The product is appreciated by local farmers although its price is relatively high.

7. CONCLUSIONS AND RECOMMENDATIONS FOR SARD

Sustainable development is the management and conservation of the natural resource base, and the orientation of technological and institutional changes in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Achievement of sustainable development for the agriculture sector and rural communities will require that the development policies adopted by GOL are successful in attaining their goals without having negative effects to sustainability. Since the largest proportion of economic activity in Lao PDR is centered on utilisation and exploitation of natural resources, sustainability of environmental quality is a prerequisite for sustainability of economic activity. Development policies must therefore focus on initiating, modifying and in some cases prohibiting actions so as to increase the sustainability of economic activity.

7.1 Management of natural resources for SARD

7.1.1 Transformation of the natural resource dependent economy

The analysis of the resource base has shown that the country is rich and diverse in its natural resources endowments viz. solar energy, land, water and natural vegetation. Review of the performance of these resources, in terms of the biomass output in its various forms, indicates that the resource base currently ensures only low levels of livelihood security for its inhabitants. Further, on several counts the resource base is subjected to degradation (deforestation, denudation of vegetation, soil erosion are the important ones) and its supporting capacity is deteriorating with the passage of time. Resource use and management systems, patterns as well as methods, which supported its dependents for generations is proving no longer sustainable. At the current levels of management and patterns of resource use, additional pressure that will be brought to bear on the natural resource base due to the inevitable demographic expansion is likely to erode further the livelihood security of its citizens and accentuate the deterioration already set in, unless remedial measures are taken. Notwithstanding the aspirations of the country and the determination of its leadership, to bring about a decisive shift in the economic base from natural resource dependency, given the low development and the competition the country has to face from its neighbours who too are seeking the same developmental path, but in a decisively advantageous position having had an early headstart, substantial dependence is likely to continue in the medium term. The issue is not confined to a structural change in GDP (decline of the agriculture sector and advances in other sectors which is generally favoured) but basically employment for the people as that ensures access to livelihood security. Despite the favourable structural changes, there is a time lag in bringing about a shift in the employment pattern to reflect the positive aspects of structural change in livelihood security improvement. Appraisal of the resource base has demonstrated the untapped potentials available, in spite of the constraints which are not insurmountable. Further, despite low levels of development the Lao PDR society, is more equitable with low income disparities, thanks to the heritage of a tradition that ensures equitable access to natural resources. With economically viable, socially equitable and environmentally compatible interventions in the use and management, supported by required infrastructure and institutions, facilitated by conducive policy environment and institutionalising enabling mechanisms, it should be possible for the natural resource base of Lao PDR, not only to support the expanding population but also to bring about substantial improvements in the livelihood security of its inhabitants on a sustainable basis. Such a national endeavour will provide the necessary breathing interval to transform the economy from its present overwhelming

dependence on natural resource base to a more balanced foundation, utilising the initiatives, talents and skills of its resourceful citizens. The policy environment that fosters such a transformation consisting of technological, infrastructural, institutional and legal interventions is outlined in the ensuing discussion.

7.1.2 Resource planning instead of commodity planning

Rural households in Lao PDR, like their counterparts in other developing countries, possess and operate small farms of the size of 1-2 hectares comprised of different land types, utilising own family labour complement of 2-3, raise food for subsistence and 4-5 heads of livestock for cash income and capital accumulation. The livelihood security is dependent, not on one or two commodities but several by putting their limited resources, land and labour, in the production of a variety of goods such as crops, livestock, fish timber through recycling of, and value addition to, resources. The objective is to maximise benefits from the resources to which they have access, by reducing environmental and biotic risks, spreading evenly the limited family labour, and ensuring the availability of food year round. The objective is not to miximise benefit from any specific resource or production of a commodity. Planning for agricultural development is synonymous with planning for increasing the output and productivity of specific commodities be they rice, maize, vegetables, fruits, egg, milk or meat. Research, extension, infrastructure, financial institutions and other support services, policies, and all such aspects of development, are focussed on the production of a few selected commodities. It has two major consequences. First the fruits of development go only to those areas where the resource conditions permit to grow the commodities in question. Second, those areas which are not endowed are left out of the mainstream of development. There is ample proof of this manifestation globally as is evidenced by the concentration of green revolution areas. Poverty persists in areas falling outside this mainstream (mountainous areas, coastal, tribal habitats, etc.) as the inhabitants have no means or support to develop the resources to which they have access. Nearer home in Lao PDR, a wetland rice development strategy is of limited use to those who are dependent on dryland cultivation as in the shifting cultivation areas of the northern provinces. For sustainable development planning should be resource based. Technology, extension and supporting infrastructure should be tailored to the resource endowments of a given area. Its practical implications are discussed a little later.

7.1.3 Holistic systems approach to resource use and management

Access to resources especially land and natural vegetation, by the rural households, to produce food, and generate cash to meet other needs, is not confined to the land individually possessed and on which exclusive use rights are exercised, but also to the land communally owned, and used for shifting cultivation, cattle grazing, food gathering through hunting and extraction of wood for timber and fuelwood (See Figure 9 and Table 5.1). The access is thus to a resource system which is put to multiple uses and not to parcels of resources. Spatially the components are linked to a system rather than being disjointed resource parcels. Further, intervention on segment has implications to others. Grazing pressure and excessive extraction of biomass from the forests (both unstocked and current) would lead to denudation of the vegetation, setting in soil erosion and causing siltation of the water courses and wetland paddies. Multiple cropping of the wetlands will aggravate grazing pressure on the drylands and wooded areas. For sustainable use of resources, a holistic system approach is required in Lao PDR, especially as the land resource base is very vulnerable on account of the rugged topography and relatively high rainfall incidence.

7.1.4 Holistic systems approach to planning research :

The implications of development with focus on resource and holistic system approach to its use and management, transcend all aspects of planning viz. research, technology generation, support services, and policy, although affecting in varying degrees. The exercise in planning resource management should model on homogenous resource endowment areas typified as agroecological zones where the potentials and constraints are fairly common. The exercise should encompass on the sustainable use of a given set of resources, so that the dependent inhabitants have the means to develop them for improving their livelihood security. Development planning systems attuned to the production of specific commodities which is generally the case, will find it difficult to adjust. The least affected is research as necessarily its focus is specific aspects and commodities. But at the stage of research planning when problems are identified and research requirements are determined, the design could be developed for the resource system while for execution could be decomposed into activities or commodities. The extension support system as it is structured is sector-wise such as agriculture, livestock, fisheries, forests, irrigation etc. But at the farm level the requirement of technology and support services is for a farming system rather than specific activities. The transformation required is at the grass roots level in the delivery system, and at the highest level of planning. In between, every level will continue in the respective specialised role to ensure effectiveness and efficiency. What is proposed is not totally new to Lao PDR. First, technology or interventions developed in many pilot projects to minimise shifting cultivation, is based on a system approach; so are the watershed management projects. Second, at the grass roots level, technology delivery is realised through voluntary farmers and model demonstration farms. What is proposed here is to update scientifically and support what they are practicing. Thirdly, the most difficult of all in many other countries, the development support structure as it is evolved in Lao PDR has a single command structure with one person responsible for the development of all the subsectors of agriculture (crops, livestock, fisheries, irrigation and forests) up from the ministry down to the level of the district. What is necessary is to bring about a change in perspective in favour of a holistic system at the intermediate levels, and equip professionally the grass roots functionaries in the development support service chain, in this case the district level functionary.

7.1.5 Strategy for sustainable use and management of resources

While identifying the possible interventions for the sustainable use and management of the land and natural vegetation (See Section 6.1) a system approach was pursued. The components of the system were identified on the basis of the intensity of use as well as the natural vegetation cover. The typology consisted of **natural vegetation** (current forests) used for extraction of timber for commerce, hunting and food gathering for subsistence; **unstocked forests** used for grazing and shifting cultivation; **drylands** for dryland crops and the **wetland paddies** for rice cultivation. All the elements in the system illustrated may not be found every where nor the proportions will be the same as the resource endowments vary from one agroecological zone to another. The design for use and management of resources is built around an overall strategy which is consistent with sustainability. Basically the strategy involve:

1. Preventing any further incursion into the **current forests** (natural forests) through shifting cultivation or clear felling, while extraction will be continued but limited to harvesting of sustainable yields whether it is commercial timber, fuelwood, non-timber forest products, hunting and food gathering and grazing. (This is consistent with the nation's objective of not

only retaining current forests at the present 47 percent level and but of expanding further to 60 percent in the future).

2. Developing the unstocked forests as a buffer which could absorb the increasing demands in forest products and income generation. This could be through developing plantations of trees or perennial crops (cashew, rubber, coffee, cardamum or fruits). Elimination of shifting cultivation from areas vulnerable to erosion under dryland farming and stabilising this practice in less vulnerable areas by intensifying cropping accompanied by terracing as well as improvements in dryland rice cultivation.

3. Intensifying the use of drylands by growing dryland crops such as maize, cotton, groundnut, fodder, medium term crops such as pine apple and perennial grasses

4. Multiple cropping on wetland paddies by introducing irrigation or taking a short duration crops soon after the harvest of the main season rice crop, and incorporating fish culture.

7.1.6 Development of road infrastructure

Self-sufficiency or subsistence is the effect and not the cause. The cause is physical isolation dictated by the rugged terrain and topography. In the absence of efficient and hence cheap transportation, primarily roads, rural households try to be self-sufficient in their basic needs. Because, even if they produce something for exchange, there is no cost effective means to take the produce to the market unless the commodity has high value per unit volume like cardamum or opium (to stretch to the extreme). The isolation due to lack of road communication is not confined to the highlands only. Even in the lowlands many villages are cut off especially during the rainy season even though rivers and streams partly overcome this handicap in the plains. In more arid ecological conditions pack animals such as donkey come to the rescue (and mules in the highlands) of the farmer. Partly the rural population overcome the problem by rearing livestock utilising the biomass available in such areas and drive them down on hoof to the markets. Livestock has thus become the source of cash income for the rural households in this country. But given the constraints in the availability of herbage there are limits to this kind of economic activity. The argument is not for capital intensive highways but easily maintainable small jeepable link roads connecting the habitations to the district centres or to the highways. The basic requirement is bridges, culverts and causeways so that the roads are passable during the rainy season. In the absence of road communication these villages remain isolated. Not only that they are unable to take their produce to the market, but the supplies and services including education and health care can not be taken to the rural communities. In order to realise SARD establishing road linkage with the rural communities is a pre-requisite. Once the habitations are linked with roads, market opportunities expand and the development process would set in. The experience within the country itself is ample proof of this development manifestation.

7.1.7. Resource planning attuned to infrastructure support

Notwithstanding the imperativeness of roads for SARD, strategies and interventions for the use and management of the resource system could be designed and developed on the basis of accessibility. Villages and habitations with access, the focus should be on commodities (vegetables, fruits, timber under farm forestry) for cash income. The choice is dictated by the market. In areas with limited access the focus should be on commodities which are less bulky and perishable, but of

high unit value such as coffee, chilies, cotton, etc.. In inaccessible areas high unit value commodities like cardamom or live animals which can trekked on hoofs could be the focus of development.

7.1.8 Accessing more power for land preparation

The most critical constraint in expanding cultivation on the drylands or introducing multiple cropping in the wetland paddies, is the unsuitability of draught power available at present for land preparation. The local plough (more appropriately the harrow) and buffalo in single harness can be used only under wetland conditions. The alternatives are introduction of iron tipped wooden ploughs drawn by cattle, and mechanical devices such as power tillers.

7.1.9 Increasing the productivity of labour in farming

Family labour is the primary source of work force for the farms. As the tools used are of low efficiency the output is low, demanding larger amounts of labour per unit output. Labour assumes a critical input in the expansion of cultivation as in shifting cultivation. Technologies that would increase productivity or reduce labour requirement (biodegradable weedicides in dryland farming) should be introduced. Besides, such measures would release labour for additional income generating activities if warranted, and help remove the drudgery of tropical farming.

7.1.10 Alternative assets to livestock

Apart from being the source of farm power and organic manure, a means of converting crop byproducts (straw) and other biomass, livestock has a very important function in the rural household economy, being the only asset with liquidity. Such a value system encourages accumulation, rather than periodic disposal through slaughter for generating income. Increasing livestock numbers beyond carrying capacity would render animal rearing unsustainable and may lead to the denudation of vegetation and other attendant resource degradation problems in grazing areas such as the 'unstocked forests' which is the primary source of forage for the livestock in the country. An alternative asset formation mechanism is the growing of trees.

7.1.11 Ground water utilisation and rural electrification

A major limiting factor for multiple cropping in the wetland paddies is the lack of moisture for crop production during the dry season. Surface irrigation projects in the country are proving capital intensive and less cost-effective in management. Utilisation of ground water is an alternative. The relatively cheap hydropower produced in the country should be extended to ground water utilisation through a massive programme of rural electrification. There will also be attendant benefits in terms of rural industrialisation and dramatic changes in the quality of rural life.

7.2 Agriculture policy

7.2.1 Food self-sufficiency

Food self-sufficiency through increasing rice production is the primary policy thrust of the GOL towards agricultural development. Food being a basic consumption commodity, its availability, accessibility (income to buy food) apart, is a fundamental responsibility of the government. Food being the largest single item in the household budget (it is true of all low income economies), its availability at affordable prices to non-food producers, has significant implications to the macroeconomic management especially in keeping inflationary pressures under control. The concern of the government in ensuring food availability is therefore legitimate.

Food security in Lao PDR has two dimensions. First the availability of food for the country as a whole, the national level. Second, availability of food within the country at the subnational levels of provinces, districts and finally the villages. The threat to food security at national level arising from food deficit, is relatively of smaller magnitudes except in years of serious natural calamities (as the loss of crops in 62000 out of 306000 hectares requiring import of 130 000 tons of rice equivalent to one eighth of the total needs for 1996 due to floods during the rainy season of 1995). At the level of the nation, demand for food is centered around the urban habitations. Most of the urban centres are adjoining to the main rice producing plains. These areas are relatively easily accessible through both road and water transportation network. The national level food security is physically solvable as importation can be resorted to, in case need arises. The country borders on two of the world's largest rice exporting nations (Thailand and Vietnam) and could readily import rice to meet deficits at possibly the lowest transportation costs and shortest delivery times in the world. Food security at subnational levels is fraught with difficulties. In the absence of adequate road network it is difficult to reach food in places where it is needed even if food is available within the country by producing it somewhere. Above all food production in developing countries such as Lao PDR is not just making certain quantities of food physically available through imports but food production is also a means of employment and income earning possibility and thereby livelihood security. Import will not be of much help on this score.

The issue of rice preference complicates food security in the country. The overwhelming dietary prefeference of the Lao population is for sticky rice, rather than the 'steam' (non-glutinous) HYV varieties available at export markets. Unless sticky rice is specifically grown by exporters for the Lao market, sticky rice will normally only be available inside Lao PDR through domestic production. The increased rice prices over time should give farmers an incentive to increase production. Development of HYV sticky rice varieties might increase production even further, but with attendant unsustainability risks from increased use of fertilisers and pesticides. Further, the 'steam' rice prices in the market is higher by a quarter to one third of that of the 'sticky' rice. The rice import option is therefore not as robust as generally made out to be.

The strategy of focussing rice production in the lowland plains may not be of much help in solving the food deficit in the northern region provinces where the sub-national food security problem persists because of the transport constraints. In Section 6.2.1 the basic constraints to increasing rice production from wetland paddies during the main season have been discussed. The second option is growing rice under irrigation during the dry season. This strategy diverts significant development resources to activities with low economic return as in capital intensive irrigation. Only one half of the irrigation potential created is utilised. The alternative is utilisation of the ground water potential. The other option is to increase the productivity of dryland rice. The strategy therefore should be

that of utilising the land resources to the best opportunity to which they can be put, thereby increase the income and strive to achieve **self-reliance** rather than **self-sufficiency**. A more appropriate general agricultural policy would be one that stresses efficiency in food crop production and profitability for producers, without specifying which crops are to be grown.

Early warning system and buffer stocks

Food production alone is not a sufficient condition though a necessary condition for food security. Management of food supply is very critical. Food is a commodity which can not be left to the full play of the market forces. No government, either of the developed or the developing countries, can afford to abdicate the fundamental responsibility of providing food to its citizens. Acquiring adequate information timely on the supply and demand within the country and outside, and some command over the supply are very vital for ensuring food security. Vigil on the supply and demand position, prices, sources of supply of food etc. is very crucial in taking timely action to prevent any human sufferings in a country like Lao PDR with a precarious food balance situation. A well oiled early warning system in position always should be made an integral part of the food security planning. Second is the effort to acquire some command over food supply by building up a buffer stock without the government being involved in the physical handling. It could also be a part of the regional food security systems (as for ASEAN). In the absence of some command over food supply the government can remain only a mute spectator to a chaotic situation in times of crisis.

Promotion of sticky rice and green rice

Value addition to the commodities produced in the country is another means of increasing income for the farmers and thereby increase their capacity for self-reliance. One possibility is to promote Lao rice in the international market, both as 'sticky rice' per se and as 'green rice'. The only other area in the world where sticky rice is grown in significant quantity is northern Thailand, but production there is declining and within a decade Lao PDR may be the only sticky rice producing nation in the world. This could present interesting opportunities. The rice market in importing developed countries basically consists of only a few varieties: pre-cooked ('Uncle Ben's') HYV, unpolished brown rice, aromatic ('Jasmine') Thai rice, Basmati or Patna rice from India, and long grain black North American wild rice. Opportunities therefore exist for opening market niches for new varieties. Lao sticky rice would certainly be a fairly unique novel product which might rapidly achieve a connoisseur status in developed countries. If export market penetration of sticky rice could be achieved, Lao producers would enjoy a world monopoly and receive premium prices. A still wider potential is the 'green rice' market. Much of the rice produced in Lao PDR is without the use of chemical fertilisers and pesticides. Preference for organic products is increasing. This opportunity should be exploited. The **low input/low output** stigma on the Lao peasant can be transformed into a virtue and blessing through a commercial success.

7.2.2 Promotion of cash crops

The policy of GOL to increase production of cash crops is sound in so far as it will diversify the rural sector in general. It should be a strategy for the intensification of the drylands which is the major source for rural employment. However some qualification on particular crops is necessary.

Choice should be on crops with opportunities for vertical integration with industry such as cotton, sugarcane etc. instead of commodities such as tobacco which is potentially a health hazard, an environmental hazard too with its increasing demand for fuelwood for processing and not the least a declining international market. Cotton seems an economically sustainable choice as it integrates vertically with the garment export industry. The latter is currently benefiting from an export quota. This is likely to be removed in future, and such a development will put the entire industry at risk since it operates on a small margin (all materials are imported and only labour is added). If cotton can be grown profitably as a dry season crop on irrigated land and sold to textile mills which in turn supply the garment industry, development of a fully integrated garment sector will be possible which captures all value added, from raw material to finished exportable product.

7.2.3 Shifting cultivation

Reduction and elimination of shifting cultivation by the year 2000 is another significant policy in the agriculture sector. Stabilisation rather than elimination is probably a less socially disruptive measure. A selective approach to suit the different resource endowments and social conditions would have to be pursued. (See Section 6.4.1). A distinction between 'slash and burn' as a land preparation practice (under sedentary agriculture as in the drylands of the lowlands even) and shifting cultivation as land management practice (moving from one location to another) has to be recognised. If 'slash and burn' as a land preparation is practiced on lands with milder slopes (which in most cases is) shifting cultivation is environmentally not a disruptive practice. Under such situations efforts should be made to increase the productivity of rice and reduce the labour inputs. Shifting cultivation as a practice moving from one location to another location and result in the destruction of woody vegetation becomes environmentally hazardous practice. Measures for increasing income from lands subjected to shifting cultivation through tree planting and raising plantations of cashewnut, rubber etc. have already been mentioned. Other measures for the rehabilitation of shifting cultivation areas include comprehensive terracing of hillsides for rice production, micro terracing of barren eroded hillsides with various cash crops including fuelwood and fruit trees, allocation of land titles for social forestry production systems, development of production and markets for non-wood forest products, and participation in hydrodam reservoir-centered economic activities for hill tribes located near future reservoirs. Further with the opening up of the area with roads would facilitate more valuable crops to grow. Therefore in the reduction and elimination of shifting cultivation infrastructure has to play a key role.

The issues of shifting cultivation have to be seen against an overall strategy for the rehabilitation of the 'unstocked forests'. This is the buffer that protects the natural forests from further incursions and human interference. This resource should also be considered as a reservoir for absorbing further demographic pressures through sustainable development programmes. The extent amounts to one fifth of the country. A master plan has to be developed for this area. Creation of a revolving fund for the rehabilitation of the 'unstocked forests' would help also mitigate the environmentally disruptive aspects of shifting cultivation. The possibility of channelling resources from the Global Environment Facility should be actively pursued.

7.3 Livestock policy

The robust growth of the livestock subsector without any particular targeted policy support from GOL indicates that some comparative advantage and opportunities exist in this subsector. These

lie in the growth of domestic demand and export potentials to Thailand and Vietnam in future. Under the prevailing management system of relying on the free range grazing, the opportunities for life stock production are constrained by the availability of forage. The forage resources from the forests, especially the relatively easily accessible 'unstocked forests' have limits. Livestock by free range grazing should be fostered only to the extent the forage resources in common lands permit. But livestock has to be fostered as an integral part of the farming system for sustainability (See Section 6.3.4). Maintaining the fertility of the crop lands depends primarily on the supply of animal manure. The possibility of greater utilisation of rice straw should be considered. Some demonstration support may be required in the area of growing high quality fodder during the dry season. Demarcation of adequate grazing lands that do not interfere with crop production lands or forest production lands will also be necessary. Strategies have to be designed to bring about changes in the objective of livestock (bovines) rearing from that of asset creation and capital accumulation to income and cash generation. Unless this transformation is brought about, the aim of households would continue to be increase in numbers and not outputs from the limited forage resources. Since livestock population is generally found to increase in tandem with population increase in livestock dependent systems, expansion in numbers will become unsustainable given the limited biomass resources. Veterinary services must be made available as Lao cattle suffer from disease problems. Improvement in stock genetics should also come about through better husbandry practices.

7.4 Fisheries policy

GOL policy is focused first on pond aquaculture as a means of providing animal protein for subsistence and markets. To a large extent this is a component of the food self-sufficiency policy which was discussed above. The focus should be on the profitability of fish farming, rather than mere subsistence goals. Dietary preference will play a role in the pricing of pond fish in comparison to river fish. Reservoir and river fisheries may thus always have the price advantage over pond fish. Nonetheless pond production should not be regarded as a cheap source of animal protein, but rather a profit-making economic activity which has its own internal strengths and weakness, potential and threats.

Reservoir fisheries potential will expand significantly in future as a result of hydrodam construction. Full realisation of the fisheries potential will depend on the presence in the reservoir of a robust inventory of species, especially small pelagic species (which may need to be introduced from other watershed if not locally native). Creating conditions to stimulate the construction of fisheries infrastructure, the profitable supply of fishing inputs, and the processing of high quality fresh, dried, smoked, salted, fermented and canned products will be critical to realising the full range of benefits that reservoir fisheries can provide. Reservoir fisheries potentials can however be easily undermined by overexploitation of the resource. A comprehensive program of resource management by the fishermen will be required.

Reservoirs are artificial aquatic environments under the control of the hydrodam (as well as the erratic rainfall which affects parts of Lao PDR). Sound environmental management of reservoirs by incorporating fisheries objectives into dam operating rules is of paramount importance. Optimal compromises between electricity production and fisheries production will have to be achieved. Hydrodam construction will present a serious migration barrier to river fish which could substantially lower fish production in tributaries as well as the Mekong River mainstream. Consideration must be given to providing bypass facilities at hydrodams as appropriate for various migratory species which are effective for both upstream spawning migrations and downstream dry season refuge migrations.

7.5 Forestry policy and strategies for SARD

7.5.1 Forestry policy

The forest resources of Lao PDR are without doubt the single most threatened natural resource of the nation. In the past excessive unsustainable felling and shifting cultivation have reduced forest cover significantly. In the future, these threat will lessen as GOL is taking action to terminate shifting cultivation by the year 2000 and enforce effective forest resource management. However, the proliferation of hydrodam development will be accompanied by permanent inundation of forest lands (hence GOL policy permits clear cutting to realise the once-only value of the tree crop).

Forest management is being enforced by designation of forest production areas under forest management plans. An oligopoly of three large regional mother companies have been given exclusive felling rights. While taking advantage of potential conservation benefits of managing conserving forest resources through fewer larger companies than numerous smaller logging enterprises, the negative fall outs such as over-capitalisation and under utilisation of capacities, preferential treatment to own companies, under pricing, etc. have to be avoided. Safeguards against such negative tendencies are: to restrict the operations of the mother companies to felling only, and to allow free market competition for all other forestry operations and services. In particular, all logs felled by the mother companies should be sold under open auction. An additional benefit of keeping log prices high is that more efficient use will be made of felled logs, and greater care will be taken to deliver sorted and undamaged logs to buyers.

Loss of forest land due to hydrodam construction will amount to several thousand square kilometres. There is no direct mitigation measure possible for this impact. However it should be clearly understood that which is of issue here is the loss of the productive forest and its associated flora and fauna biodiversity, rather than the physical land loss itself (since Lao PDR still has large land areas which are sparsely inhabited). A viable indirect mitigative approach would be to 'replace' the lost forest resources elsewhere. Thus, for every square kilometre of forest land lost, the developer would be required to replenish an equivalent area elsewhere in the region with comparable forest and biodiversity resources. The guiding principle for such a policy would be: No net loss of forest lands. Serious consideration should be given to implementing this policy as the principal means of mitigating environmental loss arising from the reservoir creation component of hydrodam development.

7.5.2 Strategies for forestry resource planning for SARD

7.5.2.1 Sustainable management and appropriate harvest of timber products from production forests

Measures include: (1) Demarcate all productive forests. (Divide productive forests into management units and management units into cutting areas). (2) Inventory each management unit and determine allowable cut. (3) Develop a management plan for each management unit. The management plan would: (a) Allocate the allowable cut to cutting areas by time, (b) Define the silvicultural activities to be carried out in each cutting area by time, (c) Define the marking rules by which timber to be harvested is marked in each cutting area, (d) Define appropriate harvesting

techniques to be used in each cutting area, (e) Define the post harvesting activities which will assure satisfactory regeneration (planting or enrichment planting) and (f) Define a monitoring schedule which will verify that all of the activities prescribed in the management plan are satisfactorily completed.

To support this policy, the harvesting firm must be made contractually responsible to carry out the harvesting in accordance to the management plan. Penalties must be prescribed for violations and the government must declare its intention to enforce the contract.

7.5.2.2 Promote the sustainable management of the Non-timber forest products

Measures includes: (1) Identifying and quantifying the non-timber forest products in the region, (2) Determining the sustainable yield of these products, (3) Developing management and extraction techniques which will enhance production, (4) Assessing potential demand in terms of quality, quality and price, (5) Transferring the management technology and market information to local communities through an appropriate extension program.

7.5.2.3 Encourage, facilitate and concentrate forest product processing and value added activity in rural communities and on rural farms

Measures include: (1) Sponsoring market analysis studies to identify products which have the greatest potential for value-added processing in the rural areas of Lao PDR, (2) Developing pilot processing projects located in rural areas to demonstrate technical methodology and (3) Determining market linkages so as to develop the appropriate marketing framework for these value-added products, (4) Promoting services and businesses that would stimulate entrepreneurship and (5) Providing business support services such as management training, technical advise and credit.

7.5.2.4 Maximize the utilization efficiency of forest products after harvest

Measures include: (1) Harmonizing harvesting activity with demand and constraints of seasons and transportation capacity, (2) Using marginal analysis to determine which logs should be taken to the landing and which should be left at the harvest site, (3) Intensively sorting logs in the concentration yard in terms of species, size and quality, (4) Allocating logs to the highest bidder in an auction that is open to all forest products industries in the area and to other interested parties.

7.5.2.5 Promote and support the participation of the rural population in the sustainable management of forest resources

Measures include: (1) Informing villagers of the program, the opportunities and responsibilities associated with it, (2) Encouraging and assisting villagers in the identification of potential forest areas and in the formulation of Joint Forest Management Associations, (3) Assisting in the development and writing of management plans for the designated forest area, (4) Assisting the villagers in applying for Joint Forest Management Agreement status, (5) Designating staff with the

specific mandate to assist in the management of the agreement forests by providing technical advise, marking harvests, and monitoring the forest on a continuous basis to verify that the terms of the management plan are being carried out and (6) Setting numerical targets for the formulation of Joint Forest Management Agreements to provide the incentive for Provincial Forestry Departments to support them.

7.5.2.6 Develop and support a marketing for forest products

To capitalize on the opportunities that could develop with an increase in the demand for forest products in the rural areas of Lao PDR, a marketing program should be developed and supported. The primary objectives of this program would be: to conduct market surveys following the product through the market from the enterprise to the final consumer; to identify constraints which reduce market efficiency and/or product quality; to resolve these constraints by providing technical assistance, information, and extension; to develop linkages between producers (farmers), traders and processors and use these linkages to develop an understanding of the capacities, needs and constraints of all of the market participants.

7.5.2.7 Make available credit for tree cropping

Credit availability limits the rural farmer's participation in tree crop establishment programs. Thus a comprehensive rural development program should include a rural farmer credit component. To allow farmers to invest in forest plantations, the credit program must take into account the delay between investment and revenue generation which is inherit the production of forest products.

7.5.2.8 Develop applied research in forestry

There is a need to support current and new programs of forest management research. As previously outlined, tropical forest management is a very complex science. Forests must be managed on a site by site; species by species basis. Many forest management methodologies used in Lao PDR are traditional procedures not supported by sound research. To meet the anticipated resource demands of the future, to maximize the returns from intensive forest management programs and maximize the contribution of the forestry sector to the economy of the nation, research efforts in tropical forest management must be increased and supported. To maximize the impact of these programs the emphasis should be on applied research and the appropriate extension programs should be developed to disseminate the information to practising foresters.

7.5.2.9 Strengthen forestry extension

To support sustainable agriculture and rural development the forestry extension program must be strengthened. The program should be a principal part of the marketing and micro-enterprise programs and assist in the promotion of "Joint Forest Management Plans". Activities should include: (1) establishing silviculture and management demonstration plots at the village level to serve as extension and training tools, (2) establishing micro-enterprise value added pilot projects to develop

and demonstrate appropriate processing technologies and to encourage farmers and entrepreneurs to invest in the establishment of these enterprises and (3) disseminating information generated by the marketing program so that forest product producers will have a better understanding of marketing alternatives.

7.6 Hydroelectric policy

The policy of GOL to rapidly develop the national hydroelectricity potential is fraught with numerous sustainability problems. Hydrodams create numerous potential non-hydroelectric benefits that require careful planning if they are to be realised and not wasted. There is a need therefore for an integrated multisectoral approach in sectoral and project planning to accurately identify problems and potential solutions, to devise and carry out mitigation measures under EMPs and to plan for full realisation of potential economic benefits. Resolution of conflicting needs between sectors is also of high importance. Focusing only on hydroelectricity production and export sales will not generate the greatest possible economic return, and will certainly lower sustainability and increase the negative environmental impacts of the project.

One option to deal with this situation is to establish river basin development authorities. This is however more suited to large basins, rather than to the numerous small tributary basins which are the object of hydrodam development in Lao PDR. A proliferation of river basin authorities is unlikely to be an effective approach. A more feasible approach might be to give the hydropower developer full authority for basin management, including the reservoir catchment and the downstream river channel. This would mean that the developer assumes the costs of basin planning, rather than GOL. However, the developer's role should limited to planning. Free market competition should be guaranteed for non-hydropower developments such as fisheries, tourism and services.

7.7 Irrigation policy

The movement away from large scale irrigation projects to smaller scale projects which are both affordable and maintainable by farmers is a welcome change in GOL irrigation policy. This creates the basis for greater sustainability of irrigated agriculture. It also gives greater control to water users.

7.8 Macro economic policy

Policy analysis for enhancing sustainability requires an awareness of the multiple impacts that all policies have. While some policies are clearly overtly environmentally impacting (i.e. a forest utilisation policy), other policies that appear at first evaluation to be environmentally neutral or benign may still have very serious concealed outcomes for environmental sustainability.

7.8.1 Complementarity between sectoral and macroeconomic policies

Both sectoral and macroeconomic policies can heavily affect sustainability. Complementarity must therefore exist between the two to avoid unsustainable outcomes. Care must be exercised to

ensure that policies do not bias terms of trade against agriculture (thereby reducing land value and decreasing the incentive to invest in soil conservation measures). Neither should they bias internal terms of trade too strongly in favour of agriculture (as this leads to excessive use of fertiliser and pesticides, groundwater depletion and surface water pollution). Inducing the growth of capital-intensive import substitution industries by overvaluing currency (thus making capital artificially cheap) is particularly unsustainable as it creates minimal employment (and thus dams excess rural labour and pushes agricultural production into marginal or forested lands).

7.8.2 Resource pricing to reflect real costs

Both real private and social costs must be incorporated into prices if resources are to be allocated efficiently. For example, soil erosion will impose a private cost on a farmer through a marginal loss of productivity, but the larger social cost (as a result of the farmer's land generating a negative externality) can include siltation of streams and eutrophication of lakes. Market prices may be insufficient to induce the farmer to make an additional investment in soil conservation in order to recoup the marginal loss in production. Government policy must in such cases have the objective of modifying land use behaviour through such instruments as subsidies, grants and taxes in order to reduce resource degradation. The policy must be broad enough to also realise cost recovery through costed benefits. Macroeconomic policies (i.e. a market determined exchange rate) and sectoral policies (i.e. attaching greater value to the agriculture sector) can lead to increases in agricultural land prices and a greater incentive for farmers to conserve their soil resources.

7.8.3 Sustainability in economic policies of GOL

Comparative review of the resource base of Lao PDR and the economic policies being implemented by GOL shows that opportunities exist for policy modification to increase their sustainability for both the environment and the economy. Recommendations for policy adjustments are presented below.

Fiscal policy

The prevailing fiscal policy of prudent expenditure is sound from the perspective of SARD. However the decrease in funding to environmental units in various GOL Departments clearly does not further the promotion of sustainable development. There is an urgent need to upgrade environmental planning, assessment and management skills, and to initiate EMPs.

Monetary policy

GOL is concerned with preventing rapid credit expansion and incorrect valuation of the kip. Credit control and market valuation of the kip are sustainable policies as they keep inflation in check and do not introduce additional resource mining pressures.

Investment policy

FDI is the major engine of economic growth of Lao PDR, and this is in keeping with the historical experience in most developed countries (almost all of which relied heavily on foreign investment for their industrialisation and economic development). FDI is also the only real option available to GOL, as using agricultural-surplus for investment under a central-planned command economy is not a particularly successful approach.

FDI is heavily focused on hydropower. While this sector certainly has a significant potential to generate foreign exchange earnings, the sector creates relatively few jobs in the post-construction period of dam operation. In the long term, the hydroelectricity sector will not be able to absorb surplus rural labour.

The most likely scenario is that surplus rural labour will migrate to urban areas, and this is already taking place. It is critical therefore that GOL promote FDI in industry and manufacturing sectors. Given the huge amount of hydroelectricity that will become available, heavy industry may be feasible and economically sustainable, but could create additional environmental problems if carried out without regard to resource degradation.

Over the next two decades, the rate of migration to urban areas will be tempered by the demand for labour at dam construction sites. But once, installed hydropower capacity has reached a certain level where FDI begins declining, urban migration will likely to intensify.

PIP is focused on road construction and rural electrification. Both of these areas will promote SARD by bringing isolated communities into the economic mainstream by improving opportunities for transport of products to more lucrative markets and providing access to the large array of production activities and social benefits that electric power provides. PIP should however be expanded to include investment in navigation sector and other infrastructure associated with hydrodam reservoirs. Experience at Nam Ngum has shown that reservoirs attract in-migration of rural populations and provide easy navigation between road heads near the dam and once remote and difficult to reach rural areas. Foreign investors are also showing interest in tourism development in reservoir areas. Rational planning of reservoir navigation and social infrastructure can yield large economic benefits, and from the perspective of social justice, provide a high level of compensation and livelihood enhancement for displaced communities (quite possibly resulting in a real net gain in standard of living compared to the pre-impoundment period).

Trade policy

GOL policy for trade is generally liberal and open, and highly sustainable. However, given its landlocked status, Lao PDR suffers from high overland transport costs for export goods to reach shipping ports. This cost is increased artificially by the existence of a GOL monopoly on transport of export goods through Thailand. The extra cost feeds back to the agriculture and natural resource sectors by marginally increasing prices, and affecting sustainability. This policy should be changed in order to allow competition and thereby efficiency in the transport industry.

Labour policy

Lao labour suffers from lack of skills, illiteracy and shortage of employment opportunities in urban areas. GOL policy should focus improving education and training institutions, initiating literacy classes, and promoting employment creation through manufacturing and services. The reduction of excess staff in state enterprises should be accelerated, as the retention of unproductive labour reduces the profitability of the enterprises..

7.9 Enabling legal environment

Lao PDR will need to choose among various strategic legal options to achieve its technical, social, economic and environmental goals in SARD. First, existing legislative and legal constraints to SARD should be removed. Second, future legislative and legal actions should be SARD-friendly.

7.9.1 Legal frame-work for SARD

The legal framework for environmental and natural resource management in Lao PDR has no means for integrating environmental concerns into the agricultural and rural development policy formulation, planning and implementation process. There is no formal EIA requirement or environmental regulatory framework for ensuring that State and private sector actions in the agricultural sector are environmentally sound and SARD-friendly. The draft Decree on Environmental Management and the Draft Law on Environmental Protection both include general requirements for environmental impact assessment (EIA). These are deficient from a legal point of view in obligating parties to complete an EIA, integrating environmental concerns into the Government's line ministries and in punishing violators. The existing informal situation where the Committee for Planning and Cooperation requires EIAs on major development projects should be formalized and specified as soon as possible. Sector-specific EIA guidelines should be developed and formalized for agriculture.

Decree No. 50/PM on Land Tax should be revised to include provisions on the granting of tax incentives to those who farm land on a permanent and sustainable basis with due regard to the conditions of water catchments and tax disincentives to those who use land in an unsustainable manner. Each natural resource management law should also include incentives and disincentives to prevent negative environmental impacts and promote SARD.

There are significant gaps (absence of any resource management legislation on water or fish; absence of EIA legislation) and weaknesses (lack of recognition or protection of existing strong customary or community natural resource management rights; failure to delegate real management powers to communities) in the existing natural resource management legislation.

The main legal threat to sustainable agriculture and rural development is uncoordinated, unsustainable, uncontrolled and poorly implemented central Government interventions such as fiscal legislation or forest concessions of weak legal support.

The general legal and regulatory framework, the public administration system and the administrative law practice in Lao PDR negatively affect the development of a transparent,

accountable and equitable environmental and natural resource management legal framework. Examples are ambiguities in legal personalities for contracts in various types of natural resource management such as water users' groups and village forest enterprises.

The lack of coordination and knowledge about implementation at the provincial, district and village levels poses a significant threat to drafting and implementing sound legislation for sustainable agriculture and rural development.

The lack of trained human resources in STENO and line ministries constrains the formulation, drafting, adoption and implementation of sound environmental management legislation. Examples are deficiencies in existing drafts of the Environment Decree and the Environment Law which could be remedied through a frank and transparent process to improve the draft legislation and clarify the policies behind it.

7.9.2 Customary laws

Little information is available within the central Government on customary laws of environmental and natural resource management use. However, previous FAO projects and an increasing number of externally-assisted projects have confirmed that customary laws, especially in land and forest management, are integral to village-level natural resource management and take precedence over formal legal requirements. Many of these are being formalized in village-level agreements under externally-assisted projects in the forestry sector. The Government's desire to promote SARD, which depends on those informal legal traditions which provide secure efficient access to resources, and its desire to eradicate backward thinking and eliminate backward traditions will conflict if more information is not made available to central Government policy makers and legislative drafters on the role these customary laws can play in promoting SARD.

The draft land and forest laws may include greater recognition of customary rights. It is important that these recognize differences among different ethnic groups. Customary land use rights and access should be recognized in a formal legal manner and traditional mechanisms supported. To promote SARD, the draft land law should ensure equitable access to land, promote SARD practices in land, enable farmers to protect their lands from permanent conversion to other uses when alternatives to such conversions exist, support customary land rights and traditional dispute resolution mechanisms where these are efficient and promote SARD, and base classifications and uses of land as much as possible on agroecological zones.

7.9.3 Legal and regulatory framework for financial and market economy

As noted already, the general contract and property laws of the Lao PDR provide a minimally adequate framework for natural resource management agreements. However, there is continuing legal uncertainty over the legal forms of contracting personalities. The contract law is general enough to consider villages, village enterprises, water users' groups and farmers' associations as juridical personalities for enforceable contracts. These are currently negotiated under the main right of the Ministry of Agriculture and Forestry as organized to "consider and approve the establishment of farmers' trading cooperatives, associations of farmers, water users' groups, agriculture-forestry producers' groups and other related farmers' organizations". Given the nascent nature of the rule of law in the Lao PDR, it would be better for SARD if these were specifically authorized in legislation.

This would protect the rights of natural resource users against outside interests and ensure that village-level natural resource management agreements and land use plans or contracts were enforceable against those proposing unsustainable agricultural and rural development.

There is no general intellectual property rights legislation which protects the biodiversity and genetic resources for the Lao PDR. The only intellectual property rights legislation appears to be Decree No. 06/PM on Trademarks (18 January 1995) which is not relevant to SARD. The Minister of Justice has proposed that a law on intellectual property be drafted for enactment in the period from 1997-2000.

The existing legal and regulatory framework is attractive to foreign investment. However, the existing land and forests legislation is not.

There are burdensome registration and licensing procedures which constrain interprovincial trade. SARD cannot be achieved in the context of unjustified trade barriers.

7.9.4 General administrative law framework

As noted in the Government's 1993 Environmental Action Plan and its background documents, "among the key institutional constraints (in environmental policy and planning) are the unclear mandates of various Government agencies in the area of environment and the absence of clearly defined lines of authority, the lack of well established procedures to assure that environmental concerns are integrated into development activities, and the limited capacity of the institutions currently involved in the environment sector". STENO's effectiveness is constrained by its unclear and diffused mandate, the lack of a clear line of authority and the limited technical capacity of its staff. The lack of a national framework has led to a proliferation of donor driven and largely uncoordinated initiatives, often resulting in duplication of efforts. Scarce human and financial resources can be used most effectively for SARD in the Lao PDR if existing resources are trained in environmental and natural resource management.

The Ministry of Justice is considering whether to draft an administrative procedure law which would apply uniform administrative procedures to all Government departments. This initiative is conducive to the promotion of SARD. An administrative procedure law would ensure transparency in legislative drafting, enactment and implementation. To promote SARD it should ensure participation by those affected in the legislative drafting process and access to laws and implementing legislation through dissemination by all appropriate means for rural, often illiterate, farmers.

While STENO's mandate does need to be revised, it is not necessary for SARD that it be done immediately. Existing legislation on the mandates, tasks and functions of the Ministry of Agriculture and Forestry ensure that SARD as a Government policy can be achieved in that line Ministry's work.

To maximize coordination among donor projects and promote SARD, formalizing SARD-specific evaluation criteria and procedures used by the Committee for Planning and Cooperation would be more effective than immediate strengthening of STENO. The three existing legal divisions in the Committee for Planning and Cooperation should be trained in legal aspects of SARD along with STENO and the Ministry of Justice. In addition, the adoption of more transparent administrative procedures for all Government departments is more important from the perspective of integrating environmental policy and planning into agricultural policy formulation and implementation.

Additional training in environmental and natural resource management is needed to target lawyers in CPC, STENO and the Ministry of Justice and ensure that environmentally-sound and SARD-friendly conditions are included in international donor projects and in contracts with the private sector.

7.9.5 Legislative priorities

Priorities in legislation are:

1. drafting of SARD-friendly and linked land, water and forest laws for adoption by the National Assembly in February 1996;

2. drafting of SARD-friendly amendments to Decree No. 50/PM on Land Tax;

3. drafting of environmental impact assessment legislation and implementing regulations which are SARD-friendly;

4. drafting of SARD-friendly amendments to the organic decree for the Committee for Planning and Cooperation;

5. drafting of an administrative procedure law which ensures transparency in legislative drafting, enactment and implementation

6. drafting of registration of nongovernmental (private voluntary) associations to implement Art. 31 of the Constitution;

7. implementation of forest, land and water legislation to protect village and user level agreements from central Government encroachment;

8. drafting of fisheries legislation;

9. drafting of protected areas legislation;

10. drafting of legislation on intellectual property rights in plant and animal genetic resources.

7.9.6 Institutional strengthening

In addition to the training mentioned in the technical assistance recommendation, as the Government's environmental coordinating department, STENO should hire in the short-term a lawyer with private contract and commercial law expertise to evaluate donor and private contracts from a SARD perspective and ensure that environmentally-sound and SARD-friendly conditions to fulfill the Government's policy are inserted as a contractual matter. STENO should also hire a natural resource economist who is able to evaluate fiscal regulatory measures, such as proposed taxes and subsidies, for their impact on SARD. There is no involvement or capacity in line Ministries, including the Ministry of Finance, to evaluate the implications for sustainability of changes in land or import/export taxes.

Working relations, especially on legal matters, are needed among STENO, the Ministry of Justice and line ministries. Cabinets of each Ministry should be communicating with each other so that implementation of the pilot decrees and future natural resource management laws contributes to SARD in Lao PDR.

For the longer term, STENO should have a lawyer on its staff who can monitor, evaluate and contribute, especially on interministerial legislative drafting committees, to the evolution of a SARD-friendly environmental and natural resource management legal framework. In addition, extension workers should have legal training, particularly alternative dispute resolution techniques based on existing customary dispute resolution mechanisms, to enable them to manage and mediate resource conflicts over competing uses.

7.9.7 Technical assistance

There is an immediate need for studies, based on extensive field work, of existing customary laws of natural resource management and recommendations on how they can be strengthened, reinforced and supported within the formal legislative framework\

END NOTE

1. Lao PDR's neighbouring countries of the Mekong basin have to content with much less. Myanmar 1.50 ha, all for 1992 population, Populous countries such as China and India have only much less (0.78 ha and 0.34 ha respectively) and that too under much lower precipitation (Computed from data in Human Development Report. UNDP 1995a).

2. In 1992, the life expectancy in the Mekong basin countries were 58 years in Myanmar, 69 in Thailand, 52 in Cambodia, 65 in Vietnam against 51 in Lao PDR 5.26 ha (HDR 1995). The crude birth rate and crude death rate per thousand population were 45.2 and 15.2 respectively in Lao PDR for 1992 (Human Development Report 1995).

3. Paddy production in the country fluctuated between -19% to +40%, ranging from 1.0 million tons to 1.6 million tons in 1994 during the period 1985 to 1994 (Stability of Paddy Production Lao PDR, Mathema P.R. 1995). The per capita availability of calorie supply was 2259 in 1952 (UNDP 1995a). Droughts and floods in 1987-88 necessitated the import of 115 000 tons of recorded rice imports in 1988 (Agricultural Sector Memorandum Lao PDR. World Bank 1994b)

4. Generally the annual population growth assumed for Lao PDR is 2.9% for the period 1992-2000 as in the Human Development Report 1995. Other documents refer to it are World Bank 1993, World Bank 1994a, and World Bank 1994b. The preliminary report on the findings of the latest population Census 1995 held in March indicate a lower annual rate of growth of 2.4%. (Central Planning Committee 1996). See End Note 3 under Section 4. The crude birth rate and crude death rate per thousand population were 45.2 and 15.2 respectively in Lao PDR for 1992 (UNDP 1995a).

5. Population in the neighbouring countries are estimated to grow between 1992 and 2000 at an annual rate of in Myanmar, 1.0% in Thailand, 2.7% in Cambodia, 2.5% in Vietnam against 2.9% in Lao PDR 5.26 ha (HDR 1995). At the above rates of growth population is anticipated to double by 2024 in Myanmar, 2054 in Thailand, 2015 in Cambodia, 2023 in Vietnam and 2015 in Lao PDR (UNDP 1995a).

6. Annual growth rate in the agriculture sector as a whole exceeded population growth, but since the mid-eighties it has been slow and modest. Growth in agricultural value added decelerated from 4.3% per annum in 1980-86 to 3.5% in 1986-92. The performance of the rice and forestry sub-sectors has been poor with their value added growing by (-)9.7% and 1.7% per annum respectively during 1986-82 (Agricultural Sector Memorandum: World Bank 1994b).

7. The continuation of stagnation which has set in the production of rice during the period 1985 to 1992 coupled with high degree of instability in the context of high population growth would result in structural rice deficits in the future. (Medium term integrated rice production programme Report of the Mission TCP/LAO/2358. FAO 1994a)

8. Area under 'season rice' (wetland rice) hovers around 380 000 hectares since 1985 with a coefficient of variation of 7.23. Similarly area under irrigated rice stagnates around 11000 hectares. While area under upland rice is declining from the high of 270000 hectares in 1985 to 220000 in 1994 (Stability of paddy production in Lao PDR. Mathema P.R. 1995). Shifting cultivation is expanding at the rate of 300000 hectares per annum (Based on data from World Bank 1994b)

9. Agriculture sector including livestock and fisheries and forestry contributes to 58% of the GDP to which 10-12 percent generated by processing and marketing activities. (World Bank 1994b). In addition, the hydropower share amounts to 1-2 %.

10. Officially recorded earnings in foreign exchange contributed by the agriculture sector (mainly timber, wood products, and coffee) amounts to two fifths of the exports. It is presumed that the contribution may go up to 55% if unofficial exports of livestock and logs are included. Unofficial log exports are estimated as much as 150 000 m2 or about US$ 43 million per year (Environmental Action Plan. STENO

1993). Even though the proportion of agriculture and forestry exports is declining from the high of 72% in 1988 to 40% in 1992 in value it has increased from US$ 42 million to 52 million during this period. Electricity, mainly hydropower accounted for 8% of the exports.

11. Fact Finding Report of the Environment: Lao PDR. Country Report (Second Revised Draft) UNCED (UNDP 1991).

12. Lao People's Democratic Republic: Environmental Overview Report No. 11978-LA. East Asia and Pacific Regional Office, Country Department 1, Agriculture and Natural Resources Operations Division. December 30, 1993 (World Bank1993).

13. Environment Action Plan: Organisation for Science, Technology and Environment, Prime Minister's Office, Lao PDR. November 1993 (STENO 1993).

14. Project Document: Environmental policy and planning for sustainable agriculture and rural development. June 1994.

15. Provinces by regions

Northern Region		Central Region		Southern Region	
Code	Province	Code	Province	Code	Province
02.	Phongsali	01	Vientiane M	14	Salavan
03.	Luoangnamtha	09	Xiankhoang	15	Champasak
04.	Oudomxai	10	Vientiane	16	Xekong
05.	Bokeo	11	Bolikhamxai	17	Attapu
06.	Louangphabang	12	Khammouan		
07.	Houaphan	13	Savannakhet		
08.	Xaignabouli				
18.	Xaysomboon Special Region	M.	Municipality		

[Spellings of various provinces, for that matter most of the place names, differ from publication to publication and from organization to organization. For standardisation, the spelling of provinces followed in **Atlas of Lao PDR 1995**, the most recent publication of the National Geographic Department is adopted in this document]

16. Growing period is here defined as the period during which precipitation exceeds half the potential evapotranspiration.

17. Major plains include the Vientiane plain (58500 ha) of the Vientiane Province and Municipality; the narrow Pecan plain (12600 ha) in the Bolikhamxai and northern parts of Khammouan provinces; the larger plains of Xebang Fai (49100 ha) in southern parts of Khammouan and northern parts of Savannakhet provinces, and Xebang Hein (83800 ha) in southern parts of Savannakhet and Salavan provinces, and the Xedong plain (42500 ha) in Salavan and Champasak provinces.

18. Species listed include two cormorants, 12 herons and egrets, five storks, three ibises, 14 ducks and geese, two cranes, eight rails and crates, and two jacanas. Some of the other wildlife species associated with wetlands are the Irravady dolphin (Oraella brevirostis), fishing cat (Felix viverrina), common otter (Lutra), Smooth-coated otter (Lutra perspicillata), hog deer (Cervus oprcinus), wild water buffalo (Bubalus bubalis), siamese crocodile (Crocodylus siamensis), river terrapin (Batagur baska), and the giant catfish (Pangasiaondon gigas).

19. Children and women in the Lao People's Democratic Republic UNICEF, 1991.

20. The proportion of the 0-14 age group is 44 percent of the total population against 52 percent of the 15-64 age-group. Average size of the family is large 6.1 in 1992. The average life span is low 51 years in 1992 (UNDP 1995a). This skewed nature is likely to exacerbate with the concerted efforts in child care services is put underway to reduce the high infant mortality rates of 125 per and under five mortality rate 182 per 1000 births in 1992 (UNDP 1995b).

21. As per the 1985 census the total work force is estimated at 1 601 535 of which 834 501 comprised women constituting 52 percent. Agriculture and forestry accounted for 90% of the employment of the work force of which women constituted 54%. Agriculture including forestry employed 775 813 women accounting for 93% of the total women employed (UNICEF1992).

22. The information for determining various kinds of land use and vegetation cover is generated by analysing data secured through remote sensing methods such as aerial photographs and satellite imagery such as SPOT images. Both national and international agencies are involved in inventorying natural resources in Lao PDR. They include the National Geographic Service, the Department of Meteorology and Hydrology, Soil Survey and Land Classification under the Department of Agriculture and Extension (MAF), Integrated Resource Mapping Centre (IRMC) of the STENO, National Office for Forest Inventory and Planning (NOFIP) under the Department of Forestry, MAF, The Mekong Secretariat, Geo-referenced International System (GRID).

23. Diverse sources have arrived at different figures with respect to the land use and vegetation coverage, depending upon the definitions pursued. Areas of various land use and vegetation classes reported by Malivanh and Swathvong (1995) based on the information on land use and vegetation provided by **The Nation Wide Forest Reconnaissance Survey** in the Lao PDR are used here. Current Forest cover in 1989 is estimated 47 percent. While the project '**Assessment and Monitoring of the Mekong Basin Forest Cover**', funded by GTZ, expects to find 'current forests' coverage only 25 to 30 %.

24. By all descriptions available, the forests classified as 'current forests' is equivalent to natural forests. Hence all through in this discussion references to **natural forests is coterminus with 'current forests'** quoted by others. Similarly **'unstocked forest' is actually understocked forest or secondary forest** (more appropriate to carry the meaning) developed after the land has once opened up for shifting cultivation or after timber extraction. However the term is being used in this document also, in order to minimise confusion to Lao PDR users.

25. It is difficult to vouchsafe on the absolute numbers. First even if the source is the same (Lao-Swedish Forestry Programme, Department of Forestry and Environment), figures vary with the periods of extraction as found in the references to sources noted, probably because of the improvements brought about with the passage of time. Second, correction factors have not seen introduced to set right the errors crept in while processing information from the imagery to mapping. For instance the total area for the country for 1982 23,030,800 hectares against the officially approved figure of 23,680,000 (Agricultural Statistics Yearbook 1993) short by 649,200 hectares while 1989 figures are based on 23,800,200 hectares (excess by 120,200 hectares). Naturally there could be errors both in absolute figures and in the proportions as well. Hence the analysis with these figures should be treated only as indicative and not absolute.

26. Crop production in Lao PDR is practised under two predominant agronomic conditions viz. wet and dry, although both are rainfed. Due to differences in elevation, arising from topographic variations, water get accumulated during the rainy season in the basins and valley bottoms which is not fully drained. As water is not fully drained, cultivation during the rainy season is done under wet conditions and invariably rice is the crop grown. Such lands are recognised as wetlands (Not to get confused with the ecologically familiar 'wetlands' more appropriately the term 'wetland paddies' is used in this discussion so as not to get confused with the ecologically familiar 'wetlands'), often interchangeably known as 'lowlands' although the valley bottoms in the high altitude mountainous areas (uplands) also constitute the wetlands. Rice produced from wetland paddies is also known as **'main season rice'**. Both 'main season rice' and dryland rice are produced during the rainy season. When irrigation is extended to the wetland paddies during the dry season (after the main rainy season) such lands are recognised as 'irrigated land'. Well drained lands, largely due

to relatively higher elevation, cultivated under rainfed 'dry' conditions even though precipitation received is as much as in the adjoining 'wetland', are also sometimes called 'uplands'. Such 'uplands' are also found in the 'lowlands', recognised as lands in the lower altitudes, where dryland crops such as maize, mung bean etc are grown. Upland cultivation is often synonymous with shifting cultivation which is invariably practiced under rainfed conditions pursuing dryland management practices, even for rice which is the major crop grown. Hence all through in this study 'lowland' and 'upland' are used in the context of the altitudinal differences in location and not to 'wetland' and 'dryland' management practices.

27. Livestock contributed to 62%, 20% and 86% cash income of the lowland, plateau and upland households respectively. Furthermore to the total household income livestock contributed as much as 56%, 46% and 56% respectively (Bounthong Bouahom 1993).

28.

Bovines, apart from the explicit purposes such as draught power, protein food supply and manure, are used as a means to convert the biomass around the immediate environs of the habitation into income and asset. Even after the NEM was initiated, land is not an exchangeable commodity that can be liquidated or pledged against credit, though the right to use is inheritable. Even such value could attached only to the agricultural land especially wetland, as all other lands are, by tradition, communally owned and no individual household could claim ownership rights even though every household within a given community enjoys usufruct rights. In a land tenure system under which exclusive land use is limited to the land put to crop production, the only means of asset accumulation is the conversion of the biomass into products of economic and exchange value, and savings with some degree of liquidity. Livestock especially the ruminants are the most suitable medium. In a high land:population situation where labour and not land, is the critical limitation, livestock production based on free range grazing is the best means to optimise the available labour. Livestock is also a commodity that can be taken to the market in a territory where the road communication is limited or non-existent. Animals can be driven to the market on their hoofs without resorting to any means of transport. All these 'not-so-explicit' factors contributed to getting livestock rearing rooted in the Laotian rural household economy.

29. In 1992 the country earned US$ 15.7 million through live animal exports which is 15% of the country's export earnings (World Bank 1994b).

30. Annual growth rate of value addition in livestock during 1986-92 was 5.7% against 1.7% for rice, 9.7% for non-rice crops,-9.3% for forestry and total agriculture 3.5%. (World Bank 1994b)

31. Milk and milk products are not a significant part of the Laotian diet. By tradition milk is meant for the off spring and not be used by the human population.

32. No firm estimates on dung output per animal is available. In the neighbouring Thailand a study estimates 1768 kg of dry dung per buffalo. At a modest rate of 1.5 tons per head (cattle being lesser in size than buffaloes) for the 2.05 million bovine population the total manure potential is estimated at 3.1 million tons per year. For a total of 0.72 million gross cropped area this is enough to supply 4.3 tons of manure per hectare. The manure potential excludes the supply from small ruminants, pigs and poultry. It also excludes the manurial contribution of animal urine. Conservation of animal manure should be seen as an important means of replenishing nutrients and enriching soils (both of the woodlands and drylands) especially the latter, for sustainable crop production.

33. Distinctive information on the origin of cattle in Lao PDR is lacking. One postulate is that the present cattle breed is a cross of the Indian Zebu with the breed from the southern parts of China came along with the migration (cattle, sheep, goats) Subsequent breeding has led to fairly uniform animal. Usually typical Lao cattle are light red and yellow in colour (but white to black cattle are noticed in some cases), short horned, with no hump for female, small dewlap or without in many cases, shortened legs and body size. The forehead is narrow and the muzzle is black in colour. Ears are small and straight to the back. The tail hair and hoof are usually black. Though small in size they are well adapted to the harsh environment (Bounthong Bouahom 1993).

34. Attempts to introduce exotic breeds of cattle and pigs have not been a resounding success Holstein Frisian in Lao Cuban farm found very vulnerable to tick, diseases and parasites. They were unable to withstand high temperature. Consequently death rate was high (Bounthong Bouahom 1993).

35. Land use for livestock production is discussed in the context of the bovine population. Buffaloes and cattle are the major ruminants depend on natural vegetation. Goats and sheep are there, but being in small number and size, in the aggregate they may not put much pressure on forage resources in Lao PDR. In fact goat rearing should be seen as an opportunity and untapped potential, given the non-graminous vegetation growth with which the country is richly endowed. Pigs and poultry do not depend on forage resources either.

36. A national survey on livestock production systems in Lao PDR was conducted by the LARED of the DLVS during 1992-93 to improve the understanding on the livestock production systems in the country. The study was fairly comprehensive and undertaken in a farming system setting covering all aspects of animal production in the rural household economy, including the resource base, use and management of resources, animal management, socioeconomic dimensions and infrastructure support. Data were collected from 319 households spread over 12 villages in six districts in six provinces covering all the three major ecological regions in the country viz. the lowland, the plateau and the upland.

37. Forestry shared 5% of the agricultural GDP which itself was 58% of the total GDP during 1991-1993. [pp 2 ASM]

38. During the three year period 1990-92 official export of 'logs and wood products' earned US$ 110.3 million against a total of US$ 142.4 million 'Agriculture and Forest products' exports which constituted 36.1 percent of the export of all products from Lao PDR estimated at US$ 305.5 million. Compiled from Table 3.4 (World Bank 1994b). In 1991, approximately 54 percent of the foreign exchange earnings were derived from forest product exports (World Bank 1994b).

39. Forests with crown density greater than 40% and diameter of dominant trees larger than 30 cm are defined as 'high density forests' which in 1989 accounted for 40.2 percent of the 'current' forests. (National reconnaissance survey 1992 adapted from World Bank 1994b). 'Current forests' in contrast have a crown density greater than 20% only.

40. In 1994, total sawmill capacity was estimated to be 1,424,500 m^3 (Lao PDR, 1994) while the allowable cut was 595,000 cubic meters (DOF, 1995).

41.

The Tropical Forestry Action Plan has recommended an annual harvest of 288000 m^3 of timber. Total commercial timber extraction (official as well as unofficial) is estimated at approximately 425 000m^3 per year which is about 150% of the sustainable rate of timber harvest (World Bank, 1993).

42. In addition to logging done on the basis of official logging quota, unofficial exports of logs to the extent of 150000 m^3 a year is estimated (STENO 1993). Sourcing from the Department of Forestry of the MAF, the Agricultural Statistics Yearbook 1993 reports that during 1992-93 516871 m^3 of forest logging occurred against a quota of 553670 m^3. Thus, in spite of fact that officially the intention is to sanction logging quotas within the sustainable limit, it appears that total resource depletion exceeds volumes which can not be sustained.

43. Chazee (1994) estimated that the total land area cleared for upland crops is about 310 000 hectares; 235 000 for rice, 30 000 for maize and 45 000 for other crops. These estimates are supported by other available data. Rainfed upland rice is almost exclusively produced by shifting cultivation. Approximately 213 000 hectares of rainfed upland rice were planted in 1994. (Table 3.6) Upland rice accounts for about 34 percent of the area planted to rice and 22 percent of the production.

44. Studies and observations made in the hilly areas of Naphok-Nabong and the Namtha, Sing and Xay Plains indicate that 'ray' areas have increased in the last three years. These sloping areas are often cultivated by new families arriving without access to lowlands and by young and new couples without rice fields in the plains or disinherited by their parents.

45. Production from Nam Ngum is estimated to have declined from 1600 in 1983 to 1140 tons in 1988 and the yield to 50 kg/ha in 1975 to 20 kg/ha by 1988.

46. Fish production in the country is estimated at 31188 in 1991, 31826 in 1992, 32591 in 1993 and 33509 in 1994 43%, 43%, 42, and 41% of the animal protein sources (meat from various sources).

47. Farming system identification, characterisation and description in the context of development discussion in Lao PDR, as is true of many other countries, generally do not reflect fully the uses, and the manner as well, to which land (and water too) resources are put, by the farming communities in order to derive livelihood security. Rural households in the developing countries draw sustenance by utilising resources, biophysical as well as human, to which they have access, in multiple ways by producing a variety of products, crops, fruits, trees, animals, fish etc. As 'farming systems' are often made synonymous with crop production (as agriculture generally is) the descriptions do not reflect the total utilisation of land resources such as livestock rearing which in the context of Lao has far greater significance (over one half the income and two thirds of the cash income) than economies of comparable development. Farm families derive benefits not only from the resources they command individually (the crop land) but also from the resources owned communally through usufruct rights. All reference to farming is only with respect to the land which is put to crops while all other land resources to which the rural households have access, especially the land used for grazing as the designated wooded or forested lands, often close to the village habitation, are excluded. Rural households put significant inputs (labour) in harvesting the biomass (grazing) in these environs to convert them into economic goods (livestock). Or directly use the biomass as fuelwood or construction timber or as raw materials for household industries and handicrafts. Even though the land is owned by the entire community and individual households can not claim ownership for purposes of transfer or exchange or sale, and households within that community do enjoy usufruct rights (in some way unrestricted to the extent capable of appropriating through grazing animals). Extent of access to the total land assumes great significance in sustaining resource use in a land- rich labour-short endowed Lao PDR. Farming systems discussion in this document attempts at a holistic view of the resource use, irrespective of the use to which land-based resources are put, and to encompass all lands, individual as well as communal, to which the rural households have access. Understanding of the total resource use and management is critical in designing strategies, policies and action for the sustainable development of the biophysical resources in the context of SARD.

48. Generally this system is identified as low land 'rainfed' farming system. The 'rainfed' attribute does not reflect a significant difference in the agronomic condition. Rainfed is used to distinguish dependence o rain and irrigation for moisture supply. Even though rice grown both under 'lowland' farming system and 'upland' farming system is rainfed, the agronomic conditions are significantly different. Rice in lowland agriculture is grown on 'wetland' where water get collected not only from the insitu rainfall but also from the small catchments of land in the higher grounds. In the absence of surface drainage water remains stagnant. Rice is grown under wet conditions after puddling and transplanting. On the other hand rice grown under rainfed conditions on the uplands is synonymous with dryland cultivation other like other dryland crops such as maize, or pulses. The slope of the land permits surface draining of the precipitation.

49. The 5.3 hectare meter of runoff per caput per annum would meet irrigation requirements for about 3 hectares in the wet season and 3 hectares in the dry season, giving a minimum 15 tons of paddy in one year. Even if only 3 percent of the run-off could be harnessed, about 0.45 tons of paddy could be produced per caput per annum (FAO 1194).

50. Sex ratio favourable to women is recognised as one of the indicators of the biophysical status of women in the society. The number of females per thousand males declined from 1040 in 1985 to 1022 in 1995 according to the population figures presented on the preliminary results of the 1995 Population

Census.

51. Intensity' referred to here is in terms of the time horizon (production cycles such as seasons or the year) and the input use as well. 'Intensity' should not be confused with exploitative extraction practices such as overfishing or overhunting,

52. Harvesting more than one crop from the same land within a year as in rainfed rice followed by irrigated dry season rice or vegetables on wetland paddies facilitated by irrigation.

53.

The difference in access to various land resources could have been better demonstrated had the required data, especially on human resources, could be disaggregated by agroecological zones. In its absence the concept is demonstrated for the three development regions viz. the North, Centre and South representing very broadly the differences in resource endowments. Physiographically the Northern region is mountainous and hence less endowed with arable land. Relatively the South has more moderate terrain and hence more arable land, and the Central region in between.

54. Annual rate of growth in population is assumed at 2.6 percent. The most often quoted annual rates of population growth for Lao PDR is 2.9 percent for the period 1992-2000 as quoted in the Human Development Report 1995, World Bank 1993, World Bank 1994a, and World Bank 1994b. The crude birth and crude death rate per thousand population were 45.2 and 15.2 respectively in Lao PDR for 1992 (UNDP 1995a). The other rate quoted at times is 2.6 percent. But the preliminary results of 1995 Census indicate that the decal growth between 1985 and 1995 has been 2.4 percent per annum. This low growth is accompanied with low expectancy of life at birth (51 years), high levels of infant mortality of 125 and under five mortality of 182 per thousand live birth. The increasing recognition of these demographic scars is likely to take redoubled effort to reduce these wastages. The result, to go by the experience of other developing countries, is likely to be an accelerated growth rate exceeding the high 2.9 percent often assumed, certainly in the initial years. However the possibility of increased access to health, education and choice of family size, are likely to decelerate the growth rate towards the terminal years of the period of reference. Hence the medium growth rate of 2.6 percent per annum is assumed. In the absence of adequate information on the possible changes in age-sex composition and worker participation rate, these demographic characteristics observed in 1985 census are also assumed to continue although during the intercensal decade the family size increased marginally from 5.96 to 6.1 persons and the sex ratio declined from 1040 to 1022 females per thousand males.

55. There is strong correlation between the growth rates in human population and livestock population in societies where livestock is a very significant component in the rural household economy in terms of cash income and asset generation as in Lao PDR. Hence the present livestock population, especially the bovines (buffaloes and cattle) is assumed to grow at the same rate as the human population. In fact since the late eighties growth of livestock sector (predominantly bovines) has been double (4.8 %) than that of the human population. The impact of technological developments which would reduce the pressure on land are not brought in, since the very purpose of this discussion is to draw attention to the need for redoubled effort in the generation and dissemination of technology for reducing the burden on resources through increasing productivity.

56. Goodbody, Swithhun quoting Inthapanya et.al (1994).

57. With no phosphate application biomass output from green manure crops was less than 3 tons, but with 30 kg P_2O_5, biomass outputs of 5-15 tons have been achieved after 55-60 days of growth under on-farm conditions, increasing rice grain yields (1.5-2.0 tons) to the equivalent of inputs of between 60-90 kg of nitrogen per hectare. (Phoudalay Lathvilayvong et al 1995).

58.

In Vientiane Municipality, the biggest internal market for rice in the country, the average price of 'sticky' rice per kg in kips was 253 in 1992, 197 in 1993 and 109 in 1994 against 338, 342, 131 respectively for the 'ordinary' rice. Though the margin of difference is not that large, even in the provincial markets the price of ordinary rice was higher than sticky rice with 91 and 79 in Luangphabang, and 77 and 73 in Champasak for 1994 (Agricultural Statistics Yearbook 1993).

59. The tendency generally found in countries where high yielding varieties have spread is that the 'low yielding' traditional varieties fetch a higher premium in the market. Preference attached to the traditional varieties is so much that even the 'progressive farmers' often continue to grow the traditional varieties for their home consumption while maximising production of HYVs for the 'market'. Often the task of the researchers is to increase the productivity of the HYVs so that low price is compensated with increased yields. In contrast, despite the low price farmers 'stick' to the production of the low yielding 'sticky rice' while the higher priced 'ordinary rice' continue to be imported. Hence the 'strange phenomena'. Explanations such as subsistence oriented production, urban preference for rice products such as noodles for which sticky rice is unsuitable, etc., are not fully convincing. Because why then the farmers in and around the Vientiane Municipality do not cash in on this opportunity by filling in the market vacuum? Is it that agronomic conditions do not allow them to produce 'ordinary varieties' which fetch a higher price? If it is so then the very strategy of going in for high yielding 'ordinary' varieties' for increasing rice production in the country deserve reconsideration.

60. Rice found in the international consumer market, outside the predominantly rice eating nations, has a limited range of choices. Much of this 'rich consumer' market is dominated by pre-cooked rice like the 'Uncle Ben's, unpolished brown rice, aromatic 'Jasmine' Thai rice, Basmathi rice of India and Pakistan, and long grain black North American wild rice (Bernacsek 1995).

61. 'Main season' rice qualify for this attribute. Increased production during dry season with fertiliser application and other inputs could be aimed for the internal market while main season rice production could be groomed for 'green rice' export.

62. Work buffalo is utilised only for the two-month period of land preparation for the 'main season rice' while it has to be fed and maintained for the rest of the ten months, although it produces manure during this period.

63. Growing wheat during the cooler months (November-March) following the rice crop has become popular and profitable since the seventies in the plains of northern Bangladesh and eastern India which are located in comparable latitude. Wheat require relatively much less moisture and can be cultivated with the residual moisture supplemented with the 'winter rains'. Even though wheat is not a staple in Lao PDR wheat bread is consumed in the urban areas. Hence wheat has a potential demand in the country.

64. The widespread market for cotton for cloth making at the rural households is not ignored. But many of those engaged in the production of cloth use mill spun threads for weaving rather than spinning threads by themselves by hand. Mill spun thread enables to increase productivity, and thereby reduces the cost which is necessary to foster a mass market for the product.

65. Pig rearing based on sugarcane is being investigated under a FAO regional project (GCP/RAS/43 JPN). If the effort becomes successful, sugarcane cultivation can be decentralised.

66. In relation to moisture availability in the wetland paddies where rain water is stored even though the rainfall regime is the same for both land types.

67. It is reported that the International Rice Research Institute (IRRI) has developed animal drawn seed drills appropriate for a variety of grains which should be tested and adapted in the country.

68. May not be so for the individual households which take up the enterprises of rearing pigs and poultry. The grain: meat price relationship obtaining in the various urban markets is extremely favourable for conversion of grains into meat which if pursued extensively can potentially make significant intrusions into the grain supply for human consumption. The technical grain : meat conversion ratios range from 2.0-3.5. (2.0-3.5 kg of grains to produce 1 kg of meat). For the Vientaine municipality sticky rice : pork price ratios were 8.6 in 1992, 10.2 ton 1993 and 9.6 in 1994 and sticky rice : chicken meat ratios were 10.5, 10.2 and 9.0 respectively. Even in the provincial markets the same trend prevailed though at lower price levels. In 1994 the sticky rice : pork ratio in Lauangphabang was 6.2 and in Champasak 10.3 and sticky rice : chicken meat ratio were 7.1 and 8.0. Given these high grain : meat price ratios, feeding the feed lot animals such as pigs d poultry with grains seems to be highly remunerative. Perhaps the purchasing power, being limited to a few of the urban populace, is not placing a heavy demand on pig and poultry met in the country and hence in turn is not making a serious enough dent into the limited supply of grains for human consumption.

69.

Reluctance of the school educated youth to return to farms, and their increasing urge to migrate to urban areas, in the absence of adequate opportunities (industrial or service) in the rural areas commensurate with the skills they have acquired, is an social phenomenon pervasive in many developing societies attendant to social development. Though may not be manifest at present, Lao PDR is unlikely to escape this social transformation when the appropriate time comes (the transition from a command to a market economy is advanced sufficiently).

70.

In pursuit of realising the development objectives for the medium term to the year 2000, the Lao PDR Government has decided on seven national programmes as priority for implementation. These are: food production, stabilisation/reduction of shifting cultivation, commercial crop production, rural development, human resources development, expansion of foreign economic relations, and infrastructure development. (Country Strategy Note: GOL-UN Working Group)

71. The area under 'upland rice', the principal crop grown under shifting cultivation accounting for fourfifths of the area has declined over the period from 300 000 hectares in 1980 to 245 000 hectares in 1986 and 200 000 hectares in 1993 (all three-year averages). Production hovers around 340000 tons between 1986 and 1993 while the yield increased from 1.3 to 1.5 tons per hectare. (Data from World Bank 1994b and Mathema 1995). Even though the annually cropped area under 'slash and burn' increased by three quarters (73%) from 352500 hectares in 1981-82 to 610700 hectares in 1988-89 while the fallow area increased only 5.7% from 4024100 to 4254000 hectares during this period indicating that the fallow period is declining. (Laurent Chazee 1994)

72. Degradation through loss of natural vegetation, and rendering the land vulnerable to soil erosion, and consequent soil loss and other ill effects on the watershed).

73. Shifting cultivation absorbs as much as 120-300 days of labour per hectare of which as much as two thirds (80-200) days are contributed by women (Laurant Chazee 1994).

74. Only less than 2 percent of the land subjected to shifting cultivation is having slopes less than less than 5 percent, and 6 percent is having 20 percent in the northern region where this practice is recognised as the most prevalent, more than 52 percent between 20-30 percent slopes and the rest 40 percent over 30 percent.

75. Opening up steep slopes for raising buckwheat which is the food staple for the people of the Bumthang district, a temperate high altitude (2400-3000 m) region in the Kingdom of Bhutan in the Himalayas used to be a common practice. Households used to open up 2-3 hectares of land to produce 300-400 kg of buckwheat. Taking advantage of the enormous demand for seed potato in the plains of India and

Bangladesh potato was introduced in this part of the country a decade ago. Potato with its high productivity could generate sufficient income from a much smaller area of less than a quarter of hectare to compensate for the grains from cultivating the slopes. The intervention caught up very fast. The area under buckwheat receded and its place was taken over by blue pines, a high natural coloniser. Independently the public distribution system of foodgrains also expanded. The result was that with the increased income communities could buy the required food without the hazardous cultivation of a low yielding buckwheat. The area under cultivation declined while forest area expanded through colonisation of blue pines.

76. Lack of road communication is much less of a problem especially for cattle as they can be driven to the markets/roadheads on their legs as is being done in cattle ranching countries.

77. Of the total requirement of labour, weeding alone accounts for one half. Entire weeding operation is the responsibility of the women in the household following the traditional gender allocation of work by the community.

78. Under shifting cultivation more damage is done to the under growth which protects the soil from erosion and facilitate regeneration, rather than to the trees per se although generally concern is seen focused largely on the destruction of the trees and the upper canopy rather than the vegetation system in its totality.

79. More focus should be on biological measures such as strip planting instead of terracing for instance as labour input is scarce. Strip cropping with perennial grasses (fodder grasses including) combined with planting of perennial bushes and trees (fruits such as pine apple, bamboo as raw materials for handicrafts) in contour trenches could be an optimal combination in many situations. A variety of appropriate interventions have been developed under the aegis of various projects within the country are available for adoption. What is required is tailoring those experiences to the specific resource endowments and market opportunities.

80. The site of the soil conservation demonstration project in the Muong Thoulakhom district on the way to Nam Ngum hydropower project is demonstrative of what nature itself can do in restoring natural vegetation. The area was left abandoned after timber harvest. A part of it was put under shifting cultivation. Subsequently to restore the degraded land, soil conservation measures including contour bunding, tree planting, incorporation of aquaculture utilising the surplus run off were implemented. In itself the measures taken are commendable yet the land surface remain bare and exposed to erosion. In contrast, in the adjoining area the land is fully covered with regenerated vegetation including useful species such as bamboo. Apart from the technical possibilities, the economic viability and replicability of the measures demonstrated against other options such as allowing the land to recuperate itself needs to be assessed.

81. Particle boards made out of bamboo splits can be developed into a vertically integrated industry with decentralised production of bamboo splits by the households in the rural ares linked to a central facility for manufacturing particle boards. Apart from the abundance in bamboo, the country has the added advantage in the traditional skills to work with bamboo possessed by the rural households. It is an opportunity to blend the skills of the people with a seemingly rich resource to produce a product with good market potential, and in the process enables to generate employment and income in the rural areas where such opportunities are limited.

82. It is not only the 'unstocked forests' and woodlands, but of equal significance, the 'natural forests' also a repository of these products, even though the former is subjected to exploitative extraction/harvests because of the relative easy accessibility. Hence this activity is discussed in this context. Further, this digression on this activity is applicable to the 'natural forest' context also and hence not repeated.

83. Fires are used by farmers not only to clear land for agriculture but also to promote the production of grass for grazing. Approximately 100 000 hectares are burned each year to improve grazing. These fires often burn beyond the intended area, destroying regeneration and damaging established forests.

Uncontrolled fires burn about 40 000 hectares of forests each year. (Chazee 1994)

84. It is estimated that between 100 and 300 thousand hectares of land is cleared every year for shifting cultivation. Similarly it is estimated that 100 thousand hectares of land is burned each year to improve grazing. But it is difficult to say how much of these intrusions into forest vegetation takes place on land under 'unstocked forests' which itself is a product of the vegetation once interfered with or 'natural forests' which is relatively undisturbed. If expansion of 'unstocked forests' which occurred during the seven years between 1981-82 and 1988-89 from 7806 to 8266 thousand hectares is taken as an indication, the intrusion into the natural forests for shifting cultivation during this period comes nearly to 66 thousand hectares per year. This conclusion corroborated in another way. Against the area of 11640 thousand hectares in 1981-82, the stock of natural forests in the country in 1988-89 is estimated at 11168 thousand hectares. The reduction works out to a little over 67 thousand hectares per year.

85. In 1994, total saw mill capacity was estimated to be 1,424,500 cubic meters (Agricultural Statistics 1993) while the allowable cut was 595 000 cubic meters (Department of Forestry, 1995).

86. Of the 11.17 million hectares of land under 'current forests' 2.62 million hectares (23.4%) are classified as 'protected areas' and 2.40 million hectares (21.5%) as 'production forests. Of the 'production forests' 50.9% (1.22 million hectares) have been inventoried so far (1992) (Agricultural Statistics 1993).

87. Hydropower could be used in bargaining better deals with the power-deficit food surplus neighbours. Easing restrictions on country's agricultural exports (especially in tariffs) and ensuring rice supply to the country are two potential areas. A power for rice deal can minimise much of the anxiety in the area of food security for the country. This will enable the country to allocate optimally the limited resources for agricultural development.

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