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Lao PDR Biodiversity: Economic Assessment

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The World Conservation Union

Report Prepared for Lao PDR National Biodiversity Strategy and Action Plan

Final Report: 18 October 2002

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ADB	African Development Bank
CBD	Convention on Biological Diversity
DAFO	District Agricultural and Forestry Office
DLF	Department of Livestock and Fisheries
DoF	Department of Forestry
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross Domestic Product
GEF	Global Environment Facility
IMF	International Monetary Fund
IUCN	The World Conservation Union
LARReC	Living Aquatic Resources Research Centre
MAF	Ministry of Agriculture and Forestry
NAFRI	National Agriculture and Forestry Research Institute
NBCA	National Biodiversity Conservation Area
NBSAP	National Biodiversity Strategy and Action Plan
NEAP	National Environmental Action Plan
NSC	National Statistical Centre
NTFP	Non-Timber Forest Products
PAFO	Provincial Agricultural and Forestry Office
PIP	Public Investment Programme
SoE	State of the Environment Report
SPC	State Planning Committee
STEA	Science, Technology and Environment Agency
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WTO	World Tourism Organisation

At the time of writing this report, US$1 = Kip 9,900

EXECUTIVE SUMMARY

The aim of the report

This report aims to document the current economic status of biodiversity in Lao PDR, and to use this information to identify needs for the use of incentives, financing mechanisms and other economic measures in the National Biodiversity Strategy and Action Plan. It therefore responds to the call in the Article 7 of the Convention on Biological Diversity for Parties to identify and monitor components of biodiversity that are economically valuable or important, as well as pointing to the way in which economic incentive measures (Article 11) and financing mechanisms (Articles 20 and 21) can be used in support of biodiversity.

The economic value of biodiversity: a summary

	Economic value (kip billion/year)
NTFP in household subsistence	1,582.7
Fisheries and aquatic animals	1,000.0
Indigenous rice varieties	929.6
Livestock production	779.5
Cultural and nature-based tourism	580.2
Commercial timber	529.2
Commercial NTFP exploitation for export	314.8
Carbon sequestration by natural forest	294.1
NTFP in household cash income	253.9
Domestic commercial NTFP exploitation	151.0
Household timber consumption	168.8
Woodfuel	45.8

What biodiversity means to the national economy

The various sub-sectors of the national economy of Lao PDR can be grouped into three major categories according to their relationship to biodiversity:

- **Biodiversity-based sectors:** including activities which are based directly on the utilisation or consumption of indigenous biological resources such as forestry (timber, wood and NTFP); fisheries and aquatic plants and animals; and agricultural production from indigenous crop and livestock varieties.
- **Biodiversity-dependent sectors:** including sectors which have a high reliance on the raw materials, services and functions that biodiversity provides, such as those that rely on watershed catchment protection services (irrigation, hydropower, domestic and urban water supplies); soil biodiversity (crop production from non-indigenous varieties); wild fodder and pasture (livestock production from non-indigenous varieties); ecological integrity and cultural diversity (tourism and associated services).
- **Non-biodiversity sectors:** including sectors that have little direct reliance on biodiversity goods and services but may impact on biodiversity status through their activities (e.g. mining, manufacturing, construction, financial institutions).

Biodiversity makes an important contribution to key national economic indicators, including:

- **GDP:** Some 66% of official Gross Domestic Product (GDP) is contributed by biodiversity-based sectors, and an additional 5% by biodiversity-dependent sectors. Accounting for the value of household NTFP consumption, which are excluded from traditional GDP statistics, the contribution of biodiversity rises to three quarters. It is estimated that biodiversity-based and biodiversity-dependent sectors generate a gross annual economic output of at least Kip 7,200 billion a year.

- **Rural livelihoods and poverty alleviation:** The direct use of biological resources by rural populations in Lao PDR is worth at least Kip 4,750 billion a year, an average of Kip 6.6 million per household or Kip 1 million per capita. NTFP alone are thought to comprise nearly half of each of household subsistence and cash income. Rice, much of it indigenous varieties, contributes two thirds of household calorie intake, wild foods contribute up to 80% of food consumption by weight, and fish and other aquatic animals comprise between 30-50% of protein consumption.
- **Employment:** More than 85% of the national workforce, including almost all of the rural population, are employed primarily in biodiversity-based economic activities, and an additional 6.6% work in biodiversity-dependent sectors.
- **Export and foreign exchange earnings:** Biodiversity-based sectors contribute 42% of export and foreign exchange earnings, and biodiversity-dependent sectors 17%.
- **Government revenues:** Biodiversity contributes to almost a third of government tax and non-tax revenues, including 14% from biodiversity-based sectors and 17% from biodiversity-dependent sectors. Royalties and revenues from biological resource use are worth an estimated Kip 78 billion a year.
- **Foreign investment:** Almost half of approved foreign investments made in Lao PDR are absorbed by biodiversity-related activities, including 4% to biodiversity-based sectors and 42% to biodiversity-dependent sectors.
- **Donor assistance:** Sixteen percent of donor grants are made to projects and programmes in biodiversity-based sectors, and half to biodiversity-dependent projects and programmes.

How biodiversity contributes to socio-economic development goals

Biodiversity is of central importance to many of the key elements in the National Development Vision to 2020 and the Fifth Five Year Socio-Economic Development Plan for 2001-2005, including:

- **Food production.** A major priority is to provide food for national self-sufficiency, and to generate a surplus that can be sold in cross-border regions and used in the food processing industry. Indigenous agrobiodiversity plays an important role in food production and food security, as well as generating products that have commercial and trade value. Future plans for agricultural development depend heavily on irrigation, which relies on the catchment protection provided by forested lands.
- **Commercial production.** This programme focuses on the production of goods for all significant sectors of the domestic market and for export to regional and international markets. Many components of biodiversity already have a significant commercial and trade value, including agricultural and forest resources. There is a high potential for further adding further value to sustainable biological resource harvesting and processing, and for developing new biodiversity markets and products.
- **Rural development.** The main purpose of the rural development programme is to alleviate poverty in rural areas through income generation and service improvement. Biological resources, including indigenous crop and livestock species and NTFP, already provide the main livelihood source of some of the poorest sectors of the rural population. They also contribute to economic and livelihood security when other sources of production become unavailable. There is a demonstrated potential for using biodiversity resources – such as through ecotourism or NTFP processing – as a source of rural income expansion and diversification.
- **Service development.** A stated goal is to develop the potential of new and emerging sectors such as tourism and trade. Both of these targeted sectors already depend heavily on biodiversity, and have a high potential for further development.

- **Foreign economic relations development.** to use global opportunities as much as possible in order to develop the national economy, promote foreign direct investment, and improve economic cooperation with foreign countries and international institutions. There is already a high global interest in Lao PDR's unique biodiversity, as evidenced by existing donor aid flows and tourist demand. There also exist many more opportunities for promote foreign investment and to market elements of biodiversity on global markets.

The economic costs of conserving biodiversity

The direct budgetary costs associated with biodiversity conservation are currently borne by the state. Primary institutional responsibilities for biodiversity conservation are currently vested in the Science, Technology & Environment Agency and Ministry of Agriculture and Forestry. A range of other government agencies have additional or indirect responsibilities for biodiversity conservation or for ensuring that negative impacts on biodiversity are mitigated, including the Ministries of Industry and Handicrafts; Communications, Transport, Post & Construction; Public Health; Finance and Education; the National Tourism Authority; and the State Planning Committee.

External financing forms an important component of funding to biodiversity conservation. There are currently a total of 62 on-going donor-supported projects and programmes dealing specifically with biodiversity conservation, running between 1993-2003. Together these are worth $150 million, or just over one sixth of total donor assistance, with an average expenditure of $16.9 million a year.

Total donor commitments to biodiversity conservation have however fallen dramatically over 2001-2003, after rising over much of the 1990s and peaking in 2000. Support to forest conservation and protected areas, in particular, has reduced.

Opportunity costs also form an important component of biodiversity conservation in Lao PDR. These are the income and other economic benefits from land, resource, investment and development activities foregone or reduced by the need to conserve biodiversity. These include reducing shifting cultivation and other agriculture in upper watersheds, regulating the utilisation of forest products including timber and wildlife, and pest damage to crops. These opportunity costs can be substantial – for example, the opportunity costs of regulating timber extraction are estimated at some 1,200 billion kip a year.

Economic needs and guiding principles for the NBSAP

This economic assessment has identified a wide range of concerns to be addressed in the NBSAP, and highlights key areas where the use of economic and financial measures are required:

- **The NBSAP should be acceptable in economic terms, and consistent with development priorities.** Lao PDR faces a range of urgent and pressing needs for development, and biodiversity conservation competes against other productive uses of scarce land, natural resources and funds in Lao PDR. Unless it can be demonstrated that biodiversity conservation is socially and developmentally worthwhile, at the community, private and national economic levels, the NBSAP is unlikely to gain government or public support. It is important to underline the high economic value of biodiversity, and the significant and wide-ranging economic costs associated with its degradation and loss, so as to justify the NBSAP as a desirable and necessary activity that is in the interests of the Lao PDR government, national economy and people. In line with the overriding goal of current socio-economic development policy, it is particularly important that the NBSAP is seen to make a demonstrable and tangible contribution to poverty alleviation.
- **The NBSAP should be economically viable**. If particular groups perceive themselves to lose out as a result of biodiversity conservation, or conservation activities, the NBSAP will

stand little chance of success and will be unsustainable over the long-term. Most groups in Lao PDR, and the national economy itself, cannot afford to support the NBSAP if it does not lead to tangible net economic benefits. There currently exist few positive economic incentives for biodiversity conservation in Lao PDR, and the provision of these benefits and incentives should be ensured in all components of the NBSAP.

- **The NBSAP should attempt to overcome the economic causes of biodiversity loss.** Multiple economic forces continue to result in biodiversity loss in Lao PDR. The NBSAP must aim to address and overcome both the direct and underlying economic causes of biodiversity degradation and loss. As well as requiring action at the level of specific economic activities and sectors which impact negatively on biodiversity, this will involve broader structural and policy changes.
- **The NBSAP should be economically equitable.** The benefits and costs of biodiversity conservation are distributed unequally between different groups. This acts as a major economic disincentive to biodiversity conservation, it also means that the groups who are responsible for conservation are often unwilling – or economically unable – to cover these costs. Unless the NBSAP is equitable in its impacts and effects, and especially targets the poorest and most vulnerable groups, it is unlikely to be either acceptable or practicable. The NBSAP should have as a key aim to redress current imbalances in the distribution of biodiversity benefits and costs in the interests of conservation and economic equity.
- **The NBSAP should be financially sustainable.** Financial resources for biodiversity conservation are scarce, and effective implementation of the NBSAP will incur additional and wide-ranging costs to many different groups. Adequate and sustainable sources of finance must be generated as part of the NBSAP, and targeted to the groups who bear the major direct and indirect costs associated with biodiversity conservation. Key beneficiaries of conservation finance include Central and Provincial Government.
- **The NBSAP should target, and involve, other sectors of the economy.** The successful implementation, and broader acceptance, of the NBSAP ultimately depends on actions being taken in non-environmental sectors of the economy, and at economic policy and planning levels. It is critical that steps are taken to involve these other sectors in NBSAP formulation and implementation, and to ensure that they mainstream NBSAP goals and objectives into their own policies, strategies and plans.
- **The NBSAP should attempt to improve the status of information on, and linkages between, biodiversity and economics.** Very little is known about the linkages between biodiversity and the Lao PDR economy, or about the economic value of biodiversity. Yet economic forces constitute the major reason for biodiversity degradation and loss, economic impacts of the NBSAP will be a key indicator of its success and broader acceptability, and the NBSAP must be responsive to changing needs and conditions in the Lao PDR economy. It will be important to further generate and disseminate information on biodiversity economic values and linkages, to monitor on-going economic status and threats to biodiversity, and to track economic impacts and effects of NBSAP implementation.

1. INTRODUCTION: Economic assessment of biodiversity in Lao PDR

1.1 Background to the assessment

Lao PDR ratified the Convention on Biological Diversity (CBD) in November 1995, and is in the process of setting in place a National Biodiversity Strategy and Action Plan (NBSAP). A first stage in this process is to prepare a Biodiversity Country Report which documents biodiversity status and trends in Lao PDR. The Country Report will form the basis of developing a Biodiversity Strategy (to be completed 2003), which will in turn be operationalised through setting in place a Biodiversity Action Plan.

This document forms a contribution towards the Biodiversity Country Report. It was prepared by the NBSAP Economics Working Group: Somvang Bouttavong (Science, Technology and Environment Agency), Lamphoukeo Kettavong (Science, Technology and Environment Agency), Sounh Manivong (National Tourism Authority) and Sawathvong Sivannavong (Ministry of Agriculture and Forestry). Technical support was provided by Lucy Emerton (IUCN – The World Conservation Union) under Project LAO/98/012.

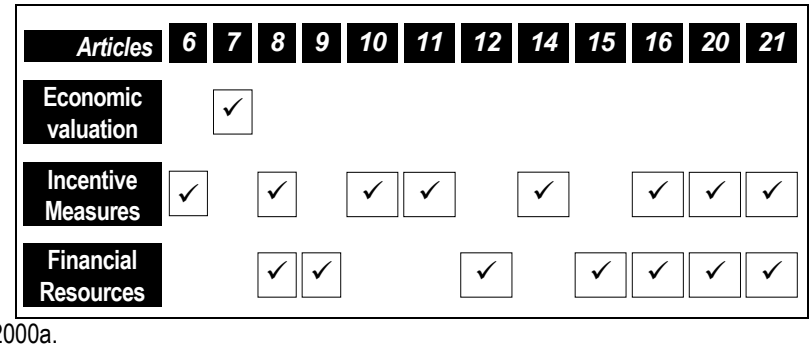
The economic assessment of Lao PDR biodiversity was carried out over a 3 week period in June-July 2002. A report on the economics of biodiversity in Lao had already been prepared by the NBSAP Economics Working Group: this formed the basis of the assessment, and of this document. Training and awareness seminars on the use of economic tools for biodiversity planning were also held.

1.2 Economics and the Convention on Biological Diversity

Economics provides a set of methods and measures that are central to biodiversity conservation. Perhaps most importantly, unless it makes demonstrable economic and financial sense for people to conserve biodiversity, it is unlikely that individuals, households, industries, companies or governments will take action to do so. People will continue to degrade and deplete biodiversity in the course of their activities because they feel that it is more profitable and economically desirable to do so. Reflected in many of the provisions of the CBD, and in the NBSAPs prepared in response to it, economics tools are forming an increasingly important part of biodiversity planning and management.

The linkages, and interdependence, between biodiversity and economics are well-recognised in the CBD. In particular, the CBD requires the use of three sets of economic measures for biodiversity conservation – valuation, incentives and finance. Article 7 calls on Parties to identify and monitor components of biodiversity that are economically valuable or important. Article 11 requires the adoption of economic measures that act as incentives for biodiversity conservation and sustainable use. Articles 20 and 21 reiterate the need to generate and allocate sufficient financial resources to biodiversity. These three sets of economic measures are reiterated throughout other articles of the CBD (Figure 1) and have been the subject of recurrent discussion since the first meetings of the Conference of the Parties and the Subsidiary Body on Technological, Technical and Scientific Advice to the CBD, resulting in a series of recommendations, decisions and calls for action on their use for biodiversity conservation (Table 1).

Figure 1: Economic measures in the Convention on Biological Diversity



From Emerton 2000a.

Table 1: Decisions of the Conference of the Parties relating to economic measures

I/2:	Financial resources and mechanism (*finance*)
II/6:	Financial resources and mechanism (*finance*)
II/7:	Consideration of Articles 6 and 8 (*finance)*
II/8:	Preliminary consideration of components of biological diversity particularly under threat and action which could be taken under the Convention (*finance)*
II/11:	Access to genetic resources (*valuation*)
III/5:	Additional guidance to the financial mechanism (*finance*)
III/6:	Additional financial resources (*finance*)
III/9:	Implementation of Articles 6 and 8 (*incentives, finance*)
III/10:	Identification, monitoring and assessment (*finance)*
III/11:	Conservation and sustainable use of agricultural biological diversity (*incentives, finance*)
III/12:	Programme of work for terrestrial biological diversity: forest biological diversity (*finance)*
III/14:	Implementation of Article 8j (*incentives, finance*)
III/15:	Access to genetic resources (*finance)*
III/18:	Incentive measures (*incentives*)
IV/4:	Status and trends of the biological diversity of inland water ecosystems and options for conservation and sustainable use (*incentives*, *valuation, finance*)
IV/5:	Conservation and sustainable use of marine biological diversity (*finance)*
IV/6:	Agricultural biological diversity (*incentives, finance*)
IV/7:	Forest biological diversity (*valuation*, *finance*)
IV/8:	Access and benefit sharing (*valuation, finance*)
I/9:	Implementation of Article 8j and related provisions (*finance)*
IV/10:	Measures for implementing the CBD (*incentives*, *valuation, finance*)
IV/12:	Additional financial resources (*finance*)
V/4:	Progress report on the implementation of the programme of work for forest biological diversity (*valuation*)
V/6:	Ecosystem approach (*incentives*, *valuation, finance*)
V/8:	Alien species that threaten ecosystems, habitats or species (*finance)*
V/9:	Global Taxonomy Initiative (*finance)*
V/11:	Additional financial resources (*finance*)
V/15:	Incentive measures (*incentives*)
V/16:	Article 8j and related provisions (*finance)*
V/24:	Sustainable use as a cross-cutting issue (*finance)*
V/25:	Biological diversity and tourism (*incentives, finance*)

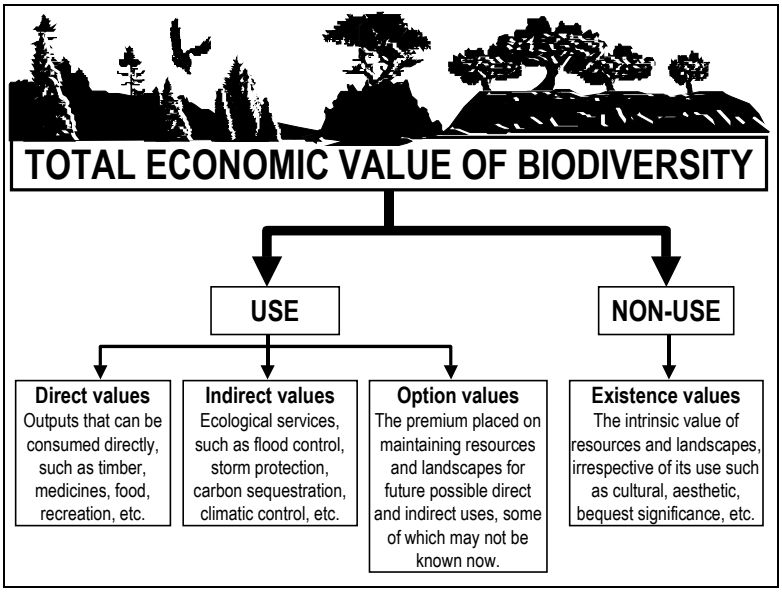
From Emerton 2002.

In line with the requirements of the CBD, and COP decisions, the economic assessment of biodiversity in Lao PDR is based on these three key economic tools and measures: economic valuation, incentive measures, and financial resources.

1.2.1 Valuation

Economic valuation is a key step in biodiversity assessment and planning. Economists and decision-makers have traditionally seen the value of biological resources only in terms of the direct uses they support – the raw materials they provide for human production and consumption (for example the timber value of natural forests or the fisheries value of coastal and marine ecosystems). Demonstrating the total economic value of biodiversity (Figure 2) ensures that the broader economic benefits of biodiversity – such as non-marketed resource use, ecosystem services and functions, future options for economic use, and non-use values – are also considered. It illustrates the benefits associated with biodiversity conservation and highlights the wide range of individuals and groups they accrue to, on and off-site.

Figure 2: Total economic value of biodiversity



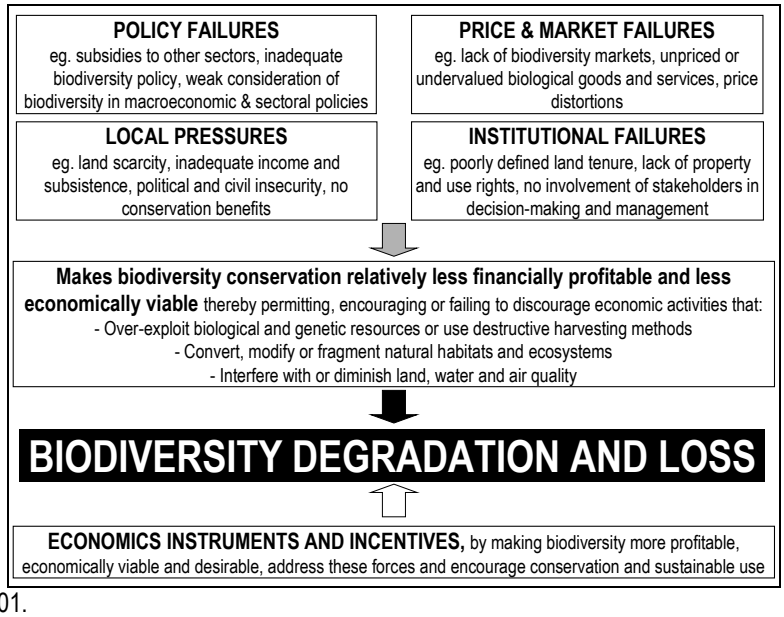
From Emerton 2000a.

Valuation also shows the high and wide-ranging economic costs associated with the loss or degradation of biodiversity and its components, including on and off-site subsistence losses and decreases in employment, income and foreign exchange earnings as well as the expenditures necessary to replace or mitigate lost biodiversity goods and functions. Calculating economic values underlines the fact that biological resources and their diversity constitute far more than a static biological reserve. Biodiversity forms a stock of natural capital, which if managed sustainably, can yield in perpetuity a wide range of economic benefits to human populations.

1.2.2 Incentives

Many of the goods and services associated with biological resources, ecosystems and their diversity are undervalued by the market, or ignored in macroeconomic and sectoral economic policies. These policy and market distortions and failures result in biodiversity being under-priced, over-consumed and under-conserved. It is treated as a free good which can be mined, converted, depleted or otherwise degraded at no cost (Figure 3).

Figure 3: Economic causes of biodiversity loss



From Emerton 2001.

Economic incentives attempt to overcome these causes of biodiversity loss. Defined in the CBD as "a specific inducement designed and implemented to influence government bodies, business, non-governmental organisations, or local people to conserve biological diversity or to use its components in a sustainable manner", incentives include measures such as property rights, taxes, subsidies, charges, fees, market establishment, loans, performance bonds and deposit systems. They are already widely used in other sectors of the economy to achieve development goals, but also have a broad range of potential applications to biodiversity conservation. They aim to change people's behaviour by making sure that they take into account the full value of biodiversity and the real costs associated with its loss when they make decisions.

1.2.3 Finance

Biodiversity conservation is not cost-free – it imposes a wide range of direct and indirect costs on different economic groups. It is necessary to find ways to offset, compensate for and fund these costs. Various mechanisms can be deployed to finance biodiversity and to compensate the people who bear the costs associated with its conservation. Financing mechanisms operate at many levels – between and within countries, from and to governments, and within the private sector and local communities.

Because traditional sources of funding — central government subventions, donor funds, and royalties and other charges — are limited, and are under competition from so many other sectors of the economy, they are rarely sufficient to finance biodiversity conservation. Yet there are many other, more innovative, ways of raising and allocating financial resources to biodiversity.

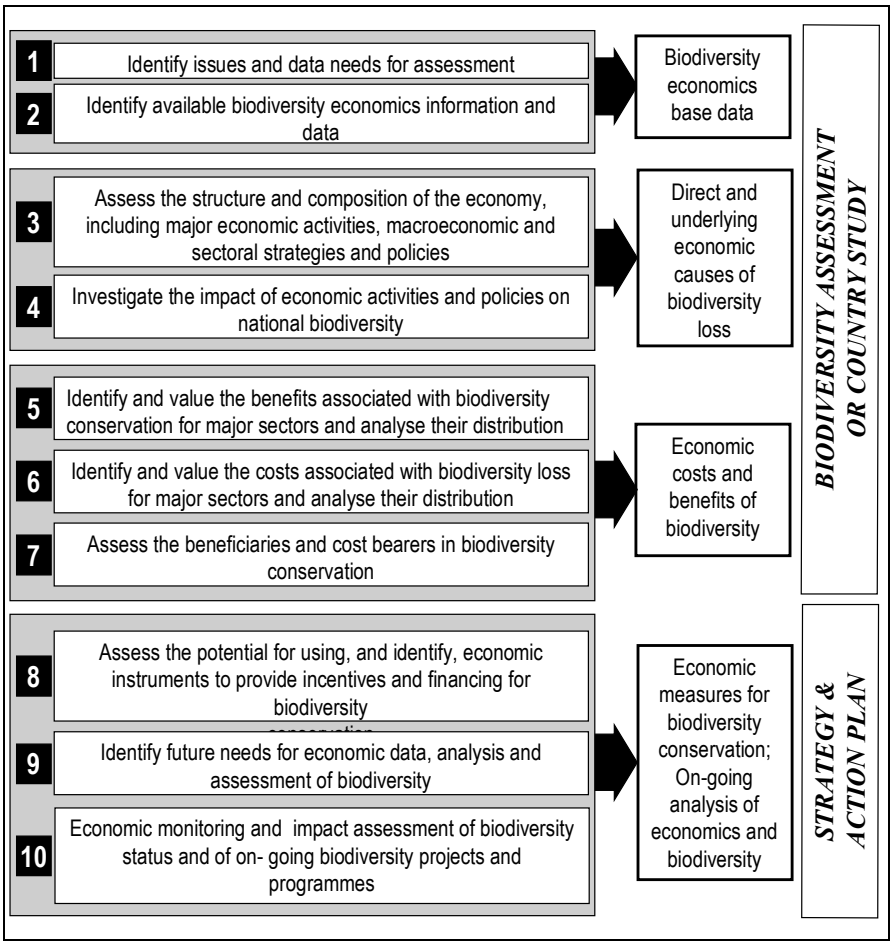
Finance can be raised directly from biodiversity resources and services. Sustainable use or trade in biodiversity includes goods such as timber and non-timber forest products and the pharmaceutical, agricultural and industrial applications of biological resources. Services include, for example, water provision, climatic regulation, tourism and scientific research. Finance can also be raised by making sure that charges are levied on economic activities which contribute to biodiversity degradation and loss – such as pollution taxes, land reclamation bonds and waste disposal charges. Other financing

mechanisms include the transfer or redistribution of funds between individuals, groups or countries through measures such as investment, trust funds, loans, debt for nature swaps and offsets.

1.3 Steps followed in the economic assessment of biodiversity in Lao PDR

The economic assessment of biodiversity in Lao PDR followed a framework for biodiversity economic planning which has been developed and applied by IUCN in other countries' NBSAP processes (Emerton 1998, 2000a, 2002). This framework specifies a series of ten steps for the use of economic measures in the National Biodiversity Country Study, Strategy and Action Plan process (Figure 4).

Figure 4: Economic steps in biodiversity planning



From Emerton 2002.

This document is concerned with economic aspects of the biodiversity assessment or country study, or with the first seven steps in this framework. It has as its main aim to document the current economic status of biodiversity, and to use this information to identify needs for the use of incentives, financing mechanisms and other economic measures in the NBSAP. A second economics technical input is planned for the Lao NBSAP which will elaborate these measures, and assist in integrating them into the Biodiversity Strategy and Action Plan.

The economic assessment of biodiversity in Lao PDR therefore involved the following information collection and analysis:

- **Identifying issues and data requirements.** Little existing information or data were available on economic aspects of biodiversity. A very important first step was therefore to broadly define the main economic issues in biodiversity conservation in Lao PDR, to highlight the type of data that would be required to carry out the economic assessment of biodiversity, and to identify where this data could be collected *(detailed data tables are presented in Chapter 9 of this report).*
- **Assessing the structure and composition of the economy, and its impacts on biodiversity**. The basic economic attributes of Lao PDR — such as its policies, sectors and performance — determine how people use and manage biodiversity. Presenting an overview of economic structure, context and policies described the economic environment in which biodiversity is managed in Lao PDR, now and in the future *(Chapter 2 of this report).*
- **Identifying and quantifying the economic benefits and costs of biodiversity.** In order to identify economic threats to biodiversity and to recommend economic measures for conservation, it is necessary to understand how biodiversity values accrue to the economy. Information on the economic values associated with biodiversity, both positive and negative, indicated the basic economic status of biodiversity in Lao PDR *(Chapters 3 and 4 of this report).*
- **Analysing the distribution and nature of biodiversity values in the economy.** Biodiversity values accrue to many different groups and sectors, and are reflected in many different economic indicators, in Lao PDR. Assessing the way in which these values accrue provided a means of showing the multiplicity of linkages between biodiversity and the Lao PDR economy. *(Chapter 5 of this report).*
- **Drawing conclusions from the economic assessment of biodiversity, and making preliminary recommendations on the potential for using economic measures in the NBSAP.** On the basis of the assessment of economic structure, biodiversity values and their linkages, conclusions were drawn about key economic issues in biodiversity conservation in Lao PDR. These conclusions provided the basis for identifying needs to integrate economic tools and measures into the forthcoming National Biodiversity Strategy and Action Plan *(Chapters 6 and 7 of this report).*

1.4 Scope of the economic valuation

Biodiversity, as defined in the CBD, is "the variability between living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". Biodiversity is therefore an attribute of life – in contrast to biological resources which are tangible parts of ecosystems and are defined by the CBD as "genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity".

This report is concerned with the economics of biodiversity - the benefits attached to conserving biodiversity in Lao PDR, the costs associated with its depletion and the economic tools and measures which can be used to achieve biodiversity conservation goals.

Looking at the value of biodiversity *per se* – the economic premium attached to the variability between living organisms over and above their individual use and non-use values – is in most cases impossible. This would involve valuing the manifestations of an attribute of living organisms – their variability – rather than the living organisms themselves. Variability is reflected in a number of economic indicators – such as opportunities for multiple use and benefits; choice between products and resources; mutual support between different species, ecosystems and sources of production; contribution to economic stability, security and risk minimisation; and maintenance of the

possibility of a wide range of future development applications. Many of these attributes are reflected in other direct, indirect, option or existence values, and it is difficult to separate out the additional value attached to diversity.

For this reason the primary focus in this report is economic assessment of the benefits attached to conserving Lao PDR's different biological resources and ecosystems, and thus maintaining their variability and diversity. The economic value of biological resources and ecosystems can together be taken as an indicator of the economic value of biodiversity, because biodiversity conservation relies on the maintenance of all these component parts.

The assessment is primarily concerned with indigenous biological resources and their diversity, and with the domestic costs and benefits of biodiversity as they accrue to Lao PDR. It focuses on conservation values, in other words legal and (where it is possible to determine) sustainable biodiversity benefits. Unless otherwise indicated, values are expressed as gross benefits at 2000/01 prices and levels. To make figures comparable over time and to cope with the rapid devaluation of the Kip over the 1990s, values are expressed mainly in constant US$ and in 2000/01 Kip billions. At the time of the study the Kip:US$ exchange rate was 9,900.

1.5 Constraints and limitations to biodiversity economic assessment

This report represents a first attempt to investigate economic aspects of biodiversity in Lao PDR. A major constraint has been lack of data. Especially, information is scarce for the subsistence utilisation of biological resources, and is virtually non-existent for the economic value of ecological goods and services. Even where data do exist, different information sources are often contradictory or present widely differing estimates of the quantity and diversity of biological resources and their use.

Where valuation has been possible it is important to stress that the resulting conclusions and figures are partial, and rely on a number of hypotheses and assumptions. The results of the assessment should be seen as a minimum estimate of the total economic value of Lao PDR's biodiversity, and of the total economic costs associated with its loss. They inevitably exclude a number of biodiversity benefits – especially non-marketed, indirect, option and existence values. The assessment comprises a first attempt to look at the economics of biodiversity conservation for Lao PDR – it provides a number of indicative values and recommendations which have been generated for planning and management purposes and cannot be seen as definitive or absolute.

2. ECONOMIC CONTEXT: Implications of economic structure, management and policies for biodiversity

Macroeconomic conditions and policies affect the status of biodiversity. They determine how the economy performs, which sectors are promoted or are made more profitable, and set the overall conditions under which people conserve or degrade biodiversity in the course of their economic activities. This chapter will review Lao PDR's economic structure, management and policies.

2.1 Overview of the Lao PDR economy

Lao PDR covers an area of 236,800 km². In 2002, it is estimated that the total population of the country is some 5.48 million people or 861,500 households, of which approximately 83% live in rural areas (Table 2).

Table 2: Population by Province, 2002

	Total population		Rural population		Urban population	
	Persons	Households	Persons	Households	Persons	Households
Phongsaly	183,071	27,999	172,087	26,319	10,984	1,680
Luang Namtha	137,842	21,538	114,409	17,876	23,433	3,661
Oudomxay	251,992	38,768	214,194	32,953	37,799	5,815
Bokeo	135,688	23,692	128,904	22,507	6,784	1,185
Luang Prabang	437,218	68,921	389,124	61,340	48,094	7,581
Huaphanh	292,914	38,768	275,339	36,442	17,575	2,326
Xayabury	349,989	54,921	325,490	51,077	24,499	3,844
Vientiane Municipality	627,827	95,843	232,296	35,462	395,531	60,381
Xieng Khouang	240,147	39,845	223,336	37,056	16,810	2,789
Vientiane	343,528	55,998	285,128	46,479	58,400	9,520
Borikhamxay	195,994	32,307	184,234	30,368	11,760	1,938
Khammuane	326,298	55,998	283,879	48,719	42,419	7,280
Savannakhet	805,514	122,766	684,687	104,351	120,827	18,415
Xaysomboon SR	64,613	8,615	58,798	7,840	5,815	775
Saravane	306,914	50,614	288,499	47,577	18,415	3,037
Sekong	76,459	11,846	64,226	9,950	12,233	1,895
Champasack	600,905	93,689	522,787	81,510	78,118	12,180
Attapeu	104,458	19,384	99,235	18,415	5,223	969
TOTAL	**5,481,373**	**861,513**	**4,546,654**	**716,240**	**934,720**	**145,273**

Calculated from 1999 population data presented in MAF 2000b, updated to 2002 levels using an average 2.5% growth rate (STEA 2000).

The economy of Lao PDR is heavily dependent on natural resources. In 2000, nominal GDP was estimated to be 13,483 billion kip or US$ 1.65 billion (IMF 2002). Although per capita GDP increased from $114 in 1985 to US$ 330 in 2000, the incidence of poverty remains high. Thirty nine percent of the population are currently thought to be living in poverty and Lao PDR is ranked 140 out of 174 in UNDP's Human Development Index, making it one of the poorest countries in the Asia region (ADB 2001a, 2001b).

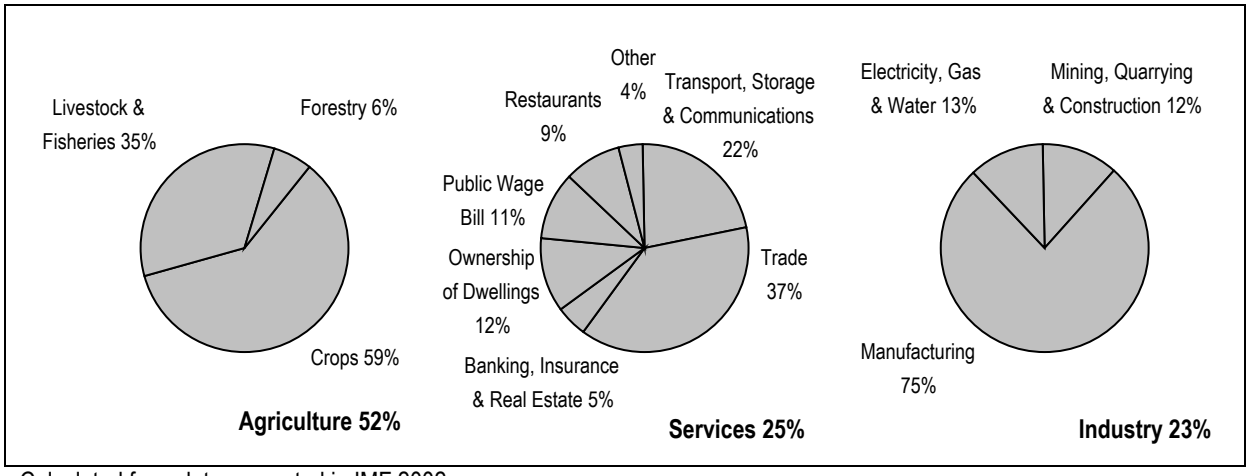
Since its establishment in 1975, Lao PDR has followed three major phases of economic policy. Until the mid-1980s the country was managed as a centrally-planned economy, characterised by

heavy state intervention in most sectors of the economy. The New Economic Mechanism, established in 1986, set in place a series of reforms which aimed to effect a transition towards a more market-driven economy. After a period of macroeconomic instability following the onset of the Asian financial crisis in 1997, economic recovery has been led by renewed efforts at economic liberalisation and stabilisation, and poverty eradication has become a guiding principle of national socio-economic development policy and planning.

2.2 Economic structure and composition

The economy of Lao PDR can be divided into three broad sectors: agriculture, services and industry (Figure 5).

Figure 5: Composition of GDP, 2000



Calculated from data presented in IMF 2002

- **Agriculture,** including crops, livestock, fisheries and forestry. In 2000, agriculture contributed just over half of GDP, and absorbed more than 85% of the labour force. The sector is dominated by subsistence production, especially of rice. Although there has been some growth in the cultivation of cash crops, especially coffee, over recent years, the relative share of different crops in agricultural production has remained relatively stable over the last decades (ADB 2001a). Major policy directions in the arable agriculture sub-sector include investment in expanding the area under irrigation, and controlling slash-and-burn cultivation. Forest production is also an important source of income, government revenues and foreign earnings.
- **Services,** including wholesale and retail trade, ownership and dwellings, non-profit institutions, public wages, banking, hotels and restaurants, transport, communications and post. In 2000, services contributed one quarter of GDP. Wholesale and retail trade dominate the sector, and have shown marked growth over recent years. The tourism sub-sector is also expanding rapidly, and is seen as an important source of future growth and foreign exchange earnings.
- **Industry,** including mining, manufacturing, construction, electricity and water. In 2000, industry contributed just under a quarter of GDP. Manufacturing activities play an especially important role in this sector, and have expanded over recent years. The hydropower sector continues to be an important source of investment, and sales of electricity have become one of the country's major exports.

Although the national economy of Lao PDR remains heavily reliant on agriculture and natural resources, and is likely to be so for the foreseeable future, the share of agriculture in GDP has been declining steadily, from 71% in 1985 to 52% in 2000. Meanwhile the contribution of industry has doubled from 11% to 23% over the same period, and the share of the service sector has increased by almost a half from 18% to 25%. Future growth strategies aim to diversify the economy further, particularly targeting growth in industrial and service sectors and modernisation in the agricultural sector.

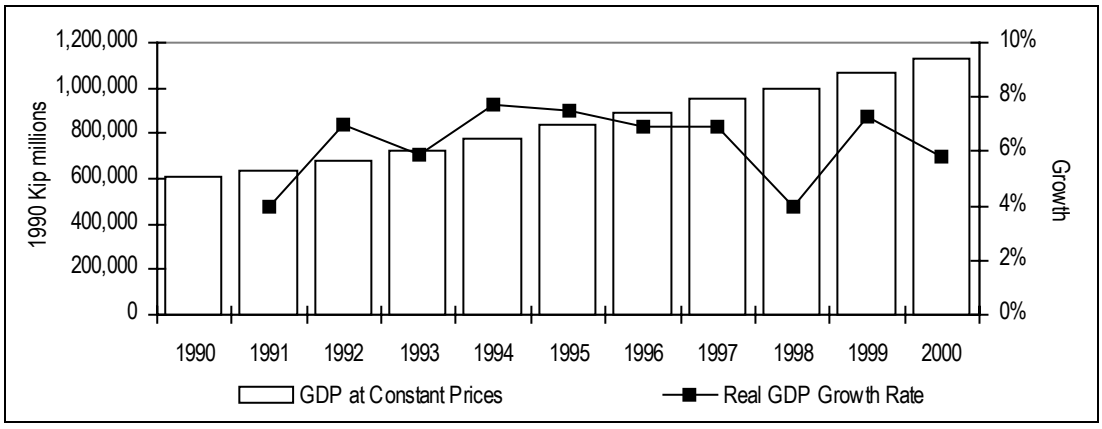
2.3 Recent economic trends

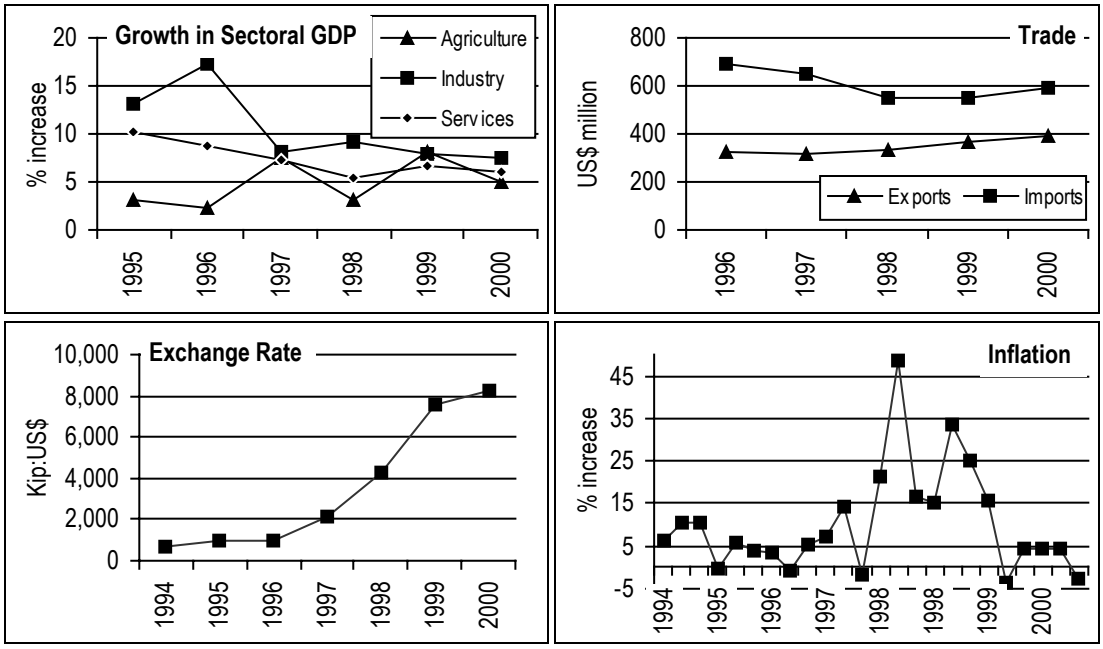
For the decade following the establishment of Lao PDR in 1975, the national economy was managed as a centrally-planned system. Economic policy and planning was characterised by heavy state intervention in most sectors. Prices remained controlled, especially in key areas such as agricultural production, energy and food, interest and exchange rates were set administratively and were relatively inflexible. Foreign investment and trade was limited, most large industries were state-owned and state-managed, and the private sector was undeveloped.

By the mid 1980s the national economy was showing signs of stagnation. Agricultural production was sluggish, there was low mobilisation of domestic savings, and few private enterprises. The New Economic Mechanism was established in 1986, in an attempt to stimulate economic recovery. This set in place a series of reforms which aimed to effect a transition towards a more market-driven economy, including market and trade liberalisation, growing private sector involvement, and progressive devolution and decentralisation of central government functions.

Reforms effected under the New Economic Mechanism contributed to a steady growth of the economy and progress of national output. GDP registered an increasing growth rate of 5.0% between 1986-1990, 6.4% between 1991-1995 and 6.2% between 1996-2000 (IMF 2002). Positive growth rates were recorded in most sectors of the economy, the exchange rate remained relatively stable, inflation was kept down, and the foreign trade balance improved (Figure 6).

Figure 6: Key economic indicators 1990-2000





From data presented in IMF 2002

These positive developments however suffered a setback in the late 1990s with the onset of the 1997 Asian financial crisis. Although impacts were less severe in Lao PDR than in many other countries in the region, vulnerability to such external shocks had already been mounting due to a slowdown in the momentum of reforms and resulting weakness in the economy. Following the crisis, foreign direct investment fell by 91% in 1997, and there was a downturn in private sector activity. Liquidity problems were registered in the banking system, there was an increasing budget deficit, and confidence in the economy declined. GDP growth rates, maintained at 7% during 1997, slowed to 4% in 1998. Because of its close links to the Thai Baht, the kip was particularly vulnerable to the exchange rate volatility that shook the region, and the domestic currency devalued sharply from 954 kip to the US Dollar in December 1996 to 7,600 kip to the Dollar in 1999. Rapid inflation was also experienced over this period, growing from an annual rate of 14.4% in September 1997 through almost 50% in 1998.

Immediate measures were set in place to contain demand-led inflation, tighten monetary policy, restrict public expenditures, stimulate savings and maintain foreign exchange reserves. Although these measures minimised the negative impacts of the crisis, the domestic economy remained weak for some time, exacerbated by inappropriate monetary and fiscal policies. Rapid monetary expansion was effected during and immediately after the crisis, rather than the tightening of macroeconomic policy that was required. Revenues fell short of expected levels and capital expenditures increased, resulting in a fiscal deficit that was higher than planned (ADB 2001a). Weakened monetary control and rapid monetary expansion fuelled the high inflation rates seen up to 1999. Meanwhile, negative real interest rates and expectations of devaluation also undermined confidence in the financial sector, keeping savings rates low and limiting monetary depth.

By the end of the 1990s Lao PDR was experiencing macroeconomic instability. Over the last two years there has however been an upturn in the economy. Agriculture has led the economic recovery process, strongly supported by growth in manufacturing and electricity production. Growth in GDP has been maintained and the government is taking steps to restore the balance between capital and recurrent spending and to contain public expenditures. The exchange rate has stabilised, the balance of payments deficit has been reduced as trade has improved and diversified, and foreign exchange reserves have increased. Money growth has also slowed down, and inflation has fallen.

The private sector is playing an increasingly important role in the economy, and in 2000 decentralisation became a key strategy for future public sector operations, defining Provinces as strategic units, districts as planning and budgeting units and villages as implementing units.

2.4 Current economic strategy

In line with the National Development Vision, defined by the Seventh Party Congress in March 2001, the Fifth Five Year Socio-Economic Development Plan for 2001-2005 has a strong focus on poverty reduction, sustained economic growth, continuing liberalisation and macroeconomic stability, and specifies clear medium-term economic goals for this period, including to:

- Achieve an overall GDP growth rate of 7-7.5 percent per year, with a 4-5 percent growth rate in the agriculture sector, 10-11 percent growth rate in the industry sector and 8-9 percent growth rate in the services sector.
- Change the composition of GDP so that 47 percent is represented by agriculture, 26 percent by industry, and 27 percent by services.
- Control the annual inflation rate to be no higher than 10 percent.
- Develop a stable exchange rate.
- Increase annual budget revenues and to manage the budget deficit at around 5 percent of GDP.
- Maintain the current account deficit at no more than 6 percent of GDP.
- Bring public investment to 12-14% of GDP and savings to 12% of GDP.
- Achieve a per capita GDP of US$ 500-550
- Reduce the incidence of poverty by half.
- Totally eliminate opium and marijuana cultivation.
- Attain rice self-sufficiency.
- Reduce the level of slash-and-burn cultivation.

2.5 Economic policy links to biodiversity

Four broad influences of economic policy on biodiversity can be identified, and are examined in further detail below, Section 6.3 (Economic factors underlying biodiversity loss):

- Through **influencing the general economic status and living conditions** of the population, economic policies affect the way in which people use lands and resources. For example the current development policy focus on poverty alleviation and stabilisation of shifting cultivation has the potential to reduce significantly local dependence on forest products collection, including unsustainable or destructive harvesting.
- By **prioritising or focusing on particular development sectors and goals**, economic policies encourage people to carry out economic activities at particular levels and in particular ways. Many of these activities influence biodiversity. For example the current socio-economic development plan has set an ambitious strategy and targets for future growth. There is a major policy focus on agricultural diversification and intensification, improved foreign trade, and expanding energy and transport infrastructure, all of which have the potential to encroach on or otherwise interfere with biodiversity. Conversely, better control of slash-and-burn cultivation and attempts at rural income diversification may result in improved conservation of biodiversity.
- The **use of economic and fiscal instruments** to achieve economic and development goals exerts a strong influence on price and market signals. Price and market liberalisation, especially in the agricultural sector, has helped to overcome many of the distortions and subsidies that have in the past discriminated against biodiversity. However prices remain distorted or non-existent for many biodiversity goods and services, for example timber prices are one of the few remaining areas of the economy that remain unliberalised to date. On-

going moves towards decentralisation and privatisation have the potential to influence the ways in which biodiversity is managed and generates benefits. As well as increasing the degree of private participation and responsibility in biodiversity conservation, the devolution of revenue collection and budgeting to Provincial and District levels opens up new possibilities for generating income from and allocating budgets to biodiversity.

- **Public spending and investment** is determined according to the economic policy emphasis accorded to different development goals and sectors. At the moment, biodiversity conservation is not considered a high priority for government spending, especially in comparison to other sectors of the economy such as agriculture, healthcare and education, and budgets to biodiversity conservation remain extremely low.

3. ECONOMIC VALUE OF BIODIVERSITY: Biodiversity economic benefits

Biodiversity generates a wide range of economic benefits, as reflected in the many sub-sectors and economic activities that are based on biological resources or depend on biodiversity services for their output. To date there have however been few attempts to quantify the role of biodiversity in economic production and consumption, and little is known about the value of biodiversity in Lao PDR. This chapter will describe, and where possible quantify, the economic benefits of biodiversity for key sectors, resources and ecosystems.

3.1 Use of agrobiodiversity

Faming, particularly rice production, provides a basic source of livelihood for the majority of Lao PDR's population. Indigenous crops and livestock varieties and their genetic diversity[1] play an important role in agricultural production. Traditional land use practices and farming systems contain high levels of agrobiodiversity, and are made up of a wide range of domesticated, semi-cultivated, transferred and non-cultivated wild species.

Agrobiodiversity yields multiple economic values. Direct values include food production and income generation, which are relatively easy to quantify in monetary terms. Although more difficult to value, the *in situ* conservation of indigenous crop and livestock varieties on farms also has a high economic benefit in terms of preserving genetic diversity, providing resistance to pest attack, disease and climatic variation, and thereby minimising risk in agroecosystems.

3.1.1 Indigenous rice varieties

Rice has long been a staple food and cash crop in Lao, which lies within the primary centre of origin and domestication of Asian Rice, *Oryza sativa L.* More than 13,000 samples of cultivated rice have been collected in the country, including wild species such as *Oryza ranulata*, *O. nivara*, and *O. rufipogon*, along with spontaneous interspecific hybrids between wild and cultivated rice. The proportion of rice production in Lao PDR made up of indigenous varieties[2] has however been decreasing over time, as improved cultivars and introduced varieties have become more common and have been promoted by government agricultural extension agencies and donor projects. In 1993 it was estimated that less than a tenth of rainfed lowland area was grown to improved varieties. By 2000 more than 70% of the area in some provinces along the Mekong River Valley was planted with improved varieties, and all of the dry season irrigated rice was composed of introduced

[1] Crop and livestock diversity in Lao PDR are affected both by human selection (such as for taste, pest resistance, commercial value) and by natural selection by the surrounding environment (such as soil type, climate, disease). Over time farmers have modified the genetic structure of populations by selecting plants and animals with preferred characteristics. The continued production, and ongoing adaptation, of indigenous agricultural varieties and farming systems maintains crop and livestock genetic diversity.

[2] Four categories of indigenous varieties of rice can be distinguished (from NAFRI 2000): Wild rice: mainly found growing on the bunds of cultivated rice fields, roadside ditches, ponds, canals, mountain slopes, forests, and other areas not regularly cultivated; Weedy intermediate rice: hybrids which are intermediate between wild and cultivated rice, often found around field borders adjacent to the cultivated rice crop; Traditional cultivars: landraces or traditional cultivars grown by farmers from seed passed down from generation to generation, and selected over time for adaptability and desirable grain-quality characteristics.; Slightly improved cultivars: varieties developed by mass selection from more popular traditional varieties, which were improved by selecting from traditional varieties and distributed by agricultural extension agencies.

or improved varieties – today only upland fields are planted wholly with traditional varieties (NAFRI 2000).

Nearly 750,000 ha was planted with rice in 2001, of which just over a fifth comprised upland rice, nearly two thirds lowland rice and 14% was grown under irrigation (MAF 2000b, see Data Annex Table 18). National rice production was in excess of 2.3 million tonnes, with a total market value of almost Kip 2,000 billion. It is known that upland rice production is comprised entirely of traditional varieties, while dry season irrigated rice uses only introduced or improved varieties (NAFRI 2000). It is assumed that approximately half of lowland rainfed rice is planted with traditional varieties. Applying current market prices, this gives a total value for traditional rice varieties of some Kip 930 billion a year (Table 3).

Table 3: Value of traditional rice varieties 2001

	Harvested area (ha)	Production (tonnes)	Total value (kip billion)	% planted with traditional varieties	Value of traditional varieties (kip billion)
Upland rainfed rice	158,005	260,232	216.3	100%	216.3
Lowland rainfed rice	486,771	1,620,269	1,426.6	50%	713.3
Dry season irrigated rice	101,971	436,254	343.8	0%	-
TOTAL	**746,747**	**2,316,754**	**1,986.7**	**54%**	**929.6**

Rice area and yields from MAF 2002b; prices from MAF 2000b.

3.1.2 Other indigenous crop varieties

No data on non-rice indigenous crop varieties are available for Lao PDR. It is possible that mung bean and soya bean production, as well as a proportion of vegetables and tubers, utilise various wild-related species, indigenous varieties and ancestral forms of cultivated plants. In 2001, more than 3 million ha were planted to these crops, yielding an output of nearly 750,000 tonnes of produce (see Data Annex Table 19).

3.1.3 Livestock production

With the exception of limited commercial pig, chicken and cattle farms in and around urban centres, the majority of livestock originate from stock domesticated within Lao PDR or in nearby China and Vietnam, and can be considered to be indigenous or traditional breeds (MAF 2001). Almost all livestock depend primarily on natural vegetation and crop residues for their energy intake. This study therefore assumes that the full output of buffalo, cattle, pig and poultry production depends directly on indigenous biodiversity. Including offtake for domestic consumption and for export[3], this gives a value of almost Kip 780 billion a year for indigenous livestock production (Table 4).

Table 4: Value of livestock production 2001

	Domestic consumption		Export		Total	
	('000 tonnes)	(no)	('000 tonnes)	(no)	('000 tonnes)	(Kip billion)
Pig	27.41	1,305,089	3.71	123,626	31.12	254.00
Poultry	16.44	18,070,461	2.58	1,984,318	19.02	232.14
Buffalo	9.87	48,365	7.08	20,818	16.94	175.66
Cattle	6.58	45,998	5.03	19,344	11.61	117.68
TOTAL	**60.30**	**19,469,913**	**18.40**	**2,148,105**	**78.69**	**779.48**

[3] Domestic meat consumption is estimated at a combined average 11 kg/capita/year; and offtake for export is between 1.5%-14% of herd, with lower rates for large stock (MAF 2001).

Domestic consumption, liveweight, consumable yield and export availability from MAF 2001, applied to prices and herd size from MAF 2002b (see Data Annex Table 21, Table 22, Table 23).

Livestock production under traditional management practices has an additional benefit to agriculture in terms of maintaining soil fertility for crop production. There is little use of chemical inputs in most farming systems in Lao PDR. Cattle and buffalo, grazed on harvested or fallow fields, provide manure which supplements soil nutrients and maintains soil fertility. Local breeds of cattle and buffalo produce an average of 0.7 tonnes of dung per year, containing 1.4% nitrogen and 1.3% phosphorus, which is equivalent to 9.8 kg of combined nutrients (Emerton and Asrat 1998). Assuming that a quarter of livestock manure is applied to fields, and using the replacement cost of fertiliser expenditures avoided suggests an annual value of Kip 11.12 billion for the contribution of livestock manure to soil fertility. This value forms a component of crop production values, considered above in Sections 3.1.1 (Indigenous rice varieties) and 3.1.2 (Other indigenous crop varieties).

3.2 Use of forest biodiversity

It is thought that almost half of the country, or 11.6 million ha, is under forest (DoF 1992). This includes, in the north, dry evergreen forest, scattered tropical montane deciduous forest and small areas of subtropical montane forest. Highland areas of the Annamite Mountains and Bolovens Plateau contain both tropical montane evergreen forest and small areas of pine forest and limestone forest. Dry Dipterocarp forest and mixed deciduous forest are found in the southern part of the country (SoE 2000).

Forests in Lao PDR are classified into five management systems: protection forest, conservation forest, production forest, rehabilitated forest and degraded forest. Approximately 2.5 million ha are designated as production forests, but it is estimated that forests with potential for commercial production may total more than 5.6 million ha (World Bank, Sida and Government of Finland 2001a). Only 57,000 ha of plantations have been established, of which less than half are available for production (World Bank, Sida and Government of Finland 2001a). Virtually all forest resource extraction can therefore be considered to originate from natural forests and to comprise indigenous species.

Indigenous forest resources yield five main categories of direct economic benefits: commercial timber exploitation, household wood consumption, fuelwood use, and non-timber forest products (NTFP) harvested at household and commercial levels.

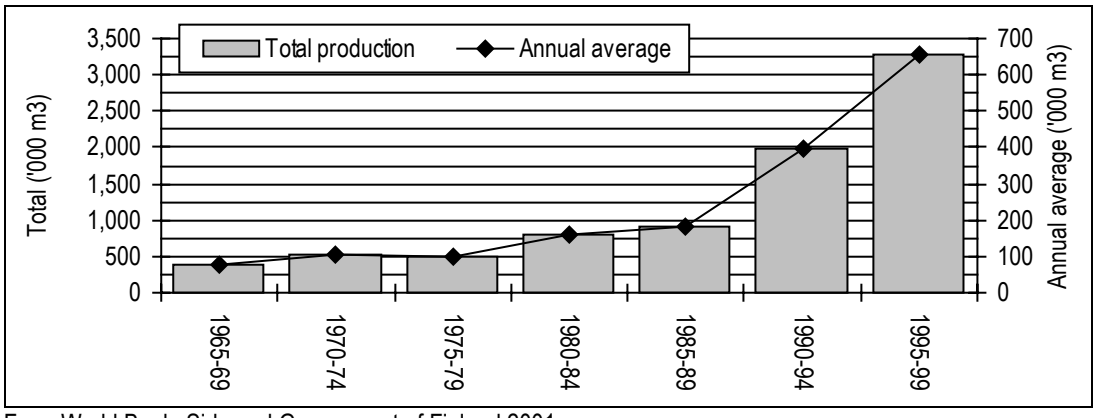
3.2.1 Commercial timber exploitation

There is a large commercial logging industry in Lao PDR. It is currently estimated that there are 725 chainsaws and 1,425 timber trucks operating in the logging sector (World Bank, Sida and Government of Finland 2001a). Log production has been increasing steadily over time (Table 5), and official statistics[4] suggest that a total of 3.3 million m^3 of timber was harvested between 1995-99, or an average of just under 650,000 m^3 a year (World Bank, Sida and Government of Finland 2001a). Production forests are thought to contain commercial timber of between 100-150 m^3/ha (STEA 2000), and the total annual allowable cut has been determined to be 282,580 m^3/year (MAF 1990). The balance of commercial timber is supplied from conversion. There has been an increasing reliance on log production from infrastructure and land development projects: between

4 This report deals only with official commercial log production. A significant volume of logs are also harvested unofficially, estimated at between 100,000 m3/year (World Bank, Sida, Government of Finland 2001a) and 150,000 m^3/year (MAF 1990) It is thought that only a small proportion of these logs – about 15% (STEA 2000) – are seized.

1995-99 almost two-thirds of harvested logs came from conversion (World Bank, Sida and Government of Finland 2001a).

Table 5: Timber production 1965-1999



From World Bank, Sida and Government of Finland 2001a.

Of average annual commercial timber demand of some 646,000 m^3 approximately 17.5% is destined for export, and the balance – just over 530,000 m^3 a year – is utilised domestically (World Bank, Sida, Government of Finland 2001a, see Data Annex Table 25, Table 26). Log production supports various domestic forest industries, including sawmills, plywood, veneer, parquet, poles, furniture and doors. All of these industries have expanded rapidly over the last decade. It is estimated that, between 1988 and 1999 the wood industry operating capacity almost doubled from just over 300,000 m^3 in 1988 (MAF 1990, see Data Annex Table 28, Table 30) to just under 600,000 m^3 in 1999 (World Bank, Sida, Government of Finland 2001a), and installed capacity is currently thought to be between 2-3 million m^3 (World Bank, Sida, Government of Finland 2001a, see Data Annex Table 30). More than 150 sawmills, almost 1,000 wooden furniture factories and 6 bamboo and rattan factories currently operate in Lao PDR (World Bank, Sida, Government of Finland 2001a, see Data Annex Table 29, Table 31).

Applying current prices to the commercial log harvest suggests that formal-sector timber exploitation has a market value of some Kip 530 billion a year, of which just over a quarter is comprised of export earnings (Table 6).

Table 6: Value of commercial timber exploitation

	Consumption (m^3 roundwood equivalent/yr)	Average price ($/$m^3$)	Total value (Kip billion/yr)
Domestic industries	532,000	75	395.0
Exports	113,000	120	134.2
TOTAL	**645,000**		**529.2**

Calculated from data presented in World Bank, Sida, Government of Finland 2001a.

3.2.2 Household wood consumption

Timber is harvested non-commercially in order to meet household demands for construction and repair, fencing, poles, furniture and other domestic uses. Much of this exploitation is carried out in degraded and non-production forests, and is comprised of small diameter, non-commercial timber.

Estimates of household timber consumption vary greatly, and timber use also differs between regions, social categories and ethnic groups. At the national level, it is thought that household wood

consumption for non-energy purposes equates to between 0.14 m^3 (Southavilay and Castrén 1998) and 0.15 m^3 (World Bank, Sida and Government of Finland 2001a[5]) per capita per year for rural households. This study assumes an average rural household wood consumption of 0.15 m^3 per capita per year[6].

These data suggest that an average of just over 680,000 m^3 of wood a year is consumed at the household level – a volume that is approximately equivalent to commercial wood exploitation household wood consumption. Applying average prices for polewood and low-grade timber to this exploitation gives a market value of just under Kip 170 billion a year for household timber consumption (Table 7).

Table 7: Value of timber consumption

	Consumption (m^3 roundwood equivalent/yr)	Average price ($/$m^3$)	Total value (Kip billion/yr)
Rural households	681,998	25	168.8

Calculated from data presented in Southavilay and Castrén 1998 and World Bank, Sida, Government of Finland 2001a.

3.2.3 Woodfuel

Firewood provides the major energy source for about 85% of the population (SoE 2000), including use for heat, cooking and light by almost all rural households. Estimates of rural firewood consumption show extreme variation, ranging from 0.75-2.92 m^3 or 0.58-2.26 tonnes[7] per capita per year (see Data Annex Table 32). This study takes an average per capita consumption of 1.2 tonnes per year, which is a conservative estimate for rural households in the Lower Mekong Region, and accounts for variability between seasons, ethnic groups and regions.

A minority of urban dwellers, and various industries, also utilise woodfuel. Detailed studies (FAO 1999, see Data Annex Table 33, Table 34) have been carried out on the volume of charcoal utilised by urban dwellers and industries (estimated at 42,146 tonnes or 280,973 m^3 wood a year[8]), and for firewood demand in cardamom, coffee, tea, brick, salt and tobacco processing industries (estimated at 111,118 tonnes or 143,468 m^3 of wood a year).

Applying current prices suggests that household and commercial woodfuel consumption has a total annual value of some Kip 45.75 billion, and accounts for the exploitation of more than 5.6 million tonnes or almost 7.5 million m^3 of raw wood a year (Table 8).

Table 8: Value of domestic and commercial woodfuel consumption

	Consumption	Consumption	Value

[5] This source quotes a total annual harvest of wood for traditional uses by rural households of at least 620,000 m^3 a year, which translates to approximately 0.15 m^3/capita/year.

[6] A detailed study carried out on the Nam Ngum plateau estimates total household wood consumption at almost ten times this amount, or more than 1.4 m^3 per capita per year (de Vletter 1997). These figures are extremely high. For example in highland areas of northern Vietnam, annual wood consumption averages between 0.1-0.25 m^3 per capita (IUCN 2002b). For this reason it is thought that estimates of between 0.14-0.15 m^3/capita/year (Southavilay and Castrén 1998, World Bank, Sida and Government of Finland 2001a) are more realistic.

[7] One cubic metre of firewood converts to 775 kg (from FAO 1999).

[8] One cubic metre of wood converts to 150 kg charcoal (from FAO 1999). This estimate seems high, given charcoal production technologies, but is based on detailed studies carried out in Lao PDR.

	in tonnes/year	in m³/year	(kip billion)
Domestic firewood	5,455,985	7,039,980	35.20
Commercial firewood	111,188	143,468	0.72
Household charcoal	9,489	63,260	2.21
Commercial charcoal	32,657	217,713	7.62
TOTAL	**5,609,319**	**7,464,421**	**45.75**

Calculated from data presented in FAO 1999, MAF 1990, Raintree and Soydara undated, Southavilay and Castrén 1998, STEA 2000, World Bank, Sida and Government of Finland 2001a.

It is worth noting that these figures of 5.6 million tonnes or 7.46 million m³ of woodfuel consumption per year are much higher than previous estimates. Previous estimates range from 1.5 million m³ for rural firewood consumption (World Bank, Sida and Government of Finland 2001a), to almost 3 million m³ for all firewood consumption (FAO 1999, SoE 2000[9]). Figures generated by this study are between two and a quarter and five times higher than these previous estimates. Three main factors account for this difference: few previous estimates include either charcoal or commercial firewood demand in their calculations, there is a great deal of inconsistency between per capita estimates and whole-country data[10], and household numbers used in this study have been updated to 2002 population levels.

3.2.4 Household use of non-timber forest products

Non-timber forest products play a central role in the rural economy of Lao PDR, and have been studied extensively (see, for example, Clendon 2001, de Beer 1991, de Vletter 1997, Enfield *et al* 1998, Foppes and Ketpanh 1997, 2000a, 2000b, Foppes *et al* 1997, IUCN 2002a, Lamxay 2001, Raintree and Soydara undated). It is known that wild plant and animal species provide a wide range of products for consumption and production, including animal proteins from foods such as wild meat, fish, frogs, shrimp, soft-shelled turtles, crabs and molluscs; plant foods such as mushrooms, bamboo shoots, wild fruits and vegetables, and honey; materials for house construction and handicraft production from bamboo, rattan, pandanus, broom grass and paper mulberry; traditional medicines; and livestock fodder and pasture.

NTFPs are known to be a particularly important component of household subsistence, especially food consumption. Wild foods are consistently ranked as the most important forest resource by rural villagers (Clendon 2001), and it is thought that wild meat and fish are the most important source of protein in most people's diet (Foppes and Ketphanh 1997). It is estimated that wild foods contribute between 61-79% of non-rice food consumption by weight, and provide an average of 4% of energy intake, 40% of calcium, 25% of iron and 40% of vitamins A and C (Clendon 2001). They are also commonly used as buffers against seasonal and emergency food shortages (de Beer 1991).

In addition to subsistence consumption, NTFPs also generate cash earnings. National studies have found that sales of NTFPs are worth an average of 11% of cash income, rising to 55% in forest-rich areas (NSC 1999). In many parts of the country NTFP cash income is far in excess of the national average. For example surveys carried out in Houapanh Province found that NTFP

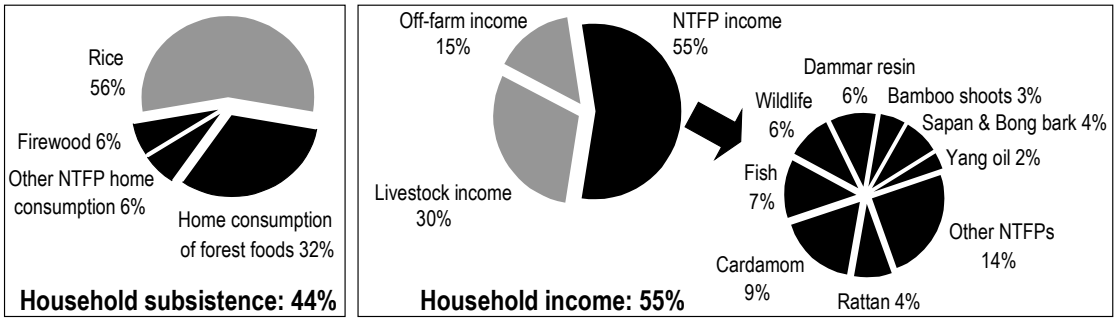
[9] This study estimates that commercial logging accounts only 15% of total wood utilisation, which equates to a total wood consumption of 4.3 million m³ at current commercial timber extraction levels. Excluding household timber consumption (682,000 m³) from the balance leaves a figure of some 2,973,000 m³.

[10] For example World Bank, Sida and Government of Finland 2001a state that average fuelwood collection is 2.5 m³/capita /year. Yet the national demand of 1.5 million m³ quoted in the same report is sufficient only to supply only a population of 600,000 people, and translates to a rural per capita consumption of 0.35 m³ at 1999 population levels.

contributed an average of 38% of village cash income, rising as high as 56% for households living within and adjacent to forests (IUCN 2002a), and on the Nakai Plateau NTFPs account for over three quarters of family income (Foppes *et al* 1997).

Although it is difficult to aggregate these data at the national level, because of wide variations in social and cultural systems, livelihoods, dependence on forest, and access to other sources of production and consumption, estimates have been generalised for the whole country. On average NTFPs are worth a total of almost $320 per year for rural households in Lao PDR, contributing about 44% of subsistence value, 55% of cash income, or 46% of the total household economy (Foppes and Ketphanh 2000a, Figure 7, see Data Annex Table 37, Table 38).

Figure 7: NTFPs in the household economy



From Foppes and Ketphanh 2000a.

Taking these average household data suggests that NTFPs may be worth some Kip 2.6 million per household per year or Kip 1,837 billion in total (Table 9). Firewood, fish and aquatic resource consumption values are excluded from this figure, as they are dealt with elsewhere in this study in Sections 3.2.3 (Woodfuel) and 3.3.1 (Fish and other aquatic animals)

Table 9: Annual value of NTFPs for household income and subsistence

	$ per household	Kip per household	Kip billion total
Household subsistence	223	2,209,680	1,582.66
Household income	36	354,470	253.89
TOTAL	**259**	**2,564,150**	**1,836.55**

Annual household values from data presented in Foppes and Ketphanh 2000a,b. Household values excludes firewood (estimated to have a value of $40 by Foppes and Ketphanh 2000a); and fish and other aquatic species (estimated to contribute 7% of NTFP value).

3.2.5 Commercial exploitation of non-timber forest products

Non-timber forest products also have a high industrial and trade value. The most important components of the commercial NTFP harvest are thought to be cardamom, eaglewood, bamboo, rattan, yang oil, benzoin, damar resin, sugar palm and malva nuts (Lamxay 2001, SoE 2000, see Data Annex Table 36).

Although commercial-level processing is as yet relatively undeveloped in Lao PDR (de Beer 1991), there are several small and medium-scale industries that use NTFP as primary inputs. These include at least 3 rattan and 5 bamboo workshops, 1 incense factory, 3 resin distillation units, 1 domestically-owned and several Vietnamese-owned berberin processing plants, and several small-scale sa paper industries and aromatic oil distillation factories (de Beer 1991, Enfield *et al* 1998, Foppes and Ketphanh 2000b, World Bank, Sida, Government of Finland 2001b). Data on commercial NTFP harvests are extremely variable, showing a rise in value of between 45-75 times

in 2000 and 2001 as compared to 1998 and 1999 (see Data Annex Table 35). Average figures for the last two years however suggest that at current levels, commercial NTFP exploitation is worth some Kip 151 billion a year.

Much of the commercial harvest of NTFPs is exported to neighbouring countries, where it is often processed and sometimes re-exported to other parts of the world. Between 1994-1998 recorded exports of NTFP were worth almost $160 million, or an average of $31.8 million a year[11] (World Bank, Sida, Government of Finland 2001b). Annual export values however varied greatly over this period (between $1.1 million and $73.2 million), and have now declined substantially from a high of over $70 million a year in the mid-1990s. Estimates of the quantities, values and current prices of major NTFP exports would suggest that today official NTFP exports are worth between $6-7 million a year (Lamxay 2001, World Bank, Sida, Government of Finland 2001a), or an average of Kip 64 billion (Table 10).

Table 10: Commercial value of NTFPs

	Value (Kip billion/yr)
Commercial NTFP harvest	207.87
NTFP export value	64.35

3.3 Use of aquatic biodiversity

Rivers, water bodies and other natural and constructed wetlands are estimated to cover just under 945,000 ha or 4% of Lao PDR, including 254,000 ha from the Mekong and other major rivers, 57,000 ha from large reservoirs, 96,000 from swamps and wetlands, 480,000 from rice fields, 10,300 from fish points, and 47,400 from small reservoirs, ponds and weirs (DLF 2001, see Data Annex Table 39). These wetland resource support a large fishery, as well as yielding a wide range of other aquatic animals that are harvested for household consumption and trade. With the exception of a small number of introduced fish used for aquaculture, almost all of the fish caught in Lao PDR are indigenous species.

3.3.1 Fish and other aquatic animals

Capture fisheries from rivers dominate the sector, accounting for up to 75% of all landings in Lao PDR (Coates 2002), and rice fields also provide an important source of fish and aquatic animals (DLF 2001). The country has one large reservoir, Nam Ngum, with modest production and a number of smaller hydropower and irrigation reservoirs that are also used for fishing. Floodplain and swamp fisheries occur in localised areas and are more common in the south of the country, although nowhere are they extensive. As yet, aquaculture activities are relatively undeveloped, partly due to the low level of marketing opportunities but also through competition from wild fisheries and rice field fisheries.

Estimates of national fisheries production vary greatly (see Data Annex Table 40). Recent studies estimate a total catch of some 200,000 tonnes of fish and other aquatic animals (Coates 2002), which is 1.5-5 times higher than previous estimates (LARReC 2000, DLF 1998 and 2001). A major reason for the divergence between these figures is that official records have not traditionally included subsistence fisheries or home consumption of aquatic animals, which account for a large proportion of total catch. Most national fishery statistics include only finfish landed at regular marketing sites.

[11] In addition, a large proportion of commercial extraction and trade takes place unofficially. It is however impossible to obtain reliable data on the scale or value of this utilisation.

An estimate of 200,000 tonnes catch for fish and other aquatic animals per annum is used in this study. This equates to an average of about 36.5 kg per capita per annum, which is considered to be realistic for a country in Southeast Asia with good water resources and a predominantly rural/agricultural population (Coates 2002). Applying a market price of 5,000 Kip on average per kg of wet fish or aquatic animals (from LARReC 2000) suggests that the total annual value of aquatic resource production is Kip 1,000 billion (Table 10). Consumption of other aquatic animals and amphibians is estimated at about 50% of total catch (Coates 2002).

Table 11: Value of fish and aquatic animals

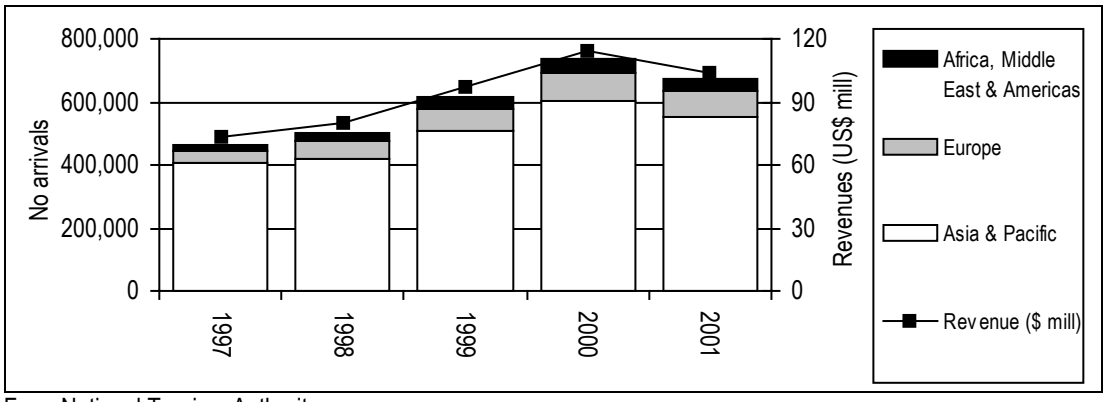
	Value (Kip billion/yr)
Fish	500.0
Other aquatic animals	500.0
TOTAL	**1,000.0**

Catch data from Coates 2002, prices from LARReC 2000.

3.4 Cultural and nature-based tourism

Lao PDR opened its doors to international tourists in 1990 and since then the tourism industry has developed rapidly to become one of the country's largest earners of foreign currency. Visitor arrivals increased more than 100 times from under 7,000 in 1990 to more than 720,000 in 2000 (ADB 2001, Figure 8), and were estimated at 674,000 in 2001 (National Tourism Authority, see Data Annex Table 41). In 2001, it was estimated that gross tourism receipts to Lao PDR were in excess of US$103 million (National Tourism Authority, see Data Annex Table 42), of which more than 30% represented foreign exchange earnings (UNDP and WTO 1998).

Figure 8: Tourist arrivals and revenues 1997-2001



From National Tourism Authority

A principal tourist attraction for international visitors is the nation's rich natural and cultural heritage. It is reported that up to 70% of tourists to Lao PDR express an interest in nature (Robichaud *et al* 2001, UNDP and WTO 1998). The National Tourism Authority has already established several ecotourism projects in co-operation with international and regional partners. For example protected areas that are being developed as nature tourism or ecotourism destinations include Dong Houa Sao, Nam Kan/Nam Nga, Nam Ha, Phou Hin Poun, Phou Khao Khoay, Phou Xang He and Xe Piane NBCAs. Although in their early stages, these experiences show that nature tourism can provide an important source of revenues for both government and local communities, as well as having significant multiplier effects for Provincial and National economies. In Nam Ha NBCA, for example, tourism earnings for the first quarter of 2001 generated income worth U$1,600 for local villages, more than US$3,000 for local food sellers, guides and transporters, almost US$400 for the NBCA Authority and over US$300 for the Provincial Tourism Office

(calculated from data presented in Robichaud *et al* 2001). More than $35,000 was earned from key natural and cultural attractions in Luang Prabang Province in 2001, and almost $40,000 from visitor sites in Champassack Province (see Data Annex Table 45).

An average of 70% of international tourists to Lao PDR visit the country for holiday purposes, staying an average of between 1 and 8 days (National Tourism Authority, UNDP and WTO 1998). It is assumed half of these tourists are expatriate Lao visiting family and friends, and that 70% of remaining international tourists visit Lao PDR primarily to enjoy the country's biodiversity, cultural heritage and diversity. Estimates of average daily expenditures for non-regional international tourists range from $30 (SUNV 2002[12]), through $50 (National Tourism Authority) to $90 (UNDP and WTO 1998) a day. Taking an average per capita daily expenditure of $60 suggests that the gross value of cultural and nature-based tourism at 2001 levels[13] may be more than US$ 59 million or Kip 580.2 billion a year at current visitation rates (Table 12).

Table 12: Value of ecotourism

	Value (Kip billion/yr)
International culture and nature-based tourism	580.2

3.5 Forest watershed catchment protection services

Lao PDR has plentiful renewable freshwater resources, estimated at an annual supply of 270,000 million m^3 (SoE 2000), or almost 50,000 m^3 per capita at current population levels. As well as being essential to human survival, freshwater resources have a wide range of economic uses including providing essential flows to natural ecosystems and supporting a wide range of domestic and industrial uses. Total annual demand water demand has been estimated at 228 m^3/capita/year, or 1.25 billion m^3, of which agriculture is estimated to account for 82% of total withdrawal, industry 10%, domestic use 8% (SoE 2000).

Biodiversity conservation makes an important contribution to the maintenance of water supply and quality. Many of the country's major rivers rise in forested areas, and natural forest cover provides essential catchment protection services to their watersheds. It is estimated that over 4.5 million km^2, or almost a third of total watershed area, are protected by forests (calculated from data in Puustjarvi 1998, see Data Annex Table 46). Watershed catchment protection is especially important on the steep slopes in upper parts of catchments, many of which are currently covered by forest. Almost 80% of the land surface of Lao PDR is hilly and mountainous terrain: more than one third of the country has a slope of more than 30%, and two thirds has a slope of more than 20% (SoE 2000). Forest cover upholds the quality and supply of water supplies, helping to regularise flow between wet and dry seasons and to reduce downstream silt and sediment loads.

Although forest cover is still extensive over much of Lao PDR and siltation and sedimentation rates remain low by international standards (SoE 2000), soil erosion resulting from deforestation is becoming a major issue in rivers such as the Sebang Hieng, Se Done, Nam Ou and the upper and lower stretches of the Mekong River (MAF 2001). For example at the Nam Dong reservoir, Luang Prabang, siltation is already impeding hydropower generation, and it is known that rapid supply of silt from tributaries during storms causes the silt load of the Sa Bang Fai river to rise to 170,000 tonnes per day in peak floods (Douglas 1998).

[12] These figures seem to include only payment for accommodation, and exclude expenditures on food, transport, souvenirs, etc.

[13] Excluding arrivals for visa renewal.

Impacts of loss of forest cover on downstream siltation and sedimentation are highly specific, and depend on the unique soil, erosivity, climate, slope and land cover characteristics of a particular area. No data are currently available for Lao PDR relating deforestation to catchment degradation and erosion. Studies from similar areas of Cambodia (IUCN 2002c), Malaysia (Mohd Shahwahid *et al* 1997, Indonesia (Magrath and Arens 1989), Philippines (Cruz *et al* 1988), Vietnam (Aylward *et al* 2002) and other parts of the Lower Mekong Basin (Douglas 1998) however suggest that soil loss arising from logging and conversion of forest to agriculture ranges between 25-80 tonnes/ha/year and that "natural" erosion rates from high tropical forests range between 3-10 tonnes/ha/year. In the absence of protected forest cover in Lao PDR's upper catchments, the next most likely alternative land use of forest clearance for agriculture, infrastructure and settlement would undoubtedly have negative effects on water flow and quality, reducing the economic output and value of downstream production and consumption.

Although data do not permit a detailed quantification of the downstream impacts of deforestation, a large amount of economic production depends directly on maintaining the integrity of watersheds, minimising runoff and erosion, and prolonging the lifespan and output of downstream reservoirs and water supplies. It is known that large reservoirs currently cover an area of at least 57,000 ha, and small reservoirs, ponds and weirs almost 50,000 ha (DLF 2001). Together these support a wide range of economic activities and uses, including:

- **Irrigated agriculture**. There is a total irrigated area of over 515,000 ha in Lao PDR, including approximately 100,000 ha planted to rice as well as areas under other crops such as vegetables (MAF 20002b, see Data Annex Table 20). If it is assumed that half of annual vegetable production is produced under irrigation, and considering all irrigated rice production, the gross value of output arising from the use of water supplies for irrigated agriculture is in excess of Kip 830 billion a year.
- **Medium and large-scale hydropower.** Existing medium and large scale hydropower dams rely on a total watershed area of more than 1.8 million ha, much of which is forested. With a combined installed capacity of over 620 MW and an annual power generation capacity of more 3,700 GWH (see Data Annex Table 47), the traded value of power generated by these schemes is almost Kip 1,300 billion a year[14].
- **Fishponds and aquaculture.** There are over 10,000 ha of constructed fishponds and aquaculture areas in Lao PDR (DLF 2001) which rely on clean and regular water supplies. Together accounting for an annual catch of some 30,000 tonnes (Coates 2002), this fishery is worth up to Kip 150 million a year.
- **Urban water supply.** Urban water consumption in Lao PDR is estimated at over 200 million m^3 a year (updated from data in SoE 2000).

Loss of forested catchment protection also affects economic production through the downstream damage costs arising from increased incidence of flooding and dry-season water supplies[15]. No detailed data are available on the relationship between deforestation and the incidence of downstream floods and low flows. It is however known that between 1995 and 1999 more than 170,000 ha of agricultural land was destroyed by floods (MAF 2000b, see Data Annex Table 48),

[14] Assume 25% transmission losses. Average domestic electricity tariffs range from 56-978 Kip/kWh, depending on level of usage and type of consumer; average import and export tariffs are 465 Kip/kWh, calculated from Thailand and Vietnam imports and Lao PDR exports. The traded value of electricity is slightly in excess of actual electricity revenues for 2000 of Kip 1,003 billion a year, as this figure includes domestic sales.

[15] Natural swamp and marsh areas may also play an important role in flood attenuation, although no information is available about the significance of these ecosystem services for Lao PDR. Wetlands act as a buffer, absorbing excess water and peak flows, and releasing them slowly.

some of which may have been caused or exacerbated by deforestation in upper catchments. At an average gross return to rice cultivation of 2.7 million kip/ha/year (calculated from data provided in MAF 2000b), flood-related costs to production may have been as high as Kip 463 billion for this period, ranging between Kip 22 billion and Kip 182 billion a year.

3.6 Forest carbon sequestration services

Growing natural vegetation stores carbon and locks it up, thereby helping to mitigate or avoid global warming. Although there are no data specific to Lao DPR, a number of estimates of carbon sequestration by tropical forest vegetation have been made. These range from an average of 100-150 tonnes of carbon per hectare of closed secondary forest to 200-250 tonnes C/ha for closed primary forest (Myers 1997). The total carbon density in Asia-Pacific forest vegetation has been estimated at 166 tonnes/ha (Sedjo and Sohngen 2000).

Carbon dioxide release, through its global warming effects, gives rise to a range of economic costs and losses — for example health costs, sea-level rise and consequent damage to infrastructure, agriculture, fisheries and other production, and needs for protective infrastructure. Although still approximate, estimates have been made of the economic benefits or costs avoided of carbon sequestration. Most studies calculate the benefits of carbon sequestration at between US$5-25 a tonne (Shogren and Toman 2000), or an average global warming damage cost of a minimum of US$20 per tonne of C released (Fankhauser and Pearce 1994).

These figures can be applied to the areas under forest vegetation in Lao PDR. Making conservative estimates based on an average sequestration of between 125-150 tonnes C/ha for dense natural forest, 75 t C/ha for disturbed natural forest, 50-75 t C/ha for regrowth and mosaic forests, and an average damage cost avoided of S$7.50/tonne of C, suggests that the total economic benefit of maintaining natural forest in Lao PDR as a carbon sink may be worth almost $6 billion in terms global warming costs offset or mitigated.

Table 13: Value of carbon sequestration by forests

Forest type	Area (ha)	Total carbon sequestered ('000 tonnes)	Value (US$ million)
Evergreen/mixed dense	1,589,653	238,448	1,788
Evergreen/mixed disturbed	4,033,725	302,529	2,269
Evergreen/mixed mosaic	2,113,086	105,654	792
Deciduous	733,141	91,643	687
Deciduous mosaic	600,227	30,011	225
Regrowth forest	317,999	23,850	179
TOTAL	**9,389,828**	**792,136**	**5,941**

Forest areas from World Bank, Sida and Government of Finland 2001a.

Forest conversion, and carbon release, takes place gradually over time. To calculate actual annual carbon sequestration values for Lao PDR it is necessary to consider deforestation rates and alternative land uses. Land use trends over past decades suggest that large areas of forests have been, and continue to be, cleared and degraded as a result of shifting cultivation practices, encroachment of permanent agriculture, clearfelling or unsustainable timber harvesting, infrastructure developments and resettlement.

Estimates of annual forest loss however vary greatly, and it is difficult to predict with any certainty what land use changes will occur in the future. Reduction in national forest area over the 1980s was estimated to be between 100,00-200,000 ha per year or about 1% of the 1981 forest area (MAF 1990, World Bank 1993). Of this, approximately half of forest clearance arose as a result of shifting

cultivation[16], and the rest was mainly accounted for by timber harvesting and forest fires. Estimates of deforestation in the latter part of the 1990s range between 0.3% to 1-2% of the national forest area per year (World Bank, Sida and Government of Finland 2001a).

This study assumes a future annual average deforestation across all forest types of 0.5% a year, balancing a reduction in area under shifting cultivation[17] with the forest clearance that will occur to resettle former shifting cultivators and allocate them alternative farming land, and also considering clearance for infrastructure, continued logging of production forests, forest fire and permanent agricultural encroachment. It assumes that the most likely alternative land use to forest will be mixed agriculture. Applying carbon sequestration rates and values as above, this translates into an annual carbon sequestration value of climate change damages avoided of US$29.71 million or Kip 294 billion a year.

3.7 Wetland pollution control and nutrient cycling services

Natural wetlands retain wastewaters and physically, chemically and biologically eliminate pollution from them. While wetland plants trap sediments and remove nutrients and suspended solids, pollutants and pathogenic organisms accumulate and decompose in the wetland's bottom sediments, and effluents are diluted. These functions play an important role in assuring local water quality, and maintaining the quality of water entering other waterbodies and rivers.

Data are almost completely absent on the role of natural wetlands in pollution control and nutrient cycling in Lao PDR. As levels of both industrial development and population density are currently low throughout much of the country, it is likely that wetlands in Vientiane provide the most significant waste treatment role. In the mid-1990s it was estimated that Vientiane Prefecture contained almost 1,500 km^2 of permanent and seasonal waterbodies, floodplains, swamps and marshes (Claridge 1996). These wetlands receive domestic sewage discharge from a large proportion of Vientiane. While Vientiane has a sewerage system, there is no waste treatment facility. Sewage is discharged into natural waterbodies, either as raw wastes or as seepage from septic tanks. A considerable quantity of household waste and sewage is discharged into wetlands and ultimately flows into the Mekong.

Studies have shown that many of the less degraded wetlands provide sufficient retention time to remove most of the organic nutrients from the water. Inorganic pollutants however remain in wastewaters, and have caused eutrophication. Although water pollution currently originates mainly from human wastes, problems are beginning to arise from industrial pollution. Textile, detergent and paper plants discharge directly into open drains without any treatment, and contribute raw wastes into wetlands and rivers.

3.8 Other biodiversity and ecosystem services

Lao PDR's indigenous biodiversity and natural ecosystems also provide a wide range of other economic services, most of which are unquantifiable on the basis of current information, but are reflected in the direct values described above in Sections 3.1-3.4 These include:

- **Microclimate regulation**, primarily reflected in agriculture, fisheries and forest resource use values. Large forest and wetland ecosystems to some extent influence local climate,

[16] Total shifting cultivation area in any one year was estimated at 300,000 ha. Of this, about one third was cleared for the first time and actually resulted in forest deforestation, and only a small proportion was in areas of high forest.

[17] Shifting cultivation has decreased over recent years, and it is the stated goal of the Government of Lao PDR to eliminate slash and burn agriculture by the year 2010.

temperatures and rainfall patterns, resulting in particular vegetation types and land use systems of economic value.

- **Pollination and pest control by insects**, primarily reflected in agricultural values. Insects play an important role in integrated pest management, and pollinate of both wild and domesticated plant species.
- **Soil biodiversity,** primarily reflected in agricultural values. A large and diverse range of living organisms and organic matter are found in soil, which maintain its fertility and productivity, enable crop production and sustain yields.
- **Wildlife habitat,** primarily reflected in NTFP, fisheries and tourism values. Natural ecosystems play an important role in providing habitat to wildlife, including rare, endangered and endemic species. Wetland ecosystems, especially, also provide nursery and breeding grounds for fish, waterfowl and other aquatic species.

3.9 Option and existence values

Option value is the premium placed on conserving biodiversity for future possible uses, over and above the value of this use. Only a small proportion of the total economic benefit of biodiversity in Lao PDR has been documented, or is currently captured or realised in cash terms. Much of the country remains remote, and there has been almost no commercial or large-scale development of biological resources except for timber and NTFPs. In conservation terms there is undoubtedly an advantage to this isolation, which may account for the relatively good biodiversity status and ecological integrity in Lao PDR. There however exist clear opportunities for increasing the level of sustainable economic values captured from biodiversity in support of socio-economic development in the future.

By definition not all of the potential uses of Lao PDR's biodiversity can be known now – many developments and applications of wild species, ecosystems and genes may only be discovered, or become necessary, in the future. Various components of biodiversity have however been demonstrated to have a high economic value in other parts of the world, or are already targeted as major areas for future economic growth in Lao PDR.

One major use of tropical biodiversity is for medicinal and pharmaceutical applications, many of which are based on medicines sourced from forest products that are already used among local communities. In the developed world it is thought that 25 per cent of all medical drugs are based on plants and plant derivatives, and in developing countries 75 per cent (Pearce and Moran 1994). Recent research indicates that the higher plants of the world's tropical forests contain about 375 potential pharmaceuticals of which approximately one in eight have already been discovered. Multiplying these values by the number of potential new drugs suggests that a complete collection and screening of all tropical plant species should be worth about US$ 3-4 billion to a private pharmaceutical company, and as much as US$ 147 billion to society as a whole (Balick and Mendelsohn 1995).

Medium and long-term development plans target tourism, hydropower, irrigation and agricultural production as major areas of future economic growth for Lao PDR. All of these sub-sectors depend on biodiversity, including reliance on agrobiodiversity, protected areas, and the watershed catchment protection functions of forests. There is undoubtedly an economic premium to conserving biodiversity and natural ecosystems to supply these demands and enable these developments in the future.

Lao PDR's biodiversity also has an extremely high economic value, regardless of its current or possible future uses. Existence value is the intrinsic significance biodiversity holds for people, at

local, national and global levels. This includes a wide range of economic benefits, such as cultural and spiritual values, aesthetic value, bequest and heritage values.

4. ECONOMIC COSTS OF BIODIVERSITY: Conservation expenditures, losses and damages

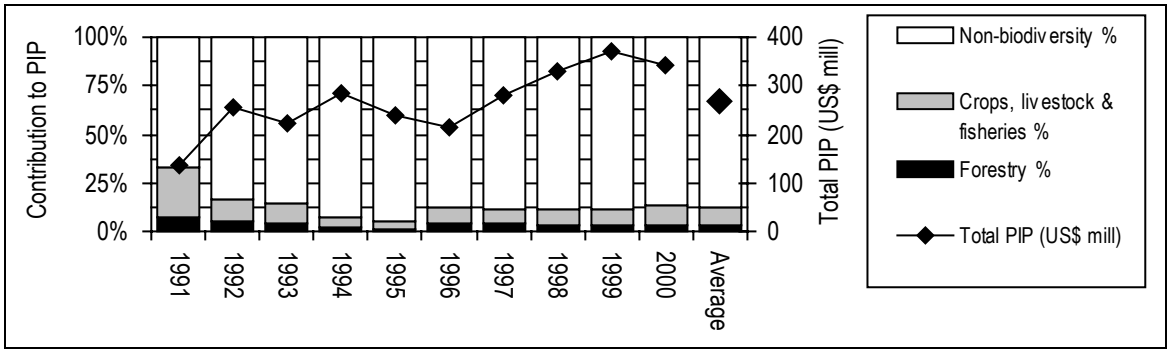
Biodiversity does not give rise to a stream of pure economic benefits. Biodiversity conservation activities require physical inputs and expenditures, and certain components of biodiversity – or their protection – cause economic losses and damages. This chapter will describe, and where possible quantify, the various economic costs that are incurred by biodiversity conservation.

4.1 Direct management costs

Currently there is little or no direct private investment in the conservation of biodiversity in Lao PDR[18]. The direct costs associated with biodiversity conservation are borne by the state. The Public Investment Programme (PIP) provides the overall framework for government investment, including both foreign and domestic contributions. It is a rolling 5-year plan which is prepared to reflect the priorities identified in the 5-year medium development plans. It has a major role in influencing overall economic growth, determining sectoral contributions, and shaping the allocation of both domestic and foreign resources. Approved components of the PIP are included in the national budget, and typically comprise about half of annual budget outlays (World Bank 1997). The PIP is also the main mechanism by which the government identifies projects that will require donor funding[19], and it is estimated that over three quarters of PIP outlays are financed from foreign sources (World Bank 1997).

No disaggregated data are available that permit all the components of biodiversity conservation in the PIP to be calculated. It is however possible to determine total public investment requirements for forestry, crops, livestock and fisheries. For the two PIPs of 1991-1995 and 1996-2000, investments in these biodiversity sectors averaged $ 33 million a year, or 12.5% of the total PIP (Figure 9).

Figure 9: Biodiversity in Public Investment Programmes 1991-1995 and 1996-2000



Calculated from data presented in MEPF 1991 (1991-1995 PIP), World Bank 1997 (1996-2000 PIP).

4.1.1 State budget allocations

Direct institutional responsibilities for biodiversity conservation are currently vested in two government agencies:

[18] A range of private investments are made in biological resource exploitation, processing and trade, but none are concerned directly with the *conservation* of biodiversity.

[19] The PIP however includes only investment projects that have a that will draw resources from the state budget, and thus excludes wholly donor-funded activities

- **Science, Technology & Environment Agency (Office of the Prime Minister):** overall coordination; oversight of environmental affairs; environmental management (setting policy and regulatory framework, monitoring state of the environment and compliance with policies and regulations); focal point for GEF projects and most international environmental conventions.
- **Ministry of Agriculture and Forestry:** Forest resource use and management; biodiversity conservation and management; soil resource management; water resource management; fisheries, livestock and crop production; agricultural, fisheries and forestry research (NAFRI, LARReC); decentralised agriculture, fisheries and forestry management (PAFOs and DAFOs).

A range of other government agencies have additional or indirect responsibilities for biodiversity conservation or for ensuring that negative impacts on biodiversity are mitigated, including the Ministry of Industry and Handicrafts (hydropower development; industrial environment development; mineral resources), Ministry of Communications, Transport, Post & Construction (development and management of infrastructure), National Tourism Authority (tourism development), Ministry of Public Health (public health and sanitation; medicinal plants), State Planning Committee (management of investment, foreign assistance and medium-term macroeconomic framework), Ministry of Finance (treasury and budget management, trade and export regulation) and Ministry of Education (biodiversity awareness and education).

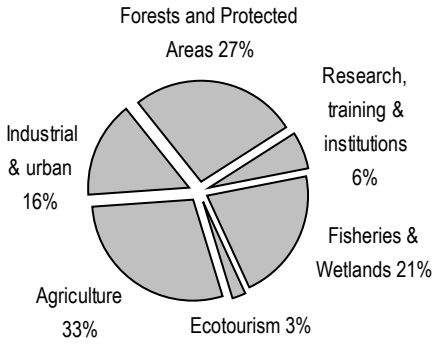
Unfortunately, no data are available as to the budgets of relevant Lao PDR government agencies that are committed to biodiversity conservation. It is however worth noting that these budget allocations are currently low, in absolute terms, and relative to budget allocations in other sectors of the economy.

4.1.2 Foreign contributions to biodiversity conservation

External financing provides a major source of support to the state budget, and also forms an important component of funding to biodiversity conservation. There are currently a total of 62 on-going donor-supported projects and programmes dealing specifically with biodiversity conservation, running between 1993-2003. Together these are worth $150 million (out of a total of 383 projects and programmes worth $947 million), with an average expenditure of $16.9 million a year over the period (Table 14).

Table 14: On-going donor commitments to biodiversity conservation 1993-2003

	Total foreign funding (US$ mill)
Bilateral assistance	45.430
Multilateral assistance	100.650
International NGO assistance	3.956
Total support to biodiversity	**150.036**



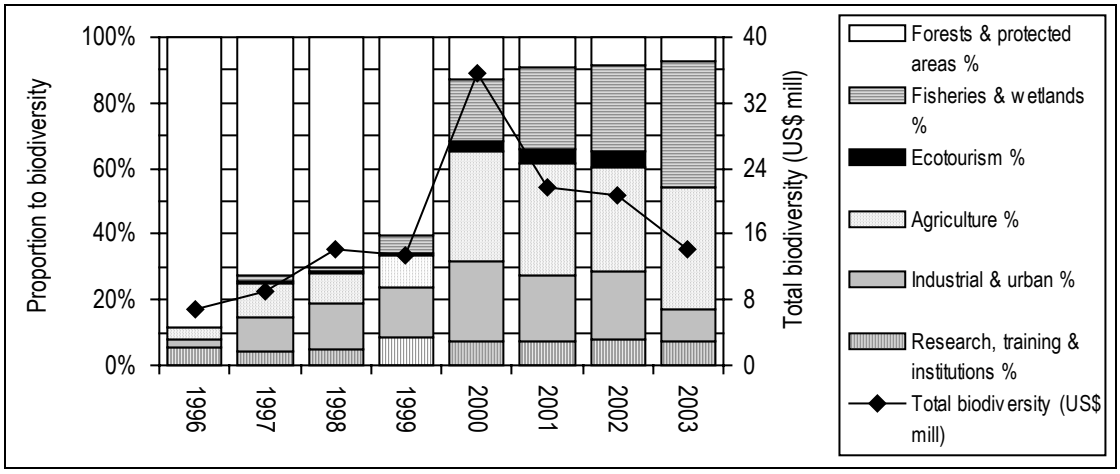
Calculated from data presented in SPC 2001b. Donor assistance includes foreign contributions of grants only.

The bulk of current donor-supported biodiversity projects deal with sustainable agriculture and land use practices (33%), forests and protected areas (27%) and fisheries and wetland conservation

(21%). Other categories of biodiversity-related donor projects include industrial and urban conservation, ecotourism, and support to research, training and institutions

Total donor commitments to biodiversity conservation have fallen dramatically for 2001-2003, after rising over much of the 1990s and peaking in 2000 (Figure 10). Support to forest conservation and protected areas, in particular, has reduced, while funding to sustainable agriculture and on-farm biodiversity conservation (partially due to foreign inflows in support of shifting cultivation stabilisation and to conservation components of the Agricultural Sector Strategy) and to fisheries and wetlands (largely as a result of the startup of several large Mekong River Commission projects) have risen.

Figure 10: Composition of donor commitments to biodiversity conservation projects and programmes 1996-2003



Calculated from detailed data presented in SPC 2001b.

In addition to donor grants, two loans from multilateral sources have been made to Lao PDR for biodiversity conservation, both in 2000. Together these loans are worth US$21.29 million (out of a total of 26 listed loans for this period, worth a total of $446.5 million). They have been granted on a highly concessional basis at 0.5-1% interest rates, with repayment over 20-40 years with 5-10 years grace period. Assuming an average 30 year repayment schedule at 0.5% interest, this translates into average annual repayments of Kip 8.08 billion for biodiversity loans.

4.2 Opportunity costs

Opportunity costs are the income and other economic benefits from land, resource, investment and development activities foregone or reduced by the need to conserve biodiversity. Three main categories of opportunity cost currently apply to biodiversity conservation in Lao PDR:

- Controlling or limiting **development technologies and production processes** which pollute, degrade or otherwise harm biological resources and ecosystems (for example industrial wastewater treatment, sustainable logging practices, mitigation of development and urban impacts on biodiversity). As industrial and urban economic activities remain relatively low-level in Lao PDR, they do not currently not pose major threats to biodiversity and there are no major opportunity costs related to their control. The industrial sector is however targeted as a major area for future growth, and urban populations are growing rapidly. Biodiversity conservation in the future may imply an increased level of costs in terms of unsustainable industrial development opportunities foregone.

- Reducing or curtailing **land and resource uses** which are incompatible with biodiversity conservation because they deplete species and convert natural habitats (for example shifting cultivation stabilisation, protected areas, logging or NTFP collection quotas, bans on hunting). These costs are likely to be high for Lao PDR. Currently a wide range of resource utilisation activities are limited or banned by law, and efforts are being made to control shifting cultivation and other agriculture in upper watersheds.
- **Damage to other economic activities** caused by wild species (for example human and livestock disease, pest damage to agriculture). These costs are significant for Lao PDR. A significant proportion of rural households suffer regular damage to agriculture from wild animals, and there is a high incidence of insect-borne disease among both humans and livestock.

The first category of opportunity costs are difficult to quantify on the basis of available information. The following paragraphs however present partial estimates of the value of land and resource opportunities foregone, and pest damage to agriculture.

4.2.1 Land and resource use opportunities foregone

A total of 3,394,000 ha of land are classified as actual or proposed conservation areas, and are legally protected (MAF 2001). The establishment of protected areas precludes certain land and resource uses, most importantly commercial timber harvesting and cultivation. The opportunity costs of these economic activities foregone can be estimated by looking at returns to non-conservation land uses. Assuming the gradual removal of conservation forests over a 50 year period, the abstraction of commercially viable timber and the subsequent conversion of cleared areas to crops gives an gross annual opportunity cost of timber and agricultural production benefits foregone of just under Kip 1,200 billion a year at current market prices (Table 15).

Table 15: Opportunity costs of crop and timber production foregone in conservation forests

	Land made available (ha/year)	Potential production value (Kip billion)
0-5% slope (logging and conversion to rice)		
Timber	16,283	302.26
Crops		10.99
6-30% slope (logging and conversion to mixed crops)		
Timber	27,023	501.62
Crops		**24.76**
30-60% (logging only)		
Timber	18,672	346.60
Total conversion of conservation forests		
Timber	**61,978**	1,150.47
Crops		35.75
TOTAL		**1,186.22**

Proportion of conservation forest under different slopes extrapolated from national forest figures presented in DoF 1992; land over 60% slope excluded, giving a total converted area of 3,098,909 ha. Potential for paddy and mixed crop cultivation in relation to land slope from MAF 2001. Potential commercial timber yield 100 m^3/ha, from STEA 2000. Assumed that 25% of timber on forest land is accessible for commercial harvest (from DoF 1992, increased from 15% to 25% in line with assumed improvements in transport and communications), and 25% of land suitable for crop cultivation, i.e. not rocky land, high altitude, rivers, settlement areas and infrastructure.

Although largely unquantifiable, another important category of land and resource use-related opportunity costs in Lao PDR are the costs of controlling the illegal wildlife trade and unofficial

logging industry in terms of unsustainable income and earnings foregone. Insufficient data however exist to enable these costs to be valued in monetary terms.

4.2.2 Pest damage to agriculture

Biodiversity also incurs costs through wild animal damage to crops. Pest damage to agriculture is a problem throughout Lao PDR (SPC 2001a). Rodents have been identified by 58% of upland rice farmers as a major constraint to rice production, and insects by 38% of farmers (Pehu 1998). Between 1995 and 1999 an average of 4,000 ha of crops a year were destroyed by pests (MAF 2000b, see Data Annex Table 24). With returns to rice production of 2.7 million kip/ha/year (calculated from data provided in MAF 2000b), this equates to a cost of Kip 10.8 billion a year.

5. BIODIVERSITY-ECONOMIC LINKAGES: The role of biodiversity in the national economy

Many of the key indicators of economic performance and growth in Lao PDR, and national socio-economic development priorities, are based directly on biodiversity or depend on the services and products it supplies. This chapter will examine and quantify the role of biodiversity in national income, and its importance to Lao PDR's stated economic growth and development priorities for the coming years.

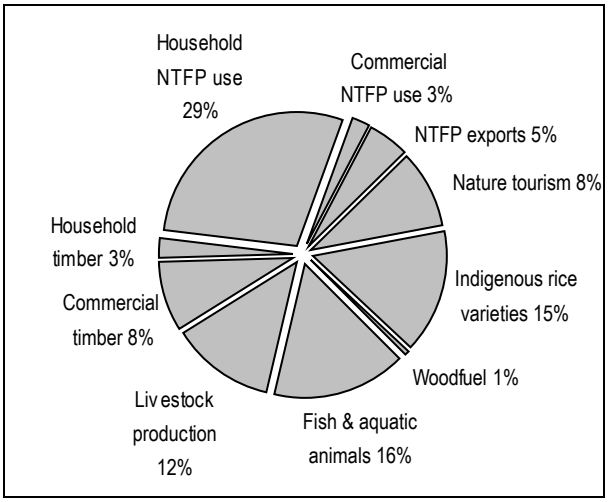
5.1 Summary of biodiversity economic benefits and costs

Table 16: Summary of biodiversity economic values quantified in this study

	Economic value (kip billion/year)
Biodiversity benefits	
NTFP in household subsistence	1,582.7
Fisheries and aquatic animals	1,000.0
Indigenous rice varieties	929.6
Livestock production	779.5
Cultural and nature-based tourism	580.2
Commercial timber	529.2
Commercial NTFP exploitation for export	314.8
Carbon sequestration by natural forest	294.1
NTFP in household cash income	253.9
Domestic commercial NTFP exploitation	151.0
Household timber consumption	168.8
Woodfuel	45.8
Biodiversity costs	
Opportunity costs of crop and timber production foregone	1,186.2
Donor grants	954.4
Annual government budgets	s/d
Pest damage to agriculture	10.8
Repayments on biodiversity loans	8.1

Note: benefits cannot aggregated to a single figure as they overlap (for example household, commercial and export NTFP use); costs are also not comparable, as they include both actual and potential (e.g. opportunity costs) values.

Figure 11: Composition of direct economic benefits of biodiversity



5.2 Biodiversity in the national economy

5.2.1 The dependence of economic activities on biodiversity

Within the broad sectors of agriculture, services and industry, the national economy of Lao PDR is comprised of various different components and activities. These sub-sectors can be grouped into three major categories according to their relationship to biodiversity:

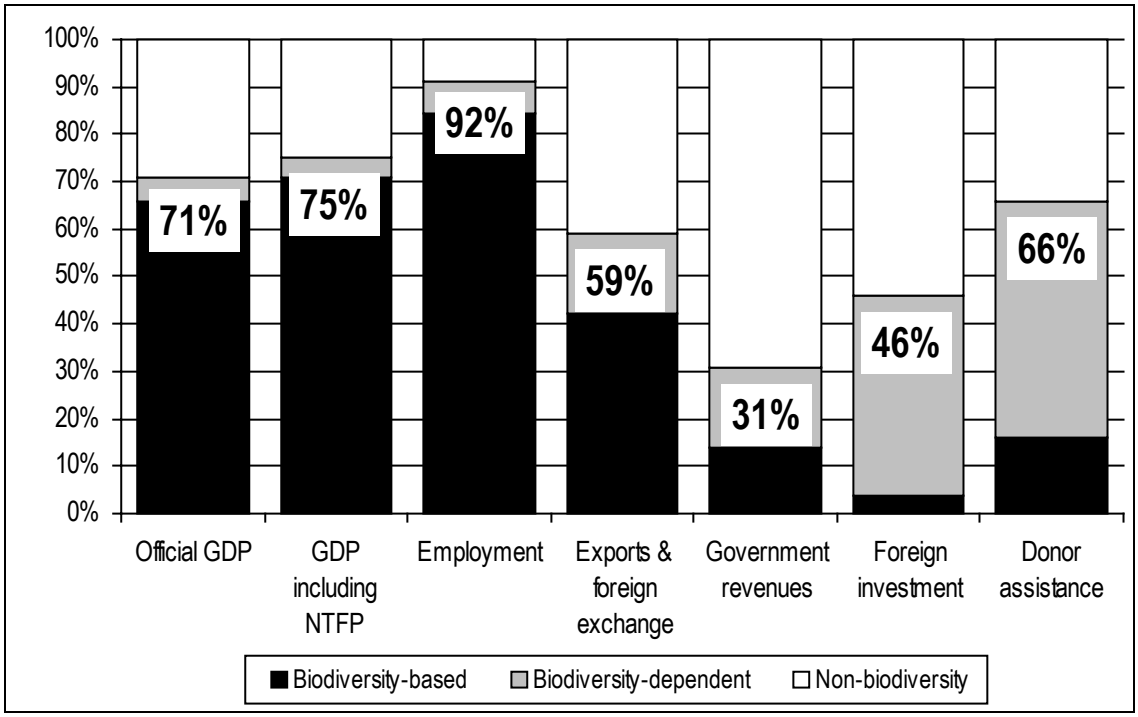
- **Biodiversity-based sectors:** including activities which are based directly on the utilisation or consumption of indigenous biological resources such as forestry (timber, wood and NTFP); fisheries and aquatic plants and animals; and agricultural production from indigenous crop and livestock varieties.
- **Biodiversity-dependent sectors:** including sectors which have a high reliance on the raw materials, services and functions that biodiversity provides, such as those that rely on watershed catchment protection services (irrigation, hydropower, domestic and urban water supplies); soil biodiversity (crop production from non-indigenous varieties); wild fodder and pasture (livestock production from non-indigenous varieties); ecological integrity and cultural diversity (tourism and associated services).
- **Non-biodiversity sectors:** including sectors that have little direct reliance on biodiversity goods and services but may impact on biodiversity status through their activities (e.g. mining, manufacturing, construction, financial institutions).

Biodiversity-based and biodiversity-dependent sectors currently account for a high proportion of economic activity in Lao PDR. At the aggregate level, it is clear that biodiversity makes an important contribution to key national economic indicators, including (Figure 12):

- **GDP:** Some 66% of official Gross Domestic Product (GDP) is contributed by biodiversity-based sectors, and an additional 5% by biodiversity-dependent sectors. Accounting for the value of household NTFP consumption, which are excluded from traditional GDP statistics, the contribution of biodiversity rises to three quarters.
- **Employment:** More than 85% of the national workforce, including almost all of the rural population, are employed primarily in biodiversity-based economic activities, and an additional 6.6% work in biodiversity-dependent sectors.
- **Export and foreign exchange earnings:** Biodiversity-based sectors contribute 42% of export and foreign exchange earnings, and biodiversity-dependent sectors 17%.
- **Government revenues:** Biodiversity contributes to almost a third of government tax and non-tax revenues, including 14% from biodiversity-based sectors and 17% from biodiversity-dependent sectors.
- **Foreign investment:** Almost half of approved foreign investments made in Lao PDR are absorbed by biodiversity-related activities, including 4% to biodiversity-based sectors and 42% to biodiversity-dependent sectors.
- **Donor assistance:** Sixteen percent of donor grants are made to projects and programmes in biodiversity-based sectors, and half to biodiversity-dependent projects and programmes.

These national economic values of biodiversity are discussed in detail in the following Sections, 5.2.1-5.2.5. It is however important to note that, as data are based primarily on official statistics and indicators of formal sector economic activities, the results present a minimum estimate of the value of biodiversity to the national economy. Much biodiversity-related economic activity takes place at the subsistence, informal or unofficial level, and it is not captured in official statistics. Statistics also exclude many of the multiplier effects of biodiversity in terms of secondary production, consumption, income, trade and employment generated.

Figure 12: Role of biodiversity in the national economy, average per year 1995-2000

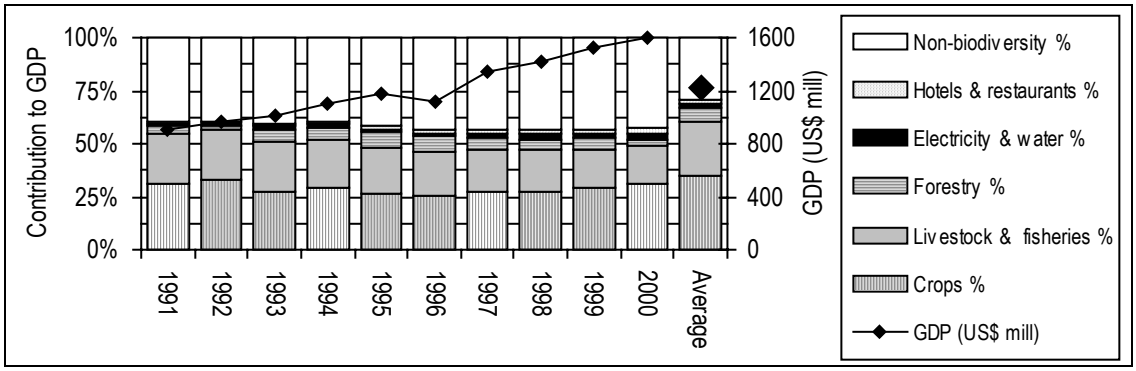


Calculated from data presented in IMF 2002 and 2002 (GDP, exports, government revenues, foreign investments), Foppes and Ketphanh 2000a, b (NTFP), MAF 2000b (employment), SPC 2001b (donor assistance).

5.2.2 GDP

Over the last decade, key biodiversity-based and biodiversity-dependent sectors of the economy have contributed the majority of recorded national income, and an average of 71% of GDP between 1991 and 2000 (Figure 13).

Figure 13: Role of biodiversity in GDP 1991-2000



Calculated from data presented in MAF 2000b, IMF 2002 and 2002. GDP by industrial origin/at factor cost, expressed in constant 1990 US$ millions.

The actual contribution of biodiversity to GDP is much higher than official records indicate. Every activity in biodiversity sectors has a multiplier effect, stimulating income, expenditures, investments, production, trade and employment elsewhere in the economy. For example biodiversity-based tourism relies on a wide range of secondary activities in transport, food and other service sectors, agricultural production stimulates expenditures on equipment and other inputs, forest resources

support multiple industries, enterprises and processing units. Also, official GDP statistics include only formal, marketed output. A high proportion of biodiversity benefits are consumed at the household level, or marketed through informal channels, and thus are not included in GDP – for example woodfuel, household timber and NTFP consumption, subsistence fisheries and all ecosystem services. GDP estimates also exclude consideration of the economic impacts and effects of biodiversity degradation as losses or costs to the national economy. In reality, the contribution of biodiversity conservation to GDP is much higher than 71%. For example, including only household consumption of NTFP increases biodiversity contributions by an additional 4%, to three quarters of total GDP.

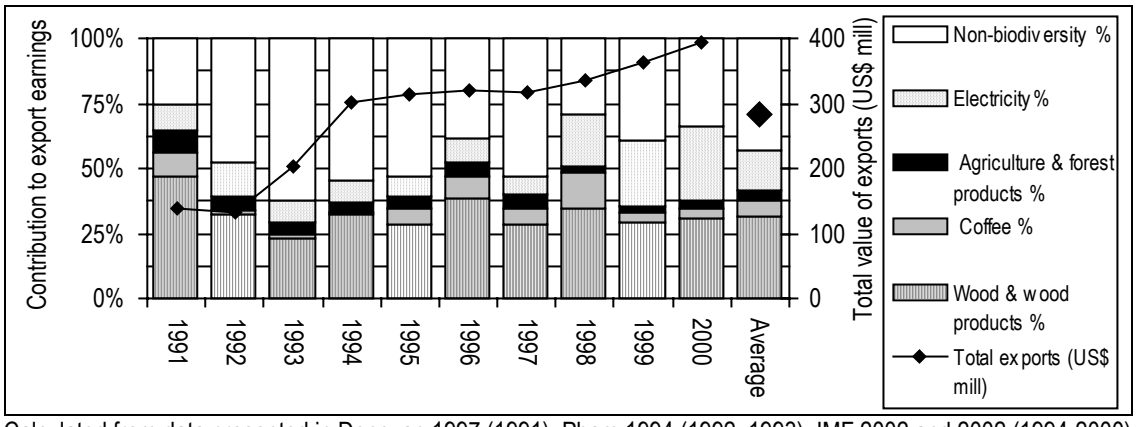
5.2.3 Employment

It is estimated that 83% of the national population reside in rural areas. Almost all of this rural population, or 4.5 million people, depend on farming, fisheries and forest products collection for their basic livelihoods. Officially, agriculture, forestry and fisheries provide the primary source of employment for 85.5% of the working population, 97.5% of which operate at the subsistence level (MAF 2000b). In addition, a high proportion of the 4.0% of the working population who are engaged in the service sector and the 2.6% engaged in craft and related trades are employed in biodiversity-dependent sectors such as tourism, forest and agricultural products processing and trade. For example, it is estimated that there are almost 600 hotels with 8,800 rooms in Lao PDR (see Data Annex Table 44), and 5,000 people are employed in hotels and guesthouses, 1,000 in travel agencies, restaurants and retail shops, and 9,000 in indirect or secondary tourism-related jobs (UNDP and WTO 1998). Including employment in agriculture, forestry and fisheries and in the biodiversity-dependent service, craft and related trades sectors, the contribution of biodiversity to national employment may be as high as 92% of the working population.

5.2.4 Exports

Biodiversity-based and biodiversity-dependent sectors of the economy have contributed an average of 59% of total export earnings over the last decade (Figure 14). Of these, timber and wood products account for more than half of total biodiversity exports, electricity just over a quarter, and other agriculture and forest products just over a fifth.

Figure 14: Role of biodiversity in export earnings 1991-2000

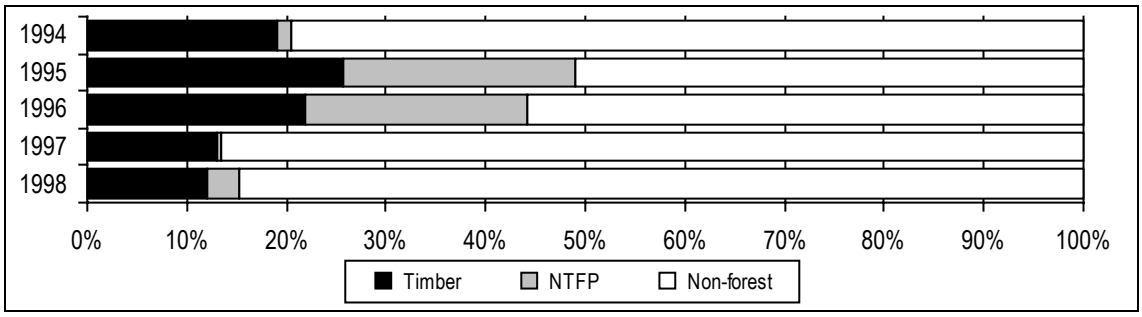


Calculated from data presented in Donovan 1997 (1991), Pham 1994 (1992, 1993), IMF 2002 and 2002 (1994-2000). Biodiversity values exclude re-exports of forest and agricultural produce.

Forest products, including timber, other wood products and NTFP, have played an especially important role in export and foreign exchange earnings. Between 1994 and 1998 they contributed between 13% and 49%, or an average of 28% or $90.2 million, of total exports (Figure 15).

Variation is mainly due to the volume of NTFP exported in different years, rising as high as 50% of total forest exports in 1995 and 1996.

Figure 15: Role of forest products in export earnings 1994-1998



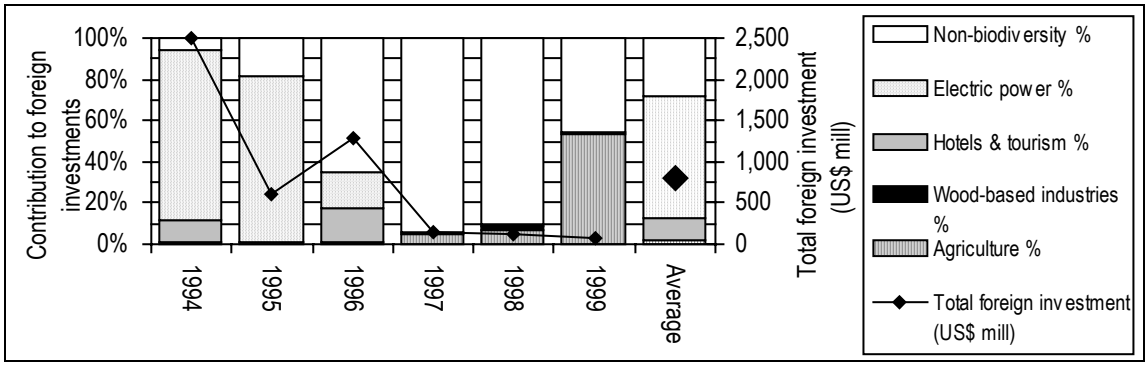
Value of timber and NTFP exports from World Bank, Sida, Government of Finland 2001b, export values from IMF 2001 and 2002.

In addition to official records, it is thought that a large volume of biodiversity products are exported informally or illegally. For example it is known that there is a significant regional trade in wildlife and NTFP originating from Lao PDR, and an estimated 100,000 m^3 of unrecorded timber exports are made each year (World Bank, Sida, Government of Finland 2001b). Officially fisheries do not generate export earnings, although there is in fact a significant unofficial cross-border trade (SoE 2000), and considerable quantities of fish pass informally between Lao PDR and Thailand (Coates 2002).

5.2.5 Foreign investment

Biodiversity-based and biodiversity-dependent sectors have played a variable role in foreign investment over the last decade (Figure 16). Very high levels of investment in the mid-1990s are largely accounted for investments in the electricity sub-sector. Agricultural enterprises and businesses have played a growing role in total foreign investment, and hotels and tourism have also started to account for a significant, although variable, share.

Figure 16: Role of biodiversity in approved foreign investments 1994-2000



Calculated from data presented in IMF 2002 and 2002.

5.2.6 Government revenues

Various types of tax and non-tax charges are levied by the government on biodiversity-related activities (Table 17). These include direct charges on the use of land and biological resources (for example land, agricultural, timber and natural resource taxes and river transport fees), taxes on

biodiversity-based business and income (for example profit tax and turnover fees), as well as a range of export duties on the trade in biodiversity goods and products.

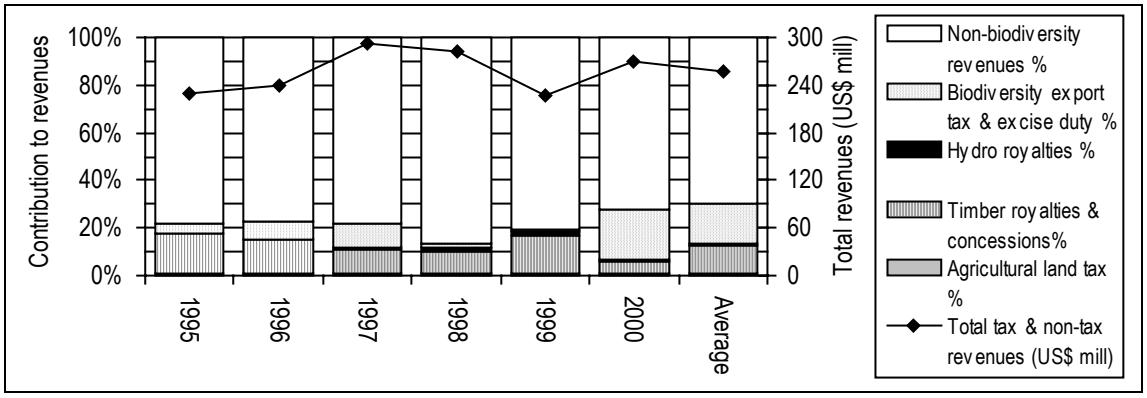
Table 17: Taxes, fees and duties levied on biodiversity-related activities

Tax	Tax rate
Profit tax on enterprises	
General rate	35%
Foreign investors	20%
Rural and lowland areas	15%
Mountain and remote areas	10%
Land tax	
Agricultural land	Kip 500-6,000/ha/yr depending on land use/quality
Exemption for holdings of less than 2 ha occupied by disabled persons; holdings in mountainous areas yielding less than 150 kg of rice per capita per year; land affected by natural disasters; newly cleared land in mountain areas (5 years) and flat lands (3 years); industrial orchards (2-3 years)	
Turnover tax	
Agricultural products, fertilisers and insecticides	5%
Foodstuffs	5%
Electricity and fuel	5%
Hotels and tourism	10%
Exemption for sales of self-produced agricultural products by peasants; forestation activities, industrial trees and fruit planting; sales of agricultural or handicraft products by government employees or cooperative members on family basis; transport by people, animals and boats without engines; rice; fertiliser	
Agricultural tax on rice	2-4% of production
Agricultural tax on other crops	3-5% of selling price
River transport fees	
Boats	Kip 200-20,000 depending on boat size
Export duties	
Electricity	20% of invoice value
Coffee	5% of FOB value
Livestock	5% of FOB value
Logs and sawn timber	Variable
Semi-finished wood products (lumber, parquet)	30% of FOB value
Finished wood products (plywood)	3% of FOB value
Timber and natural resources taxes	
Timber tax (includes previous reforestation and resource taxes, and export duties)	Average \$15.650/m^3
Construction materials	Kip 50/ 100 m^3

From data presented in Pham 1994, IMF 2002.

Between 1995 and 2000, biodiversity-related income contributed just over 31% of total government tax and non-tax revenues (Figure 17). Although the relative importance of forest revenues has fallen over the last decade, declining from 20% of all revenues in the mid-1990s (MAF 2002a) to 5.4% in 2000, forest products remain an important component of government earnings from biodiversity. Timber royalties and concessions, and export duties, contributed the major proportion of biodiversity revenues, accounting for average contributions of 39% and 56% respectively between 1995-2000.

Figure 17: Biodiversity in government revenues 1991-2000



Calculated from data presented in World Bank 1997 (1991-3), IMF 2002 and 2002 (1994-2000). As no disaggregated data available on biodiversity-related export taxes and excise duties, proportion estimated from contribution of biodiversity products to total export earnings (calculated from data presented in IMF 2002 and 2002).

Official records and collections underestimate the total earning potential of biodiversity for government. Collection rates are low, many biodiversity activities are carried out informally, evade tax or under-report on earnings. For example, in the forest sector it is estimated that over the last 5 years the Treasury has only realised about one third of the market value of timber harvested (World Bank, Sida and Government of Finland 2001a), and that forest revenues collection rates cover only around 50% of actual taxable income (MAF 2002a).

5.3 The importance of biodiversity to socio-economic development priorities

Current socio-economic priorities for Lao PDR are clearly articulated in the National Development Vision to 2020 and the current Fifth Five Year Socio-Economic Development Plan for 2001-2005 that has been prepared in support of this long-term policy framework. Overriding goals are to graduate from least-developed country status by the year 2020, to reduce poverty by half by the year 2005, and to eradicate poverty completely by 2010. The National Development Vision has been operationalised into eight priority programmes: food production, commercial production, shifting cultivation stabilisation, infrastructure development, rural development, human resource development, service development, and foreign economic relations development.

Biodiversity is of central importance to many of the key elements in these socio-economic development priorities and targets, including:

- **Food production.** A major priority is to provide food for national self-sufficiency, and to generate a surplus that can be sold in cross-border regions and used in the food processing industry. Indigenous agrobiodiversity plays an important role in food production and food security, as well as generating products that have commercial and trade value. Future plans for agricultural development depend heavily on irrigation, which relies on the catchment protection provided by forested lands.
- **Commercial production.** This programme focuses on the production of goods for all significant sectors of the domestic market and for export to regional and international markets. Many components of biodiversity already have a significant commercial and trade value, including agricultural and forest resources. There is a high potential for further adding further value to sustainable biological resource harvesting and processing, and for developing new biodiversity markets and products.
- **Rural development.** The main purpose of the rural development programme is to alleviate poverty in rural areas through income generation and service improvement. Biological

resources, including indigenous crop and livestock species and NTFP, already provide the main livelihood source of some of the poorest sectors of the rural population. They also contribute to economic and livelihood security when other sources of production become unavailable. There is a demonstrated potential for using biodiversity resources – such as through ecotourism or NTFP processing – as a source of rural income expansion and diversification.

- **Service development.** A stated goal is to develop the potential of new and emerging sectors such as tourism and trade. Both of these targeted sectors already depend heavily on biodiversity, and have a high potential for further development.
- **Foreign economic relations development.** to use global opportunities as much as possible in order to develop the national economy, promote foreign direct investment, and improve economic cooperation with foreign countries and international institutions. There is already a high global interest in Lao PDR's unique biodiversity, as evidenced by existing donor aid flows and tourist demand. There also exist many more opportunities for promote foreign investment and to market elements of biodiversity on global markets.

6. CONCLUSIONS: Economic issues in biodiversity conservation

Economic assessment of biodiversity in Lao PDR highlights a number of key issues and conclusions, including the economic justification for biodiversity conservation, the economic costs of biodiversity loss, and the economic causes of biodiversity degradation. This chapter will draw together information on current economic structure and management, and on biodiversity economic costs, benefits and values, in order to summarise conclusions about economic issues facing biodiversity in Lao PDR.

6.1 Economic justification for biodiversity conservation

To date there has been little appreciation of the importance of biodiversity in economic terms, and conservation has often been seen as an uneconomic or unproductive use of land, funds and other resources Analysis however shows that the significant and wide-ranging benefits associated with Lao PDR's biodiversity present a strong economic justification for conservation:

- **Biodiversity makes an major contribution to national economic activity and growth.** Official statistics under-represent the role of biodiversity in the national economy, both because they ignore subsistence-level activities, ecosystem functions and indirect contributions to economic activity and also because they omit any consideration of biodiversity degradation and loss as an economic cost. Yet most of the key sectors of the Lao PDR economy depend on biodiversity, including agriculture, forestry, fisheries, tourism and hydropower, as well as a large proportion of external trade and foreign exchange earnings. It is estimated that biodiversity-based and biodiversity-dependent sectors generate a gross annual economic output of at least Kip 7,200 billion a year[20]. They contribute up to three quarters of GDP, 92% of employment, 59% of exports and foreign exchange earnings, and 46% of foreign investment.
- **Biodiversity contributes to government revenues.** The government of Lao PDR benefits from biodiversity both through the income, royalties and other fiscal revenues earned from biological resource use and because biodiversity conservation implies substantial savings in public expenditure. Royalties and revenues from biological resource use are worth an estimated Kip 78 billion a year, or an average of 31% of total government revenues. Other, unquantified, taxes and earnings related to biodiversity – for example trade, income, value-added, profit and turnover taxes – will increase this value still further.
- **Biodiversity forms an integral part of rural livelihoods and poverty alleviation.** The direct use of biological resources by rural populations in Lao PDR is worth at least Kip 4,750 billion a year[21], an average of Kip 6.6 million per household or Kip 1 million per capita. NTFP alone are thought to comprise nearly half of each of household subsistence and cash income (Foppes and Kephanh 2000a). Rice, much of it indigenous varieties, contributes two thirds of household calorie intake (NAFRI 2000), wild foods contribute up to 80% of food consumption by weight (Clendon 2001), and fish and other aquatic animals comprise between 30-50% of protein consumption (Coates 2002, LARReC 2000, SoE 2000). Biological resources, especially forest resources and agrobiodiversity, contribute almost all rural subsistence and income. In many areas of the country there are no available or affordable alternatives to biological resource-based sources of subsistence and income, especially for

[20] Calculated from biodiversity contribution to GDP at factor cost, also including subsistence NTFP use.

[21] Including NTFP and timber use, woodfuel consumption, fisheries and agricultural production from indigenous varieties.

more remote, vulnerable and poorer sectors of the population and in times of uncertainty and stress.

- **Biodiversity plays an important role in supporting urban and commercial production and consumption in key sectors of the economy.** Urban and commercial activities depend heavily on biodiversity, through the consumption of biological resources such as fuelwood, NTFP, timber, fish and agricultural produce as raw materials or primary inputs. Urban and industrial consumers also benefit from the conservation of ecosystems and their related functions, including erosion control, water control and purification, which in turn contribute to electricity generation, water quality and flow and protection of settlements and infrastructure. Formal sector timber and NTFP earnings, woodfuel use and nature-based tourism are worth at least Kip 1,400 billion a year.

6.2 Economic costs of biodiversity degradation

The Lao PDR economy has experienced rapid growth rates, in excess of 6% over the last decade. Agricultural output has grown by 5.2% over the last 5 years, the industrial sector by 10% and services by 6.8%. The incidence of poverty has fallen by over 13% since 1993, and per capita GDP has increased almost threefold since 1985. Interest rates have fallen, exchange rates remained stable and inflation held down, the trade balance has improved and private sector investment has grown rapidly. Overall the national economy has performed well, and gives a positive picture of economic growth prospects for the country.

Closer analysis of this encouraging economic picture however raises causes for concern. While the national economy is undoubtedly growing, at the same time there are signs of biodiversity loss. Forest area has declined, wetlands have decreased and wildlife numbers have fallen. Land degradation and resource depletion are occurring, and other renewable and non-renewable natural resources are being rapidly depleted. Yet biodiversity degradation and loss is not just an ecological issue, it is also incurring high economic and development costs. Already vulnerable and with limited sources of income, employment and foreign exchange, these are economic costs that the Lao PDR economy can ill afford to bear, and include:

- **Exacerbated rural poverty and livelihood insecurity.** Biodiversity degradation and loss has potentially devastating impacts at the local level, reflected in falling income and subsistence and severely weakened livelihoods. Most rural communities in Lao PDR depend on biological resources for their livelihoods, and are hit hardest by biodiversity degradation. Loss of ecosystem services also has a major effect on rural populations' access to basic services such as clean and regular water supplies. Biodiversity loss impacts the most on the poorest and most vulnerable sectors of the population, whose livelihood bases are already limited and insecure, who lack alternatives sources of income and subsistence, and who are least able to bear these social and economic costs.
- **Increased pressure government budgets.** Biodiversity loss is reflected in a decline in government revenues, many of which depend on biodiversity-based or biodiversity-dependent sectors of the economy. Increased public expenditures are also required as a response to the effects of biodiversity loss. The government of Lao PDR, because it is responsible for maintaining the basic living standards and security of the country's population, is be forced to deal with many of the social and economic effects of biodiversity degradation – such as falling income, declining production and livelihood insecurity. The state is also be largely responsible for investing in the infrastructure and equipment necessary to mitigate or offset the effects of degradation or loss of ecosystem functions – such as de-silting water bodies, purification of water supplies, reforestation, erosion control, waste control and treatment.

- **Declining trade, commerce and industrial output.** Biological resources support a high level of industry, commerce and trade, add value through processing, and have major multiplier effects on national employment, services and industrial output. Many industrial and commercial sectors of the economy also rely on ecosystem services, which enable and support production. Biodiversity degradation and loss has the potential to impact heavily on trade, commerce and industrial output, and on the jobs, earnings, exports and revenues that these sectors generate for the broader Lao PDR economy.
- **Reduced future opportunities for economic growth.** There is a risk that biodiversity loss will undermine much of the progress achieved in national economic growth over the last decades. Effects include a slowdown in national income and growth, macroeconomic instability, and declining foreign exchange earnings, trade, employment and output. Many of the areas of the economy that have been targeted for growth over the current planning period depend on biodiversity, including hydropower, irrigated agriculture, tourism and other services. Biodiversity also makes a significant contribution to national priority programmes and socio-economic development targets such as food security, rural poverty alleviation, rural and commercial development. The continued loss of biodiversity also precludes or diminishes the possibility of future precludes a range of future development opportunities and sources of support for the economy, many of which are not known now.

6.3 Economic factors underlying biodiversity loss

Economic production and consumption activities are the primary cause of biodiversity degradation and loss in Lao PDR. Most basically, economic activities impact on biodiversity through:

- **Overexploitation of biological resources and destructive harvesting techniques.** Although there is little information about the impacts of subsistence-level resource use, activities in the logging, NTFP and wildlife trade sectors are known to involve unsustainable exploitation of key areas and species, and sometimes employ destructive harvesting techniques.
- **Modification and conversion of natural ecosystems.** There has been widescale conversion of natural forest and wetland ecosystems for agriculture, settlement and infrastructure, and modification of hydrological flows for water-based developments such as hydropower and irrigation.
- **Knock-on effects or externalities from other production processes.** Although urban, commercial and industrial activities are currently carried out at low levels, pollution of air, land and water is starting to become a problem in some areas.

These activities comprise the direct economic causes of biodiversity loss. Yet a range of underlying economic factors motivate these activities, and cause or encourage them to take place in ways which over-exploit, modify, convert or otherwise degrade biodiversity. Economic structural and policy factors constitute the underlying root causes of biodiversity conservation and loss, and include:

- **Prioritisation of biodiversity-impacting sectors and budgets.** Many of the economic sectors that are prioritised for future growth have the potential to impact negatively on biodiversity, including industry, agriculture and energy development. Risks include resource overexploitation, loss of indigenous species, habitat conversion and interference with land, water and air quality. For example genetic erosion of agrobiodiversity is already occurring as a result of the introduction of improved species of crops and livestock (NAFRI 2000), aquaculture based on exotic fish is being promoted (MAF 2001), and alien invasive species are starting to become a problem especially in aquatic ecosystems (Wetlands International and World Bank 2000). Large-scale irrigation, hydropower and industrial developments are all impacting on ecosystem and hydrological integrity. To date, there has been weak integration

of biodiversity concerns or consideration of the economic costs of biodiversity loss into these economic development plans. There has also been little recognition of biodiversity as a socially or economically productive sector of the economy, and government funding to conservation-related activities remain extremely low, both in absolute terms and relative to other sectors of the economy.

- **Price and market distortions.** Although the Lao PDR economy has undergone substantial liberalisation over recent years, price and market distortions continue to contribute to the under-valuation of biodiversity, encourage biodiversity-degrading activities, or promote particular economic activities at the cost of biodiversity. Implicit subsidies still exist, particularly to agricultural sector activities, for example in the provision of preferential credit, minimum farmgate prices, relatively lower tax rates and trade duties on agricultural products and inputs. Biodiversity conservation-related activities are not subject to such preferential treatment. Exemptions on agricultural land tax for newly-cleared land in both mountain and lowland areas, and on newly-established industrial orchards may provide disincentives to biodiversity conservation, although these are to some extent balanced by reduced land taxes on stabilised land use and reforestation, and exemptions on turnover tax for forestation activities. Within the logging sector, exemption from the reforestation component of timber tax for replanting and the current ban on log export may act as positive incentives for biodiversity conservation. Low timber royalty rates are however thought to run the risk of promoting excessive demand, and tax variation between different timber products encourage the use of only premium quality logs and encourage wastage in harvesting (World Bank, Sida and Government of Finland 2001a).
- **Low returns to biodiversity-conserving activities.** Because few positive economic incentives are provided for biodiversity conservation, overall or in comparison to other economic activities, land and resource uses, there are still few opportunities for local communities, the private sector or industries to profit or economically benefit from conserving biodiversity. Markets in sustainable biodiversity products and services remain undeveloped, and are subject to little prioritisation or preferential treatment in economic planning and management. In many cases it still makes more economic sense, and yields higher profits, to deplete biodiversity through carrying out activities such as land clearance, over-logging, unsustainable NTFP collection or trade in wildlife, than it does to engage in biodiversity-conserving economic activities. Biodiversity economic benefits and costs remain unbalanced, and unequally distributed between groups. Of particular concern is the fact that, while local communities bear many of the indirect and opportunity costs of conservation, few incentives and opportunities exist for them to capture conservation values or to benefit in economic terms from conservation. Simultaneously, while many of the benefits and profits from unsustainable economic activities accrue to commercial-level operations, there exist weak penalties or economic disincentives against biodiversity degradation.
- **Structural conditions, including rural poverty.** Many of the ultimate root causes of biodiversity loss are structural in nature, and include both economic and non-economic factors. Urgent needs for rapid economic growth and expansion of key sectors, macroeconomic instability. widespread rural poverty and livelihood insecurity, and limited opportunities for income and employment all act as an obstacle to biodiversity conservation.
- **Exogenous factors and external forces.** A wide range of external economic forces have impacted heavily on biodiversity in Lao PDR. International economic trends and price and market conditions all alter the profitability of different land and resource uses, and impact on biodiversity. Examples include fluctuations in commodity prices for export crops (for example increased world coffee prices, and their impacts on land clearance for coffee in Lao PDR), changes in regional demand and prices of key forest products (for example high demand for Lao PDR wildlife products, the collapse of regional yang oil prices and the subsequent increase in logging of *Dipterocarpus alatus* in Lao PDR), regional and global

economic instability (for example the 1997 Asian financial crisis and the recent downturn in the world economy, and their impacts on international tourism to Lao PDR).

7. RECOMMENDATIONS: Economic and financial measures in the NBSAP

This report has described the linkages between biodiversity and economics for Lao PDR. It is important that this information and analysis, and these issues arising from it, is reflected in the NBSAP. This chapter will summarise needs and opportunities to use economic and financial measures in support of biodiversity conservation within Lao PDR's NBSAP.

7.1 Economic needs and guiding principles for the NBSAP

This economic assessment has identified a wide range of concerns to be addressed in the NBSAP, and highlights key areas where the use of economic and financial measures are required. This provides various basic economic principles for the NBSAP:

- **The NBSAP should be acceptable in economic terms, and consistent with development priorities.** Lao PDR faces a range of urgent and pressing needs for development, and biodiversity conservation competes against other productive uses of scarce land, natural resources and funds in Lao PDR. Unless it can be demonstrated that biodiversity conservation is socially and developmentally worthwhile, at the community, private and national economic levels, the NBSAP is unlikely to gain government or public support. It is important to underline the high economic value of biodiversity, and the significant and wide-ranging economic costs associated with its degradation and loss, so as to justify the NBSAP as a desirable and necessary activity that is in the interests of the Lao PDR government, national economy and people. In line with the overriding goal of current socio-economic development policy, it is particularly important that the NBSAP is seen to make a demonstrable and tangible contribution to poverty alleviation.
- **The NBSAP should be economically viable**. If particular groups perceive themselves to lose out as a result of biodiversity conservation, or conservation activities, the NBSAP will stand little chance of success and will be unsustainable over the long-term. Most groups in Lao PDR, and the national economy itself, cannot afford to support the NBSAP if it does not lead to tangible net economic benefits. There currently exist few positive economic incentives for biodiversity conservation in Lao PDR, and the provision of these benefits and incentives should be ensured in all components of the NBSAP.
- **The NBSAP should attempt to overcome the economic causes of biodiversity loss.** Multiple economic forces continue to result in biodiversity loss in Lao PDR. The NBSAP must aim to address and overcome both the direct and underlying economic causes of biodiversity degradation and loss. As well as requiring action at the level of specific economic activities and sectors which impact negatively on biodiversity, this will involve broader structural and policy changes.
- **The NBSAP should be economically equitable.** The benefits and costs of biodiversity conservation are distributed unequally between different groups. This acts as a major economic disincentive to biodiversity conservation, it also means that the groups who are responsible for conservation are often unwilling – or economically unable – to cover these costs. Unless the NBSAP is equitable in its impacts and effects, and especially targets the poorest and most vulnerable groups, it is unlikely to be either acceptable or practicable. The NBSAP should have as a key aim to redress current imbalances in the distribution of biodiversity benefits and costs in the interests of conservation and economic equity.
- **The NBSAP should be financially sustainable.** Financial resources for biodiversity conservation are scarce, and effective implementation of the NBSAP will incur additional and wide-ranging costs to many different groups. Adequate and sustainable sources of finance

must be generated as part of the NBSAP, and targeted to the groups who bear the major direct and indirect costs associated with biodiversity conservation. Key beneficiaries of conservation finance include Central and Provincial Government.

- **The NBSAP should target, and involve, other sectors of the economy.** The successful implementation, and broader acceptance, of the NBSAP ultimately depends on actions being taken in non-environmental sectors of the economy, and at economic policy and planning levels. It is critical that steps are taken to involve these other sectors in NBSAP formulation and implementation, and to ensure that they mainstream NBSAP goals and objectives into their own policies, strategies and plans.
- **The NBSAP should attempt to improve the status of information on, and linkages between, biodiversity and economics.** Very little is known about the linkages between biodiversity and the Lao PDR economy, or about the economic value of biodiversity. Yet economic forces constitute the major reason for biodiversity degradation and loss, economic impacts of the NBSAP will be a key indicator of its success and broader acceptability, and the NBSAP must be responsive to changing needs and conditions in the Lao PDR economy. It will be important to further generate and disseminate information on biodiversity economic values and linkages, to monitor on-going economic status and threats to biodiversity, and to track economic impacts and effects of NBSAP implementation.

7.2 Using economic incentives in the NBSAP

The assessment has demonstrated the need to make biodiversity conservation economically attractive in Lao PDR. In particular there currently exist few incentives for commercial users of biological resources or for the sectors that potentially contribute to biodiversity degradation to carry out their activities in ways or at levels that are compatible with conservation. In some cases economic disincentives to biodiversity conservation exist. Another clear need for economic incentives is at the local level, among poor rural communities who currently depend heavily on biodiversity and yet have few opportunities to benefit directly from conservation.

The use of economic incentive measures, as required by Article 11 of the CBD, will form a central aspect of the NBSAP. Of particular relevance are elements of Article 10 of the CBD – the integration of sustainable use into decision making, local participation and benefits, and co-operation between the government and the private sector.

Key elements of the use of economic incentives in the NBSAP will be:

- Ensuring that there is a clear understanding of the potential economic impacts of all elements of the NBSAP, and that actions are incorporated which ensure their economic viability for involved and affected groups.
- Setting in place clear economic disincentives to biodiversity degradation, especially for biodiversity-impacting sectors of the economy. Possible examples include the use of environmental bonds and deposits for infrastructure developments in sensitive ecosystems, or the rationalisation of existing penalties and fines against unsustainable resource exploitation.
- Using fiscal instruments to promote biodiversity-conserving economic activities. Possible examples include the provision of preferential credit to sustainable biodiversity-based enterprises, lower tax rates or tax exemptions on conservation-based land uses, or reductions in tariffs on imported clean technologies and equipment.
- Using market and price instruments to increase the profitability and value-added to sustainable biodiversity utilisation. Possible examples include certification of sustainable timber exports, research and development of new biodiversity markets and products, eco-

tourism development, support to local NTFP processing industries, or payments to landholders for the provision of environmental services.

- Employing broad-based enabling economic incentives to counterbalance community-level threats to biodiversity that arise from unsustainable use. Possible examples include allowing local rights to biodiversity management and sustainable use, livelihood development and diversification activities, provision of alternative sources of income and employment, or activities aiming at rural poverty alleviation in areas of high biodiversity.
- Ensuring that all incentives are appropriate and acceptable in the light of socio-economic conditions and priorities in Lao PDR. For example
  - Prices are already high, and purchasing power low: economic incentives should attempt, where possible, to present positive incentives for saving money, increasing production efficiency or contributing to consumer choice rather than increasing prices to penalise directly for biodiversity impacts.
  - Poverty is widespread: economic incentives which balance more equitably the costs and benefits of conservation or redistribute income will be more effective than those which further widen disparities in socio-economic status.
  - Livelihood and production sources are limited: rather than increasing reliance on existing economic activities, economic incentives should attempt to open up additional production and consumption choices and economic opportunities.
  - Economic liberalisation, privatisation and decentralisation are key to macroeconomic policy: economic incentives should attempt to support these goals by aiming to minimise the costs of conservation to government, strengthen local authorities, and contribute to national development goals.
  - The economy is already heavily dependent on external financial assistance and is highly vulnerable to external shocks: economic incentives should decrease, rather than increase, this dependence and vulnerability.
  - Government budgets and implementation capacities are limited: economic incentives should be low cost to set in place, and should wherever possible rely on positive inducements for biodiversity conservation rather than demanding penalties which are difficult to enforce and collect.

7.3 A financing strategy for the NBSAP

The assessment has highlighted the high and wide-ranging costs and funding requirements for biodiversity conservation in Lao PDR. Raising funds to cover these costs is a major priority, as few financial resources for biodiversity conservation are available. It is also clear that the costs of biodiversity conservation currently accrue mainly to government (direct costs) and local communities (opportunity costs). Neither of these groups are currently in a position to bear these costs. It is of critical importance that sufficient funds are allocated to both these groups, and targeted directly at biodiversity conservation.

A financing strategy will form a key element of the NBSAP, including the provision of new and additional funding for biodiversity from both domestic and foreign sources as stated in Article 20 of the CBD, and the strengthening of financial institutions as mentioned in Article 21.

Key elements of a financing strategy in the NBSAP will be:

- Making a clear assessment of NBSAP-related costs, including both direct and indirect costs, and ensuring that adequate funding sources are made available to cover these costs.
- Ensuring that finance is targeted to the groups, sectors and activities which bear the direct and indirect costs of biodiversity conservation.

- Designing NBSAP activities to minimise costs, and to be financially efficient in their operations.
- Obtaining increased state budget allocations to biodiversity conservation activities.
- Raising additional state revenues that can be reinvested in conservation activities. Possible examples include the use of economic instruments that generate budgetary earnings or savings, or the rationalisation of existing biodiversity royalties, taxes and fees.
- Obtaining increased foreign aid flows to biodiversity conservation activities.
- Developing prices and markets for biodiversity goods and services so as to ensure that consumers of biodiversity goods and services pay a fair price for this use, where there is a willingness and ability to do so. Possible examples include the development of visitor fees for NBCAs or the use of payments for environmental services, including cross-sectoral transfers between water, hydropower and irrigations sectors, biodiversity agencies and landholders.
- Strengthening the degree to which biodiversity is integrated into the operations of existing financial institutions. Possible examples include the provision of grants, loans and credit to sustainable biodiversity business and enterprise.
- Using innovative international funding mechanisms as a mechanism to increase financial flows to biodiversity. Possible examples include debt-for-nature swaps, carbon offset charges, bioprospecting fees, eco-labelling and green marketing, and soliciting investment from the private sector.

7.4 Mainstreaming biodiversity into economic sectors

The assessment has shown that many of the direct and underlying causes of biodiversity loss in Lao PDR arise from economic policies and activities in other sectors of the economy. There is currently little integration of biodiversity concerns into these other sectors, and little understanding of either the economic value of biodiversity conservation or the economic costs of biodiversity degradation. Many of these sectors also benefit from biodiversity, and there are clear opportunities for them to contribute towards the costs of its conservation.

The effectiveness, and broader acceptability, of the NBSAP will depend to a large extent on the integration of biodiversity into macroeconomic and sectoral plans, programmes and policies, as stated in Article 6b of the CBD.

Key elements of the mainstreaming biodiversity into economic sectors in the NBSAP will be:

- Ensuring that the NBSAP is harmonised with current socio-economic development goals and public investment priorities, especially poverty alleviation.
- Communicating information on biodiversity values, threats and impacts to macroeconomic and sectoral planners, policy makers and decision-makers.
- Working with sectors to modify their economic statistics and indicators to incorporate biodiversity economic values, including estimates of national income and economic growth.
- Using economic and financial instruments to ensure that sectors incorporate biodiversity values into their operations and activities.

7.5 Research, training and awareness needs in the economics of biodiversity

The assessment has found that capacity to undertake biodiversity economic analysis, and existing data about economic aspects of biodiversity, are currently underdeveloped in Lao PDR. Strengthening this capacity and information base is a prerequisite to ensuring that there is a better understanding of the economic benefits of conservation and the economic costs of biodiversity

loss, that biodiversity concerns are incorporated into sectoral policy and planning, and that the biodiversity economic status and threats are monitored in the future.

The further formulation and implementation of the NBSAP relies on improved biodiversity economics research, training and awareness, as stated in Article 12 of the CBD which calls for the establishment of research and training programmes in measures for the conservation and sustainable use of biodiversity, and Article 13 which emphasises the importance of public education and awareness.

Key elements of biodiversity economics research, training and awareness in the NBSAP will be:

- Incorporating biodiversity and environmental aspects into existing training curricula in Lao PDR.
- Developing capacity and human resources within research institutes and other government agencies to utilise basic biodiversity economic tools, such as valuation, incentives measures and conservation financing.
- Promoting economics research in key areas that will enable a better understanding of biodiversity-economic linkages or have practical or policy relevance to biodiversity conservation. Possible examples include extended valuation of biodiversity benefits and costs, research on economic opportunities to increase sustainable biodiversity values, assessment of additional biodiversity finance and funding opportunities or improved analysis of economic policy impacts on biodiversity.
- Continuing to communicate and disseminate information through various media, in order to increase awareness on the economics of biodiversity.

7.6 Biodiversity economic monitoring, impact assessment and threat analysis

The assessment has indicated current economic benefits, costs and threats to biodiversity in Lao PDR, and made broad recommendations for the use of economic measures in the NBSAP. It is however a first attempt to carry out this type of analysis, and has been prepared to assist in the formulation of the NBSAP. It will be important to continue to update and improve information, disseminate it to planners and policy makers, and use it to monitor changes in biodiversity economic status, threats and impacts. Economic information will also form an important component of NBSAP monitoring and impact assessment.

This reflects the call in Article 7 of the CBD for parties to identify and monitor biodiversity and to identify threats, the call in Article 14 for appropriate impact assessment procedures, and the call in Article 10 for the adoption of measures to avoid or minimise such adverse impacts.

Key elements of biodiversity economic monitoring, impact assessment and threat analysis in the NBSAP will be:

- Extending the information presented in this report to generate a biodiversity economics baseline, and to regularly update this information.
- Tracking changes in economic status, indicators and conditions, and their impacts on or threats to biodiversity.
- Monitoring and evaluating the economic impacts of the NBSAP.
- Feeding information generated back into both conservation and development policy making and planning, and ensuring that it is used to inform the development of additional or modified economic and financial measures for biodiversity conservation..

7.7 Specific economic issues to be addressed in the NBSAP

In addition to these more general principles to be incorporated into the NBSAP, work carried out in support of this assessment by the NBSAP Economics Working Group has identified a range of specific economic issues to be addressed. These include the need to:

- **Integrate biodiversity conservation policies into socio-economic development planning and implementation.** The failure to sufficiently integrate biodiversity conservation planning into development planning and infrastructure projects (e.g. road building, dams) can result in severe biodiversity impacts.
  - Integrate biodiversity conservation concerns more effectively into the development planning (and infrastructure projects) of major development institutions (e.g. ADB, World Bank). For example, assess the potential biodiversity impacts of infrastructure development proposes under the ADB's Greater Mekong Sub-Region Plan and recommend suitable alternatives that better integrate biodiversity conservation concerns and overall sustainable development goals.
  - Introduce spatial planning at the local level to support improved biodiversity conservation. National priorities are often handed down to local levels for implementation without adequate consultation are regard for local concerns. Spatial planning represents an important but currently neglected planning and management tool for reducing conflicts between national policies and local needs.
- **Develop natural resources management and development policies that better address the environmental and socio-economic realities of upland areas.** Upland areas are particularly important for biodiversity conservation because they contain many of the remaining high priority habitats. Upland development and natural resources policies are often determined by national economic development objectives and do not adequately reflect local concerns and environment realities, such as the fragile nature of the uplands, the finite extent of the resources, the inter-related consequences, of over-exploitation, and the cultural values of the resident communities. The cultural gap between lowland and upland often results in lowland development " solutions" -such as sedentary agriculture, cash crops, and even plantation - being applied in upland situations without appreciation for the security provided by the diverse and low intensity swidden systems already in place. All too often, central governments reap short-term gains from natural resource exploitation (e.g., timber) while claiming that traditional resource users are destroying these valuable long- term resource.
  - Build capacity of government staff and community groups to address upland policy issues. Upland policies require a strong understanding of existing subsistence systems because increased commercialisation of production factors (land, NTFPs, water) can lead to displacement and further pressures on the natural resources. Development of upland policies should include a significant capacity-building component including exposure trips, formal and on-the-job training sessions, and opportunities to apply new skills with the active support of technical experts. In addition, encouraging the formation and strengthening of community groups will help to ensure that local concerns and realities are reflected in upland policies.
  - Encourage ongoing efforts to development upland policies on biodiversity conservation and development. A review of existing efforts with recommendations for biodiversity conservation would be useful. The most important issues to review and assess include:
    - ❖ Land-use planning methods and the level of local participation
    - ❖ Potential for land allocation, titling, and tenure mechanisms that are simple and affordable, recognize existing livelihood system , and address user rights
    - ❖ Community forest management arrangements

- ❖ Upland agriculture extension techniques
- ❖ Provincial natural resources management

- **Encourage forest management reform and the adoption of more sustainable approaches.** Unsustainable logging has been the reason for substantial forest cover loses in Lao PDR.
  - Support improved legal instrument for regulating /management the forestry sector. The introduction and / or improvement of legislation addressing forest concession , management and community-manage forests could help to reduce future forest cover losses and encourage more sustainable forestry practices.
  - Build awareness and understanding about forest management certification an timber flow monitoring .
- **Move beyond policy commitments for biodiversity conservation to "on ground" implementation, protection and enforcement.** Despite considerable effort and investments, conservation efforts have yet to demonstrate sufficient promise for effective biodiversity conservation in Lao PDR, as has been the case in many tropical countries . Effective conservation in Lao PDR requires improving enforcement, monitoring , implementing capacity, and social support for conservation.
  - Strengthen protected areas management, wildlife trade monitoring and enforcement, and government, capacity for conservation planning and management. Thus far, the FLMEC countries policy commitments (e.g. CITES) have been insufficiently implemented and enforced. In par this is due to constraints on government implementing capacity. Capacity-building efforts should be assessed, refined, and expanded for: training, equipping, and deploying protected areas staff; building skill in biodiversity assessment and monitoring; promoting understanding and appreciation at all levels of the traditional management regimes communities; and developing national -levels training curricula, to be used for in-service training and formal education .
  - Increase biodiversity conservation education and awareness.
    - ❖ Formal Education: Opportunities for integrating environmental education in to schooling curriculum should be assessed, as the education of school children has proven an effective way to raise awareness about biodiversity and environmental concerns in other countries.
    - ❖ Non-Formal Education: Incorporating environmental concepts into existing programs with farmer's groups, women's groups, youth groups, the business community, civil servants and other associations can be a valuable way build understanding and support for environmental action.
    - ❖ Informal Education: Awareness raising may best be achieved through the use of progressive social marketing strategies that include the press, advertisers, television, and film industries.

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9. DATA ANNEX

9.1 Agricultural production

Table 18: Rice area, yield and production 2001

	Lowland rice			Dry season rice			Upland rice		
Province	Harvest ('000 ha)	Yield (t/ha)	Production (tonnes)	Harvest ('000 ha)	Yield (t/ha)	Production (tonnes)	Harvest ('000 ha)	Yield (t/ha)	Production (tonnes)
Phongsaly	5.79	3.20	18,528	0.00	3.33	10	12.60	1.85	23,310
Luang Namtha	10.29	3.70	38,073	0.33	4.00	1,320	11.30	1.81	20,444
Oudomxay	9.77	3.20	31,264	0.42	3.11	1,291	21.91	1.99	43,601
Bokeo	10.37	3.50	36,295	0.14	3.41	460	5.28	1.88	9,926
Luang Prabang	10.26	3.44	35,277	2.10	4.14	8,694	30.90	1.79	55,311
Huaphanh	11.54	3.20	36,928	1.25	3.10	3,860	18.02	1.84	33,148
Xayabury	21.67	3.21	69,561	1.35	3.31	4,462	16.77	1.00	16,770
Vientiane Municipality	47.84	3.83	183,212	22.01	4.62	101,672			-
Xieng Khouang	14.40	3.56	51,264	0.06	3.28	190	8.90	0.90	8,010
Vientiane	41.38	4.09	169,244	10.08	4.22	42,538	5.08	1.51	7,671
Borikhamxay	16.95	3.15	53,377	7.52	4.23	31,797	5.10	1.65	8,407
Khammuane	34.96	2.75	96,140	8.36	4.23	35,371	3.67	1.83	6,716
Savannakhet	105.29	3.43	361,145	22.75	4.30	97,829	2.50	0.93	2,325
Xaysomboon SR	2.78	3.22	8,952	0.04	3.90	160	1.09	0.86	937
Saravane	54.83	3.01	165,038	6.60	4.11	27,126	7.45	1.79	13,336
Sekong	3.29	3.30	10,841	0.47	4.06	1,904	4.42	1.70	7,506
Champasack	73.44	2.97	218,117	18.10	4.20	76,020	1.47	1.01	1,485
Attapeu	11.94	3.10	37,014	0.41	3.78	1,550	1.57	0.85	1,330
TOTAL	**486.77**		**1,620,269**	**101.97**		**436,254**	**158.01**		**260,232**

From MAF 2002b

Table 19: Root crops, mung bean and soya bean area, yield and production 2001

	Root crops			Mung bean			Soya bean		
Province	Harvest ('000 ha)	Yield (t/ha)	Production (tonnes)	Harvest ('000 ha)	Yield (t/ha)	Production (tonnes)	Harvest ('000 ha)	Yield (t/ha)	Production (tonnes)
Phongsaly	0.50	6.03	2,985	0.02	0.86	17	0.05	0.66	33
Luang Namtha	0.83	8.30	6,889	0.16	0.80	125	0.27	0.89	236
Oudomxay	0.75	4.35	3,263	0.14	1.02	147	0.20	1.70	340
Bokeo	0.09	6.17	543	0.01	0.70	7	0.09	0.80	72
Luang Prabang	1.36	6.69	9,085	0.25	0.90	227	0.24	0.78	190
Huaphanh	1.45	5.35	7,758	0.06	0.88	55	0.78	1.01	785
Xayabury	0.25	5.82	1,443	0.09	0.90	79	0.05	0.83	45
Vientiane Municipality	0.37	8.16	3,044	0.20	0.83	168	0.04	0.85	32
Xieng Khouang	1.33	5.00	6,650	0.04	0.93	37	0.23	0.70	161
Vientiane	0.94	10.90	10,213	0.24	4.14	973	0.04	1.14	46
Borikhamxay	2.21	5.38	11,901	0.09	0.78	70	0.02	0.70	13
Khammuane	0.93	6.12	5,692			-	0.03	0.70	21
Savannakhet	1.24	5.87	7,302	0.08	0.80	63	0.07	0.79	55
Xaysomboon SR	0.26	5.00	1,300	0.02	0.83	17	0.01	0.71	10
Saravane	0.83	5.99	4,984	0.27	0.90	243	0.19	0.83	158
Sekong	2.00	5.56	11,137	0.03	0.86	26	0.02	0.79	16
Champasack	0.75	5.23	3,933	0.59	0.87	512	0.86	0.83	714
Attapeu	0.23	4.56	1,040	0.08	0.85	69	0.09	0.80	72
TOTAL	**16.32**		**99,160**	**2.37**		**2,836**	**3.28**		**2,998**

From MAF 2002b

Table 20: Irrigated crop area, production and value 2001

		Irrigated rice			Vegetables		
Province	**Total irrigated area (ha)**	**Area (ha)**	**Production (tonnes)**	**Value (Kip mill)**	**Area (ha)**	**Production (tonnes)**	**Value (Kip mill)**
Phongsaly	6,391	3	10	8	670	2,117	3,176
Luang Namtha	10,852	330	1,320	1,080	2,878	12,951	19,427
Oudomxay	11,528	415	1,291	1,056	2,516	8,303	12,455
Bokeo	10,426	135	460	377	1,387	10,014	15,021
Luang Prabang	12,768	2,100	8,694	7,112	7,691	35,609	53,414
Huaphanh	13,903	1,245	3,860	3,157	2,114	8,519	12,779
Xayabury	22,228	1,348	4,462	3,650	7,845	30,360	45,540
Vientiane Municipality	80,460	22,007	101,672	83,168	10,942	91,366	137,049
Xieng Khouang	15,459	58	190	156	2,482	12,956	19,434
Vientiane	63,944	10,080	42,538	34,796	13,320	79,920	119,880
Borikhamxay	35,792	7,517	31,797	26,010	9,333	60,944	91,416
Khammuane	38,814	8,362	35,371	28,934	10,940	69,250	103,875
Savannakhet	77,809	22,751	97,829	80,024	13,230	92,610	138,915
Xaysomboon SR	2,868	41	160	131	1,078	3,935	5,903
Saravane	29,433	6,600	27,126	22,189	6,853	30,155	45,233
Sekong	4,140	469	1,904	1,558	1,583	8,311	12,467
Champasack	72,578	18,100	76,020	62,184	13,188	66,599	99,899
Attapeu	6,010	410	1,550	1,268	1,540	6,730	10,095
TOTAL	**515,403**	**101,971**	**436,254**	**356,856**	**109,590**	**630,649**	**945,974**

From MAF 2002b

Table 21: Livestock population 2001

Province	**Buffalo ('000 head)**	**Cattle ('000 head)**	**Pig ('000 head)**	**Poultry ('000 head)**
Phongsaly	32.00	16.50	67.70	310.00
Luang Namtha	20.80	20.20	80.90	256.50
Oudomxay	46.20	33.30	81.40	502.90
Bokeo	22.70	19.60	52.40	370.90
Luang Prabang	62.50	38.10	140.40	1,003.70
Huaphanh	30.80	41.90	38.40	503.60
Xayabury	67.80	65.80	110.70	1,457.00
Vientiane Municipality	32.40	56.10	45.50	1,674.00
Xieng Khouang	43.80	79.60	71.60	482.50
Vientiane	68.60	88.50	84.80	1,054.30
Borikhamxay	37.20	38.60	39.30	605.70
Khammuane	92.70	51.60	65.60	719.60
Savannakhet	236.30	417.20	240.70	2,069.00
Xaysomboon SR	11.40	22.80	12.60	160.10
Saravane	116.10	127.90	86.10	1,911.30
Sekong	71.20	75.30	120.20	657.40
Champasack	40.30	9.40	45.90	230.90
Attapeu	18.60	14.20	41.70	93.80
TOTAL	**1,051.40**	**1,216.60**	**1,425.90**	**14,063.20**

From MAF 2002b

Table 22: Domestic consumption and export of livestock 2001

	Domestic consumption (kg/capita)	Liveweight at offtake (kg/head)	Consumable yield (%)	Export availability (% herd)
Pig	5.0	30	70%	8.67
Poultry	3.0	1.3	70%	14.11
Buffalo	1.8	340	60%	1.98
Cattle	1.2	260	55%	1.59

From MAF 2001.

Table 23: Value of livestock production 2001

	Domestic consumption		Export		Total	
	('000 tonnes)	(no)	('000 tonnes)	(no)	('000 tonnes)	(Kip billion)
Pig	27.41	1,305,089	3.71	123,626	31.12	254.00
Poultry	16.44	18,070,461	2.58	1,984,318	19.02	232.14
Buffalo	9.87	48,365	7.08	20,818	16.94	175.66
Cattle	6.58	45,998	5.03	19,344	11.61	117.68
TOTAL	**60.30**	**19,469,913**	**18.40**	**2,148,105**	**78.69**	**779.48**

Domestic consumption, liveweight, consumable yield and export availability from MAF 2001, prices and herd size from MAF 2002b.

Table 24: Crop damage by pests 1995-99

Province	1995 (ha destroyed)	1996 (ha destroyed)	1997 (ha destroyed)	1998 (ha destroyed)	1999 (ha destroyed)	Weighted average (ha/yr)
Phongsaly	63	2	800			173
Luang Namtha		1	45	55	10	22
Oudomxay	50		205	1,094	2,696	809
Bokeo	56					11
Luang Prabang	100	9	300			82
Huaphanh	148	604	1,200	1,974	62	798
Xayabury	95	30	90		70	57
Vientiane Municipality	117	169		130		83
Xieng Khouang	768			100	90	192
Vientiane	78	81	1,300	20	142	324
Borikhamxay	1,525	647	800		127	620
Khammuane	49	564				123
Savannakhet	347	243	85	41	120	167
Xaysomboon SR	158	52				42
Saravane	102	10			1,075	237
Sekong	37	802	200	6		209
Champasack	57	1		59		23
Attapeu	348					70
TOTAL	**4,098**	**3,215**	**5,025**	**3,479**	**4,392**	**4,042**

From MAF 2000b

9.2 Timber and wood products

Table 25: Commercial log supply and demand 1995-1999

	1995	1996	1997	1998	1999	Average
Production forests ('000 m^3)	204	263	170	257	319	243
Development conversion ('000 m^3)	670	396	389	208	415	416
Total supply ('000 m^3 roundwood)	**874**	**659**	**559**	**465**	**734**	**658**
Domestic utilisation ('000 m^3 roundwood)	628	494	490	420	630	532
- Of which sawn timber ('000 m^3 processed)	*304*	*232*	*220*	*185*	*300*	*248*
-Of which plywood ('000 m^3 processed)	*10*	*15*	*25*	*25*	*15*	*18*
Exports ('000 m^3 roundwood)	150	238	68	83	28	113
Total demand ('000 m^3 roundwood)	**778**	**732**	**558**	**503**	**658**	**646**

From data presented in World Bank, Sida, Government of Finland 2001a. Official production and demand only.

Table 26: Timber and wood exports 1995-2000

Year	Logs (m^3)	Sawntimber (m^3)	Semi-finished products (m^3)	Finished products (m^3)	Finished products (tonnes)	Plywood (m^3)
1995-6	238,827	177,959	3,626	11,184	719	
1996-7	62,449	97,469	641	494		18,234
1997-8	13,437	56,539	6,652	3,326		
1998-99	8,238	37,565	17,099	21,416		
1999-2000	156,783	57,839	1,062	5,171		8,398
Average 1995-2000	**95,946.8**	**85,474.2**	**5,816.0**	**8,318.2**	**719.0**	**13,316.0**

From MAF 2000a

Table 27: Number of forest industries 1988

Province	No sawmills	Sawmills above 1000 m^3 capacity	Other forest industry units (mainly furniture)	Total no of forest industry units
Phongsaly	1	1	0	1
Luang Namtha	2	1	0	2
Bokeo	3	2	0	3
Oudomxay	2	2	0	2
Huaphanh	0	0	0	0
Xieng Khouang	4	4	0	4
Xayabury	7	2	3	10
Luang Prabang	12	2	10	20
Vientiane	15	15	44	56
Vientiane Municipality	24	14	436	460
Borikhamxay	4	2	4	8
Khammuane	10	10	14	23
Savannakhet	34	15	69	103
Saravane	3	3	0	3
Sekong	3	1	0	3
Champasack	11	5	24	33
Attapeu	3	2	3	6
TOTAL	**136**	**80**	**607**	**739**

From MAF 1990

Table 28: Number of forest industries 1999

Type of processing industry	No. units
Sawmill	109
Plywood factory	2
Resaw shops	18
Furniture factory	38
Parquet factory	3
Rattan factory	3
Bong bark factory	1
Bamboo factory	5
Chainsaw	725
Log trucks	1,425

From World Bank, Sida, Government of Finland 2001b

Table 29: Forest industry production 1988

Type of industry	No plants	Production ('000 m^3)	Capacity ('000 m^3)
Rotary plywood	1	6.6	14.4
Sliced veneer	1	0.3	0.6
Sawn timber	130	80	280
Parquet	25	6	12.5
Wooden furniture	575		
TOTAL	**732**	**92.9**	**307.5**

From MAF 1990

Table 30: Forest industry production 1999

Region	Operating capacity (m^3 log input)	No. units	Potential limber output (m^3 lumber)
North	34,100	16	16811
Central	482,500	91	240768
South	76,500	26	36873
TOTAL	**593,100**	**133**	**294,452**

From World Bank, Sida, Government of Finland 2001a

Table 31: Forest industries 2000/01

Types of factory	Approved factory			Update		
	Approved by local	Approved by central	Total	Maintained	Being considered	Cancel
Sawmill by foreigner	0	26	26	23	3	0
Sawmill by Lao	40	94	134	82	30	22
Wood processing	0	11	11	11	0	0
Small sawmill	0	21	21	14	4	3
Wood Furniture	923	32	955	704	119	132
Bamboo factory	4	0	4	3	0	1
Rattan factory	1	1	2	2	0	0
Paper mill for buddhism use	1	0	1	1	0	0
Perfume factory	9	1	10	8	1	1
TOTAL	**978**	**186**	**1164**	**848**	**157**	**159**

9.3 Woodfuel

Table 32: Estimates of domestic firewood consumption

Source	Consumption in tonnes/capita/year	Consumption in m^3/capita/year
FAO 1999	0.58	0.75*
STEA 2000	0.78	1.00
MAF 1990	0.79	1.02
Raintree and Soydara undated	1.19	1.54+
de Vletter 1997	1.19	1.54+
World Bank, Sida and Government of Finland 2001a	1.94	2.50
de Vletter 1997	2.26	2.92+
AVERAGE USED IN THIS STUDY	**1.20**	**1.55**

+Assume household size 6.5 (Southavilay and Castrén 1998)

Table 33: Commercial and industrial firewood consumption

	Consumption in tonnes/year	Consumption in m^3/year
Cardamom production	56,236	72,563
Coffee processing	9,040	11,665
Tea processing	1,943	2,507
Brick factories	41,339	53,341
Salt production	4,185	5,400
Tobacco production	194	250
TOTAL	**112,937**	**145,725**

Table 34: Charcoal consumption

	Consumption in tonnes/year	Consumption in m^3/year
Household	9,489	63,260
Commercial	32,657	217,713
TOTAL	**42,146**	**280,973**

From FAO 1999, Household consumption accounts for 20-25% of national total of 42,146 tonnes/year, 1 m^3 wood produces 150 kg charcoal (FAO 1999)

9.4 Non-timber forest products

Table 35: Commercial NTFP exploitation 1998-2001

	1998 (US$)	1999 (US$)	2000 (US$)	2001 (US$)
wai	9,892.33	22,451.84	12,055	223,043
Small rattan	9.10	20,616.41	12	10,400
Bamboo	5,108.99	19,315.52	6,206,400	-
Fire wood	1,083.22	1,281.96	3,871,275	-
Khang	-	-	-	-
Mak Tao	187,351.20	5,811.20	5,998,000	4,819
Khi Si	23,768.42	26,050.41	351,000	35,538
Dok Khem	24,585.41	1,381.54	424	7,000,000
Por Sa	630.52	7,830.18	-	1,325
Mak Neng	32,266.50	10,829.09	-	14,753
Mak Khen	-	0.89	-	-
Ynarn	-	21,574.72	-	-
Chan Dai	3,073.12	474.81	-	-
Pfad (wood)	15.63	55.15	-	-
Peuk Bong	272.82	2,149.43	-	2,719
Man On Ling	-	8,694.43	-	-
Mak Sengbeua	18.33	-	-	6,534,820
Kheu Hem	-	-	600	94
Mak Chong	3,592.74	3,362.41	-	110,381
Ya Houa	4.55	-	-	-
Si Siad	-	23.45	-	-
Mak Vai	8,646.84	31,735.65	14	-
Kedsana	1,222.68	30,819.77	3,634	-
Bamboo shoot	-	-	-	-
Mushroom	-	-	-	-
Honey	21.24	-	-	-
Oil from vegetable	-	-	-	-
Kham Kheu	-	-	-	-
Oil from Kedsana	3,616.50	-	-	-
Peuak Meuk	4,846.78	1,028.14	79	-
Mak Kha	-	-	-	-
Garco	-	121.48	-	-
N/a	-	163.20	-	-
Mak Kham Phep	-	16.88	-	-
Mak Kham	-	67.53	-	-
Phoud Mai	-	-	-	-
Kood vegetable	-	-	-	-
Mak Hen	-	-	-	-
Oil from Dipterocapus	-	-	1,920	1,150
Root of timber	-	-	-	32,794
Houa Poa Pet	-	-	-	-
Mak Ka	-	-	-	-
Nor Mai Heng	-	-	-	86,000
Dok Pheung	-	-	-	-
Kheu Tin Ty	-	-	-	-
Phik Pee Khoa	-	6.33	-	-
Khi Chia		22.51		
TOTAL	**310,026.94**	**215,884.93**	**16,445,413**	**14,057,836**

All figures in US$. From DoF annual reports.

Table 36: NTFPs with commercial and export value

		Production (yield per year)	Average exports 1995-99 (t/yr)	Average export value 1995-99 (US$/yr)
Cardamom	maak naeng *Amomum spp.*	*Wild*: 330 kg fresh fruit/ha; 55 kg dry fruit/ha. *Cultivated:* 600 kg fresh fruit/ha; 99 kg dry fruit/ha	285	1,400,000
Fern roots.	hak tin hung *Helminthostachys spp*	4.5 kg fresh roots/ha, 1.5 kg dry roots/ha	816	890,000
Malva nut	mak chong *Scaphium macropodum*	20 kg/tree/season; 300-400 kg/ha	420	760,000
Benzoin/ styrax.	ynan *Styrax spp*	15-20 tonnes benzoin/tree	40	480,000
Berberin	kheua haem *Coscimum fenestratum*	757 kg of vine/ha; 2.3 kg dry berberin powder/ha	20	400,000
Yang oil	nam man yang *Dipterocarpus spp*	30-150 litres of oil/tree	N/d	300,000
Damar resin	khii sii Dipterocarpaceae family	15-20 kg resin/tree	835	272,000
Sugar palm	maak tao taad *Arenga westerhoutii*	200-300 kg fruit/tree; 200 litres juice/tree; 60-105 kg seeds/tree	615	268,000
Rattan	wai		150 (stems) 123 (fruit)	120,000 25,000
Bong bark	peuak bong Lauraceae family	30 kg fresh bark/tree	325	94,000
Tiger grass	khem *Thysanolaena latifolia*	50 clumps/ha	320	83,000
Paper mulberry	po sa *Broussonetia papyrifera*		146	49,000
	sa pan *Boemeria malabarica*	1.7 tonnes of dry bark/ha	168	38,000
Strychnine seeds	mak saeng beua *Strychnos nux vomica*		33	4,000
Bitter bamboo shoots	nohrmaikhom *Indosasa sinica*	800-1000 kg/ha	N/d	N/d
Eaglewood	mai ketsana *Aquilaria crassna*	3-4.5 kg wood chips/tree; 1-1.5 litres oil/ha	N/d	N/d
TOTAL				**5,183,000**

From Lamxay 2001.

Table 37: Value of NTFPs in the rural household economy

	Value (US$/hhold/yr)
Forest foods	200
Firewood	40
Other NTFP	40
Rice	350
Cash income from NTFP	38.5
Cash income from livestock	21
Other cash income	10.5
TOTAL	**700**

From various sources, calculated in Foppes and Ketphanh 2000a, b.

Table 38: Percentage contribution of NTFPs to household cash income

	% contribution
All NTFP	55
Cardamom	9.5
Fish	7
Wildlife	5.8
Dammar resin	5.6
Bamboo shoots	3
Rattan canes	2.6
Sapan bark	2.5
Bong bark	2
Rattan shoots	1.8
Yang oil	1.8
Other NTFPs	13.6
Livestock	24
Rice	9
Other crops	8
Labour	1
Off-farm income	2

From Foppes and Ketphanh 2000a, b.

9.5 Fisheries

Table 39: Fisheries areas and productivity 2001

	Water resources	Total area (ha)	Productivity (kg/ha/year)
Capture Fishery	Mekong river and 14 Tributaries	254,150	70
	Reservoirs	57,025	60
	Shallow Irrigation and Small Reservoirs	34,460	150
	Swamps and Wetlands	95,686	30
Ponds, Pools and Aquaculture	Fish ponds	10,300	1,000
	Rice-Cum-Fish	3,050	150
	Rain-fed rice and Irrigated rice field	477,176	50
	Small natural pools oxbows and Irrigation weirs	12,934	573
TOTAL		**944,781**	

From DLF 2001

Table 40: Estimates of fisheries production

Capture fishery	Fish ponds	Rice fields	Pools, lakes and weirs	Total	Source
				42,000	DLF 1998
				60,000	FAO and MRC quoted in Coates 2002
29,250	10,399	24,325	7,441	71,316	DLF 2001
40,000					SoE 2000
80,000-85,000	15,000-20,000				LARReC 2000
150,000	30,000		20,000	200,000	Coates 2002

All figures tonnes/year.

9.6 Tourism

Table 41: Tourist arrivals 1997-2001

	Number of arrivals	Average length of stay (days)	Revenue (US$)
1997	463,200	5.00	73,276,904
1998	500,200	5.00	79,960,145
1999	614,278	5.50	97,265,324
2000	737,208	5.50	113,898,285
2001	673,823	8.00	103,786,323

From National Tourism Authority

Table 42: Tourist revenues by category 2001

	Number of arrivals	Average length of stay (days)	Expenditures (US$/day)	Revenue (US$)
International tourists	168,545	8	50	67,418,000
Regional tourists	501,199	1-4	12-70	36,042,085
Tourist for Visa Extensions	4,079	3	27	326,238
TOTAL	**673,823**			**103,786,323**

From National Tourism Authority

Table 43: Visitors by Province 1997-2001

Province	1997	1998	1999	2000	2001
Vientiane Municipality	277,292	312,640	482,199	486,613	429,420
Champassak	23,260	28,019	29,019	34,796	55,142
Khammoune	22,718	24,360	11,455	13,712	20,317
Bokeo	16,543	19,002	21,120	25,286	42,561
Luang Namtha	18,032	18,600	20,700	24,770	41,704
Savannakhet	140,412	144,840	90,910	109,033	113,287
Luang Prabang	30,769	44,538	61,034	165,222	51,207
Bolikhamxay	14,900	13,388	29,734	35,681	23,900
Xieng Khouang	1,771	4,500	-	-	35,744
Saravanh	1,266	-	-	-	-
Oudomxay	5,438	-	-	-	18,654
Huaphanh	943	732	-	-	398
Sayabouli	-	8,300	6,200	7,446	9,014
Vientiane	-	-	-	-	-

From National Tourism Authority

Table 44: Hotels, guest houses and rooms by Province, 1996-2001

Province	Number of Establishments						Number of Rooms					
	1996	1997	1998	1999	2000	2001	1996	1997	1998	1999	2000	2001
Attapeu	-	4	3	3	4	4	-	43	37	41	94	74
Bokeo	2	5	5	6	16	21	30	88	88	143	307	254
Bolikhamxay	13	3	8	8	16	23	117	61	96	115	200	331
Champassak	13	14	18	18	56	65	245	246	306	374	759	889
Houaphanh	5	6	8	8	10	10	54	60	83	83	106	119
Khammouane	6	4	11	11	13	16	160	124	196	236	281	320
Luang Namtha	10	14	26	26	25	31	107	113	246	269	263	312
Luang Prabang	20	33	45	67	100	116	385	462	539	864	1048	1173
Oudomxay	9	18	21	22	31	31	140	187	203	279	568	568
Phongsaly	-	11	11	11	11	20	-	66	70	77	77	203
Saravane	1	3	4	4	8	11	15	23	33	45	66	96
Savannakhet	15	18	22	22	25	29	282	338	424	399	512	479
Sayabouli	5	5	16	16	15	7	68	68	220	220	196	99
Sekong	-	1	1	1	1	1	-	16	15	15	15	16
Vientiane Municipality	64	68	81	81	98	119	1845	1884	2099	2033	2351	2782
Vientiane Province	7	10	10	14	14	53	127	157	165	184	184	899
Xieng Khouang	12	16	16	16	24	13	126	172	179	147	286	163
Saysomboun	-	-	1	1	1	1	-	-	20	20	20	20
TOTAL	**182**	**233**	**307**	**335**	**468**	**571**	**3701**	**4108**	**5019**	**5544**	**7333**	**8797**

From National Tourism Authority

Table 45: Tourists numbers and revenues for main attractions in Luang Prabang, Champassack and Luang Namtha Provinces 2001

	Number of Tourists	Revenue (US$)
Luang Prabang Province		
Kuangsi Falls	38,200	21,222
Old palace	22,398	12,443
Xiengthong temple	13,283	2,951
Luang Namtha Province		
Namha eco-tourism	2,000	34,400
Champassack Province		
Khone Phapheng Falls	34,000	34,000
Wat Phou	24,219	4,992

From National Tourism Authority. * October 2000-Febuary 2002

9.7 Ecosystem services

Table 46: Forest cover in watersheds 1998

	Vegetation cover within watershed classes 1+2+3 ('000 km²)
North	**7,550.7**
Dense forest	250.1
Other forest	1,811.0
Non-forested	5,489.6
Central	**5,158.7**
Dense forest	848.0
Other forest	201.2
Non-forested	4,109.5
South	**2,484.9**
Dense forest	140.6
Other forest	1,346.5
Non-forested	997.8
Whole country	**15,194.3**
Dense forest	1,238.7
Other forest	3,358.7
Non-forested	10,596.9

From Puustjarvi 1998.

Table 47: Existing hydropower facilities, watershed areas, capacity and power generation

	Area of watershed ('000 ha)	Installed capacity (MW)	Annual generation (GWH)	Traded value (Kip billion)
Nam Ngum 1	846	150	1,117.005	363.96
Xeset 1	32	45	168.016	54.74
Theun Hinboun	890	210	1,507.000	491.03
Houay Ho	19	150	625.860	203.92
Nam Leuk	32	60	263.486	85.85
Xe Labam	nd	5	24.263	7.91
Nam Dong	nd	1	5.735	1.87
TOTAL	**1,819**	**621**	**3,711.365**	**1,209.28**

Installed capacity and annual generation from EdL 2000 Report, watershed area from MAF 2000a.

Table 48: Flood damage 1995-99

	1995	1996	1997	1998	1999
Area destroyed (ha)	62,230	67,456	33,375		8,502
Persons affected			1,022,907	90,472	
Households affected			189,273	18,096	

From MAF 2000b.