

# Natural Disasters and Mitigative Measures

## in the Lao PDR

### Country Report

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## 1. Introduction

**The Lao PDR**, situated in the center of the south-east Asian peninsula, covers an area of about 237,000 km<sup>2</sup>, extends 1000 km from north to south and 500 km from east to west at its widest point in the north and only 150 km at its narrowest point in the south. Lao PDR is landlocked and virtually all of the country is in the lower watershed of the Mekong River which traverses the country from north to south. Almost 80% of the land surface is hilly and mountainous terrain rising between 200m and 3000m above the Mekong's alluvial plains. The mountainous terrain renders internal and external communication difficult and costly and severely limits the amount of land suitable for intensive agricultural production.

**Geologically**, the Lao PDR consists of the older mountainous regions along the Annamite range and the younger alluvial plains bordering the Korat plateau. There are two major geo-tectonic folds running through the territory of Laos: one between the Korat plateau and the Himalayan plait, which extends from North of Khammouane Province to North of Savannakhet Province into Vietnam; and one from Chiang Mai - Chiang Rai crossing through Bokeo, Luang Prabang and Xieng Khouang Provinces into Vietnam.

The **Climate**: The climate is sub-tropical and dominated by the southwest monsoon which brings high rainfall, high humidity and high temperatures between mid-April and mid-October. While over 70% of the rain falls during the wet season, the climate is characterised by high inter-annual variability with relatively frequent occurrence of flooding and drought. Average temperatures range from around 20°C in the mountainous areas and on the highland plateaux to 25°C-27°C in the plains.

There are three main agro-climatic zones;

- **The mountainous north** : With elevations over 1,000metres and steep slopes is dominated by moist to dry subtropical climate with annual rainfall between 1,500- 2,500 mm. The area experiences a cooler dry season and hence higher intra-annual temperature variations than the rest of the country. The soils have low water retention capacity and generally low fertility. The combination of a rugged terrain and relatively poor soils leads to a high occurrence of slash-and-burn. This, in return, has the consequence that every year there are forest fires in excess what is needed for shifting cultivation. In the last four years, there were two earthquakes registered in the North of the Lao PDR.
- **The mountainous parts of the center and the south**: With elevations between 500 and 1,000 m (and some peaks over 2,000m) but generally moderate slopes is dominated by a tropical monsoon climate with annual rainfall from 2,500-3,500 mm on the Bolovens plateau. Also in this area, forest fire are more the rule than the exception.
- **The plains**: They are located along the Mekong river and its tributaries including the Vientiane plain, the narrow plain in Bolikhamsay province and northern Khammouane province, the larger plain of southern Khammouane province and Savannakhet province and a series of smaller plains in the southern provinces ( Champassak, Saravane, Attapeu). These areas are inhabited by more than 50% of the population and are dominated by a moist to dry tropical climate with annual rainfall varying from 1,200 to 2,000 mm. The flood plains and immediate adjacent levies are generally characterised by recent alluvial deposits which are acidic and shallow, with low organic matter and low fertility. The younger alluvial soils of the flood plains are somewhat more fertile than the older terrace soils, but they are often subject to wet season flooding.

**Economically**, the Lao PDR is still in its beginning to develop an industrial base. There is no chemical industry or other large scale industry in the country. Therefore, massive spills of hazardous chemicals are unlikely to occur in the near future. Because the country has no borders with the sea, oil spills, which bother neighbouring countries, are not of relevance here.

## **2. The basis for Disaster preparedness**

At the 1986 Government Congress, the New Economic Mechanism emerged as a means to promote a market- based economic system based on de-centralized economic decision- making and an expanded private sector. The New Economic Mechanism subsequently was included in the country' s 1991 Constitution and has since become the basis of a national reform process based on sustainable development and the conservation of natural resources. More recently, the government also has emphasised rural development as a key priority for realising the stated objectives of accelerated socio-economic development and improved living standards through the expansion of

economic, social and physical infrastructure. The national priority programmes, all of which in some manner can be related to disaster reduction are food production, stabilisation/reduction of shifting cultivation, commercial production, infrastructure development, improved foreign economic relations, rural development, human resource development and services development.

### 3. Occurrence of Natural Disasters

#### 3.1 Flooding

Flooding is the main natural disaster in the Lao PDR - both in terms of frequency as in terms of consequences. There are floods along the Mekong river every year in the central and southern parts of the country. Those areas represent almost a half of the country's surface and rice and agricultural production are concentrated here. Flooding in the North and East is rare, sometimes Oudomxay Province is affected. But because of the sloping area, the force of flood water is strong and therefore floods in the North are far more devastating than in the centre and the South.

**Table 1: List of flooding.**

Year	Type of Damage	Damage cost ( \$us)	Location of Damage
1966	Large flood	13,800,000	Central
1968	Flood	2,830,000	Southern
1969	Flood	1,020,000	Central
1970	Flood	30,000	Central
1971	Large flood	3,573,000	Central
1972	Flood and Drought	40,000	
1973	Flood	3,700,000	Central
1974	Flood	180,000	Southern
1976	Flash Flood	9,000,000	
1977	Severe Drought	15,000,000	
1978	Large flood	5,700,000	
1979	Flood and Drought	3,600,000	
1980	Flood	3,000,000	Central
1981	Flood	682,000	Central
1984	Flood	3,430,000	
1985	Flash Flood	1,000,000	Oudomsay Province
1986	Flood and Drought	2,000,000	
1990	Flood	100,000	Central
1991	Flood and Drought	3,650,000	Central
1992	Flood, Drought and Forest Fires	302,151,200	Central and northern
1993	Flood and Drought	21,827,927	Central Southern

1994	Flood	21,152,400	Central Southern
1995	Large flood	33,000,000	Central Southern and
1996			
1997	Flood and Drought	1,196,614	Central Southern and

Source: Ministry of Agriculture and Forestry, 1995

**Table 2. Flood and Damaged rice fields 1994 , 1995 and 1997 by province.**

Province	Damaged 1994 (hectares)	Transplanted 1995	Damaged 1995	Transplanted 1997 (hectares)	Damaged 1997 (hectares)
Vientiane	2,485	33,523	7,425	38,660	4,700
Vientiane Prefecture	1,800	42,737	17,396	47,500	2,800
Bolikhamsay	5,997	18,791	8,157	26,700	5,870
Khammouane	13,702	41,781	13,498	41,750	6,900
Savannakhet	4,457	93,039	6,791	106,295	8,285
Champassak	3,102	36,918	8,300	80,160	5,750
Total	31,633	306,789	61,567	341,065	34,305

Source: Ministry of Agriculture and Forestry, 1995-97

**Table 3. Flood affected population, 1995 and 1997**

Province	population 1995	Number of families 1995	Number of families 1997	Average number/family	growth rate
Vientiane prefecture	528,109	88,863	22,225	5.94	3.4
Vientiane Province	286,089	47,167	14,130	6.07	-
Bolikhamsay	163,847	26,642	12,372	6.15	-
Khammouane	273,779	49,839	49,948	5.49	2.5
Savannakhet	671,581	106,858	7,657	6.28	2.1

Champassak	500,994	84,230	13,039	5.95	2.2
Total	2,424,399	403,549	119,371	-	-
Whole Country	4,581,258	752,102	238,762	6.09	2.4

Source: Ministry of Agriculture and Forestry, 1995-97

The major floods occurred in Laos since the past 35 years, with severe or exceptional flooding in 1966, 1978, 1983, 1990, 1991, 1993 and 1995. As a general condition, floods are experienced from August to September in the central and southern provinces of the country.

In order to initiate mitigation measures, the government has started to collect data on the most affected areas, to undertake surveys on the most important catchment areas with the use of RS/GIS with the aim for river rectification in the future.

### 3.2. Droughts

This type of disaster is the second most important after flooding. It occurs over the whole country. However, regions which most experience droughts are the same with the most floods (central and southern provinces). Hereby one has to consider that a short drought of, for example two weeks occurring during the seedlings preparation can have serious consequences. When all seedlings (before transplanting) die, the farmers have to start anew. The process of transplanting will therefore be delayed by approx. four weeks and, when the normal rainy season floods occur, the newly transplanted rice will be not high enough to withstand even that normal water level.

**Table 4: Consequences of droughts**

Year	Type of Damage	Damage cost ( \$us)	Location of Damage
1967	Drought	5,200,000	Central and Southern
1972	Flood and Drought	40,000	
1975	Drought	not available	
1977	Severe Drought	15,000,000	
1979	Flood and Drought	3,600,000	
1982	Drought	not available	
1983	Drought	50% below normal production levels	
1986	Flood and Drought	2,000,000	
1987	Drought	5,000,000	Central and northern

1988	Drought	Crop losses of 40,000,000 production Electricity Production(hydro) 10,500,000	Southern
1989	Drought	20,000,000	Southern
1991	Flood and Drought	3,650,000	Central
1992	Flood, Drought and Forest Fires	302,151,200	Central and northern
1993	Flood and Drought	21,827,927	Central ,Southern

Source: Ministry of Agriculture and Forestry, 1995

In the above mentioned areas, there are more than 400,000 hectares under paddy cultivation. However, if they are hit by drought, only 18,000 hectares have irrigation and the remaining area has to remain barren. In 1996, the government has purchased 7,027 pump units for improving this situation. Since then, 99,700 hectares of paddy fields can be artificially irrigated. Other cash-crops can be irrigated up to 50,000 hectares.

The use of pumping stations has improved the situation considerably but, in order to have enough water available, the government pays great attention to the protection of watersheds and the creation of artificial water retaining basins.

### 3.3. Fires

Forest fires have always occurred in Laos. They are mostly observed during the dry season (February to April) particularly in the mountain-ous north and north-east. In 1998 an unusual drought as a possible consequence of this year' s El Nino occurred and led to a much higher incidence of forest fires.

Table 5: Areas affected by forest fires nationwide

Location	1996	1997	1998
Luang Prabang*	-	-	- 3,000 ha
Bokeo*	-	-	4,200 ha along the Lao ? Thai border
Oudomxay*	35,000 ha	25,000 ha	20,000 ha
Luang Namtha*	-	-	17 mountains along the Lao - Chinese border
Phongsaly*	-	-	-
Saygnabuly*	15,000 ha slash-and-burn	15,000 ha slash-and-burn	127,360 ha

Viengtiane**			710 ha
Viengtiane Prefecture**			1,240 ha
Xieng Khouang**			10,000 ha
Houaphane**			
Saysomboune**			
Bolikhamstay**			
Khammouane**			58 ha
Savannakhet**			600 ha
Salavane**			100 ha
Champasack**			200 ha
Sekong**			67,527 ha
Attapeu**			
TOTAL	50,000 ha	40,000 ha	134,995 ha

Source: \* Provincial administration

\*\* Ministry of Agriculture/Forestry, Dept. of Forestry

### 3.3.1. Urban Fires

Urban fires occur frequently in the Lao PDR, mainly due to the cooking habit of the population, traditions connected to spiritual beliefs and its spreading is facilitated by mostly wooden houses.

In addition they derive from neglecting the cooking fire or the back – yard burning of household waste. Another reason for urban fires is the outdated electricity equipment of houses, markets and factory buildings.

Each major town has at least one fire brigade.

### 3.3.2. Forest Fires

Each year, the Lao PDR suffers a loss of its forest cover due to uncontrolled forest fires.

- o The main reason for forest fires is slash-and-burn cultivation without proper supervision by the farmers. Often much more area than planned for cultivation is burned. There are no fire-breaks in the Lao PDR.
- o Another reason for this is for chasing animals out of the forest for shooting them easily.
- o Secondary forest is often burned in order to convert this area into grazing land.
- o In areas, where the boundary between the Lao PDR and its neighbours is not defined by a waterway, often forest fires spread from neighbouring countries.

One countermeasure to prevent forest fires is the at present ongoing activity of the government to issue land titles to the population (including for forests). This leads to a sense of ownership and prevents major fires. The strategy has proven very successful up to now. As a member of ASEAN,

the Lao PDR has actively participated in the development of its haze action plan, which also deals with the prevention of forest fires.

There is also a Prime Minister's Order to establish fire prevention units at village level. This, however, faces many difficulties because of the lack of equipment and communication. Often there are only some buckets for extinguishing a fire.

### **3.4. Typhoon**

Typhoons accompany the onset of the rainy season every year (May, June). Because of its protection by mountain range, typhoons here are quite mild. However, material damage (uproofing of houses, felling of trees and electricity posts) is quite wide spread. For example, on 23.4.97 a typhoon in Bokeo has destroyed 112 houses and made 607 people homeless. The total damage amounted to 260 million Kips (approx. 200,000 US Dollars).

### **3.5. The Erosion and Sedimentation**

Rivers are running from the mountains to the Mekong River generally through such steep gradients that many of them increase rapidly in times of heavy rains and carry large amount of alluvial soil downstream. In addition, wherever the forest or other vegetation cover is depleted, the water usually carries away a large amount of topsoil.

The main causes of landslides are heavy rainfall, deforestation and other activities on high slopes.

- **Soil Erosion**

Adequate data on erosion is not available but the predominant soil types and heavy rainfall, suggest that a significant part of the country is susceptible to erosion.

A recent analysis of sedimentation data in the lower Mekong basin furthermore suggests that sediment rates in the southern parts of Laos have increased substantially over the past twenty years and are among the highest in the region, although the exact causes for the increase have not yet been determined. This suggests that further research and monitoring in the watersheds of the southern Mekong tributaries which carry these high sedimentation loads is warranted.

In 1996, landslide occurred in Oudomxay province. It was originated by heavy rainfall and inadequate soil structure. It led to the breaking of a 1MW hydro-power dam, which apparently was not surveyed properly. Another landslide destroyed the Nam Phao Dam in Bolikhamxay Province (1.5 MW).

- **River erosion**

Sedimentation of storage reservoirs and high sediment flows in rivers as a result of erosion of upstream catchments, pose a significant potential threat to hydro power schemes and irrigation development. Siltation of the reservoirs reduces storage available for power generation or irrigation and high sediment flows in rivers and canals tend to damage machinery and restrict flows.

River bank erosion is very high in the area of the Golden Triangle (border area between Laos, Thailand and Myanmar). Every year, in each village, more than ten houses have to be moved away from the Mekong. There are about 30 villages along the river in this area. Other areas of the Lao PDR, such as Vientiane Municipality, Bolikhamxay, Thakhek, Savannakhet, Pakse, Champassak and Khong are also heavily affected.

### **Table 6.** Suspended sediment flow in selected rivers

Rivers Catchment Area Mean Flow Sediment Yield

km<sup>2</sup> m<sup>3</sup>/sec ton/km<sup>2</sup>

Mekong at LuangPrabang 268,000 3,973 122

Mekong at Pakse 545,000 9,805 178

Xe bang hieng (Mek .trib.Savannakhet 19,400 499 345

Se done ( Mek. Trib. Champasack) 5,760 154 229

Nam Leuk (Mek. Trib. Vientiane) 5,115 297 212

Nam Ngum ( Mek. Trib. Vientiane) 16,500 696 48

Nam Khan ( Mek. Trib. Luang Prabang) 5,800 83 66

Source: Mekong Secretariat, " The lower Mekong basin: Suspended sediment Transport and Sedimentation Problems (1995)" .

### **3.6. Earthquakes**

Old French surveys (from 1890 - 1975) and recent data from Vietnam and Thailand suggest that earthquakes have frequently occurred in the North of Laos. Their magnitude was always quite low. However, the data collected in the past only show that there was an earthquake in a certain region but give no detail as on the damage and duration.

A major earthquake has been recorded for the first time in the history of Laos, at 1.00AM of 31,October 1994 . The epicenter was placed at 20<sup>0</sup> 19' 50" N and 102<sup>0</sup> 26' 40" E (Xeung hok village, district of Muong Gnoi, Luang Prabang province). Fortunately at that time, the earthquake did not destroy any assets and kill any people.

The second one observed in the recent past, hit in November 1996 at 20<sup>0</sup> 15' N and 100<sup>0</sup> 30' E in Houay Xay District of Bokeo Province. More than 60 houses were destroyed, among them a hotel with approx. 20 rooms and the cultural hall of the province. Repair costs were about 100,000 US Dollars.

There is no strong motion measuring station (seismic station) in the whole country but, with increasing activity observed along the Luang Prabang fold further earthquakes are expected and such a station maybe needed for prediction.

## **4. Mitigation of Natural Disasters in the Laos in the past**

1. In the past, the government has given welfare and replacement seeds and animals to the victims of floods, droughts and fires.
2. Flood protection dikes along all major towns were constructed.
3. There are also some flood protection dikes to protect strategic areas.
4. Each major town has at least one professional fire brigade for urban fires.
5. In the recent past, village units for forest fire protection were established.

## **5. Problems, facing the Lao PDR**

- From all disasters, only fires have government units responsible.
- There is not sufficient legislative framework for the management of disasters.
- Human resources for proper research on disasters are not sufficient.
- Another problem is the lack of proper information and data channels and equipment.
- Fire extinguishing equipment is also not sufficient. There are no hydrants and techniques are usually outdated.
- Budget to cover disaster prevention and mitigation is too low.

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## **6. Government Strategy**

1. The Lao PDR is preparing its haze action plan.
2. Expand disaster units to all levels of the government.
3. Establish a legal framework (regulating rights and duties in the case of emergency)
4. Improve the communication system and upgrade equipment.
5. Establish a social welfare fund for the victims of disasters.
6. Provide sufficient funds for research and early warning systems.