

LAOS COUNTRY REPORT: REVIEW OF YEAR 2005 FLOOD, FORECAST AND WARNING SYSTEM IN LAO P.D.R

By Department of Meteorology and Hydrology

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Abstract

The topography of Lao People's Democratic Republic is closely related to the geology with watershed highlands of granites. The slopes of the mountains generate the draining down rapidly from upstream to low lands or to the Mekong River during heavy rainfall season. Mostly 1,865 kilometres the length of Mekong River flow trough Lao territory. In Lao PDR, Agriculture is the principal economic sector, contributing 55 % and covers a wide range of activities from subsistence production to Agriculture related industries. About 80 % of the population is engaged in Agriculture mostly in the plain, valley broadly defined to include livestock, crops, fisheries and forestry. A forest covers 47 % (MRC Source 2000) of the land and the fertile flood plain embraces about 30 % along the Mekong River.

Lao PDR has experienced 27 floods with different magnitudes and duration from 1966 to 2002.

In year 2005 flood of the Mekong River and its tributaries are mainly caused by storm rainfall of catchments in the upstream of the Mekong River and local heavy rainfall, result from strong southwest monsoon rainfall with Inter – Tropical Convergence Zone (ITCZ) and typhoon originating in south of China Sea during the months of August to September.

The most affecting provinces by flash flood and flood in year 2005 are: Oudomxay, Bolikhamxay, Khammuane, Savannakhet, Saravane and Champasack .The water levels along River of Mekong especially from Bolikhamxay to Champasack provinces raised over the flood warning stage during the end of August 2005. As a result many districts along Mekong River and downstream of its tributaries were flooded, causing damages to national infrastructures, agriculture production, and human settlements, and results in losses to livestock and human lives.

The main function of Meteorology and Hydrology of Lao PDR is to provide the weather and flood forecasts and issue warnings to public and to ministries concerned.

The National Disaster Management Office (NDMO) (Ministry of Labor and Social Welfare) is an agency responsible to the victims of the flood, with the support of the United Nation Development Program (UNDP) in 1997 for the formulation of the government policy on Disaster Management.

In August 1999 Lao PDR established an Inter – Ministerial National Disaster Committee (NDMC). The NDMO is played as secretariat of the NDMC and has a function to coordinate procedures with Disaster Management organizations and government institutions, other agencies and stakeholders such as: United Nation (UN), international nongovernmental organizations (NGOs).

This paper is the review of year 2005 flood, operational flood forecasting along the Mekong River and Warning system in Lao PDR during rainy season (from July to August).

INTRODUCTION

Geographically setting, the Lao People's Democratic Republic is dominated by two features: The mountains of the North and East and the Mekong River and its east bank tributaries. Extensive mountain ranges cover 70 % of the whole territory, stretching from the left bank of the Mekong River. The total area cultivated for agricultural purposes is 710.000 hectares.

The climate characteristics of Lao People's Democratic Republic are tropical monsoon with alternating wet and dry seasons.

- **The dry season** (Northeast monsoon) affects from mid - October to mid - May, when atmospheric is high, it's a dry period with low humidity and temperature. The temperature is lowest in December - January (13 ° - 17 °C) and highest in April (35 ° - 38 °C). The annual average temperature is 26 ° C.

- **The rainy season** (southwest monsoon) affects from mid - May to mid - October, it's the period of heavy and frequent rainfall with height humidity. The average annual precipitation range from 900 - 3500 millimetres from, which 80 % were, concentrated from May to September. The humidity ranges from 65 - 95 % temperature.

- **The short drought of about 2 weeks** is normally experienced between the ends of June to the beginning of July.

Lao PDR as well as is located in the areas where in the most amount of rainfall in Indochina Peninsula , especially in the mountainous areas in the northern and central parts of the country receive more than 3000 millimeters of annual rainfall. During the last 37 years (1966 - 2002), 27 notable floods occurred with an average frequency once in approximate 1.4 years. Of these 27 historic floods only 6 were large floods (1966, 1971,1978,1995,1996 and 2002), giving an average frequency of once in every 6.2 years.

On average about 3 Tropical Cyclones of various intensities make landfall to Republic of Vietnam after that move through Lao territory per annum.

The impact by Tropical Cylones and is associated with heavy monsoon rainfall such as: storms winds ,torrential rains, landslide, flood phenomenon cause damages to national infrastructures, agriculture production, and human settlements, and results in losses to livestock and human lives. Therefore the Tropical Cylones & Flood monitoring and accurate of Tropical Cylones & Food forecasts and warning at Department of Meteorology and Hydrology (DMH) of LAOS is a great importance to assist the government and public users to take prevention activities when a Tropical Cyclone approaching or pass over LAOS.

Year 2005 flood caused by the combination of tropical Depression *WASHI* 0508, Tropical storm *VICENTI* 0516 and Tropical storm *DAMREY* 0518 and is associated with strong southwest monsoon during the month of July and August.

The flood 2005 was considered as the highest affecting the main central and southern low lying rice production areas.

I. OVERVIEW OF METEOROLOGICAL AND HYDROLOGICAL CONDITION DURING THE YEAR 2005

1.1 Meteorological Condition

The occurrence of a series of extreme weather disturbances such as: Tropical cyclones, strong southwest monsoon, local heavy rainfall in the country that caused of damage to properties and infrastructure.

- **Southwest monsoon in 2005**

The onset of southwest monsoon took place similarly normal (mid-May). During mid-June the strong Southwest monsoon prevailed over Laos, as result widespread light rain observed over the country with heavy rain in central stations of Mekong River. Almost the positive monthly rainfall departure observed at northern and central stations. Where the monthly rainfall of June recorded at Pakxan station is 1059.8 millimeters and above normal 309.9 millimeters (monthly normal is 749.9 millimeters). For Thakhek station recorded 554.8 millimeters, the rainfall departure is above normal 166.5 millimeters.

The second wave of southwest monsoon covered all parts of Laos during mid – July to August, where continuous rain observed in the central and southern stations of the country.

Table 1. Shows the monthly rainfall departure (in millimetres) at main stations of Mekong River during June to September

Station	June			July			August			September		
	Pa	Pn	Δ P	Pa	Pn	Δ P	Pa	Pn	Δ P	Pa	Pn	Δ P
L. prabang	304.5	177.4	127.1	290.7	224.1	66.0	264.6	268.5	-3.9	199.9	268.5	-68.6
Vientiane	337.2	279.2	58.0	238.3	275.1	-38.8	423.8	330.5	93.3	466.6	330.5	136.1
Paksane	1059.8	749.5	309.9	737.8	819.1	-81.3	856.0	650.9	205.9	376.6	650.9	-274.3
Thakhek	554.8	388.3	166.5	735.6	502.8	232.8	835.3	528.2	307.1	482.7	528.2	-04.5
Savannakhet	190.2	322.7	-132.5	603.6	220.4	383.2	279.8	340.1	-60.1	326.0	218.7	107.3
Pakse	277.1	362.4	-85.8	416.2	373.5	42.7	511.4	480.6	30.8	356.9	308.6	48.3

- **Tropical Cyclones that impacted to Lao PDR Year 2005:**

Direct affects:

About 3 Tropical cyclones pass over Laos (TD. WASHI 0508 TS. VICENTI 0516 TS. DAMREY 0518 and DEPRESSION).

- **TD WASHI 0508 :** A Tropical Depression WASHI (0508) formed in Gulf of Tonkin, it made landfall over northern of Vietnam on 00 UTC 31/7/2005 and moved through Xiengkhuang, Huaphanh, Luangprabang Odomxay provinces in midnight of July 31/18 UTC . The impact by this Tropical Clyclone and is associated with heavy monsoon rainfall such as: Storm winds, torrential rains and landslide phenomenon cause damages in to infrastructure, agriculture production and result in losses to livestock.
- **Depression:** On 30 August 2005 pass over central part of Laos.

- **TS VICENTI 0516** : Tropical storm VICENTI 0516 pass over central part of Laos (Thakhek, Savannakhet and Seno) on September 18/06 UTC and moved through Xaysomboune district , capital city Vientiane and Vientiane provinces) on Sep.18/18 UTC , after that at the same day on 21 UTC it moved northwest direction over Xayaboury and Bokeo provinces. The heavy rainfall observed more than 100.0 mm / 24 hour in many stations.
- **TS DAMREY 0518**: Typhoon DAMREY 0518 pass over northern part of Laos

(Xiengkhuang, Xaysomboune district) on September 27/18 UTC and moved through (capital city Vientiane and Vientiane provinces) on Sep. 28/00 UTC and after that it moved northwest direction over Luangprabang and Xayaboury provinces.

Indirect affects: **TS. MATSA 0509** made landfall over south of China on 7th August 2005 , it reinforced the strong southwest monsoon from Andaman sea in to Laos and produced heavy rainfall over central and southern parts of country , caused damages by flash flood , landslide in to Agriculture rice fields of the people at Oudomxay , Khammuane, Savannakhet and Attapeu provinces. The list of Tropical Best Tracks over Laos in year 2005 sees table .2

Table .2 shows the list of Tropical Best Tracks over Laos in year 2005

Name of Tropical Cyclones	Duration Beginning - ending	Time / Location during the passage of TCs		Pressure (hPa)	Max. wind (Kt)	Grade
		Time (UTC)	(°N) / (°E)			
TS 0508 WASHI	26 Jul – 31 Jul	Jul 31/18	20.0/103.0	998	----	TD
TS 0516 VICENTI	17 Sep – 18 Sep	Sep 18/00	16.8/108.4	985	40	TS
		18/06	17.0/106.2	----	----	TS
		18/18	19.3/102.4	998	----	TD
		18/21	20.0/101.0	1000	----	TD
TY 0518 DAMREY	21 Sep – 27 Sep	Sep 27/06	19.7/105.0	----	----	TS
		27/18	19.0/103.0	1000	----	TD
		28/00	18.2/102.0	1004	----	L
TY 0521 KAI-TAK	29 Oct – 02 Nov	Nov 02/00	19.0/106.6	990	30	TS
		02/12	19.0/105.0	1004	----	TD
		02/15:30	20.0/107.0	----	----	L
		02/17	----	----	----	Dissip

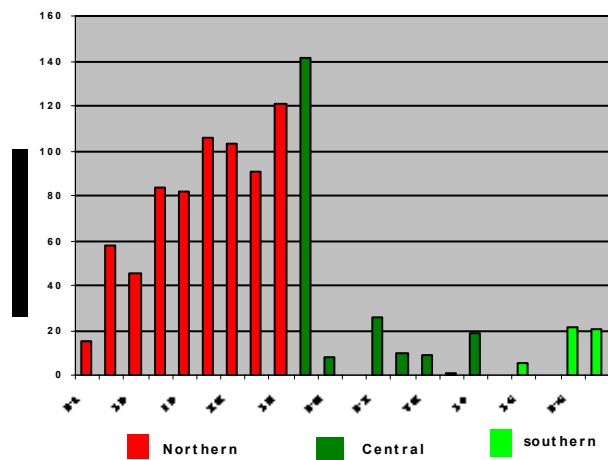
Depression	Passed over central of Laos on 30 August 2005
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1.2 Hydrological Condition

Flash flood by Tropical Cyclone

The observed rainfall in many synoptic stations during the passage of tropical storm WASHI (0508) on 31 July 2005 broke the maximum recorded rainfall in northern part provinces of the country. The resulting flash flood and landslides practically destroyed several villages of Oudomxay province.

Daily Rainfall distribution by Tropical Storm Washi (0508) on 31 July



Flash flood pictures by Tropical Storm Washi (0508) at Oudomxay



Flash flood and landslide destroyed Road and irrigation channel at Oudomxay



Table 3 Shows the flash flood damages by TS WASHI (0508) at Odomxay on 31 July 2005 reported by MAF on October 2005

N0	Description	Damages by flash flood
1	District	7 Districts
2	Irrigation affected	46 villages
3	Irrigation damaged	22 schemes
4	Irrigation channels affected by landslide	675 meters
5	Rice fields affected	31 villages
6	Rice fields flooded	319 hectares
7	Rice fields damaged	51 hectares
8	Other planting areas damaged	203 hectares
9	Fishery affected	12 villages
10	Fish ponds flooded	78 sites
11	Fish ponds Damaged	27 sites (18 hectares)

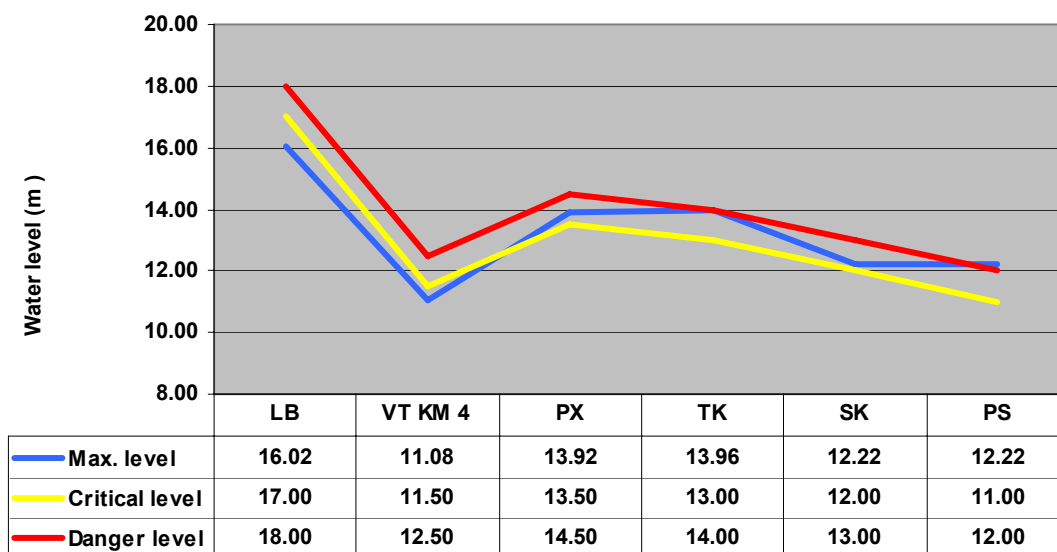
Damaged cost: 1.576.000.000 Kip (157.600 USD)

Flood from Mekong River and its tributaries:

As resulted heavy rain in to consecutive days between mid – July and August at central and southern parts of Laos, where on 22/8/2005 the maximum water level at hydrological Pakxan station risen up to 13.92 meters and was higher than critical value 0.42 m (critical level is 13.50 m, danger level is 14.50 m). On the same day the maximum peaks of Xebanfay river risen up to 20.68 meters at station of Xebanfay district (the water level of this year is 0.58 meters grater than year 2004) and the maximum peaks also observed at station Mahaxay district (Xebanfay river) 16.60 meters (the water level of this year was higher than of Year 2004 about 1.47 meters).

Therefore one day later the maximum peak 13.96 meters occurred at Thakhek station on 23/8/2005 and was higher 0.97 m than warning value (critearical level is 13.00 m, danger level is 14.00 m). After those 2 days later the exceeding peak value from critical level observed at Savannakhet station 0.22 m. For Pakse station the exceeding flood peak value occurred on 19/8/2005 and on 25/8/2005 between 0.04 m and 0.23 m respectively (critical level is 12.00 m, danger level is 13.00 m).

The Water Level at Main Stations of Mekong River in August, 2005
The maximum Water Level at Main Stations of Mekong River in August, 2005



Flood pictures Khammuane province

Families, people affected at Mahaxay district on August 2005



Households affected at Mahaxay district on August 2005



Rice fields flooded at Thakhek district Hinboune district along Namdon



Table.4: Shows the flood damages in 2005 reported by MAF and NDMO

N0	Description	Damages in 2005
1	Provinces	8
2	Districts / Villages	84 / 2510
3	Families / people affected	85.533 households / 480.913 persons
4	Rice fields affected	87.725 ha flooded (panting areas in 2005 is 684.555 hectares)
5	Damaged rice fields	54.775 hectares damaged
6	Livestock damaged	14.941 heads (buffalo, cattle, pigs and poultry)
7	Fish ponds damaged	4289 sites = 609 hectares
8	Irrigation affected	1.421 projects sites
9	Irrigation damaged	117 schemes
10	Irrigation channels	15.124 meters affected by landslide
11	School affected	102 schools
12	Route affected	225.726 kilometres

Damaged cost: 218.304 USD

Data sources from MAF, October 2005

1.3 Lessons learned

- Hydro – meteorological networks should be rehabilitated every year before rainy season (from May to October).
- At the beginning of rainy season DMH should be equipped the rain gauge, staff gauge, telecommunication facilities and permanent hydrologist at the remote stations to make ensure the data transmission in real time to Headquarter DMH.
- DMH well organized the working group on flood and drought monitoring during rainy season.
- The long – range weather forecasts, as well as seasonal out look is needed to Prepare for Agriculture sector and flood management program and other agencies Concerned in Lao PDR.

- One month before rainy season, the NDMC concerned 13 ministries should be organized meeting for underline of each reasonability.
- The NDMC should be organized meeting two time per year (before rainy season for flood preparedness and after rainy season for flood impact assessment)
- Promotion coordination between DMH and mass – media and line ministries concerned should be ready prepared.
- The weather and flood forecasts information, warnings and dissemination at DMH should be in proper and timely manner.

II. CAPACITY OF PROVIDING THE WEATHER AND FLOOD FORECASTS, WARNING SYSTEM DISSEMINATION AT DMH LAOS

2.1 Current status of Hydro – Meteorological Department LAOS

DMH in Lao PDR is a governmental organization under the Ministry of Agriculture and Forestry (MAF). DMH is assigned as national service Provider of both fields Meteorological and Hydrological monitoring and products.

DMH's administrative structure is divided into 2 levels:

- **The Headquarter level:** looks after strategic plans, principles, and regulations for the whole country. Data collection, processing, analysis, archiving and disseminating services are also roles of Headquarter level.
- **The Provincial level:** is responsible for routine operational duties of all stations.

● **Hydro – meteorological Network in Laos**

The weather observation network at Department of Meteorology and Hydrology of Laos consists of total 50 stations, in which 17 station are main synoptic surface stations , all the other are secondary synoptic stations(monthly data recording only). There are 113 rain gauges apart from 50 stations.

■ Meteorological Network :

- Main synoptic station = 17 stations
- Secondary synoptic station = 33 stations (monthly data recording only)
- Rain gauges = 113 stations.

■ Hydrological Network :

- Staff gauges = 109 stations
- Discharge = 49 stations

- C – Band Doppler radar at DMH Headquarter and MTSAT–1R satellite receiving station is included, which started operate in early March 2006.

● **Data collection at DMH**

- At national level: All domestic stations transmit their observed, raw data encoded format to DMH by SSB HF transceiver and Public telephone. These data are served for weather

and flood forecast and some selected data are exchanged regionally via GTS network of WMO and AFTN of ICAO.

- **International level:** Data from other countries can be collected by GTS link from Bangkok RTH and in order to fulfil the task of weather forecast and warning on Hydro – meteorological severe events. The structure of data collection for Weather Forecasting at DMH sees **Annex1**.

2.2 **Flood forecasting and Warning systems**

- The flood forecasting was set up in July 1966 after severe flooding 1995 in Vientiane plain.
- From July 2000 the flood forecasting unit established (lead time of forecast is 24 hours).
- From 2004 up to date the product of flood forecasting was upgrade from 24 to 48 hours.

The flood forecast along Mekong River in Lao PDR usually commence during rainy season, which period from July to September of the year. Especially DMH assigned the working team on weather, flood monitoring and forecasting in rainy season.

• **Real – time data collection for flood forecasting**

- Department of Meteorology and Hydrology, especially Hydrological Division receives data from different sources to perform the forecast such as from provincial hydrological stations. The DMH exchange data with MRC (Mekong River Commission) and every day receive the result of flood forecasting bulletin from MRC.
- Necessary information: Real – time data (water level and rainfall) observed at 7:00 am (00:00 UTC) is collected from 7 stations, which located along the Mekong River in Lao PDR.

Table5: Shows the station names, communication and types of real time data

No	Station code	Mekong River station name	Communication for Data collecting	Data Types
1		Pakbeng	HF/SSB Radio & telephone	H , RR
2	019594	Luangprabang	HF/SSB Radio & telephone	H , RR
3	019801	Vientiane (KM 4)	HF/SSB Radio & telephone	H , RR
4	012703	Paksane	HF/SSB Radio & telephone	H , RR
5	013102	Thakhek	HF/SSB Radio & telephone	H , RR
6	013401	Savannakhet	HF/SSB Radio & telephone	H , RR
7	019802	Pakse	HF/SSB Radio & telephone	H , RR

HF/SSB: High Frequency Radio / Single Side Band Transceivers.

H: Water level at 07:00 am (00:00 UTC).

RR: Total Rainfall 24 hours observed

- Information Real – time data (water level and rainfall) observed at 7:00 am (00:00UTC) is collected by HF/SSB from main tributaries of the Mekong River in Lao PDR.
- Additional Real - time rainfall, synoptic, climatic data, weather situation and other information are received from the Weather Forecasting Division (same Department) The Weather Forecasting Division and Hydrological Division are very closely analyzed the weather situation for adding in to flood forecasting in wet season.
- Supplementary information: Real – time data (water level and rainfall) observed at 7:00 am (00:00 UTC) is collected by E–mail from the two upstream stations of the Mekong River in China (Yanjinghon 92980 and Hana 92600).

- **Data processing and Forecasting**

At the present flood forecasting of the Mekong River in Lao PDR use method of stage correlation between upstream and downstream of water levels with related the lag time for the Mekong mainstream. For example from Luangprabang to Vientiane, there is 426 km of length and about 48 hours or 2 days of lag time. Distance between two stations and flood propagation time are shows in table 6.

Table 6: Shows the flood propagation time (hours) from Houeisai to Pakse

Stations	Distance between two stations	Velocity (m/s)	Flood propagation time (hours)
Houeisai - Luangprabang	302 KM	2.5	33.555
Luangprabang - Vientiane	426 KM	2.4	49.306
Vientiane - Paksane	225 KM	2.2	28.408
Paksane - Thakhek	133 KM	2.0	13.899
Thakhek - Savannakhet	90 KM	1.8	13.899
Savannakhet – Pakse	257 KM		
(Savannakhet – Sebanghieng)	(100 KM)	(1.7)	(16.34)
(Sebanghieng - Pakse)	(157 KM)	(1.6)	(26.43)
Houeisai – Pakse	1433 KM		186.401 = 8 days

Statistical formula is used as the following:

$$H_{VT, \text{ forecast}} = (H_{LB, \text{ yesterday}} - H_{LB, \text{ day before yesterday}}) * 0.35 + H_{VT, \text{ today}}$$

- The basin run – off and depth run – off model for Numnum dam.

After receiving all necessary information, the data is processed and analyzed. Then the data is entered in to the flood - forecasting model PC at the Forecasting unit.

The preparation of flood forecast bulletins have be completed at 10:00 am every day.

The duration of flood forecast time for Mekong River in Lao PDR is only 48 hours (from 07:00 am today to 07:00 am day after tomorrow) and update every day.

The main contain of the forecasts are water levels and forecast includes 6 stations:

1. Luangprabang
2. Vientiane
3. Paksane
4. Thakhek
5. Savannakhet
6. Pakse
7. Water level in front of Numngnum dam

The sample of flood forecasting bulletin and warning are shown in **Annex.2** and **Annex.3**

- **Flood forecast verification**

The average bias of flood forecasting for Mekong river mainstream in Lao PDR ranges between – 10 cm to + 10 . All the above mentioned relationships are under estimated in general, but adjustments form local rainfall between stations are needed in some circumstances.

- **Forecasts and Warning Dissemination**

- Mains users of Meteorological and Hydrological products are:
 - Aviation.
 - Agriculture sectors.
 - Hydro power.
 - Construction projects.
- Regarding service to public , Meteorological and Hydrological data, weather and flood forecasts are disseminated to ministries and organizations concerned such as :
 - TV, Radio stations, newspapers.
 - Ministry of Agriculture and Forestry.
 - Prime Minister office.
 - NDMO
 - Ministry of Industry and Handicraft.
 - Mekong River Committee secretariat
 - Provincial Authorities concerned.
 - International Organizations.

➤ Private sectors.

The HF/SSB Radio transceivers network, Public telephone, Facsimile and E – Mail are used for delivering the weather and flood forecasts and Tropical Cyclone Warnings to public. The structure for disseminating of weather and flood forecasts & Warnings sees **Annex 4**.

- In case the water level at that station reaching below to Warning level 0.50 meters , DMH have to provide the warnings message and timely broadcasting the information to mass – media, MAF and to NDMO
 - DMH make interview to Mass – media.
 - DMH sent the information to focus areas.
 - Ministry of Agriculture and Forestry releases the warning message to Public through TV and News papers.
 - Especially the warning message is released by NDMO through National and Municipality Radio Stations during daily program for disaster management.
- In case emergency, the water level exceeding from warning level , DMH have to provide the urgent warning and rapidly sent to focus areas , mass – media , MAF and NDMO.
 - DMH make again interview to Mass – media.
 - DMH provide an announcement warning and send to MAF, after that MAF report to Prime minister.
 - Ministry of Agriculture and Forestry releases the urgent warning to Public through Radio, TV and News papers.
 - At the same time DMH send the urgent warning to NDMO.
 - NDMC (NDMO) sends the urgent warning to PDMC → DDMC → Focus areas.
 - National and Municipality Radio Stations are frequently broadcaster in to many programs of the day.

III. CONCLUSION, PLAN NEAR FUTURE AND RECOMMENDATION

- **Conclusion :**

In Lao PDR from 1966 to 2002 experienced 27 floods from Mekong River with an average frequency of one in 1.4 year. Of these 27 historic floods only 6 were large floods: 1966, 1971,1978,1995,1996 and 2002, giving an average frequency 6.2 years.

In 2005 the onset of monsoon heavy rainfall from Andaman sea and is associated with 5 tropical best tracks over Laos caused flash flood , landslide and flood over 8 provinces of the country . As result 84 districts, 2510 Villages, 85.533 households and 480.913 persons were affected and causing damages to infrastructure, agriculture production and human settlement, and result in losses of livestock and human lives.

Flood from Mekong River and its tributaries in 2005 were considered as the highest affecting at central and southern low – laying rice production areas. The districts were highest damaged by food are: Hinboun, Nongbok, Thakhek, Mahaxay, Atsaphone, Champhone and Songkhone

(Khammuane and Savannakhet provinces). The extreme weather monitoring and accurate of forecasts and warnings at DMH of Laos is a great importance to assist the government and public users to take prevention activities.

- **Aspect of DMH and community relationship that must be strengthened:**

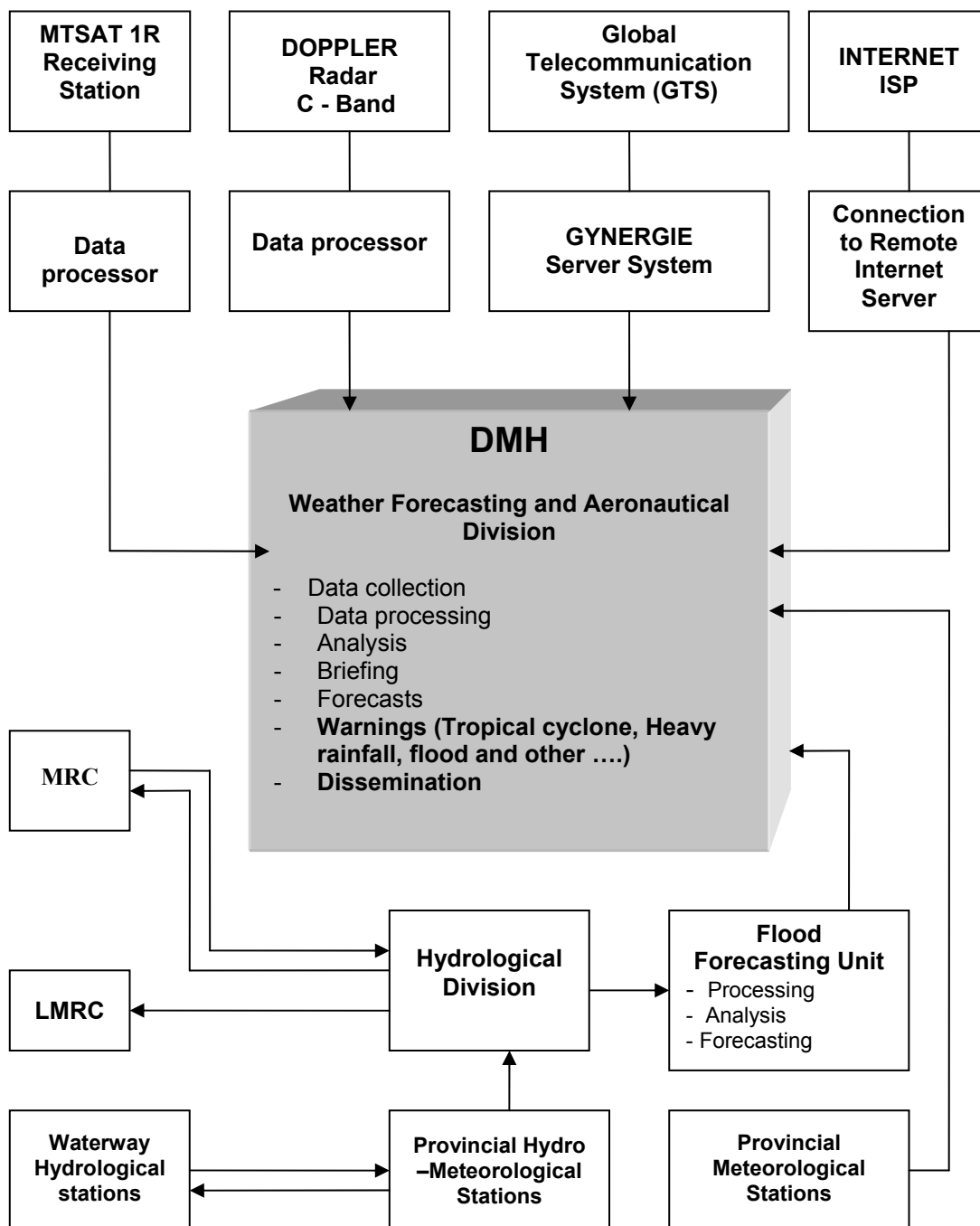
- Improvement of tropical cyclone monitoring capability.
- Upgrade of precision rainfall monitoring under coverage areas of Radar.
- Improvement of accurate weather, flood forecast and warnings information and dissemination in proper and timely manner.
- Increase of issuance of forecasts and warnings during severe weather condition.
- Especially this rainy season, DMH plan to disseminate directly the early warnings to community at some flood risk areas of Khammuane and Savannakhet provinces.

- **Recommendation:**

For today real - time of hydro - meteorological data from main tributaries for flood a forecasting of Mekong River in Laos is very limited. Means hydro–meteorological network as well as telecommunication need to be extended.

- National Flood Forecasting Center should be established at DMH LAO PDR and flood forecasting site need to be implemented at some main tributaries.
- The technique, facilities and training on flood forecasting need to be improved and help from outside
- Communication and awareness on utilize the hydro – meteorological information to the local community at flood risk areas need to be improved.
- Telecommunication for early warning dissemination need to be extended at flood risk areas (district to village levels).
- Flood mapping is very necessary at flood risk areas should be established.
- Mechanism, methodology, Human and tools for flood preparedness, flood forecast and warning system should be established.
- The DMH suggestion is to have the FMM (MRCs) medium and long – range flood forecasting for prevention activities.

Structure of Data Collection in DMH Lao PDR



Annex 2

LAO PEOPLE'S DEMOCRATIC REPUBLIC
Peace Independence Democracy Unity Prosperity

Ministry of Agriculture and Forestry
Department of Meteorology and Hydrology

FORECASTS BULLETIN

Forecast issued at: 10:00 am August 19, 2005

Forecast period: 20 - 21 August, 2005

No	Stations / River	Rainfall in (mm)	Water level In (m)			Warning	Danger	Forecasted Water level	
			18 Aug	18Aug	19Aug			Diff.	20Aug
1	Pakbeng (Mekong)	2.5	21.12	23.01	1.89	29.00	30.00		
2	Luangprabang (Mekong)	24.5	15.25	15.93	0.68	17.50	18.00	16.88	17.35
3	Vientiane (Mekong KM 4)	19.8	8.82	10.43	1.61	11.50	12.50	11.43	12.35
4	Paksane (Mekong)	14.5	12.89	13.15	0.26	13.50	14.50	13.96	14.46
5	Thakhek (Mekong)	40.0	13.12	13.29	0.17	13.00	13.50	13.42	13.82
6	Savannakhet (Mekong)	54.0	11.30	11.60	0.30	12.00	13.00	11.69	11.75
7	Pakse (Mekong)	57.5	11.82	12.22	0.40	11.00	12.00	12.37	12.37
8	NamNgum Dam Upstream	77.0	211.06	211.52	0.46	212.00	212.31	211.98	212.48
9	Nam Ngum Dam (downstream)		169.40	169.70	0.30				
10	Inflow (Q in m3/s) to reservoir		2408.126	2179.187	-228.9				
11	Turbine (Q in m3/s)		448.221	445.421	-2.80				
12	Spil Way (Q in m3/s)								

Remarks: 0.00: No Rain
Opening Spill Way

Vientiane, 19/08/2005
Director General of DMH

LAO PEOPLE'S DEMOCRATIC REPUBLIC

Peace Independence Democracy Unity Prosperity

Ministry of Agriculture and Forestry

Department of Meteorology and Hydrology

WARNING No03.....

Warning issued by DMH at: 10:00 am 18 August, 2005

Tropical Cyclone and flood Warnings

The strong SW monsoon from Bay Bengal over Laos and is associated with TD over Gulf of Tonkin (20.0 N/107.2E) at 07:00 am 18/8/2005 is forecast to move northwest about 8 kts and estimated over land of Vietnam this afternoon and move over northern of Laos at 20.0N/103.0 E in mid – night.

Heavy rain with speed winds 10 – 15 mps will be expected at Bolikhamxay and Khammuane areas. Light rain with thunders over Vientiane, XK, SN, VS, OS and LB. Therefore inhabitants within these above mentioned areas are advised to be aware of damages which may be caused by flash flood.

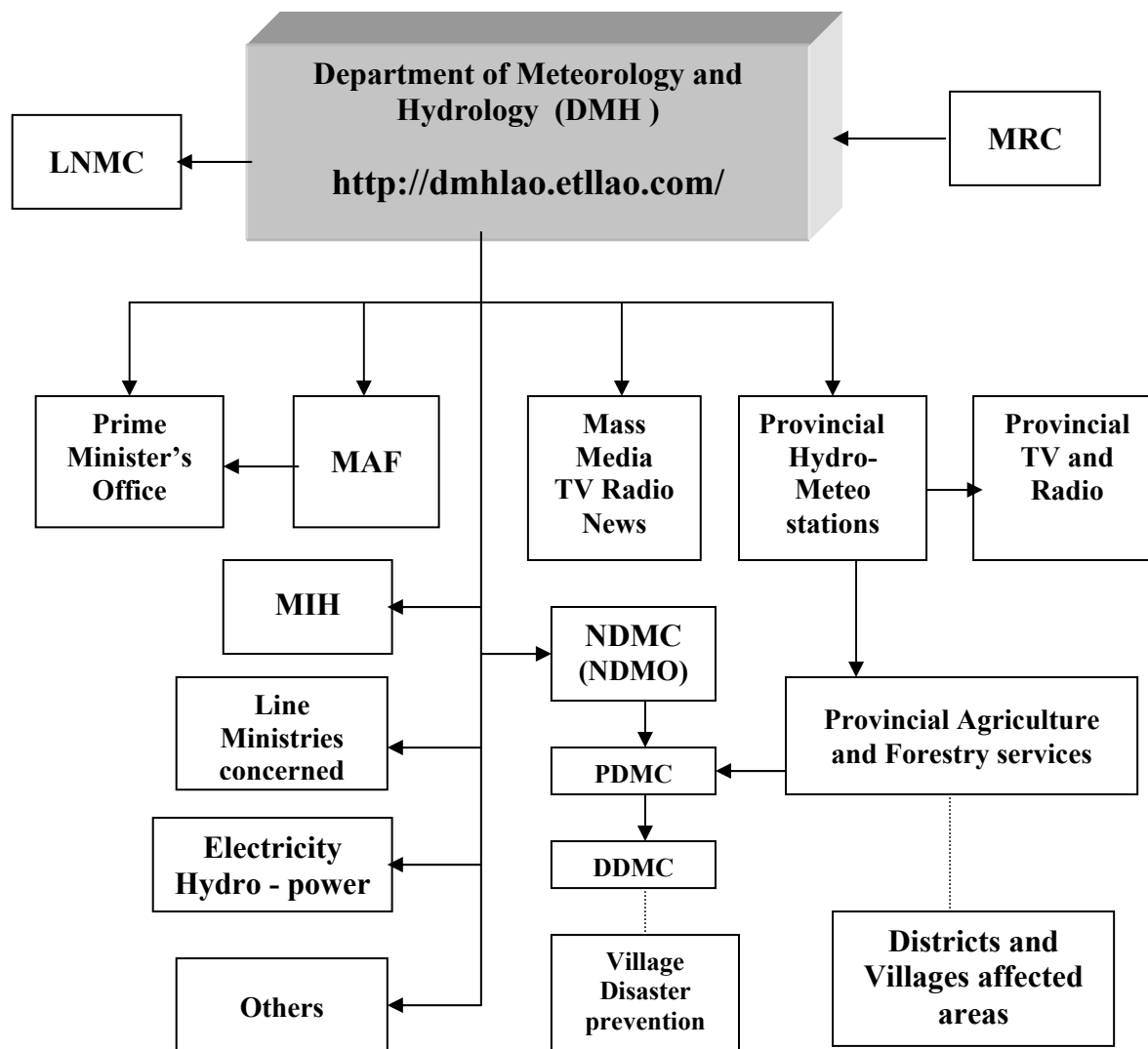
For today water level at 07: 00 am at Pakxan station is 13.15 m (warning level is 13.50 m and Danger level is 14.50 m). In addition by local heavy rainfall the water level forecast must be exceeded warning level on tomorrow morning. The latest water level forecast for tomorrow morning at Pakxan station is 13.96 m and for day after tomorrow is 14.46 .Therefore inhabitants who lives at low – lying areas are advised to be aware of damages which may be caused by flood.

Please follow next warning for the necessary action taking.

Vientiane, 18/08/2005

Director General of DMH

Dissemination structure for Forecasting & warning in Lao PDR.



Remark: Lack of Telecommunication system

LNMC: Lao National Mekong Committee

MRC: Mekong River Committee

MAF: Ministry of Agriculture and Forestry