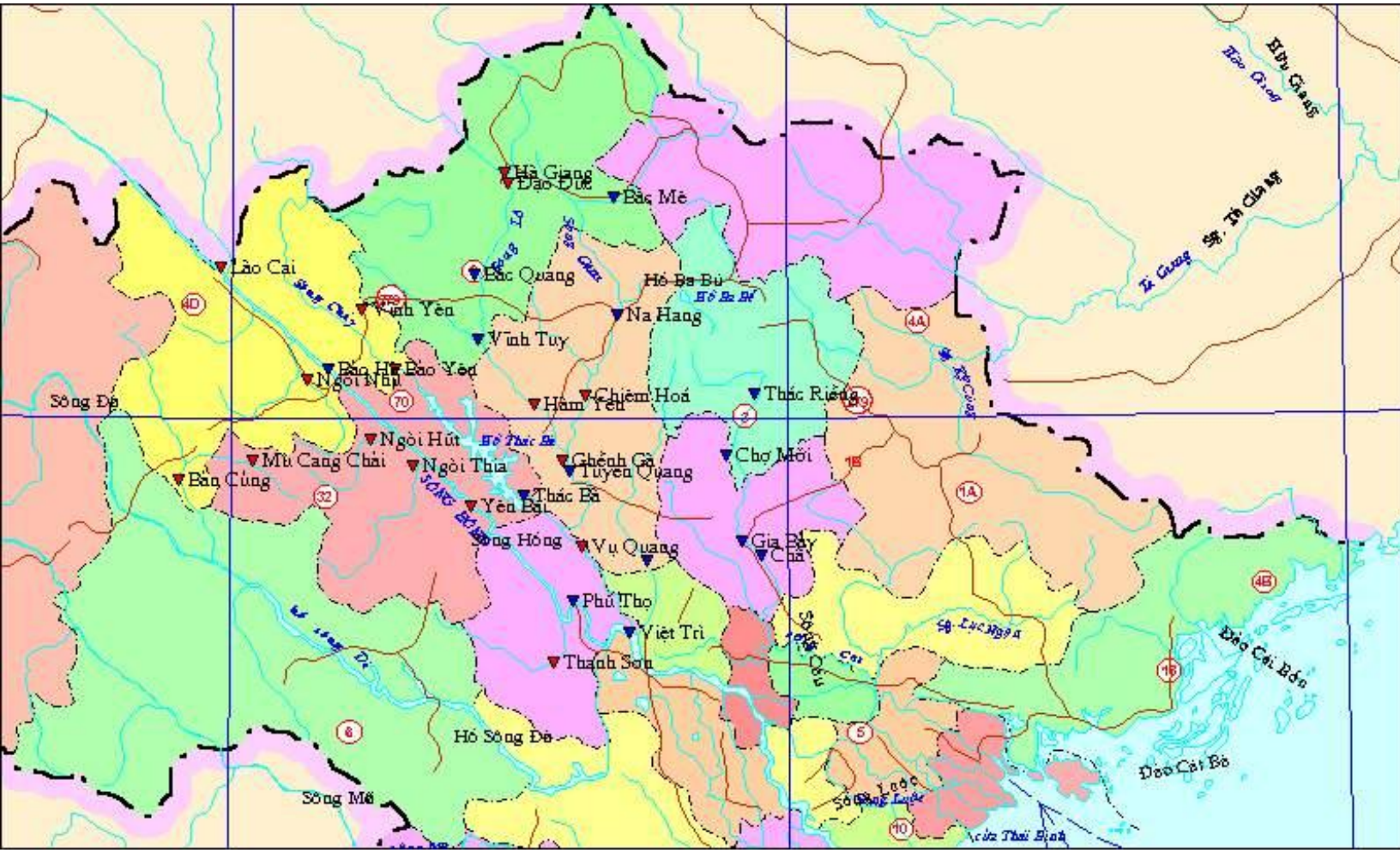
UNJP/VIE/037/UNJ

"Strengthening Capacities to Enhance Coordinated and Integrated Disaster Risk Reduction Actions and Adaptation to Climate Change in Agriculture in the Northern Mountain Regions of Viet Nam"



Training Needs Assessment for Provincial and District Staff on Forecast Products and Early Warning Information

Hanoi, 2011

Table of Contents

1. Introduction

Viet Nam is prone to natural disasters, with typhoons, storms, floods, droughts, mudslides, forest fires and salt-water intrusion presenting recurring risks, especially for children, women, and the elderly. Every year, the country suffers directly from six to ten storms and tropical depressions causing heavy rains and flooding. Viet Nam is considered as one of the most vulnerable countries to the impacts of climate change and associated phenomenon such as sea level rise, increased frequency of natural disasters like typhoons, floods and droughts. Annual average temperature during the last fifty years (1951 - 2000) in Viet Nam increased by 0.7ºC and was higher than annual average value of the previous decades (from 1931 to 1960).

Agriculture is the largest employer (57 percent of the total labour force) and will continue to play a significant role in employment creation and poverty reduction. The agriculture activities are highly exposed to recurring natural hazards especially in most vulnerable areas including northern mountain region. In recent years, disaster occurred in mountainous areas with increasingly unprecedented severity and scale, devastating small watersheds, causing serious losses in term of human lives, properties and ecological environment. The year 2008 has been one of the worst in terms of impacts of storms and floods. During August 2008 tropical storm Kammuri caused severe damages in North Viet Nam, particularly in Phu Tho, Yen Bai and Lao Cai Provinces. In early November 2008, heavy rain and flooding affected twenty provinces in the region. Floods in mid-November once again resulted in loss of 208,719 ha of rice and 26,130 ha of aquaculture and extensive irrigation infrastructures. The economic losses exceed USD 430 million.

In response to the flooding in 2008, at the request of the Government of Viet Nam through the Ministry of Agriculture and Rural Development (MARD), the Food and Agriculture Organization (FAO) funded project UNJP/VIE/037/UNJ titled "**Strengthening Capacities to Enhance Coordinated and Integrated Disaster Risk Reduction Actions and Adaptation to Climate Change in Agriculture in the Northern Mountain Regions of Viet Nam**" will assist MARD and the Central Committee for Flood and Storm Control (CCFSC) at various levels in strengthening technical and institutional capacity building for preparedness and mitigation taking into account the consideration that preparedness is based on the analysis of disaster risks, good early warning systems and linked to climate change adaptation and long term development. The target beneficiaries are the most vulnerable communities affected by recurrent climate related risks, especially those in the Northern Mountain Regions. As a pilot project, communities in three provinces (Phu Tho, Yen Bai and Lao Cai) within the Northern Mountain Region will be selected as "targeted beneficiary communes".

Together with technical capacity building, measures to enhance institutional support services is required to enhance coordinated and integrated disaster risk reduction (DRR) actions and adaptation to climate change at local level. Two major aspects are considered for improvement: (i) improving provincial, district and community level seed production, storage and maintenance and (ii) make available usable early warning products including weather/climate forecast products for agricultural applications. And, the project component **"Improvement of Early Warning and Weather/Climate Forecast Systems in Northern Mountain Region"** is implemented to address the second aspect.

The major activities of project component include:

- review the existing early warning systems and products available at the national level and document the strengths and weaknesses of the system in addressing needs of the MARD/DARD at national and provincial levels;
- strengthen the existing forecast products at the provincial level, ensuring timely information and communication flow as needed between district and national levels;
- discuss the climate change scenarios results and impacts relevant to northern mountain region with MARD in close collaboration with Department of Scientific Technology and Climate Change Adaptation;
- assess training needs related to understanding of available forecast products at national, provincial and district levels with MARD/DARD;
- organize training programme to the provincial and district level staff to familiarize existing forecast products and early warning information and its application in agriculture for risk reduction

This report focuses on the assessment of training needs related to understanding of available forecast products at national, provincial and district levels with MARD/DARD, especially for 3 pilot provinces (Phu Tho, Yen Bai and Lao Cai).

Main information to be gathered through investigation included natural disaters and their impacts during the past 10 years and their tendency in the years to come in the three pilot provinces; available weather, climate and hydrological forecasts and warnings for the pilot provinces; end-users' awareness and ability in use/ intepretation of meteorological and hydrological forecasts and warnings for taking appropriate decisions on preparedness and response measures and gaps to be filled, training needs and topics.

2. Training assessment

2.1 Site survey

2.1.1 ***Geographical and climatic characteristics of Lao Cai, Yen Bai and Phu Tho Provinces***

Lao Cai, Yen Bai and Phu Tho are mountainous provinces in Northern Viet Nam. Their topography is complex and divided by differently oriented mountainous ranges and river valleys of major river systems, such as the Red river and the Lo River. In these provinces, rainy season begins in April and ends in October. Due to complicated and slope topography during rainy season there is a significant number of flash floods and landslides causing serious damages in human lives and properties. In contrast, during dry season lasting from November to March of the following year, drought and water scarcity occur very seriously.

The Lao Cai Province is located in the northeastern mountainous region of Vietnam. The topography is very complex, with high mountains range that divide several valley lowlands, to create different climatic zones. In fact, more than 80% of the province' s area has slopes over 25o. The province covers an area of almost 6,400 km2. Altitude ranges between 80m and more than 3,000 masl. Two rivers run through the Province, the Thao River (130 km) and the Chay river (124km). The flow distributes according to the seasons: in the flooding season, starting from May and June until September and October; and the dry season starting from October, November to April and May of the next year; flow in flooding season accounts for 70 - 75% of yearly flow. Groundwater resources contain reserves of approximately 30 million m3.

Main soil types include the Red yellow, found in lower altitudes and accouting for more than 40% of the province' s natural area. This soil is highly fertile and suitable for long-term industrial crops and annual trees. In addition, the Yellow red humus can be found in Lao Cai, accounting for over 30% of the natural area.

Climate in the province is characterized by tropical monsoon climate influenced a subtropical and temperate zone in some areas, favorable for agriculture, forestry, husbandry development, especially for many kinds of plants and animals with high economic value such as temperate fruit trees, herbs, cardamom, sind hybird cow. There are two main seasons: a rainy season spanning from April to October, and a dry season starting from October to March. The average annual temperature ranges from 22 to 24 oC, and rainfall varies between 1,400 mm and 3,000 mm. Average annual humidity is over 80%.

Population in Lao Cai reaches 589,500 (2007) including 314,520 people in working age (accouting for 53%). There are 25 ethnic groups living in the province, including Kinh group (35.9%), H'mông group for (22.21%), Tay group (15.84%) and Dao (14.05%) among others.

The Yen Bai Province is a mountain province characterized by high terrain and by three major mountain ranges running in direction Northwest – Southeast that divide the province in two major areas: the highland on the West, with average elevation over 600 m and accounting for 67% of the province's surface. The lowland on the East, characterized by elevations below 600 masl, mainly low hilly terrain, including the Red river valley basin and an artificial lake with a surface of 20,000 hectares. The total natural area of the province is 6,899.5 km2, accounting for 2% of the country's natural area. In 2007, the province counted a population of 749.1 thousand people with an average population density of 109 people/km2 but unevenly distributed among regions.

The main kind of soil in Yen Bai province is gray soil (82.36%), the remaining is alit humus, alluvial, clay soil and red soil. The province's climate is tropical monsoon, with an average temperature of 230C. Rainfall ranges between 1,400 and 2,400 mm/year, favourable for agriculture-forestry development. Based on the climate characteristics, Yen Bai province is divided into 5 climatic sub-regions.

Two major rivers flow through the province: the Thao and the Chay rivers, both flowing the the Lao Cai province. The Red and the Chay rivers have abundant potential to provide for irrigation water for agriculture and forestry production and as water source for communities living in riparian zones. Overall, this province had sufficient surface water to satisfy the demand of life and production. However, due to the characteristics of the terrain, climate impacts and the consequences of deforestation for many years, among other factors, the water level between rainy and dry season has changed considerably. During the dry season, the water level of rivers and streams is very low. Water for irrigation is not enough, and the Thac Ba hydroelectric plant operates in adverse conditions. To the West, dry weather and the depletion of streams causes water shortages for production and human consumption. On the other hand, during the rainy season, water discharges and levels rise quickly, causing frequent flash floods and damaging crops and infrastructure.Overall, water in large rivers and streams is of good quality and less contaminated, thus meeting the requirement of agriculture-forestry production and for human consumption.

The Phu Tho is a mountain province located in Northern midland, in the area of exchange between the Red River Delta and the northwest region. The province's total area is about 3,500 Km2. According to its geographic characteristices, it can be divided into the southern and western mountain sub-region (64% of total area) at an average height of 200m - 500m above the sea level; the midland sub-region that has a topography with low hills and mounds of 50m - 200m intermixing with fields' slopes and the delta sub-region, an ancient alluvial soil and field along the rivers including some areas with low mounds, fairy even and flat terrain.

Currently, about 54.8% of the potential agricultural - forestry land has been used; 81.2 thousand ha remain unused including 57.86 thousand ha of hills and mountains. Soil assessments in Phu Tho showed that land can be used to plant material trees serving for some processing industries. Productivity in some places can be improved and the land-use coefficient has the potential to rise up to 2.5 times (the land use coefficient currently reaches 2.2 times) for the protection and enrichment of land resources for industrial and urban development.

The Province has tropical monsoon climate, with cold winters and a rainy season extending from May to October. The annual average temperature is about 23oC, and rainfall ranges between 1,600 and 1,800mm annually. Average annual humidity is relatively high, at 85-87%. Major rivers in the Province include the Thao, Lo, Chay, Pho and Day rivers. They bring abundant water resources. River flow regulation depends on rainfall, consistent with the rainy and flooding season lasting for 5 months (from June to October). The flow in flooding season accounts for about 71% of the year's flow.

Population in Phu Tho reaches 1,300,000 people, of which rural population accounts for 85%. There are 28 ethnic groups, the largest being the Kinh group, with 1,044,979 people, accounting for 85.89% of the province's total population.

2.1.2 ***Main natural disasters occurred in Lao Cai, Yen Bai and Phu Tho provinces***

The main natural disasters occurred in the three pilot provinces are flood, flash flood, inundation, drought, hail, thunderstorms, cold surge, forest fire. Flood, flash flood are often recorded during rainy season from May to August. Drought and associated forest fire occur in the period from December to April next year. During the past 10 years (from 2001 to 2010), there were some natural disasters recorded in the 3 provinces causing a lot of losses in human life and property to the local people, namely:

- Flash flood: 29-31 July 2002 in Lao Cai;
- Flash flood: 19 July 2005 in Van Chan, Tram Tau, Mu Cang Chai, Nghia Lo Town – Yen Bai province;
- Flash flood: 8-9 August 2008 in Bat Xat, Sa Pa, Bao Thang and Bao Yen – Lao Cai Province;
- Drought: occurred in the 6 first months of 2010
- Cold surges: recorded in the begining of 2008 and 2011

Table 1: Time of occurrence of weather, climate and water related disasters in the Northern mountainous areas (including Phu Tho, Yen Bai and Lao Cai provinces)

Disaster type	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Cold surge	X											X
Drought		X	X	X	X							
Forest fire	X	X	X	X								
Thunderstorm, hail				X	X	X						
Flood, flash flood						X	X	X	X			

The affect of natural disaster and abnormal weather phenomena occurred in the recent years likely has an increasing tendency. Natural disasters such as flood, flash flood, tonado, thunderstorm, lightning, hail, cold surge, heavy rains associated with tropical cyclones, etc occur likely more often, with higher intensity, more complecated and more difficult to be predicted. In the three pilot provinces (Phu Tho, Yen Bai and Lao Cai), period of possible occurrence of disasters is longer, from December in previous year to August, September next year

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2.1.3 ***Meteorological and hydrological observation networks in Lao Cai, Yen Bai and Phu Tho provinces***

There is a list of major meteorological and hydrological observation stations in these provinces as shown in the table 1.

Table 1: List of the meteorological and hydrological station networks in the Viet Bac region

Meteorological Stations

No	Province	Station
1	Lào Cai	Bắc Hà
2		Lao Cai
3		Sa Pa
4		Phố Ràng
5	Yên Bái	Lục yên
6		Mù Cang Chải
7		Văn Chấn
8		Yên Bái
9	Phú Thọ	Minh Đài
10		Phú Hộ
11		Việt Trì

Hydrological Stations

No	Province	Station	River
1	Lào Cai	Bản Củng	Nậm Mu
2		Lào Cai	Hồng
3		Ngòi Nhù	Nậm Mít
4		Bảo Hà	Hồng
5		Bảo Yên	Chảy
6		Vĩnh Yên	Nghĩa Đô
7	Yên Bái	Mù Cang Chải	Nậm Kim
8		Ngòi Hút	Hút
9		Ngòi Thia	Ngòi Thia
10		Thác Bà	Chảy
11		Yên Bái	Hồng
12	Phú Thọ	Phú Thọ	Hồng
13		Thanh Sơn	Bứa
14		Việt Trì	Lô
15		Vụ Quang	Lô

Figure 1. Meteorological observation network in the Mid-Northern (Viet Bac) region

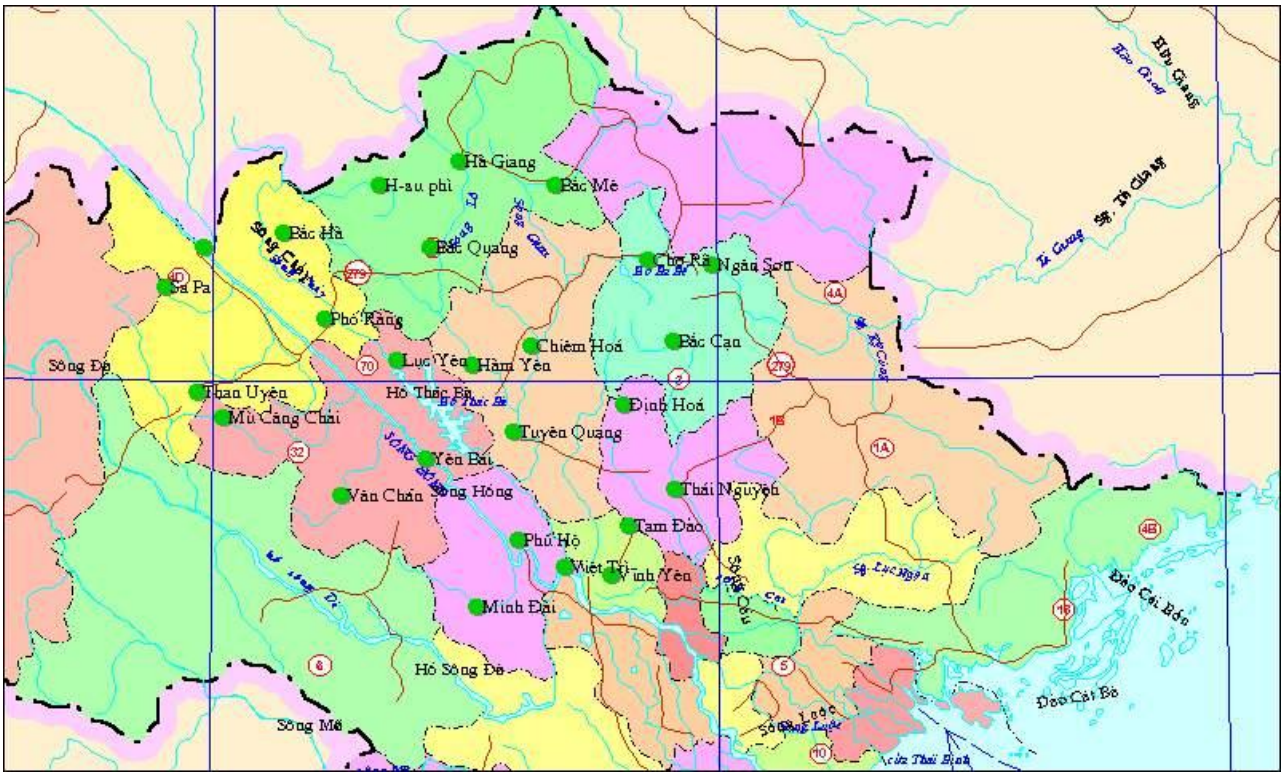
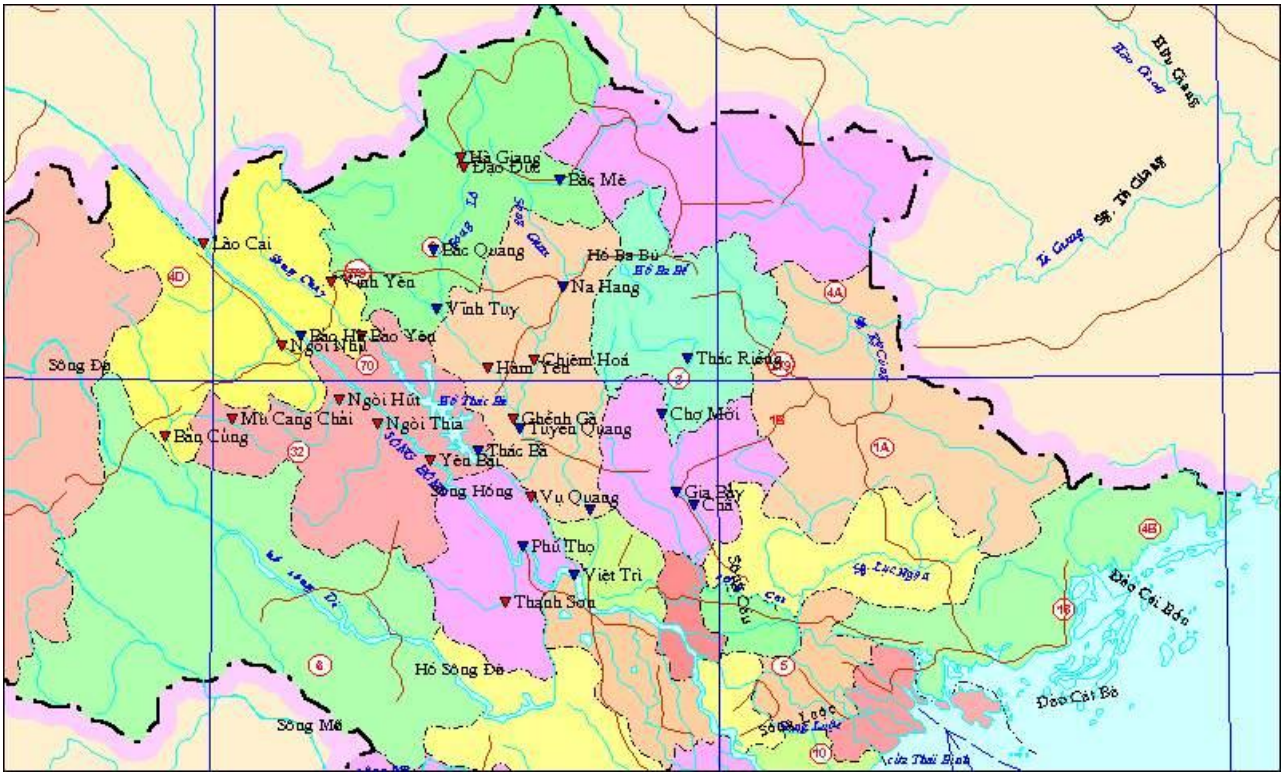


Figure 2. Hydrological observation network in the Mid-Northern (Viet Bac) region



2.1.4 ***Study on trends of annual mean temperature and rainfall in recent years***

In this paper data of monthly mean temperature and monthly rainfall in 3 stations of 3 investigated areas including Sa Pa (Lao Cai), Yen Bai (Yen bai) and Phu Ho (Phu Tho) of period 1980-2010 are used. During period of above mentioned 3 decades annual mean temperature of the 1st decade 1981 - 1990 in all 3 stations was exceeded that value of 2001 - 2010 in 0,1°C, 0,4°C and 1,5°C respectively (table 1). In parallel, increasing trend in temperature in above mentioned areas also observed in Fig 1 with temperature trend equations in forms:

- For Sa Pa: y = 0.0062x + 15.249
- For Yen Bai: y = 0.0191x + 22.874
- For Phu Ho: y = 0.0703x + 21.904

Table 2. Annual mean temperature (°C) during 1981 - 1990 and 2001 - 2010

Decade	Sa Pa	Yen Bai	Phu Ho
1981 - 1990	15,2	23,0	22,1
2001 - 2010	15,4	24,4	23,6
Difference	0,2	0,4	1,5

As for the trend in rainfall during last 30 years mean rainfall of decade of 1981 - 1990 in all 3 stations Sa Pa, Yen Bai and Phu Ho is below that value of decade of 2001 - 2010 in values of table 2. In parallel, decreasing trend in annual rainfall is showed in picture 2 with rainfall trend equations in following forms:

For Sa Pa: y = -13.438x + 2962.8

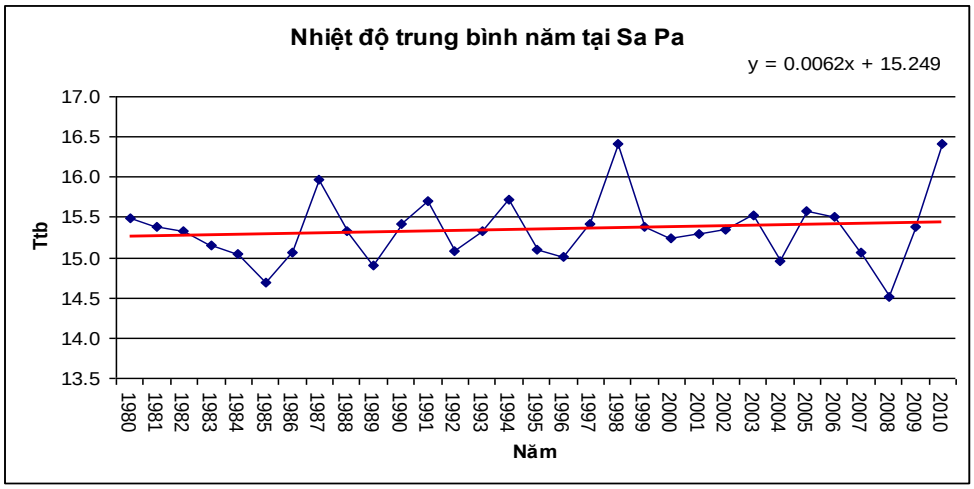
For Yen Bai: y = -13.305x + 2053

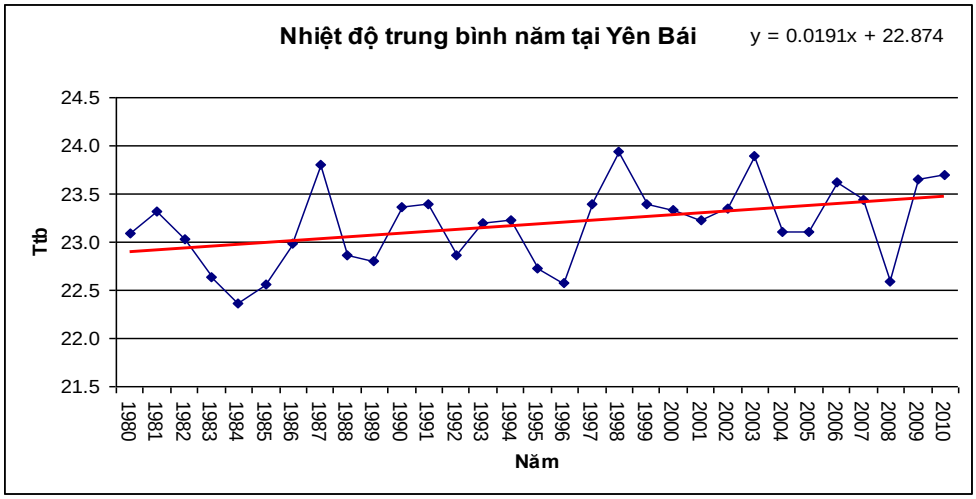
For Phu Ho : y = -23.18x + 1933.7

Table 3. Mean rainfalls (mm) during 1981 - 1990 and 2001 – 2010

Decade	Sa Pa	Yen Bai	Phu Ho
1981 - 1990	2868	1967	1705
2001 - 2010	2669	1701	1423
Difference	-199	-266	-281

Figure 3. Annual mean temperature trends in Sa Pa, Yen Bai and Phu Ho.





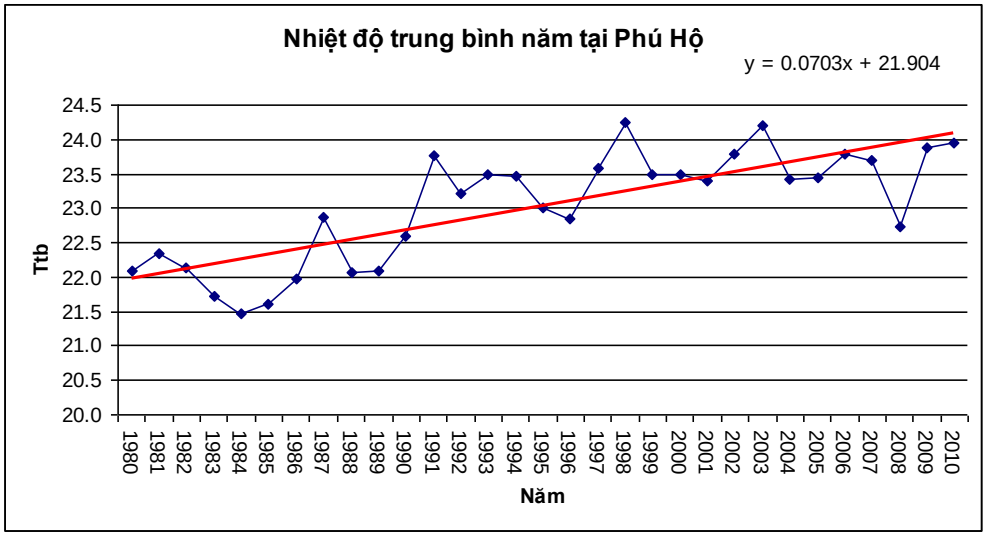
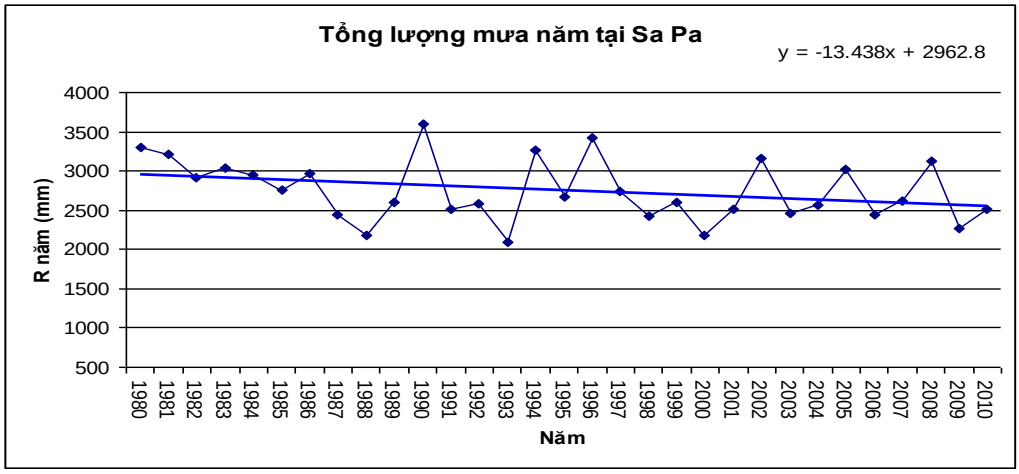
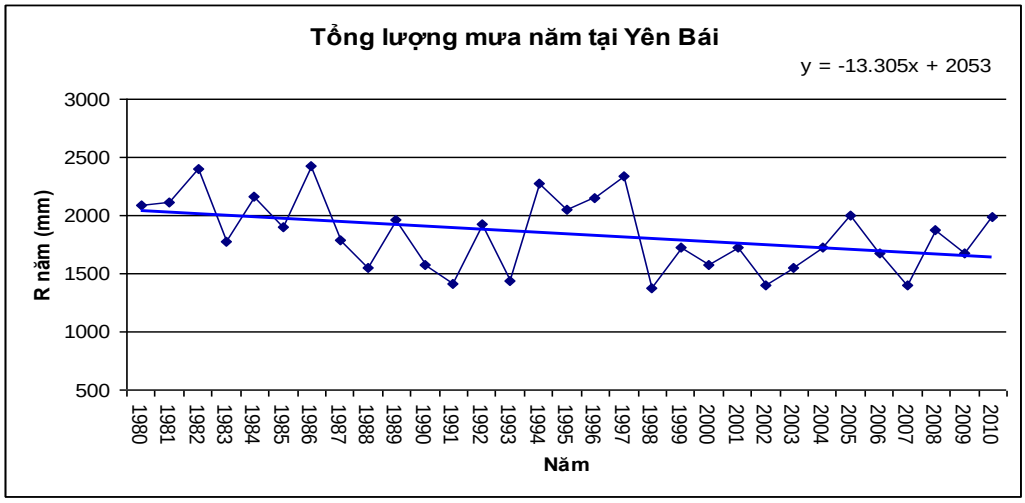
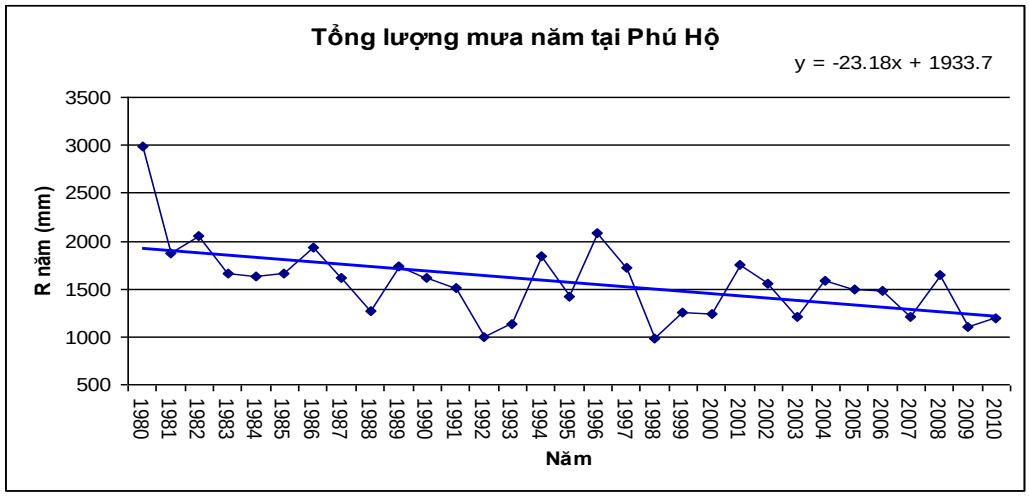


Figure 4. Trends in annual rainfall in Sa Pa, Yen Bai and Phu Ho







2.1.5 ***Remarks***

Climate change increases variation, anomalies and extremeness of weather phenomena such as droughts, torrential rains, floods, flash floods, squalls, thunderstorms, tropical storms, etc, especially when they are associated with El Nino, La Nina.

Variations in circulation regimes, including atmospheric disturbances, moisture contents and water evaporation will lead to variation in rainfall amount and spatial and temporal rainfall distribution. As a consequence, it results in variation in water regime and water resource and water levels in water reservoirs. According to IPCC 2007 Report, annual mean currents could be increased in 10-40% in high latitude regions and tropical wet regions but that could be decreased in 10 - 30% in dry regions of middle latitude regions and tropics. Moreover, areas affected by droughts could be expanded, extreme rains could occur more frequently and the risk of floods and inundation could be increased.

Global warming and impact of climate change are not only affecting worldwide areas but small regions. This factor can be observed in this study as trend in increasing temperature and decreasing rainfall in above mentioned areas. However, study that is more serious should be carried out for other weather elements.

2.1.6 ***Meteorological and hydrological forecasts and warnings in Lao Cai, Yen Bai and Phu Tho provinces***

The provincial hydro-meteorological center of Lao Cai, Yen Bai and Phu Tho belong to the Mid-Northern Regional Hydro-Meteorological Center under the National Hydro-Meteorological Service of Viet Nam (NHMS). Their tasks are providing meteorological and hydrological forecasts and warnings for disaster prevention and preparedness and socio-economical development in each province.

They issue daily meteorological and hydrological forecasts. In case of significant meteorological phenomena they will provide forecasts and warnings for tropical storms, cold air surges, thunderstorms, floods, etc. These weather and hydrologic forecasts and warnings are sent to local authorities, committee for disaster prevention and preparedness, Red Cross organizations and public media for taking appropriate actions

Apart from these tasks, provincial hydro-meteorological centers collaborate with provincial media for educating public on disaster prevention and preparedness, climate change and environmental protection to enhance the knowledge and awareness of commune population.

Government's Decision No 929/QĐ-TTg dated 22/6/2010 on Development Strategy of Meteorological and Hydrological Services toward 2020 emphasized the important role of NHMS in socio-economical development and national defense and security, especially in disaster prevention and preparedness**.** It also emphasized the necessity of investment in meteorological and hydrological services for improving accuracy of weather, climate and hydrological information and forecasts and warnings to serve disaster prevention and preparedness, sustainable socio-economic development, security and national defense in the context of climate change. This Government's Decision also pointed out that in the near future provincial hydro-meteorological centers could receive significant investments for strengthening their capacities, especially in promoting hydro-meteorological observation network by equipping modern stations, measurement devices as well as forecasting techniques and methods for improving contents and forms of weather forecasting bulletins and warnings to match the requirements of economical developments and population communities.

2.2 Comments/views of provincial authorities and relevant agencies on meteorological and hydrological forecasts and warnings

The official letters were sent to the provincial authorities and relevant ministries and agencies asking their comments/ views on the existing weather, climate and hydrological forecasts and warnings as well as recommendations for improvement of the bulletins in the future. The feedbacks from Lao Cai, Yen Bai and Phu Tho People's Committees and some relevant agencies are as the following:

Org	Comments/ recommendations
Yen Bai DONRE	- Yen Bai DONRE, DARD have not yet received hydro-met. Forecasts and warnings from Central Hydro-Met. Forecasting Center as well as from Mid-Northern Regional Hydro-Met. Center. - It is recommended to issue specialized hydro-met. Bulletins to serve economic activities such as: aquaculture, transportation, reservoir management, hydro-power, etc. - Regarding agricultural meteorology, it is recommended to describe influence of weather on crop calendar, farming practices and plant and husbandry protection. - Regarding delivery mean, it is recommended to send forecast and warning bulletins not only through post but also through email.
Phu Tho DONRE	**1. About content of hydro-meteorological forecasts and warnings:** At present, the People's Committee and relevant departments only receive decadal, monthly hydro-met. Bulletins and seasonal outlooks. It is recommended to add more information on: - Tropical depression and tropical cyclone forecasts; - Flood forecasts and warnings; - Short-range weather and hydrological forecasts. **2. About form and mean of forecasts bulletin delivery**: Beside of provision of hydro-met. Information in paper form through post offices, it is recommended to upload the information to internet.

Tuyen Quang DONRE	**1. Regarding hydro-meteorological bulletins issued by the Mid-Northern Regional Hydro-Meteorological Center, it is recommended to add the following information:** - Warnings of severe weather phenomena such as: flash flood, thunderstorms, squalls, landslides. - Short-range hydrological forecasts. **2. Regarding hydro-meteorological bulletins issued by the provincial hydro-meteorological centers, it is recommended to add the following information:** - Warnings of severe weather phenomena such as: flash flood, thunderstorms, squalls, landslides for smaller area. - Short-range hydrological forecasts. **3. Regarding contents of forecast bulletins: For short and medium range hydrological forecasts, it is recommended to put value of water discharge measured at hydrological stations in the bulletins.** **4. Regarding delivery mean:** - For hydro-power plan: It is recommended to have a regulation of partnership between DONRE and Hydropower company in provision of river observation and measurement data. - It is recommended to establish a link between Central Hydro-Meteorological Forecasting Center, Regional Hydro-Meteorological Center, Provincial Hydro-Meteorological Center and DONRE on weather, climate and hydrological information and forecasts. **5. Recommendations** - Establishing some more meteorological and hydrological stations. - Building some flood monitoring stands in the province. - Organizing public awareness raising workshops for disaster managers and relevant units from provincial down to commune levels.
The Voice of Viet Nam (VOV)	**Recommendations:** - To add summary of weather situation in various regions in the past before weather forecast bulletin. - To issue weekly weather forecast and provide it to VOV on Monday each week; to issue and provide to the Voice of Viet Nam a monthly climate forecast to broadcast at the beginning of each month. - To arrange at least one staff to collaborate with VOV in broadcasting, analyzing abnormal weather phenomena as well as in participating in Q & A forum. - To issue seasonal climate and hydrological outlook and provide it to VOV to put in Programme of Agriculture and Rural Development. - To issue weather forecasts over the sea. - To increase the number of tropical cyclone and flood forecast and warning bulletins in case of tropical cyclone and flood. To simplify wording in the bulletins so that thay are easy understandable and usable.

National Committee for Search and Rescue	For improving quality of hydro-meteorological forecast and warning bulletins to better serve natural disaster risk reduction and search and rescue activities, it is recommended that: - Forecast occurrence and development of extreme severe weather phenomena; forecast hydrological parameters that may lead to flood, inundation with various lead-times. - For weather situation that may lead to heavy rains causing flood, flash flood, landslide, etc. the number of bulletins should be more, the information should be more detailed and accurate. - Add short clear detailed easily understandable guidance on severe weather, hydrological phenomena - Minimize using specialized wordings in hydro-meteorological forecast bulletins. - Improve quality of marine meteorological forecast, warnings and advisories - Improve forms and contents of forecast and warning bulletins. For this purpose, it is recommended to have a feedback mechanism to get comments/views from end-users on the exist bulletins. - Collaborate with mass media agencies to broadcast comprehensive adequate easily understandable and updated information on weather, coming disasters through mass media facilities.
Ministry of Industry and Commerce	**Comments:** **1. existing meteorological and hydrological forecast and warning bulletins:** - Information for hydro power generation is rather adequate in number of forecast bulletins. - Information in big river systems: Red – Thai Binh river, Dong Nai river has rather high accuracy and meets requirement of correct forecast exceeding 80% for medium and short range forecasts. - Information in small river basins, especially in the Central Viet Nam has accuracy of about 70% for medium and short range forecasts. **2. Recommendations:** - In general, quality of forecast bulletins is good only for some river basins, but for majority of rivers the forecast accuracy is still limitted. It is recommended that new forecast technology be introduced to adapt with local topography in order to improve the forecast accuracy. For big river basins such as Red – Thai Binh, Dong Nai, thank to quite good observation station network, accuracy of forecasts is rather high. For small river basins, due to sparse station network the accuracy of forecasts is lower. The present forecasts mainly give values of water level and discharge at several measuring points in a certain river basin, they can not show whole the picture of flow behavior over the basin, that may affect accuracy of forecasts of in-flow water to reservoirs. It is recommended that more stations be set up in the basin where hydro-power plans are under operation or planned to be built in the near future in order to rationally and effectively manage reservoirs. - Beside provision of daily numerical forecasts of water level and discharge at hydrological stations, it is recommended to provide additional rainfall forecast within 24 hours to come. - Regarding seasonal outlooks, it is recommended to add information of possible dates of start and end of coming flood season in comparison to mean values. It is also recommended to add information of special weather phenomena during the season, for example, in El Nino or La Nina year, the distribution of river flow may be directly affected.

Ministry of Construction	1. To issue specialized information and forecast bulletins for various stakes holders/ end-users. It is recommended to conduct survey on demands/ requirement of end-users to meteorological and hydrological services. In case of Ministry of Construction, beside existing weather, climate and hydrological information, the forecasts and warning of rainfall and urban inundation in big cities are very necessary. 2. It is recommended to publicize mean values of climatic and hydrologic parameters and factors to help construction sector in making infrastructure construction projection.
Ministry of Transportation	**Recommendations:** 1. To clarify monsoon warning bulletins could be considered as strong wind warning bulletins mentioned in the Decision No 133/2009/QĐ-TTg dated 03/11/2009 or not? 2. Amendment, correction: - To add information of possible affected areas, sheltered areas (area, technical features: capacity, operation area, etc.) and warning time of area in danger, sheltered area should be synchronous and unity between forecast and warning bulletins and advisory bulletins. - To provide additional bulletins in English at the same time, frequency and the same contents as in Vietnamese version bulletins. - To add final monsoon warning bulletin. 3. Delivery mean: - Setting up collaboration mechanism between authorized agency to issue forecast and warning bulletins and bulletin receiving, interpreting units. Based on this, it is recommended to set up agreements on provision, receiving of meteorological and hydrological forecast and warning bulletins to ensure that the bulletins are provided and received correctly, timely and reliably. - There should be a specialized channel for meteorological and hydrological forecast and warning bulletins delivery

3. Conclusions and Recommendations

3.1 Conclusions

In general, weather, climate and hydrological information, forecasts and warnings timely and effectively serve disaster risk reduction activities and socio-economic development. However, in the context of global change and climate change natural disasters become more severe in terms of frequency of occurrence, intensity, predictability, the requirements for the better improved meteorological and hydrological services are increasing rapidly. In the context of weather, climate and hydrological services, the processes that make up forecasts, warnings and service delivery are:

- Data collection and analysis;
- Production of forecasts and warnings (forecast technology and skill);
- Dissemination of products and services received by users; and,
- Understanding and use of forecasts.

To improve the quality of weather products and services, NHMS must assess and analyze each step and sub-steps of the forecast process to determine where root problems may exist and how better to correct them. According to the results of assessment of training needs, all 4 components need education and training.

Within the framework of this FAO funded project the component, "understanding and use of forecasts" should be emphasized.

3.2 Recommendations

Three (3) training courses for the government staff at provincial, district and commune levels in three pilot provinces (Lao Cai, Yen Bai, Phu Tho) in understanding and use of weather, climate and hydrological forecasts and warnings to respond to increasing natural disasters due to global change and climate change are very necessary and needed.

The objectives of the training are the following:

- To familiarize the provincial staff with existing weather/climate/hydrological forecast products and early warning information and its potential application in agriculture for disaster risk reduction;
- To enhance capacity for developing localised early warning systems and weather/climate/hydrological forecast and warning information application for risk management and adaptation at the provincial level.