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CLIMATE ACTION PLAN FOR LAO CAI CITY

Responding to Climate Change from 2014–2020 and Visioning to 2030

VIETNAM

September 2014

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M-BRACE	Mekong-Building Climate Resilience Asian Cities	LGSAT	Local Government Self-Assessment Tool
NTP-RCC	National Target Program to Respond to Climate Change	DONRE	Department of Natural Resource and Environment
SEDP	Socio-economic Development Plan	DARD	Department of Agriculture and Rural Development
USAID	United States Agency for International Development	DOC	Department of Construction
PPC	Lao Cai Provincial People's Committee	DOT	Department of Transport
LCPC	Lao Cai City People's Committee	DOST	Department of Science and Technology
ISET	Institute for Social and Environmental Transition	CFSC	Committee for Flood and Storm Control
NISTPASS	National Institute for Science and Technology Plan and Strategy Studies	WB	World Bank
		AFD	French Development Agency
PMB	Project Management Board	SLD	Shared Learning Dialogue
CAFTA	China-ASEAN Free Trade Area	GDP	Gross Domestic Product
UNISDR	United Nations International Strategy for Disaster Reduction	ODA	Official Development Aid

SECTION 1
INTRODUCTION

1. OVERVIEW

In 2011, Lao Cai City was selected by the Institute for Social and Environmental Transition (ISET) to implement the project "Mekong-Building Climate Resilient Asian Cities" funded by the United States Agency for International Development (USAID). One of the main components of the project is to develop an Action Plan to Respond to Climate Change in Lao Cai City (the Action Plan) to help build and strengthen climate resilience in the urban context. An interdisciplinary working group has developed the plan, with technical support from ISET, the National Institute for Science and Technology Policy and Strategic Studies (NISTPASS) and in-depth consultations with stakeholders and vulnerable communities. The working group collected suggestions from the stakeholders and worked together to revise the draft of the Action Plan accordingly, they then shared the revised draft with stakeholders before reaching a consensus.

The action plan focuses on analyzing the current and future vulnerability of the city to climate change and uses these analyses as a basis for the identification of short, medium and long-term priority adaptive measures. This action plan applies the "no regret" approach to identify adaptive measures, which can be integrated into the existing plans and programs to enhance the city's resilience and benefit communities vulnerable to climate change. The Action Plan covers:

- Section I: An evaluation of the natural condition and the socio-economic development context for an in-depth analysis of climate change impacts at present and into the future.
- Section II: Goals and objectives to build climate resilience for Lao Cai city
- Section III: Identification of priority measures; and
- Section IV: Implementation

2. APPROACH

STAGE 1 INCEPTION	STAGE 2 RESEARCH	STAGE 3 DRAFTING THE ACTION PLAN
This is the preparation stage, which includes the initial identification of climate change impacts in Lao Cai, the establishment of a working group, and mobilizing the commitment and support of the city authorities and the community.	This stage focuses on understanding the historical and forecasted climate information, the sector and socio-economic development plans of the city, understanding in more detail the climate change impacts on Lao Cai (compared with stage 1) and assessing vulnerability. Results of this stage includes information about the types of natural disasters related to climate change which cause the most serious impacts to Lao Cai, the region, employment sectors, community groups (and who is most vulnerable), and problems that the city is facing more generally.	This stage begins with an identification of overall goals and specific objectives. Together with the vulnerability assessment, these provide the basis for prioritizing adaptive measures to minimize vulnerability and increase the resilience of the city. Specific actions are identified and accompanied with an appropriate measure. The draft Action Plan is then shared for feedback, revised, finalized, issued and approved.

To develop the Action Plan of Lao Cai city to respond to climate change, the project has used the following approaches:

Data brief and analysis

This method is used to collect information and documents related to the project, such as legal documents related to climate change of the province/city; development plans and socio-economic development plans; programs and projects related to climate change; research related to climate change; hydro-meteorological documents; natural disasters documents and information about natural resources and the environment. As there is no specialized agency for climate change in Lao Cai, this process encountered many difficulties and information was limited, particularly information related to institutions and policies and information about projects related to climate change.

Vulnerability assessment

The vulnerability assessment was conducted as follows:

i. A review and analysis of relevant documents

ii. An institution evaluation and analysis

iii. Pilot vulnerability assessments carried out in communes/wards with areas that are specifically vulnerable to the severe impacts of natural disasters

iv. Overlays and analysis of Geographical Information System maps.

The assessment was based mainly on available information and data and results of community-level surveys and interviews in five communes and wards, namely Cam Duong, Ta Phoi, Xuan Tang, Binh Minh and Kim Tan.

Field surveys

This approach is used to collect field information and confirm accuracy of the secondary information collected. The project has conducted surveys for vulnerability assessment in five communes/wards throughout the city (Binh Minh, Kim Tan, Xuan Tang, Cam Duong and Ta Phoi), and looked at water use facilities in 17/17 communes/wards of the city. During the surveys, real stories and images related to natural disasters and people's lives were recorded by the research team. The research team also conducted participatory rapid assessment using organizational analysis (Venn diagram), historical information analysis, transect walk, seasonal calendar, and facilitated interviews.

Map

The project team has collected topographic maps and maps showing the current urban and land use planning; infrastructure and population distribution planning; and risks of flashfloods and landslides. After that, maps of inundation, flashflood and landslide hazards are overlaid with maps of land use and urban infrastructure. The hazard maps used were developed based on the historic floods in May 2011, and the Red River floods of 2% and 10% frequency. Based on the overlaid maps, the project has analyzed and identified vulnerable areas and systems, level of impacts at present and in the future, and cause of impacts. This method is applied to understand the changes of flashflood and inundation impacts on the areas and infrastructure system in the city at present and in the future (corresponding to the timeframe of the city's development plan) to help develop solutions to the flashflood and inundation problem at present and in the future.

Expert consultation

This approach is applied for information that cannot be collected by the above methods. The project has organized Shared Learning Dialogue (SLD) workshops, which has involved over 70 participants from government agencies, political and social organizations and localities in Lao Cai city and Lao Cai province. The workshops have included discussions on issues and priority areas that should be considered during the project implementation phase. The project has also hosted a workshop to assess institutional issues related to climate change in Lao Cai province, with the participation of leaders from Lao Cai city People's Committee, provincial departments and agencies, and the Economic Department, and the Natural Resources and Environment Department of Lao Cai City.

Priority assessment

It is not feasible for the city to implement the climate adaptive measures all at once. Therefore, the working group has conducted priority assessment to select measures which are most urgent, economically feasible and beneficial to a range of community groups, and that the city can implement with its own resources. These selected measures are the basis of the Action Plan.

Implementation

To implement the project, Lao Cai Provincial People's Committee (PPC) has established the Project Management Board (PMB) and has assigned the Department of Natural Resources and Environment as the main contact for all departments/agencies/localities in relation to all aspects of the project implementation. The PMB is responsible for directly assisting the PPC to manage and direct the project implementation. The PMB members include leaders of the Department of Natural Resources and Environment, the Division of Environmental Protection and the Lao Cai City People's Committee.

The project has also established an extended working group, which consists of leaders and experts of the Department of Natural Resources and Environment, the Department of Construction, the Department of Agriculture and Rural Development, the Department of Transport, the Department of Planning and Investment, the Center for Hydro-meteorological Forecasting, and the Lao Cai City People's Committee. The working group is tasked with conducting the vulnerability assessment and developing the Action Plan for Lao Cai City.

3. BACKGROUND OF LAO CAI CITY

3.1. Geography

Location

Lao Cai is a mountainous city bordering China to the north. It lies on the banks of the Red River, at a latitude from 22°25' to 25°30' north and longitude from 103°37' to 104°22'east. With a good transport system, Lao Cai benefits from the development of the economic corridor of Kunming-Lao Cai-Hanoi-Hai Phong. This is a driving force to promote industrial, commercial and tourist development and enhance the role of Lao Cai as a gateway for trade with the southwestern region of China.

Topography

Lao Cai City is located in the bottom of the Red River valley bounded by the parallel ancient rocky ranges of Hoang Lien Son and Con Voi. The terrain is divided by the rivers, streams and rivulets among the hills, and slopes down from the northwest to the southeast. The area has three main terrain types: the mountainous and hilly terrain with an average gradient of about 12° concentrated mainly in Ta Phoi and Hop Thanh communes and partly in Van Hoa and Dong Tuyen communes; the low terrain with an average gradient of 6°–9° lying along the banks of the Red River and among the hills, mainly in the urban wards and Cam Duong commune and partly in Van Hoa and Dong Tuyen communes; and alluvial terrain along the rivers which is narrow in area and concentrated only along the Red River and at the end of Ngoi Dum stream.

Hydro-meteorological conditions

CLIMATE

Lao Cai city has a subtropical climate with monsoons and has two distinct seasons: the rainy season from April to September and the dry season from October to March. Situated deeply inland, the city rarely suffers from the direct impacts of storms, but suffers outer rainbands. Outer rainbands usually cause moderate rain and heavy rain which lasts 2–3 days, resulting in big floods and strong currents in the rivers and streams, increasing land intrusion and erosion and affecting agricultural production, tourism and people's lives.

PRECIPITATION

Average annual precipitation is from 1,600mm to 1,800mm. The rainy season lasts from May to September (accounting for 80% of annual precipitation). The dry season lasts from October to April.

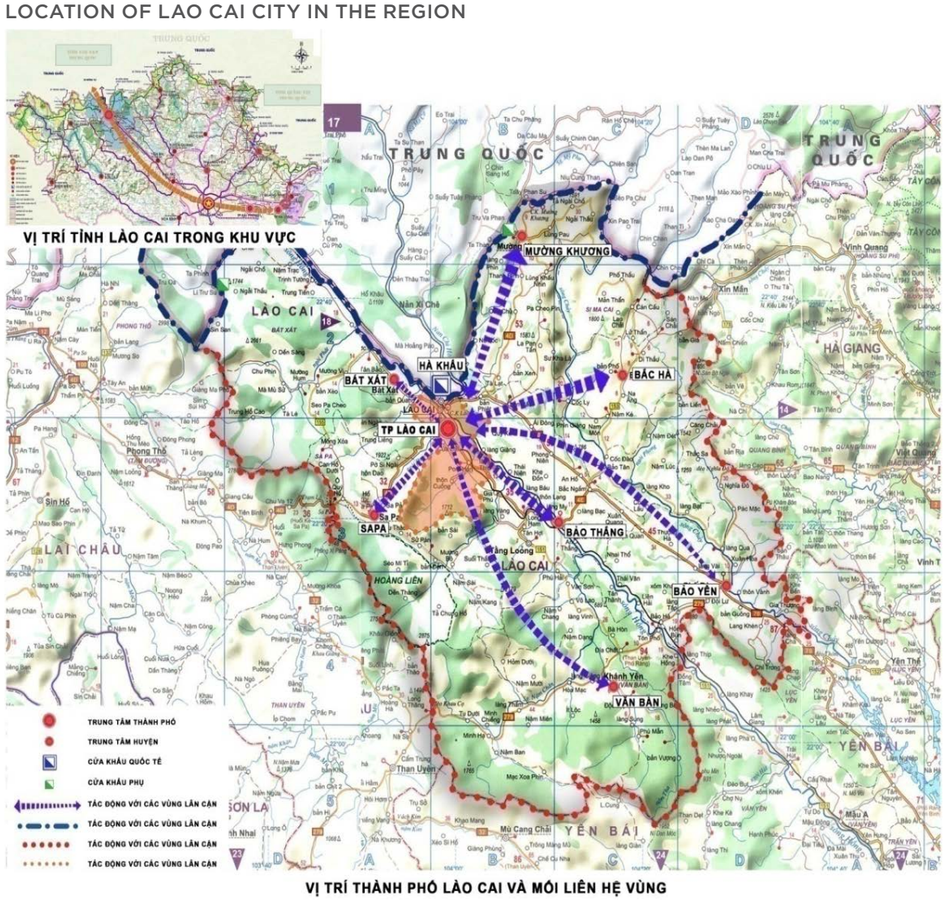
TEMPERATURE

The range in temperature, rainfall and humidity in the city is not large. The average temperature is 22.8°C, in the coldest month is 16°C, and temperature range is 11°C. Average annual air temperature ranges at 19°C. In 2007, average temperature was up to 23.65°C because average air temperature in April, May, June, July, August and September was higher than the yearly average. The hottest months in the year are June, July and August.

TYPES OF EXTREME WEATHER

A northern mountainous city with terrain resembling a bowl, in recent years Lao Cai city has suffered various types of natural disasters and extreme weather such as flashfloods, landslides and inundation, lightning, thunderstorms, tornadoes, and extreme cold and heat waves.

FIGURE 1
LOCATION OF LAO CAI CITY IN THE REGION



Hydrology

The hydrological regime is influenced mainly by the Red River and the Nam Thi River, which both originate from the Yunnan province in China. The Nam Thi River runs through the city and has a length of 2km and a basin width of 120m. It has slow flow, which is favorable for the development of waterway transportation. The Red River also runs through the city and has a length of about 15km; it runs from the northwest to the southeast and has an average width of 185–210m. It has an average flow of 530m^3/s, turbidity of 2,730g/m^3, lowest water level of 74.25m, and highest water level of 86.85m. The riverbed is large and steep, creating swift flows that erode the riverbanks.

The hydrological regime of the city is also affected by the Ngoi Dum, the Ngoi Duong and the Lang Nhon streams and other streams and rivulets, which originate from the Hoang Lien Son range and run through the city before flowing into the Red River. The average drainage density of the river system is 0.3km/km^2, and the narrow flows and high gradient are the causes of flashfloods and inundation in the rainy season.

Natural resources and environment

FOREST RESOURCES

The total area of forestland is 11,431 hectares (ha), including 2,121ha of economic forests and 9,310ha of protective forests. The forest coverage rate is 45.6%.

SOIL RESOURCES

Lao Cai city has a range of soil resources with a diverse soil structure, including humus soil, red and yellow soil and ancient alluvial soil in different microclimate areas and altitudes. These soils create favorable conditions to develop many varieties of tropical and subtropical crops. According to a land inventory survey in 2010, the city has a total natural area of 22,967.2ha, accounting for 2.85% of the province's area. Area of land in use for different purposes is 18,547.86 ha, accounting for 80.75% of the total natural area of the city.

MINERAL RESOURCES

The mineral resources in Lao Cai City are abundant with some mines having large reserve, good for mining and the processing industry. The city has the country's largest apatite mine with reserves of 1.4 billion tons with a mining and production area of hundreds of hectares, concentrated in the Ta Phoi, Cam Duong and Dong Tuyen communes.

WATER RESOURCES

The surface water source for daily use and production activities comes from the Red River, Nam Thi River, Ngoi Dum Stream, and the Ngoi Duong Stream. The Nam Thi river water is the main source for the Lao Cai City water plant. The Red River has an important role in waterway transportation and trade between Lao Cai province and the downstream provinces. However, the quality of the Red River water at certain times of the year can be low, due to unidentified contaminants.

ENVIRONMENT

The current environmental problems of Lao Cai city have been acknowledged and are being addressed. However, there are still shortcomings that need to be resolved including:

- Domestic wastewater and wastewater from industrial zones (Bac Duyen Hai and Dong Pho Moi) is not been thoroughly treated.
- Mining and processing activities pollute the air and water sources, obstruct river flows and fill up the canals in the Cam Duong, Pom Han and Dong Tuyen communes.
- In the city there are two large rivers originating from the Yunnan province of China and over the past several years the quality of the water has been declining. However to date there has been no agreement made between Lao Cai and Yunnan province to address the water quality issue.

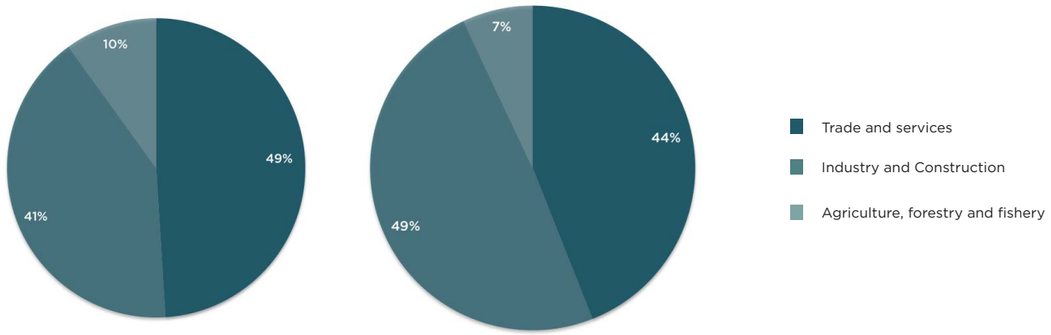
3.2. Socio-economic conditions

Economic development

The average economic growth rate in the 2005–2010 period was 13.5%. The agriculture, forestry and fishery industries increased by 3.78%, the industry and construction industry increased by 13.58%, and services industry increased by 14.54%. In 2012, the economic growth rate reached 16.18%, 106.4% higher than target, in which trade and services increased by 16.43%; construction industry increased by 17.24%; and agriculture and forestry increased by 5.84%. Per capita income reached VND 29.6 million. In short, there was a shift in the economic structure towards a gradual increase in the contribution of the construction and service sectors to the GDP, and a gradual decrease in that of the agriculture, forestry and aquaculture sectors to the GDP.

FIGURE 2

ECONOMIC DEVELOPMENT STRUCTURE IN 2005 (LEFT) AND 2010 (RIGHT)



The agriculture, forestry and aquaculture: The industries have experienced growth in recent years, largely thanks to forming a focus production area, which has resulted in good quality and safe products. Forestation has been promoted, with 55ha of forest planted in 2012, achieving 100% of the sectors planned progress. 1,170ha of ineffective protective forests was also converted into productive forests.

Industry and handicraft: The industry sector has maintained a relatively high growth rate. There are currently 590 industrial and handicraft entities in the city. Industrial activities focus on mining, mineral processing, production of fertilizers, chemicals, and hydropower.

Trade and services: Currently, the city has more than 8,000 trade and service establishments, an increase of nearly 1.5 times since 2005. The number of tourists increases by 13.5% per year on average. The financial and banking services, telecommunications and post, hotels and restaurants and market systems have been developing, meeting the expected requirements. The border economy continues to play a dynamic role, creating an average increase of budget revenue of 32% per year.

Social situations

There are 21 ethnic groups living in Lao Cai City, mostly Kinh, Tay, Mong, Dao, Giay, Nung and Hoa. In recent years, Lao Cai city's population has increased sharply. In the initial period after the province was re-established (before 1990), the former Cam Duong town had a total population

FIGURE 3

LAO CAI CITY'S POPULATION IN THE 2005-2010 PERIOD AND EXPECTED POPULATION UNTIL 2020 AND 2030

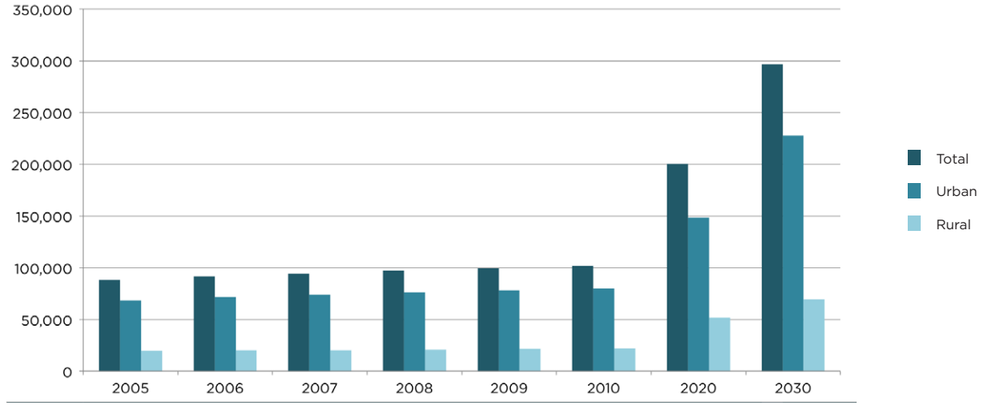
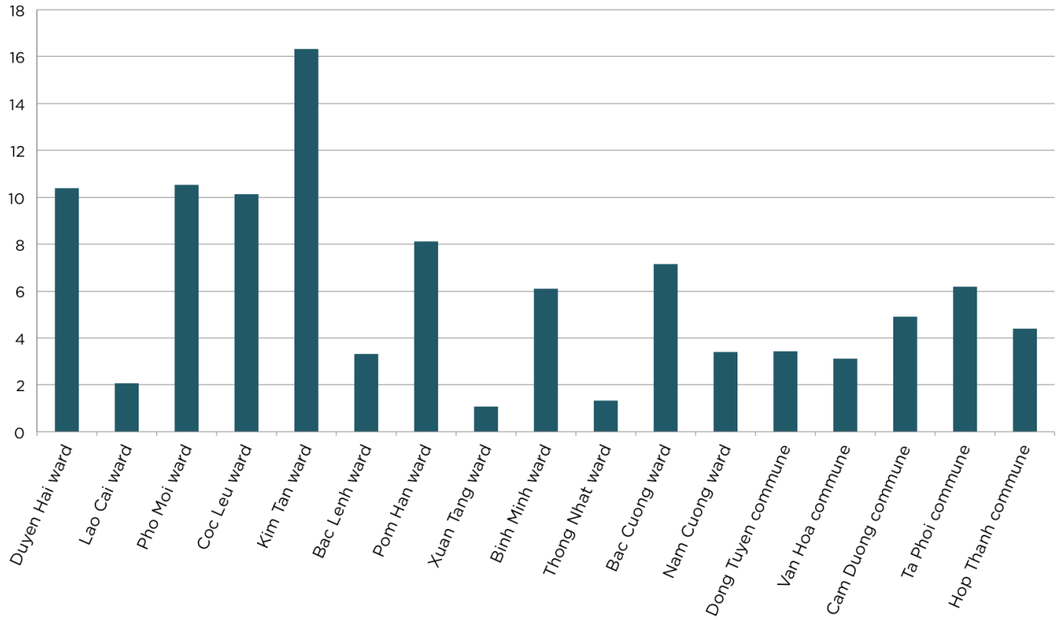


FIGURE 4

POPULATION OF WARDS/COMMUNES OF LAO CAI CITY IN 2010 (x1000 PEOPLE)

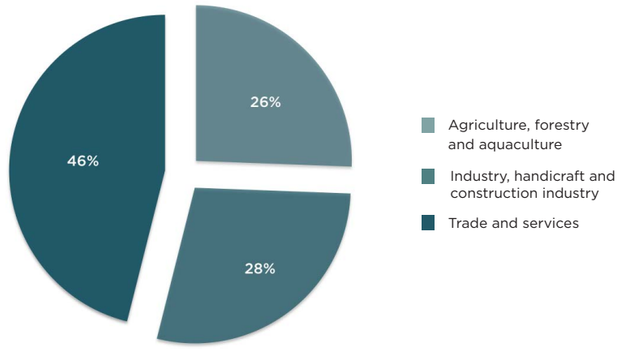


of less than 10,000 people. In 2012 the city had a population of 108,000 people and a population density of 444 people/km^2, mainly concentrated in urban wards (73%), such as Kim Tan, Pho Moi, Duyen Hai, Coc Leu, Pom Han and Bac Cuong.

Urban population forecasts: In the future, the population of Lao Cai city will continue to experience large changes due to immigration. It is expected that the population growth rate will reach 5% in the 2010–2020 period, and 3% in the 2020–2030 period. At this rate, the population of Lao Cai city will increase to about 200,000 people by 2020 and 300,000 by 2030.

Labor and employment: The city's working age population is currently 62,280 people, or 61.1% of the total population. The labor structure, the service, industry and construction sectors have all been experiencing growth in terms of number of workers.

FIGURE 5
LABOR STRUCTURE OF LAO CAI CITY IN 2010



Annual per capita income in the city has increased significantly in recent years, from VND 7.95 million (about USD 500[1]) in 2005 to VND 22.75 million (about USD 1,090[2]) in 2012 (an increase of 2.7 times). This income level is equivalent to 137% of per capita income of Vietnam. The city is working to raise per capita income to USD 2,800–3,000/year by 2015 and USD 5,000/year by 2020. The objective is to reduce the urban unemployment rate to below 5% by 2015 and below 3% by 2020.

Social security in the area is relatively stable. The number of poor urban households decreased from 9.89% in 2005 to 1% in 2012. In rural areas, the number declined from 31% to 8%. The city is aiming to reduce the poverty rate to 2% by 2020.[3]

Healthcare, culture and education

There are currently 63 health care facilities in Lao Cai City, of which 27 are public facilities, including four provincial hospitals, six regional polyclinics and 17 commune/ward level clinics; and the remaining facilities are privately owned. There are 725 hospital beds (100% are public facilities beds) and 1,040 health officials. The communes/wards have reached 100% in terms of the national standards for health care. However the quality of services in some health facilities remains poor, due to a lack of equipment and experienced doctors.

The attendance rate of all elementary aged children in the communes and wards is 100%. The city has 22 schools that are of a national standard, which accounts for 34.4% of the schools managed by the city. All communes and wards have community-learning centers. The city has invested in developing a system of professional schools, which includes one university, two colleges, and intermediate and vocational training schools.

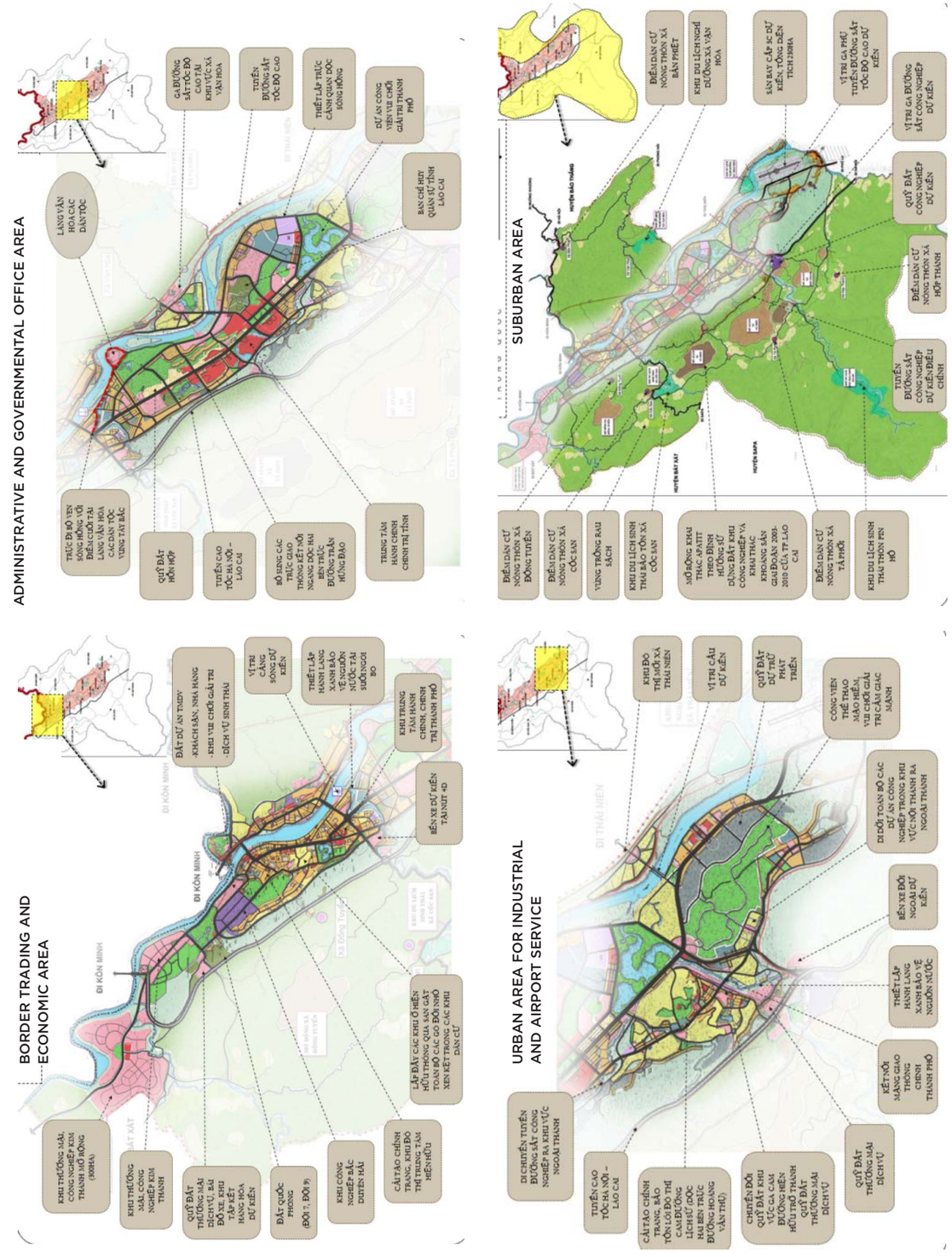
3.3. Socio-economic and urban spatial development planning by 2020

Since Lao Cai province was re-established in 1991, the urbanization process has occurred rapidly, particularly in Lao Cai City. There has been a range of construction projects carried out focusing on urban infrastructure and residential areas. According to the socio-economic development master plan of Lao Cai city, in the period 2006–2020, the average economic growth rate of 13.5–14% per year is forecasted to be maintained. The city strives to become a grade-II city by 2015, and a grade-I city by 2020. The economic structure is aiming to shift strongly towards industrialization, so that non-agricultural sectors will account for 95–96% of total GDP by 2015, and 97–98% by 2020.

Land use planning

The city is focusing on stabilizing the existing area of protective forests and developing economic forests on unused land. Afforestation areas are concentrated mainly in Ta Phoi commune, Pho Moi ward, Hop Thanh commune and Nam Cuong ward. Landscape forests are concentrated in Bac Cuong, Nam Cuong, Binh Minh and Thong Nhat wards along Tran Hung Dao road and Highway 4E. By 2030, the objective is for agricultural land to be reduced to about 12,000ha (a decrease of 1,800ha compared to

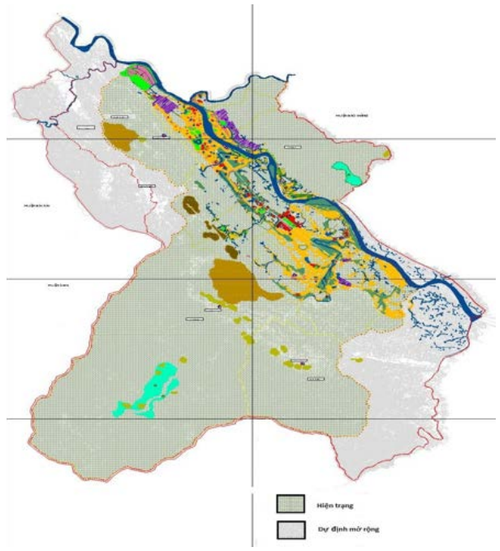
FIGURE 6
MAP OF LAND USE PLANNING IN LAO CAI CITY BY 2030



2012, and 1,200ha compared to 2020). Similarly, wet rice cultivation land is expected to decrease by about 50–70% (approximately 450–650ha) due to a changing crop structure and conversion to non-agricultural land. Lao Cai city is expected to expand to an area of 31,170ha by 2030. The expanded area of 8,203ha is allocated as follows:

- *The northern and southwestern areas* will be expanded to Bat Xat town and throughout Coc San commune (4,033ha). This extended area will be connected with the trade and service area of the city to form the Lao Cai border gate economic zone, Sa Pa tourism area and a clean vegetable cultivation area.
- *The southern area* will be expanded to Ben Den Bridge in Gia Phu commune (4,170ha). This extended area will be connected to the area reserved for building an airport and the Cam Duong residential area.

FIGURE 7
MAP OF LAND USE PLANNING IN LAO CAI CITY BY 2030



4. RATIONALE OF THE ACTION PLAN DEVELOPMENT

Lao Cai city has an important geographical position for national defense and security and for international trade development. The city is the meeting point of many railway lines, roadways and waterway routes, which facilitate economic activities between the city and other localities in the region. These features shorten travel time and costs. The city is rich in natural resources, which has great advantages for the socio-economic development of the region. The city has the country's largest apatite mine, with a reserve of 1.4 billion tons, which hosts a large mining and production area of hundreds of hectares concentrated in Ta Phoi, Cam Duong and Dong Tuyen communes; and a graphite mine in Nam Thi with a reserve of 25.5 million tons. Given Lao Cai is an important transport hub and a major economic center, it is an ideal transit place for the exchange of goods and trade negotiations with other provinces in the country, and Yunnan and western China markets in the China-ASEAN Free Trade Area (CAFTA).

The city is increasingly suffering from the impacts of climate change. Temperatures in the region tend to increase rapidly and extreme climate phenomena can occur repeatedly and more vigorously. In particular, natural catastrophes, such as flashfloods and landslides are becoming more hazardous. This directly affects the life and production of local communities as well as the growth and development of many species in the mountainous areas, placing pressure on the local socio-economic development. Over the 11 year period from 2002–2012, there were 20 flashfloods and landslides in Lao Cai, leaving 261 people dead, 218 people injured, 1,744 houses washed away or completely damaged, over 12,000ha of rice and vegetable crops damaged (of which nearly 1,000ha of agricultural land was eroded and became uncultivable) and over 13,000 transport and irrigation works and infrastructure was destroyed. The total economic loss was more than 1,500 billion dong. Lao Cai city was one of the localities in the province most heavily affected by the severe landslides and floods.

Lao Cai City has recognized the importance of minimizing the impacts of climate change and becoming a climate resilient city. In the city's long-term strategy, it has identified climate change resilience as a key objective and has identified that actions should commence immediately to better guide the urban planning and economic development of the city. This is an important impetus for Lao Cai City to develop and implement the Action Plan, to ensure the city can remain sustainable under the increasing and unpredictable impacts of climate change. The National Target Program to Respond to Climate Change, which is being implemented in Lao Cai province and throughout Vietnam, is also an important factor. The program provides an opportunity for the province to access new resources and enhance awareness and capacity of officials from all levels and sectors as well as communities in Lao Cai.

SECTION 2
CLIMATE CHANGE AND VULNERABILITY OF LAO CAI CITY

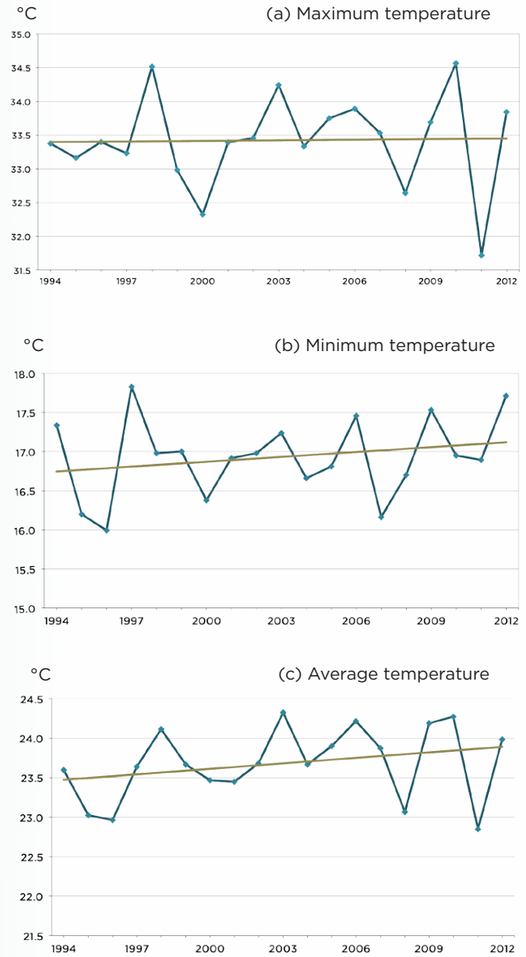
1. CURRENT CLIMATE CHANGE AND VULNERABILITY

1.1. Signs of climate change in Lao Cai

TEMPERATURE

During the last 15 years, the temperature in the area has been increasing at an average rate of 0.1–1.5°C per decade and there have also been multiple abnormal temperature events. In summer, heat waves last longer, and range mostly from severe to extremely severe. For example, a heat wave in May 2012—which had a maximum temperature of up to 40.3°C, and lasted for 7 days continuously—was considered the most severe heat wave in 55 years. Heat waves sometimes occur earlier than usual, for instance, there was a heat wave at the end of February 2010 with temperatures of up to 35°C. These abnormal heat waves can sometimes alternate with extreme and prolonged cold waves. For example, the cold wave from January to February 2008, which lasted for 40 days, with local temperature dropping down to 7.6°C, had killed thousands of livestock and poultry.

FIGURE 8
CHANGES OF TEMPERATURE IN LAO CAI CITY PERIOD 1994–2012*



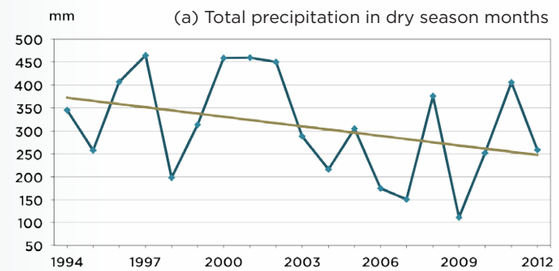
* Source: Lao Cai Hydro-meteorological Forecasting Center

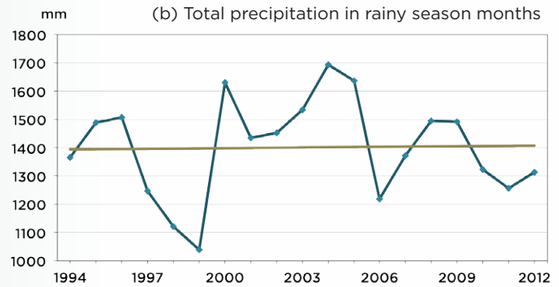
PRECIPITATION

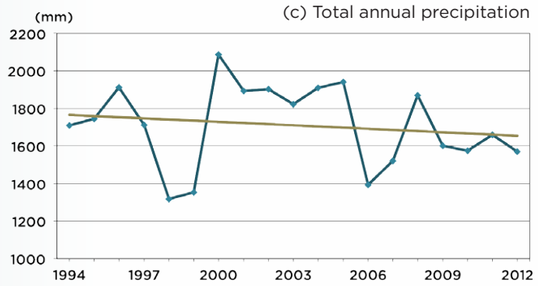
During the last 10 years, extreme precipitation events in Lao Cai have been decreasing in number but increasing in frequency. Rainfall distribution has been decreasing in the dry season and increasing in the rainy season. Time periods with little or no rain tend to be longer (from 40–50 days), while unusually extreme rainfall can occur and cause floods in winters—such as a rain event that occurred on November 30, 2011 with precipitation of up to 103.4mm.

FIGURE 9

PRECIPITATION IN LAO CAI CITY PERIOD 1994–2012*







* Source: Lao Cai Hydro-meteorological Forecasting Center

1.2. Impacts of climate change on Lao Cai City

In Lao Cai City in terms of weather events, changes in precipitation—followed by abnormal changes in temperature—are causing the most significant impacts.

Changes in ***precipitation*** leads to an increase in the magnitude and duration of droughts, erosion, flood intensity, and flood depth. Unusual changes in temperature can increase local temperatures and intensify extreme cold weather.

Flashfloods often happen from May to September every year, occurring mostly in July through to August in the ravines and flumes of Ngoi Duong and Ngoi Dum basins. ***Landslides*** often occur on steep slopes at mining sites in Ta Phoi and Hop Thanh communes, Nam Cuong ward, and along the banks of the Red River and the Nam Thi River. These types of natural disasters often happen very quickly, unexpectedly and violently, which can lead to a loss of human life, infrastructure and socio-economic development, especially in Ta Phoi and Hop Thanh wards, which is mostly inhabited by ethnic minorities.

Inundation is often caused by heavy rainfall in the area combined with floods from upstream. It often happens in areas along the Red River such as Xuan Tang, Binh Minh, Van Hoa and some locations in Kim Tan ward (by Ngoi Dum Stream, Nha Son road group 23-26), Nam Cuong ward (Road B4, Tran Hung Dao Street, and the Square).

Tornadoes and whirlwinds often happen in the period from April to June. The most affected areas are Duyen Hai ward (Industrial Zone), Ta Phoi commune (Phin Ho Thau), Cam Duong commune, and Van Hoa commune. On May 05, 2012, a tornado with wind speed of grade 7–8 and gusts of grade 9–10 ripped off the roofs of 40 houses and knocked down 25 trees in Coc Leu and Nam Cuong ward and Van Hoa commune.

Extreme cold waves often occur in the period from December to February, affecting the whole city, but most seriously the mountainous villages of Ta Phoi and Hop Thanh communes. According to statistics of the Ta Phoi Commune People's Committee, extreme cold waves have killed 518 water buffalos and cows since 2008, and 275 in 2010 alone.

1.3. Current climate vulnerability

According to the results of the current climate vulnerability assessment, many types of natural disasters affect Lao Cai. However in recent years, flashfloods, landslides and inundation are the three most dangerous natural disasters. Therefore, the assessments focused on impacts and causes of vulnerability of urban infrastructure and community groups in Lao Cai City related to these three natural disasters.

Key impacts of natural disasters on communities

Based on the data and documents collected under the Vulnerability Assessment, the key impacts of natural disasters on local communities includes:

- human: injuries and other health impacts caused by the occurrence or intensification of outbreaks during and after disaster events, including deaths in some cases;
- production and business: crops and livestock damages causing loss of productivity; loss of cultivation land due to sand or soil deposition on rice or vegetable fields; loss of livestock and aquaculture products due to stable damages, drowned or washed away livestock, and diseases; disruptions of business activities and services; and soaked or washed away goods;
- physical: damages to houses and agriculture facilities, buried or washed away assets, domestic tools and goods;
- other: disruption of daily activities due to power blackouts or water cut-offs, and damage and inundation of roads, schools and clinics.

Currently the most vulnerable areas include Cam Duong, Ta Phoi, Hop Thanh, Binh Minh, Van Hoa, Xuan Tang and Kim Tan.

Vulnerable population groups are described below.

i. The agriculture production group is highly vulnerable to extreme climate events. Among them, the most vulnerable are rice and vegetable farmers in Cam Duong, Ta Phoi, Hop Thanh, Xuan Tang, Van Hoa and Binh Minh

EXAMPLES OF NATURAL DISASTERS THAT CAUSED HEAVY DAMAGES TO LAO CAI CITY

On September 10, 2007, an unexpected flashflood occurred on Ngoi Dung stream, flowing through Thoong Ve, Phin Ho Hau village and Ta Phoi commune of Lao Cai City. The flashflood left eight people dead (missing) and three people injured, one of whom was seriously hurt.

On July 25, 2012, heavy rain caused by the outer rainbands of Typhoon no. 4 led to a flashflood that swept through Da 2 village of Cam Duong commune. The flashflood killed one person, swept away 12 cattle, damaged 63.2ha of rice, and eroded 12,737m3 of soil and rocks and many roads.

During the night of July 23, 2011, heavy rain led to high floods in Doi stream at Cam Duong ward, with a flood amplitude of about 2.8m. The flood washed away two houses, and heavily flooded 16 houses under 1–3 meters of water and 30 houses under 60–80cm of water. The flood also destroyed 10ha of vegetable and flowers, buried 6ha of orchard, and destroyed several concreat bridges in Lung Thang village.

Source: Lao Cai Provincial Committee for Flood and Storm Control

TABLE 1
SUMMARY OF NATURAL DISASTER DAMAGES IN LAO CAI CITY (2004–2011)

No.	Category	Damage (year)							
		Unit	2004	2005	2006	2007	2009	2010	2011
I. Household									
1	Death	Person				8			
2	Injury	Person		2					2
3	Houses collapsed, washed away, damaged, or flooded	Household	85	142	49	76	656		279
4	Resettlement	Household			34	17	29		
II. Agriculture									
1	Loss or damages of rice and vegetable crops	ha	20	42.5	39.26	48.87	38.95		913 households affected
2	Death of livestock	Unit		52					02 cold water fish farming cooperatives

wards/communes. Followed by those with livelihoods in aquaculture, livestock and poultry raising, fruit growing, and forestry production. The resilience of these group is also limited by other factors such as low and unstable income, lack of knowledge in the areas of climate change and adaptive measures, inappropriate urban development practices, and ineffective social and labor policies.

ii. The service and commerce group is moderately vulnerable to extreme climate events, however the impacts on this group may lead to high economic losses. Fortunately, thanks to good infrastructure and financial capacity, this group has a fairly high adaptive capacity. Households with small businesses in high-disaster-risk areas such as in Xuan Tang, Cam Duong and Kim Tan are those most seriously affected and most vulnerable.

iii. Resettled community group: Although not very large in quantity, this population group is quite vulnerable to the effects of climate change because a large proportion of them depend on agricultural livelihoods, which are highly sensitive to natural disasters and extreme climate events. At the same time, they have very limited capacity to adapt as they often have unstable livelihoods, a low income, a low quality of infrastructure and social services available to them in the new resettlement areas, and a lack of policies to support them during and after resettlement. The few policies that do exist do not include support for livelihood changes or job seeking. The areas with large numbers of resettled households that need more attention include, Cam Duong, Binh Minh and Xuan Tang.

iv. Urban resident group has the lowest vulnerability among all the groups. The most urgent issue for this group is localized flooding in several wards/communes such as Kim Tam, Coc Leu, and Bac Cuong, caused not only by heavy rain but also by poor urban development and urban drainage systems.

Climate impacts on infrastructure systems

The main types of urban infrastructure that can be affected by natural disasters are discussed under this assessment includes traffic infrastructure, water irrigation and urban drainage infrastructure, public facilities and houses.

Key damages to infrastructure can include:

- subsidence and breaching of roads;
- damages to bridges, culverts, underground drains, and flood spillways;
- disruptions to drainage channels and water supply facilities;
- drain blockage and debris deposition;
- toppling of pylons;
- subsidence, cracking or collapse of public facilities and houses due to flashfloods and landslides;
- traffic congestions and damages of roads caused by prolonged inundation; and
- riverbank erosion and dyke damage.

Based on previous assessments of the level and scale of damage, the transportation system is the most seriously affected by disasters such as flashfloods, landslides and flooding, followed by water irrigation and water supply infrastructure, houses, and public facilities. Most disaster-prone areas have roads that are affected by disasters, while only several peri-urban communes with agriculture production have irrigation works. The table below summarizes issues related to flashfloods, landslides and flooding of infrastructure in Lao Cai City.

TABLE 2
VULNERABILITY OF INFRASTRUCTURE TO NATURAL DISASTERS

No.	Type of infrastructure	Level of impact	Disasters	Areas with most affected infrastructure
1	Transport	++++	Flashfloods and landslides	• Roads in mountainous communes: Ta Phoi, Hop Thanh, Dong Tuyen, Cam Duong • Nam Cuong ward (stream area)
			Flooding and inundation	Binh Minh, Van Hoa, Xuan Tang, and some roads in Kim Tan ward
2	Irrigation and Drainage	+++	Flashfloods and landslides	Infrastructure in peri-urban communes: Ta Phoi, Hop Thanh, Dong Tuyen and Cam Duong
			Flooding and inundation	Binh Minh, Van Hoa, Xuan Tang and Kim Tan
3	Housing	++	Flashfloods and landslides	Houses along the Ngoi Duong stream-Ta Phoi, Cam Duong, Hop Thanh
			Flooding and inundation	• Riverine areas (Binh Minh, Van Hoa, Xuan Tang) • Areas along Dum stream in Kim Tan ward
4	Public works	+	Flashfloods and landslides	Houses along the Ngoi Duong stream-Ta Phoi, Cam Duong, Hop Thanh
			Flooding and inundation	• Riverine areas in Binh Minh, Van Hoa and Xuan Tang • Areas along Dum stream in Kim Tan ward

TABLE 3
MATRIX FOR ASSESSING CURRENT CLIMATE CHANGE VULNERABILITY

CLIMATE IMPACTS	Vulnerability of urban infrastructure				Vulnerability of communities			
	Trans-portation	Irrigation, water drainage	Housing	Public facility	Agriculture	Industry, services	Resettlement	Other urban communities
Flashfloods, landslides	++++	++++	+++	++	++++	++	+++	++
Flooding, inundation	++	++	++	+	++++	+	++	++
Lightning strikes, tornadoes	+	-	++	+	++	+	++	++
Extreme cold waves	-	-	-	-	+++	-	++	++
Heat waves, droughts, water shortage	-	-	-	-	++	+	++	++

Notes: very high vulnerability ++++ | high vulnerability +++ | medium vulnerability ++ | low vulnerability + | no vulnerability -

1.4. Resilience of Lao Cai City

The Assessment of Lao Cai City's resilience was conducted based on the participatory vulnerability assessment process, and the Local Government Self-Assessment Tool (LGSAT) developed by the United Nations' International Strategy for Disaster Reduction (UNISDR). This tool was used to support the local government to assess their institutional capacity on a 1–5 scale. The tool allows the city to assess multiple factors that relate to its climate resilience, including: financial capacity, local government staff and local community's awareness and knowledge of climate change, infrastructure quality, and climate change institutions.

Financial capacity

Climate change is a long-term issue, which has a high level of uncertainty and at the same time there are many other urgent problems facing Lao Cai City such as rapid urbanization, high resettlement demand, and an increasing demand for water and energy. As local financial resources are limited, it is becoming challenging to balance resources for short, medium and long-term priorities. In order to build a sustainable and resilient city, which can address all the above issues, support from the central government and from other organizations in Vietnam and internationally is required.

At present the local budget for flood and storm control remains low, currently sitting at about VND 200 million/year, which equals only about 30% of what is required. The budget mostly focuses on emergency response, natural disaster recovery, and short-term prevention, with no financial mechanisms available for allocating funds for climate change response. Community resources are scattered, among which the income levels of the resettled group and the agriculture production group is meager and unstable.

Awareness and knowledge of disaster reduction and climate change adaptation

Climate change is highly uncertain and the capacity of climate projection models and technical capacity is still limited. For this reason, the local government had to make decisions and development plans in the context of uncertainty, and without consideration of climate change. This situation requires for the application of a new approach for resilience planning.

The role and awareness of the private sector in responding to climate change is still unclear. Awareness building is an important aspect that can contribute significantly to building resilience for the city, but as yet has not been focused on. The agriculture production group, the resettlement group, and the immigrant workers have the most limited access to information compared to the other groups. According to the general assessment, climate awareness in Lao Cai is currently at a medium level (two out of five), thus the Ability to learn and to adapt to climate change is an area that needs improvement in the future.

Quality of infrastructure

During the past several years, the infrastructure for disaster prevention and reduction in Lao Cai has been gradually upgraded, but is still only satisfies about 60% of what is actually required. Furthermore, the early warning system for flashfloods and storms is not completed and still limited in terms of technical quality. The coordination and information sharing among stakeholders, and the level of accuracy and availability of information is low and not up to an acceptable standard (at two out of five). Therefore, it is fair to say that the flexibility, redundancy and safe failure of the current infrastructure system remains limited.

Supportive policies for climate change adaptation

Coordination system and mechanism: In Lao Cai Province and Lao Cai City, there has been no system established for the preparation and response to climate change, and no mechanism for monitoring the effectiveness of climate change responses, especially the integration of climate change into local development plans. Climate change is a regional issue that needs the cooperation of all areas in the Lao Cai province as well as with surrounding provinces. For example, collaboration is needed for protecting headwater forests in Sapa, preventing fires in forests between Lao Cai and Lai Chau, and preventing floods on the Red River. These collaborations have been initiated, but so far have not proven to be effective.

Socio-economic development and urban development policies and plans: Although climate change has yet to be clearly integrated into policies and plans in the city, disaster risk reduction has been considered in the development of these policies and plans. Specifically, disaster risk reduction was integrated to some extent into the former plan for Lao Cai City to become a grade-III city, and the current plan to become a grade-II city. However, collaboration across sectors and levels in development planning is still limited and lacks consistency. The planning and construction of economic zones and fundamental infrastructure such as transportation infrastructure of grade II only looks at historical patterns. It fails to consider extreme conditions beyond design capacity. The participation of the community and civil society in the planning process also remains limited. The province and city do not have any agency or staff officially assigned to work on climate change (a rank of three over five).

Policies to support local people before, during and after natural disasters, including environmental protection and restoration have been implemented (four over five). However, these policies only apply for local people, and not for the informal immigrant workers. While there is policy to support resettlement and ensure the safety of people living in disaster-prone areas, a lack of in-depth research leads to gaps in the existing policies, such as inadequate infrastructure and difficulties in livelihoods.

2. CLIMATE CHANGE AND FUTURE VULNERABILITY OF LAO CAI CITY

2.1. Climate change scenarios

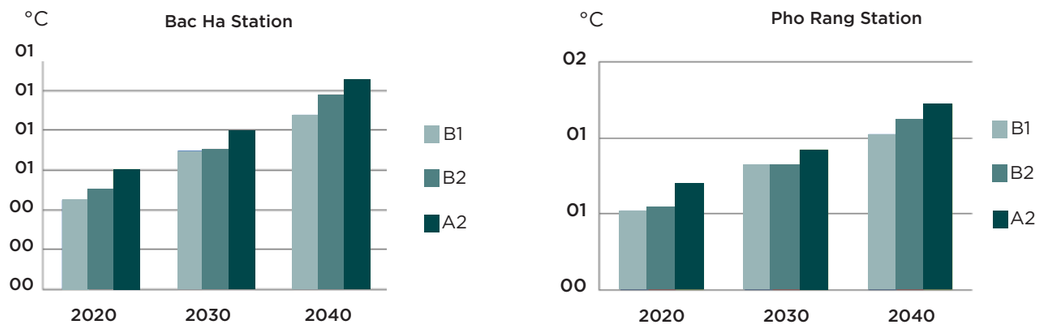
Climate change scenarios for Lao Cai City were updated based on the climate change scenarios of Lao Cai Province[4]. These scenarios were approved under Decision no. 2227/QD-UBND dated August 31, 2012 by the Lao Cai Provincial People's Committee.

According to temperature scenarios calculated based on data from two stations at Bac Ha and Pho Rang, the temperature of Lao Cai province and Lao Cai City tends to increase in all seasons. Increase in spring and winter temperature is higher than in summer and autumn. These changes are presented in Table 4 below.

TABLE 4
INCREASES IN AVERAGE TEMPERATURE (°C) THROUGH THE DECADES OF THE 21ST CENTURY COMPARED WITH THE 1980–1999 PERIOD OF LAO CAI CORRESPONDING TO SCENARIOS B1, B2 AND A2

STATIONS	Winter (Dec–Feb)			Spring (Mar–May)			Summer (Jun–Aug)			Autumn (Sep–Nov)		
	2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
	SCENARIO B1											
Bac Ha	0.5	0.8	1.1	0.5	0.7	0.9	0.3	0.5	0.6	0.5	0.7	0.9
Pho Rang	0.5	0.8	1.0	0.5	0.8	1.0	0.6	0.9	1.1	0.5	0.8	1.0
	SCENARIO B2											
Bac Ha	0.6	0.8	1.2	0.5	0.7	1.0	0.4	0.5	0.7	0.5	0.7	1.0
Pho Rang	0.6	0.8	1.1	0.5	0.8	1.1	0.6	0.9	1.2	0.5	0.8	1.1
	SCENARIO A2											
Bac Ha	0.7	0.9	1.2	0.6	0.8	1.1	0.5	0.6	0.8	0.6	0.9	1.1
Pho Rang	0.7	0.9	1.2	0.7	0.9	1.2	0.7	1.0	1.3	0.7	0.9	1.2

FIGURE 10
INCREASE IN AVERAGE ANNUAL TEMPERATURE IN LAO CAI COMPARED TO THE 1980–1999 PERIOD BASED ON EMISSION SCENARIOS B1, B2 AND A2



Differences in average annual temperatures between different scenarios are illustrated in the figure above (Figure 10).

According to analysis results from the PRECIS[5] Regional Climate Modeling System, average high temperature tend to increase, with the increase in summer and autumn (June to August and September to November) being higher than in winter and spring (from December to February and March to May). Average high temperature will increase by about 0.48°C in the 2000–2019 period and 0.9°C in the 2020–2039 period (Table 5).

Average low temperature tends to increase most in summer months, and least in winter months compared to the 1980–1999 period (Table 6).

TABLE 5
INCREASES IN AVERAGE HIGH TEMPERATURE (°C) IN LAO CAI BY SEASON THROUGH THE DECADES OF THE 21ST CENTURY COMPARED TO PERIOD 1980–1999 UNDER SCENARIO B2

Duration	Seasons (°C)				
	Winter (Dec–Feb)	Spring (Mar–May)	Summer (Jun–Aug)	Autumn (Sep–Nov)	Year
2000–2019	0.09	0.14	0.94	0.76	0.48
2020–2039	0.95	-0.10	1.54	1.22	0.90

TABLE 6
INCREASE IN AVERAGE LOW TEMPERATURE (°C) IN LAO CAI BY SEASON THROUGH THE DECADES OF THE 21ST CENTURY COMPARED TO PERIOD 1980–1999 UNDER SCENARIO B2

Duration	Seasons (°C)				
	Winter (Dec–Feb)	Spring (Mar–May)	Summer (Jun–Aug)	Autumn (Sep–Nov)	Year
2000–2019	-0.42	0.58	0.50	0.67	0.33
2020–2039	0.10	0.80	1.07	0.99	0.74

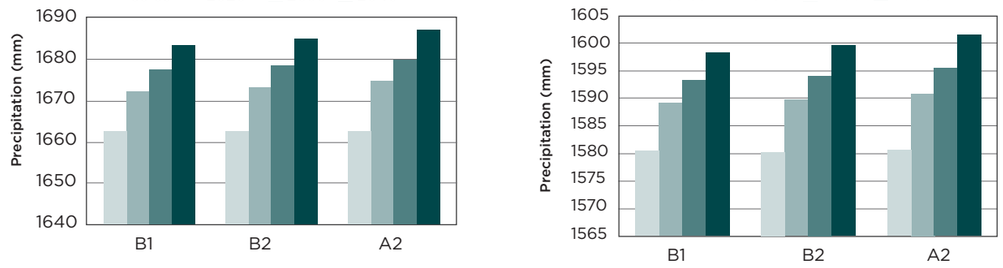
In general, precipitation rates at all stations in Lao Cai tend to increase under various scenarios, although not evenly among different months of the year. Differences between scenarios are not high, only 0.6–0.7% by 2020 and 1.2–1.5% by 2040.

TABLE 7
CHANGES IN PRECIPITATION (%) IN LAO CAI THROUGH THE DECADES OF THE 21ST CENTURY COMPARED TO PERIOD 1980–1999

STATIONS	Winter (Dec–Feb)			Spring (Mar–May)			Summer (Jun–Aug)			Autumn (Sep–Nov)		
	2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
	SCENARIO B1											
Bac Ha	0.5	0.8	1.2	-0.3	-0.4	-0.6	1.7	2.6	3.6	0.5	0.7	1.1
Pho Rang	0.1	0.2	0.3	-0.6	-0.9	-1.2	1.8	2.9	3.9	0.8	1.0	1.5
	SCENARIO B2											
Bac Ha	0.6	0.9	1.3	-0.3	-0.5	-0.7	1.9	2.7	3.8	0.5	0.8	1.1
Pho Rang	0.2	0.2	0.4	-0.6	-0.9	-1.3	2.0	3.0	4.2	0.8	1.1	1.6
	SCENARIO A2											
Bac Ha	0.7	1.0	1.4	-0.4	-0.5	-0.7	2.0	3.0	4.2	0.6	0.9	1.2
Pho Rang	0.2	0.3	0.4	-0.7	-1.0	-1.4	2.2	3.3	4.6	0.8	1.2	1.7

Average annual precipitation levels projected for each monitoring station by 2040 under emission scenario A2, B2 and B1 are presented in Figure 11 below.

FIGURE 11
SCENARIOS OF AVERAGE ANNUAL PRECIPITATION CHANGES AT BAC HA AND PHO RANG STATIONS



Precipitation statistics in Lao Cai (Table 8) shows that daily high precipitation tends to increase throughout the 21st Century. In the meantime, the annual average level of daily high precipitation decreased in the period from 2000–2009 and is expected to increase in the period from 2020–2039.

In the future, in addition to the current disasters affecting Lao Cai (such as flashflood, landside and flooding), the city may also suffer from the serious impacts of droughts, water scarcity in the dry season, and the increasing impacts of prolonged heat or cold waves.

TABLE 8
CHANGES IN HIGHEST DAILY PRECIPITATION (%) IN LAO CAI THROUGH THE DECADES OF THE 21ST CENTURY COMPARED TO PERIOD 1980–1999 UNDER SCENARIO B2

Duration	Highest daily precipitation (mm)	
	Highest	Average yearly highest
2000–2019	17.7	-5.1
2020–2039	19.0	3.3

Water shortages and droughts may also become more severe into the future, partly due to the impacts of climate change and also because of an increasing demand for water. The water demand issue will be exacerbated as a result of economic and population growth, as well as difficulties in managing the quantity and quality of water on the Red River and Nam Thi River, both of which originate from China. The mining industry has the possibility of bringing large economic benefits to the city, however a lack of suitable approaches and mechanisms for mining management might intensify the impacts of natural disasters and climate change on infrastructure and community groups.

2.2. Future vulnerability

In the future Lao Cai is expected to be affected by a range of natural disasters, similar to those of which it already experiences (flashfloods, landslides, extreme cold waves and heat waves, tornados and inundation), but with an increased intensity. However, due to lack of detailed scenarios for Lao Cai City (current scenarios are for Lao Cai Province in general), the assessment of future vulnerability of Lao Cai has certain limitations.

Impacts of climate change on urban development and spatial planning

The Vulnerability Assessment Report of Lao Cai City discussed that although the city was aware of the 2% flood possibility when developing the current urban spatial plan, the current Red River dykes was only built to sustain 4–7% floods only. This is due to limited financing and the challenges of the natural elevation of the city. Dyke construction will shrink the river, sometimes by up to 40–60cm from the original width, as was the case in the Coc Leu-Kim Tan area. The future impacts of climate change may lead to more intense floods, which could seriously impact the local community and the economy unless the city has appropriate adaptation measures. Furthermore, extreme heat waves, extreme cold waves and droughts may also create more serious impacts in the future. The most vulnerable areas likely to be affected in the future include Cam Duong, Ta Phoi, Hop Thanh, Binh Minh, Van Hoa, Xuan Tang and Kim Tam.

Vulnerable communities

According to the 2013 Vulnerability Assessment Report of Lao Cai City, there will be changes in the vulnerability of the following groups:

Agriculture production group: According to the city's development plan, agriculture production will only contribute to a small proportion of the future economic structure of Lao Cai City. This means the number of people participating in agriculture production will decrease. However agriculture production—especially rice and vegetable production—will still be situated in high-risk areas (such as Cam Duong, Ta Phoi, Hop Thanh, Van Hoa and wards/communes northwest of the city) and will therefore require support to help protect them from the impacts of climate change. The Coc San commune (in the northwest area of the extended area of Lao Cai City) is planned for agriculture development, but has a high risk to flashfloods and landslides along the Ngoi Dum stream, and is highly sensitive to the impacts of climate change. As agriculture households are mainly affected by flashfloods, landslides and flooding, in the future their vulnerability is likely to increase considerably due to the predicted increase in frequency and intensity of these natural disasters. Agriculture households are also likely to be affected by the impacts of multiple extreme weather events such as extreme and prolonged heat waves and cold waves, and severe droughts in dry season.

Agriculture households are also likely to loose their cultivation land due to urban expansion and public infrastructure development. Unless they receive support from the local government, in terms of finding new livelihoods and sources of income, agriculture households are likely to be highly vulnerable in the future.

Commerce and service group: This group is expected to play an important role in the future in terms of the local economy, with an increase in both quantity and size of businesses predicted. This group is also expected to suffer from the increasing impacts of natural disasters and extreme weather events. However, they will be the least vulnerable of the groups as by comparison they are more financially secure and supported by better infrastructure. Business, trade and service activities in high-risk areas such as along the Red River, Nam Thi River, and streams where infrastructure construction is not adequate and/or does not satisfy safety standards (such as dykes that can only sustain 4–7% floods) may face a higher risk of being impacted when severe floods occur.

Resettlement group: The predicted increase in frequency and intensity of natural disasters may lead to more severe impacts on communities living along streams and rivers. Natural disasters may also affect a larger proportion of people, which means resettlement need will increase. Current data shows that the resettlement group usually consists of people that depend on agriculture livelihoods, have a low income and a low living standard. There is still limited planning and support available to resettled communities in terms of infrastructure, basic social services and livelihood transition support. If these limitations are not adequately addressed in the future, the growing number of resettlement households will become even more vulnerable.

Other urban groups: Other urban groups in the future might include a large number of immigrant workers from surrounding areas and provinces who have come to find jobs in the city. Among this group, immigrant workers and manual labors are expected to be the largest, partly because of the growing demand from the mining and mineral processing industry and the commercial and service sector. These people typically have a lower income and living standard and face a lot of difficulty in accessing basic social services such as health care, education and insurance. For this reason, the city needs to pay more attention to managing resettlement and in developing and implementing supportive policies to build resilience and reduce vulnerability for this population group.

Vulnerable livelihoods

Agriculture: Climate change can delay maturation of spring rice crops, and speed up maturation of autumn rice crops by up to 30 days (however the productivity of autumn crop tends to increase minimally). While climate change may facilitate the photosynthesis of plants, it does not have any significant effect on plant growth and productivity. Furthermore, the potential increase in extreme cold and hot weather can lead to significant changes in maturation period and productivity of plants. Climate change may lead to changes in food crops in Lao Cai due to droughts and water shortage (such as in Xuan Tang, Ta Phoi and Hop Thanh); or flooding (such as in Binh Minh and Cam Duong). Higher temperature allows pests to thrive and increases the demand for water, fertilizers and pesticides, thus leads to increases in production costs and environment pollution.

Animal husbandry: Climate change can affect the food supply and growth cycle of many types of cattle and poultry, can weaken their immune system, and can increase the chance of disease and transmission, causing large losses for farmers. In animal husbandry, productivity and output of certain types of livestock can decrease due to the impacts of increasingly fluctuating temperature, humidity and a range of other external factors.

Aquaculture: When the temperature increases, the oxygen content in the water decreases, affecting the growth and development of fish and aquaculture species. However, increases in temperature can

also have advantages for the aquaculture industry. The increase in temperature within certain limits can increase primary productivity of aquaculture ponds, by facilitating the development of certain aquatic species, which can act as a food source for other aquaculture species. Increased water temperature in spring can also promote an abundance of aquatic biomass, which means ponds can be stocked earlier.

Forestry: The forecasted changes in temperature and precipitation associated with climate change pose the risk of changing forest area and type. In the coming years, because the increase in temperature is expected to only be minor, the impact might not be immediately apparent. However in the short term, the impacts from droughts and water scarcity will create a high risk for forest fires. During the period from November to March each year, the risk of forest fires is expected to increase, with the level of increase in scenario A2 being higher than in scenario B2 and B1, though only slightly. December is the month expected to have the highest risk (16–17 days). Forest fires are likely to occur more towards the beginning and the end of the high season (October and March). In other words, the forest fire season will most likely start earlier and end later than historically has been the case.

Energy: Average temperature is forecasted to increase by 1–2°C in the future, while winter temperature is expected to decrease significantly. The increase in extreme weather events is likely to have a significant impact on the increase in energy consumption for cooling, heating, preserving materials, irrigation, and drainage. Climate change is likely to affect the hydrological regime of rivers and streams, which will in turn affect the power generation capacity of hydropower stations. It may also limit the ability to build more hydropower stations, thus affecting the overall power supply. In the long run, when energy demand increases, the power supply sector will have to build more hydropower plants, or potentially more thermoelectric power plants that use fossil fuels for power generation (the main accelerator of climate change). Climate change can also cause some new power plant projects to be cancelled or modified.

Industry: Climate change may affect the industrial facilities such as factories, transportation and distribution system for material, goods and equipment, and materials, which will increase the costs of industrial production. Climate change affects the mining industry and leads to unsustainable mining practices, which can potentially exacerbate disaster risks.

Infrastructure

The infrastructure system is likely to be affected by similar climate events in the future, however the level of impact is expected to increase. Specifically, the duration of exposure is expected to extend from April to October. A common issue that affects most urban infrastructure is that their design and construction is based on historical data, with little consideration of climate change. Therefore the damages from extreme climate events are likely to be severe. It is therefore necessary to proactively plan for extreme events and potential impacts in order to respond to them more effectively and reduce the risk of damage.

Transport infrastructure, especially roadway infrastructure, will continue to be extremely vulnerable to the impacts of climate change in the future, especially in the high-risk areas of Cam Duong, Ta Phoi, Hop Thanh and Dong Tuyen communes, roads along the Red River and the Nam Thi River, and roads in mining areas.

The design of the urban drainage system did not consider the potential impacts of climate change and the increasing amount of wastewater associated with the socio-economic development process. Several roads in the Kim Tan ward and along the Red River have a low level of elevation. It is predicted that the drainage system here will not be able to handle the cumulative impact of a big flood on the Red River and a flashflood from the mountain. The drainage system in Kim Tan, Van Hoa, Xuan Tang and Binh Minh are also considered particularly vulnerable.

The vulnerability of irrigation work is expected to remain stable in the future, along with an expected decrease in agriculture (2–3% of the economic structure). According to the city's plan, the system of irrigation works—mainly in Ta Phoi, Dong Tuyen, Hop Thanh and Coc San commune (the extended city area)—will be 100% reinforced by 2020. However, irrigation facilities are often directly affected by natural disasters such as flashfloods and landslides and typically do not satisfy the safety standards required to withstand extreme natural disasters and climate events. The Noi Bai-Lao Cai Highway is a part of the Asian Highway, connected with the Kunming-Hekou Highway in China and the Bac Thang Long-Noi Bai Highway in Hanoi, with the section in Lao Cai of 19km. The construction of this highway—crossing most of the main streams such as Ngoi Dum and Ngoi Duong—may lead to obstruction of stream flows, accumulation of flood water and siltation in many irrigation works and channels, limit drainage capacity, localize flooding, and degrade irrigation works.

Overall, the vulnerability of irrigation works under future climate condition may change if appropriate measures are not put in place to mitigate impacts of new constructions.

Public facilities: According to an institutional assessment, most of the public facilities such as schools, hospitals, clinics, and office buildings of major agencies were built with consideration of natural disaster risks. Facilities in sensitive areas are currently being planned for relocation or an upgrade. Therefore, this group has a relatively low vulnerability compared to other groups. However, public facilities situated along rivers and streams in Cam Duong, Ta Phoi and Hop Thanh will still be vulnerable to climate events and natural disasters.

In summary, the ***flexibility, redundancy and safe failure*** capacities of infrastructure systems in Lao Cai city will be improved in the future when climate change is integrated into the planning process, particularly when special consideration is given to extreme climate events, climate variations and uncertainties.

Based on the identified impacts of climate change on Lao Cai City, its future vulnerability issues can be summarized as follows:

TABLE 9
FUTURE CLIMATE CHANGE VULNERABILITY ASSESSMENT MATRIX

CLIMATE IMPACTS	Vulnerability of urban infrastructure				Vulnerability of communities			
	Trans-portation	Irrigation, water drainage	Housing	Public facility	Agriculture	Industry, services	Resettlement	Other urban communities
Flashfloods, landslides	++++	++	+++	++	+++	+++	++++	+++
Flooding, inundation	++	++	+++	+++	++	+++	++++	++
Lightning strikes, tornadoes	-	-	-	++	++	++	++	++
Extreme cold waves	-	-	-	-	++	-	++	+
Heat waves, droughts, water shortage	-	-	-	-	+	++	++	++

Notes: very high vulnerability ++++ | high vulnerability +++ | medium vulnerability ++ | low vulnerability + | no vulnerability -

Adaptive capacity of the community in the future

In order to become a grade-II and eventually a grade-I city, Lao Cai City will need to focus its resources on socio-economic development and building a comprehensive infrastructure system. The city has already succeeded in its efforts to improve local community's adaptive capacity in terms of becoming a grade II or grade I, as summarized below:

Climate change awareness: To prepare for future climate change impacts, the national government, ministries and provinces all have to develop policies and solutions to build capacity to respond. The Lao Cai province has already developed an Action Plan to Respond to Climate Change, with the objective of raising awareness about climate change across all management levels and the local community. Through awareness raising activities, it is expected that the majority of government staff will have a general knowledge about the signs and impacts of climate change. From now until 2015 and in the long-term 2020, communication activities will be carried out, to help local communities access knowledge and improve their resilience to climate change. With a systematic approach in raising climate awareness, the ability to learn of Lao Cai City is expected to improve significantly.

Institution: There is expected to be more interest from the national level in regards to integrating climate change into socio-economic development processes at the provincial and city levels. A range of related policies and action plans are expected to be launched or promoted. However, an existing challenge not only for Lao Cai but also other provinces and cities is that the development process does not always proceed according to plan. There may be process delays, a lack of funding, challenges in the land clearing process in terms of resettling communities, or impacts from natural disasters. These issues can affect a program's ability to deliver the objectives according to schedule, create difficulties in attracting additional funding, and affect the community's overall resilience. Therefore, it is critical to further strengthen the collaboration between local governments with the private sector and the local community. This is critical now more so than ever given the industry, service and trade sectors are expected to grow and hold a larger share of the city's economic structure.

Finance: As the cultural, economic and political center of Lao Cai province, with a border gate to Yunnan province of China, Lao Cai City has many opportunities to attract domestic and international investment for its socio-economic development, infrastructure development, and community awareness raising and resilience building. However, in this process, the leadership of the local government and key departments (such as the Department of Finance, the Department of Planning and Investment, the Department of Natural Resources and Environment, and the Department of Agriculture and Rural Development) must play a strong role in allocating a budget for climate change resilience building. Given the industry, service and trade sector is expected to hold over 80% of the economic structure, there should be mechanisms to mobilize support from the private sector.

By 2020, Lao Cai City aims to have a yearly per capita income of USD 5,000 (five times higher than in 2010), and a poverty rate of about 2%. With these targets, it is expected that the people living in Lao Cai city will enjoy a more stable income and have a better standard of living. Thus, there is hope more people will be in a position to invest in climate change adaptation. However, in the process of socio-economic development and with a decline expected in agricultural production, it is necessary to formulate appropriate supportive policies to avoid broadening the economic inequality spectrum. This can easily happen when most of the increase in income tends to fall on the business sector, and the majority of un-skilled workers are still disadvantaged by the lack of training and job support.

Endnotes

1. Oanda exchange rate of December 31, 2005: 15,900 VND/USD at http://www.oanda.com/currency/converter/
2. Oanda exchange rate of December 31, 2012: 20,815 VND/USD at http://www.oanda.com/currency/converter/
3. New criteria for identifying poor household were applied since January 01, 2011.
4. The Action Plan to Respond to Climate change of Lao Cai Province was developed using the Model for the Assessment of Greenhouse-gas Induced Climate Change, and a Regional SCENario GENerator (MAGICC/SCENGEN) version 5.3 Hue City Statistical Yearbook 2011
5. Providing Regional Climates for Impacts Studies

SECTION 3
ACTION PLAN TO RESPOND TO CLIMATE CHANGE IN LAO CAI CITY

1. GOALS AND OBJECTIVES

Goals

The overall goal of this Action Plan is to strengthen the climate change resilience of Lao Cai City; improve its adaptive capacity; support its proactive responses to climate change; promote the effective use of natural resources in the context of upgrading the city; and improve the adaptive capacity of the poor and vulnerable sectors to ensure an improved standard of living, long-term security and sustainable development.

Objectives

- Improve the capacity and awareness of local government agencies and departments, civil society, and the community in climate change and improve their capacity to develop action plans;
- Strengthen the resilience of infrastructure, community groups and sectors vulnerable to climate impacts;
- Strengthen the collaboration between departments, agencies and organizations in developing and implementing plans giving consideration to climate change
- Promote the integration of climate change into urban plans and development plans of the city, with special attention to spatial development plans and urban infrastructure development plans (long term);
- Integrate climate change into the resettlement process, giving special attention to social services and livelihood support;
- Improve the capacity and quality of natural disaster projection and early warning systems in the context of climate change; and
- Develop a climate change database to support the integration of climate change into the city's development plans.

2. IDENTIFYING ADAPTIVE MEASURES AND ACTIONS

In identifying measures and actions to respond to climate change, the project applied both top-down and bottom-up approaches and engaged both city and provincial level agencies and departments, and the local community. The local community helped identify and prioritize actions under each measure identified and prioritized by the city. All measures and actions included in the action plan were shared with all stakeholders in order to reach a final agreement.

Measures and actions were identified giving consideration to the city's objectives and missions as assigned under decision no. 2227/QD-UBND (dated August 21, 2012 by Lao Cai PPC on the Action Plan to Implement the National Target Program to Respond to Climate Change in Lao Cai province). As stated in the decisions, the province need to ensure that the measures and actions are feasible, the objective of adapting and reducing impacts of climate change across sectors is met, and that the measures are consistent to each sector's functions and mandates, and do not overlap with existing their assignments. Accordingly, the criteria for prioritization of measures and projects are as follows:

- Urgency: projects to reduce the current impacts of climate change, especially increases in frequency and intensity of natural disasters
- Protection of vulnerable communities
- Cost-effectiveness: cost-effective projects based on cost-benefit analysis, projects with low cost and high level of impact
- Integration of climate resilience into existing projects/programs, strategies, urban plans, sector plans, and city development plans
- Implementation is feasible and under the city's authority

3. GENERAL ADAPTIVE MEASURES

- Establish a coordinating agency of climate change at the provincial level;
- Develop mechanisms for inter-sector and cross-level collaboration to respond to climate change;
- Promote the integration of climate change (in terms of activities and budget) into the socio-economic development plans of Lao Cai Province and Lao Cai City, which includes assessment of current socio-economic conditions, plans, and orientations, land use plans, urban spatial plans, infrastructure development, water supply, irrigation, transport, and residential area, with consideration of natural disaster and climate change risks;
- Improve capacity and awareness across levels and sectors, civil society and mass organizations of natural disaster risk reduction and climate change adaptation, extend communication activities to improve community awareness and provide training on disaster risk reduction and climate change adaptation to all levels and sectors;
- Propose increases in budget allocation for disaster prevention and recovery and climate response in all levels and sectors. This should include financial support disaster recovery as well as support to recovery of the environment, and additional support to households that were evacuated because of the disasters. At the same time, develop a disaster support mechanism for Lao Cai city and establish the disaster prevention fund with participation of the private sector and the community;
- Develop programs and projects to mobilize funding from individuals and organizations across Vietnam and internationally to implement the Action Plan;
- Develop mechanisms to provide loans to households with a high disaster risk based on each household's situation (periodical disbursement), and design insurance package for climate change risks;
- Design community models to respond to climate change: detailed plans to respond to natural disasters and climate change at commune/ward level, residential group level and household level, build safe shelters, develop a green agriculture industry, improve capacity for ward/commune level clinics in disaster-prone areas;
- Develop livelihoods, improve the living quality, and stabilize housing for vulnerable groups, such as resettlement households who loss their cultivation land, poor households, and households with houses in high disaster risk areas;
- Establish a warning system for disease outbreaks to protect public health in the context of climate change, especially for communities living in the border gate area with China;
- Have an annual review and adjust the Action Plan (if needed), develop climate change scenarios, disaster hazard maps for Lao Cai City in the context of climate change;
- Assess the change in demographic characteristics, conduct supplementary vulnerability assessment focusing on immigrant worker group with low living standard, the poor, and those with high risk livelihoods, and propose policies to manage and support this group of the population; and
- Strengthen the capacity of hydro-meteorological forecasting, in terms of human, equipment, and technology.

4. MEASURES TO ADAPT TO CLIMATE CHANGE RELATED RISKS

a. Floods and flashfloods

- Assess the current condition of all infrastructures that affect flood drainage, with special attention to road systems, weirs, stream bridges and river bridges. This includes Road TN7 of Xuan Tang ward, all weirs in Cam Duong commune, ore transportation roads in Xuan Canh-Cam Duong area, and Group 28-30 hanging bridge of Binh Minh ward, on the basis of investigating and proposing suitable measures for adjustment with consideration of climate change;
- Evaluate future drainage capacity of the urban drainage system in condition of 1–2% flood event of the Red River, as well as lower frequency floods that might occur as a result of climate change, and identify measures to minimize damages. Allocate regular funds for repairs, maintenance and upgrade the city drainage system to make sure the drainage capacity is suitable under climate change conditions;
- Develop a plan for buffer zones along the dykes at both sides of the rivers, especially the Red River, restrict the construction and development of housing in the buffer zones to reduce climate impacts and disaster risks;
- Strengthen the management and monitoring of mining activities, reclaim mining lands while managing landfills, and define clear responsibilities of mining project investors in restoring the river and stream system and dumping of mining waste water. In the short term, focus on dredging all streams and rivers affected by sand sediments from mining activities, to bring these streams and rivers back to their original state;
- Improve the flood resistant capacity of key transportation routes usually affected by flashfloods, extend the road system, and replace weirs with bridges;
- Develop flashflood warning maps for Lao Cai city under climate change scenarios;
- Improve early warning systems and provide emergency equipment for timely rescue and support during disasters; and
- Improve the climate resilience of agriculture and aquaculture by changing crop structure, optimizing season calendars, planting trees along streams to prevent sand intrusion, upgrade irrigation channels and aquaculture ponds, strengthen disease prevention efforts, and select aquaculture products based on climate change conditions.

b. Inundation

- Recommend the national government develop a collaboration mechanism for cross-border river water management (watershed management) with China;
- Review and adjust mechanisms, policies and plans related to housing, flood prevention, planning of urban transportation system, drainage and irrigation systems, and residential areas with consideration of climate change;
- Review and adjust land use plans for wards frequently affected by localized flooding (cultivation area in group 1 of Xuan Tang ward and ward 9 of Binh Minh ward);
- Improve the capacity of management agencies in the management and operation of irrigation facilities and urban drainage facilities, including flood and storm control and disaster reduction infrastructure;
- Research optimizing season schedules and adjusting crop structure. For flood-prone areas, select more flood-resistant crops or shorter-term crops to reduce disaster damages;
- Assess the conditions of the water drainage infrastructure, consider new construction or upgrading the drain system, upgrade all water retention ponds in urban area of the city and the road system of Xuan Tang, Ta Phoi, Hop Thanh and Binh Minh wards; and
- Allocate regular funds for repairs, maintenance and upgrade of the city's drainage systems.

c. Landslide and riverbank erosion

- Upgrade the dyke system to integrate climate change consideration, especially sections along Ngoi Duong stream in Cam Duong commune and Binh Minh ward;
- Strengthen the management and monitoring of mining activities, especially the management of landfills, assess the impacts of dynamite on the physical characteristic of soil and rock layers; specify the responsibilities of the mining project investors in upgrading the river system, restoring the environment and protecting and recovering forests (in replacement of forest areas claimed by mining activities);
- Assess the condition and provide resettlement for households in high erosion risk areas;
- Develop erosion risk warning maps, install warning signs in high risk areas of the city;
- Develop mechanism for communication to encourage riverine communities in high risk areas to plant trees along rivers and streams to prevent sand deposit; and
- Construct a system of dykes to protect settlement areas, public structures and agriculture facilities.

d. Droughts and water shortage

- Conduct a comprehensive assessment of water supply-demand balance in the watershed, develop plans and strategy for water supply in the city. The planning process has to consider design capacity and demand level, and conduct additional assessment on water volume, quality of surface water and groundwater resources so that effective strategies can be developed for effective use of these resources in the future;
- Ensure water is supplied to 100% of urban residents, especially in new urban areas, resettlement areas and mountainous community areas; ensure there is adequate water supply for manufacturing industries in the new industrial areas of the city (Ta Phoi, Hop Thanh, Van Hoa); extend the assessment to all areas in the urban expansion plan of the city, including assessment of water supply to domestic and production use in these areas;
- Consider a change of land use for areas with serious water shortages (Xuan Tang and Ta Phoi wards), adjust crop structure towards more drought-resistant crops, or investigate construction of regional water irrigation reservoirs;
- Support finance for maintaining and upgrading of the irrigation channel system in key production areas (Binh Minh, Ta Phoi, Hop Thanh and Xuan Tang wards);
- Plant forests for biological generation and retention of water resources .

e. Extreme and prolonged cold and heat waves, localized heat waves

- Reinforce disease outbreak control during seasonal transition periods;
- Promote communication and encourage communities to use clean and renewable energy, save natural resources, and limit greenhouse gas emission;
- Provide technical support for the designing and construction of houses and farm facilities that can resist extreme hot and cold weather;
- Research and support new plant and crops that are more cold resistant;
- Provide technical support and financial support to improve cold resistance in rural areas;
- Improve the weather forecasts and regular warnings of extreme cold fronts; and
- Develop urban plans that can avoid "heat island" effect by appropriately distributing new construction, planting trees and using balancing lakes.

f. Lightning and tornadoes

- Check all public trees in the city for trimming, select types of trees that have deep roots and can resist storms and tornadoes;
- Organize communication and awareness raising for communities on the risk of tornadoes and lightning, instruct people to reinforce their roofs and houses to withstand tornadoes and avoid lightning strikes; and
- Investigate and conduct in-depth evaluation of lightning strikes in mining areas to find solutions.

5. PRIORITY MEASURES FOR PERIOD FROM 2015–2020

Based on the general measures and measures proposed for types of disasters, the team has proposed priority measures to be implemented in each period. The criteria are determined based on in-depth interviews with city level agencies and city leaders, drawing on the experience of experts and input from the inter-departmental technical group.

Priority measures for period 2015-2020

TABLE 10

LIST OF PRIORITY TASKS AND PROJECTS UNDER THE ACTION PLAN TO RESPOND TO CLIMATE CHANGE OF LAO CAI CITY

No.	Item	Local budget plan (LCPC) (Million VND/year)		Lead	Coordinate	Integration program	
		2014-2015	2016-2020				
1	Awareness raising for government officials across levels on climate change	140	200			National Target Program to Respond to Climate Change (provincial action plan); Provincial training program on responding to natural disasters, floods and storms; Education projects of the province and city	
	Activity 1: Organize training and awareness raising for leaders across levels in the city on climate change, integrating climate change into planning, socioeconomic development plans (SEDP) and sector plans. Special attention should be paid to building capacity in the management and operation of irrigation infrastructure, resettlement planning, and mining activities in the context of climate change.	30	50	LCPC	DONRE		
	Activity 2: Organize training and awareness raising for communities in the 17 wards and communes of Lao Cai city (on clean energy, renewable energy, saving natural resources, crop shifting, tornado and lightning threats, technical guidance on agriculture and house reinforcement)	60	100	LCPC	DONRE, DARD		
	Activity 3: Develop documentary and brochures on clean energy, renewable energy, saving natural resources, emergency and rescue manuals	50	50	LCPC	DONRE		
2	Promotion of climate change integration into the city socio-economic development programs	50	50	LCPC	DONRE, DOC, DOT	Target projects and programs of the city: Project on city development, SEDP; provincial climate change integration program	
	Activity 1: Review the city's development projects and programs, based on which to develop the Pilot project on integrating climate change into sector development plans						
	Activity 2: Select one to two areas under the city SEDP to pilot climate change integration based on the new guidelines by Ministry of Planning and Investment and Ministry of Construction						
	Activity 3: Draw experience from the two pilot research, and share lessons with other departments and agencies						
	Activity 4: Apply for all the other sectors (from 2016)						
3	Capacity building in weather forecast and disaster warning						
	Activity 1: Develop new stations for community monitoring of rainfall and hydrology monitoring in the city. In the short term, install a simple monitoring system (flood gauges along main streams and rivers such as Ngoi Duong, Ngoi Dum, and community rainfall monitoring stations)	Provincial budget; external support	Provincial budget; external support	DARD	Hydro-meteorological center; LCPC	NTP-RCC; Disaster Risk Reduction and Management Program	
	Activity 2: Develop the weather forecast program on the television and radio station of the city	20	20	City Television and Radio station	Hydro-meteorological center		
	Activity 3: Update climate change scenarios for Lao Cai city and develop natural hazard zoning map with consideration of climate change for disaster prevention and reduction	Provincial budget; external support		DONRE	DARD and related departments		
4	Review current conditions of all structures affecting flood drainage, especially the road system, weirs, and stream / river / channel bridges, based on which to investigate and suggest effective adjustments in consideration of climate change. Promote inspection and monitoring and securing disaster management infrastructure of the city such as the embankment, irrigation and bench-marking systems						
	Activity 1: Review current conditions of floodway obstruction caused by construction and buildings, and deal with each case, with special attention to weirs and core transportation facilities	10			DARD, DOT, DONRE	Disaster Prevention and Reduction Program; New Rural Area Development program; city urban development plan	
	Activity 2: Select priority issues to deal with (build bridge to replace weirs, raise road elevation, improve frequency flood resistance capacity of structures, etc.	Provincial and national governments			DARD, DOT, DONRE	Disaster Prevention and Reduction Program; New Rural Area Development program; city urban development plan	
	Activity 3: Identify high disaster risk areas that have not implemented any measures in building adaptive capacity, consider installing more warning signs for the community	100		LCPC	DARD	Disaster Prevention and Reduction Program	

5	Reinforcement of river/stream embankment system, and road talus with consideration of climate change						
	Activity 1: Reinforce talus along road 4D, old 4E (or new D2), roads surrounding mines	Mining companies; national and provincial support		DOC	Other departments	Disaster Prevention and Reduction Program; NTP-RCC	
	Activity 2: Continue to reinforce the dyke system of the Red River, Ngoi Duong and Ngoi Dum streams. Build small-scale facilities for natural disaster reduction	National support		DARD	Other departments		
6	Resettlement for people in areas vulnerable to climate change					Target program to resettle 100 households vulnerable to natural disasters in Lao Cai city from 2013–2020; Urban expansion and upgrade plan	
	Activity 1: Assess and make a list of areas and households vulnerable to climate change for resettlement; make plans to move these groups away from high disaster risk areas	10	10	LCPC	DARD		
	Activity 2: Move households out of vulnerable areas, at the same time organize crop schedule for stable livelihoods of these groups and consider other aspects of their lives such as infrastructure, services, livelihoods, culture (especially for ethnic minority groups)	Provincial budget		Lao Cai City People's Committee	DARD		
7	Application of information technology in data collection, storing and processing; forming of a data storing system for development and implementation of disaster reduction and climate change adaptation					Program on science and technology application	
	Activity 1: Develop mechanisms to integrate climate data collection and storing into other database programs of the city			Lao Cai City People's Committee	DONRE; DOST; Hydro-meteorological center		
	Activity 2: Develop mechanism for information sharing and engage participation of organizations and individuals in information collection and updating						
8	Adjustment of rural infrastructure system, natural disaster prevention and reduction in association with environmental protection towards building climate resilience for Lao Cai province						
	Activity 1: Assess and adjust plans of the systems of drainage channels and water storage lakes and rural infrastructure, and land use plan	National and provincial budget		LCPC	Related departments / agencies	National target program on development of new rural areas period 2010–2020	
	Activity 2: Research and suggest the development of concentrated livestock husbandry farms away from residential areas with standard sanitation	National and provincial budget					
9	Promotion of forest planting, forest protection and quality improvement; forest location planning in line with plans for disaster reduction and climate change adaptation plans	Program on sustainable management and development of forests under Vietnam's forestry development strategy period 2006- 2020		DARD	Other related departments / agencies		
10	Strengthening management of mining and mining land reclamation activities, with attention to landfill management; Clear regulations on responsibilities of investors in mining activities; Recovery of rivers/ streams that receive waste from mining activities					Program on inspection of related organizations; Supervision program of the People's Council; New urban area project	
	Activity 1: Regularly check and monitor mining and processing activities in the city (at least twice a year) in terms of environment protection and recovery	30	50	LCPC	DONRE		
	Activity 2: Investigate and monitor impacts of mining activities on rivers/stream deposit levels in the city to identify causes and accountability	30	50				
	Activity 3: Clear and dredge floodway streams in deposited areas	10,000 (for the whole period)		LCPC; DARD	Related departments	Project on dredging floodways (5km of river bed in the city center area)	
11	Investment in drainage and solid waste processing systems to improve the drainage capacity for Lao Cai city						
	Activity 1: Improve the drainage system of Lao Cai city to reduce flooding in urban areas, regulate the frequency and time of annual dredging of the drainage system	National support, international donor support; loans (ongoing)		ODA project management board	LCPC; departments	Program on infrastructure improvement for Lao Cai city from WB loans, AFD	
	Activity 2: Construct a new waste water treatment factory and solid waste treatment factory for Lao Cai city						
	Activity 3: Upgrade the water supply system to satisfy demand of the entire city						

6. RECOMMENDATIONS

In order to build climate resilience for Lao Cai City, apart from a comprehensive set of priority implementation measures, it is recommended that:

- Sectors should increase their budget allocation for prevention, control and recovery of natural disasters and responses to climate change. This should include financial support for disaster recovery as well as support for recovery of the environment, and additional support to households that were evacuated because of the disasters; Develop a disaster support mechanism for Lao Cai city; Strengthen the disaster prevention fund with participation of the private sector and the community
- There are two rivers running through Lao Cai city—the Red River and the Nam Thi River—both originating from China. Therefore, in order to control the flow and quality of water in these two rivers, it is suggested that the provincial People's Committee and national ministries act early to develop a cooperation program with China and China's border province for cross-border watershed management.
- Lao Cai borders with the Hekou district, Yunnan province in China and with the Lao Cai International Border gate. The city is also a point of commercial cooperation on the East-West economic corridor of Lao Cai-Hanoi-Hai Phong. During the past several years, labor immigrants in the city have been increasing in number. This is a group considered highly vulnerable to climate change. Therefore, it is suggested that the provincial People's Committee consider supporting Lao Cai city in assessing the vulnerability of this group in more detail and providing better management and supportive policies.
- Climate change is a multi-sector issue, therefore, in order for an effective response to be established, it is suggested that the provincial People's Committee establish a specialized body for climate change coordination and develop cross-sector and cross-level coordinating mechanisms for climate change.

SECTION 4
IMPLEMENTATION

1. RESPONSIBILITIES OF DEPARTMENTS, AGENCIES, ORGANIZATIONS AND LAO CAI CITY PEOPLE'S COMMITTEE

THE LAO CAI CITY PEOPLE'S COMMITTEE

- chair and coordinate with relevant departments, agencies and units to propose and develop mechanisms and policies to manage and administer the implementation of the action plan and submit these proposals to the provincial People's Committee for approval, or issue them based on specifications of authority;
- actively mobilize and propose resources and develop plans on integrating the plan into other related activities in the area to achieve targets in the action plan;
- proactively develop plans on moving people from disaster risk areas and resettling them; Develop and implement models of community's effective response to climate change;
- direct the commune/ward people's committees to strengthen the management of disaster risks and responses to climate change; manage and operate projects to enhance the capacity of disaster risk management and responses to climate change; and
- take initiative in dissemination and enhancement of community awareness in management of disaster risks and response to climate change.

THE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENT

- support Lao Cai city People's Committee and relevant departments, agencies and units in implementing the action plan;
- coordinate information, education and communication activities related to climate change;
- guide, monitor and evaluate the action plan implementation; and
- coordinate with the city People's Committee to integrate clime change into related plans (land use, natural resources), environmental protection and climate change response.

THE DEPARTMENT OF AGRICULTURE AND RURAL DEVELOPMENT

- support Lao Cai city People's Committee and relevant departments, agencies and units in managing natural disasters and responding to climate change; and
- work with the city People's Committee in integrating related activities into agriculture and forestry planning and development; preventing natural disasters and responding to climate change in the agricultural sector; researching and developing varieties of plants and animals adaptive to the local conditions in the context of climate change; developing projects and plans on water supply to agricultural production; and moving people from high disaster risk areas and resettling them.

THE DEPARTMENT OF PLANNING AND INVESTMENT

- chair and work with other departments, agencies and the Lao Cai city People's Committee in reviewing and adjusting strategies and plans on socio-economic development of the province to respond effectively to climate change and ensure the sustainable development objectives of the province;
- work with other departments, agencies and Lao Cai city People's Committees in coordinating budget sources for projects, plans and tasks of the action plan; and
- attract more investment at home and abroad for climate change response.

OTHER RELATED DEPARTMENTS AND AGENCIES

- implement the assigned tasks in the action plan; and
- proactively participate in coordinated activities according to the proposed tasks of the action plan. Integrate activities of this plan into related activities of other programs and plans to achieve objectives of the action plan.

COMMUNE/WARD PEOPLE'S COMMITTEES IN THE CITY

- provide regularly updates about natural disaster situations; propose measures to prevent, respond to and reduce disaster risks and adapt to climate change;
- effectively implement the 4-spot motto in overcoming and coping with natural disasters; and
- manage and effectively operate the early warning systems at rivers, streams and vulnerable areas.

2. PARTICIPATION OF SOCIAL ORGANIZATIONS, BUSINESSES AND PEOPLE

COMMUNITY
Mobilize community and households to actively participate in building, operating and managing climate response projects, replicate and popularize the experience of climate resilience models. Encourage socio-political institutions, social-professional organizations and mass organizations to actively participate in implementing the action plan of the province and city. Establish self-managing organizations to monitor and respond quickly to impacts of climate change, especially abnormal natural disasters.

NON-GOVERNMENTAL ORGANIZATIONS
Create favorable conditions for non-governmental organizations to participate in implementing programs and plans on response to climate change. Create favorable conditions for non-governmental organizations to carry out activities to respond to climate change at community level; organize communication and raise awareness on climate change.

BUSINESSES
Develop mechanism and policies to encourage businesses to invest in climate change adaptation and mitigation projects.

3. FINANCIAL MECHANISM AND INVESTMENT

The approach is to promote internal resources, at the same time use international capital sources under the following general principles:

- Take advantage of international capital (non-refundable grants and loans) together with the State budget, State credit and people's capital;
- Use appropriate capital structure, in which budget capital supports and stimulates other sources;
- Encourage and create favorable conditions to attract investment from enterprises and people in any form.
- Prepare budget plan; distribute and allocate funds; manage, use and finalize expenditures and plan implementation in accordance with regulations of the State Budget Law and law guidelines.
- The targeted budget support program will provide funds for activities of the plan, which are identified, disbursed and monitored under the mechanism of the State Budget Law and the National Target Program for the province.
- The disbursement of the targeted budget support program is expected to take place efficiently as scheduled on the principle "the ODA budget is integrated into the budget and will be transferred directly to the programs".
- The targeted budget support program facilitates the integration of ODA funds into the efforts to achieve the common goals. This is a new step in harmonizing the procedures.
- The targeted budget support program will be implemented based on mechanisms of the national target program with a change in the allocation of funds; the monitoring and evaluation is based on the decentralization of management. The reporting mechanism is based on normal process/procedure, which only needs improvement during the implementation of the targeted budget support program.

Method of fund raising: Renew ways of mobilizing financial resources of the community, on the basis of the State's investment as a major source and the society's capital as a central source to create a legal basis to encourage the participation of the people, economic sectors and society in response to climate change; promote internal resources, and encourage project users to contribute funds for the construction, operation, maintenance and management of projects; attract more ODA and other funding sources. Give priority to communes with difficulties and areas regularly suffering natural disasters.

Method of capital planning: Based on the total cost of all projects assigned by the provincial People's Committee, the city People's Committee is responsible for integrating the targeted programs in the area and allocating funds for the local plans.

4. MECHANISMS FOR MONITORING AND ASSESSMENT OF THE ACTION PLAN IMPLEMENTATION

The monitoring and assessment plan is aimed to ensure monitoring and evaluating of the implementation of the objectives and tasks of the action plan are carried out in an objective manner.

Aims of monitoring and evaluation include:

- monitoring and evaluating the situation and results of the action plan implementation, shortcomings, difficulties and causes to allows appropriate adjustments to be made when needed;
- proposing measures to promote positive aspects and overcome shortcomings to help agencies involved in developing policies have sufficient information to improve and adjust policies and mechanisms to promote activities in each period; and
- providing information about progress and results of the implementation of the action plan objectives to help complete information source and statistics on the plan.

The monitoring and evaluation will include the following tasks:

- monitoring and evaluating the mobilization and allocation of resources for the action plan objectives (input): results and efficiency of using resources;

- monitoring and evaluating the implementation of the action plan objectives (outputs): Results and performance levels;
- monitoring and evaluating the development and implementation of the mechanism and policies of the action plan: compliance and impacts of policies and mechanisms on the implementation of the objectives and targets of the action plan;
- monitoring and evaluating the implementation of the action plan objectives of the agencies and localities: results and performance levels
- finding the strengths, weaknesses, shortcomings and challenges as well as opportunities in implementing the objectives and targets of the action plan; and
- based on these findings, pointing out causes and suggesting ways and orientations for overcoming or promotion. Every year, agencies and units involved in the action plan implementation must evaluate results of the previous year and propose implementation plans for next year and report to the provincial People's Committee for direction.

The monitoring and evaluation of the action plan implementation objectives will be implemented as follows:

- The Office of Natural Resources and Environment is responsible for *collection, summarization, management and storage of information* and preparation of periodic reports.
- The city People's Committee *approves and submits periodic reports* to the provincial People's Committee.
- The departments and agencies are responsible for *giving annual reports on their support for the city* to implement the action plan.

A WOMAN STANDS NEXT TO THE LINE THAT MARKS THE UNPRECEDENTED LEVEL OF FLOODING EXPERIENCED AT HER HOUSE IN LAO CAI. THE FLOOD LEVELS ROSE WITH ONLY A FEW MINUTES WARNING
Photo Credit: Richard Friend, ISET-International

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