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Foreword

This report presents the results of a project sponsored by Sida (Swedish International Development Cooperation Agency) in Hanoi, Vietnam, within a funding mechanism called Partner-Driven Cooperation. In the project, which was a collaboration between the Vietnamese NGO WARECOD (Center for Water Resources Conservation and Development) and the Swedish research institute FOI (Swedish Defence Research Agency), two climate change adaptation tools were applied in two districts in the region of Cao Bang in north-eastern Vietnam. These tools had previously been developed and used at the local level in Sweden, but this was the first time for them to be applied outside that context.

A Local Climate Impacts Profile (LCLIP) and Socio-Economic Scenarios obtained using the two tools resulted in two different reports targeted at the authorities in Bao Lam (LCLIP) and Nguyen Binh (scenarios). This is the report for the district of Nguyen Binh. In order to carry out our investigations, close collaboration with the authorities in Nguyen Binh was required and we appreciate their cooperation. In particular we want to thank Mr. Dam Van Ly – head of DONRE Cao Bang Province. Mr. Nong The Phuc - the vice chairman of Nguyen Binh People Committee, all participants in the two workshops that were organized in Nguyen Binh and all respondents to the questionnaire that was distributed.

The contents of this report are the sole responsibility of the authors. The report is also available in Vietnamese.

Sammanfattning

Vietnam är ett av de länder som kommer att drabbas allra hårdast av framtida klimatförändringar. Detta innebär att hela det vietnamesiska samhället kommer att behöva anpassas till ett förändrat klimat. Denna rapport beskriver ett klimatanpassningsprojekt som genomförts i Nguyen Binh i norra Vietnam. Projektets mål var att stödja Nguyen Binh i identifieringen av utmaningar och anpassningsåtgärder med anledning av ett förändrat klimat.

Kommunal klimatanpassning kräver ofta att besluts fattas över traditionella administrativa gränser vilket i många fall strider mot hur beslutsfattande normalt går till. Vi valde därför att i detta projekt arbeta med deltagande scenarioplanering som metod. Ett scenario ger i detta sammanhang en kortfattad beskrivning av framtida möjliga socioekonomiska förhållande i Nguyen Binh. I projektet använder vi en stegvis metod för att utveckla och använda socioekonomiska scenarier för att stödja det lokala klimatanpassningsarbetet.

Tre olika scenarier som beskriver tre olika möjliga framtider för Nguyen Binh år 2023 togs fram. Det första scenariot betonar Nguyen Binhs förmåga att bemästra situationen trots en något sämre ekonomisk utveckling. I det andra scenariot beskrivs en framtid där ekoturismen utvecklas starkt i Nguyen Binh. I det sista scenariot har Nguyen Binh genomgått en relativt kraftig industrialisering, bl.a. med gruvdrift. Med dessa scenarier som grund identifierades utmaningar och anpassningsstrategier. De viktigaste anpassningsstrategierna var:

- Planera för kampanjer för att sprida kunskap om klimatförändringarna;

- Följ utvecklingen på regional och nationell nivå vad gäller framtagandet av klimatscenarier;

- Utveckla ett flexibelt ramverk för skogens utveckling, där strategier för urskog kombineras med strategier för nyplantering samt integrering av skogs- och jordbruk;

- Undersök möjligheterna att anskaffa moderna alarmsystem för skogsbrand samt möjligheten att erhålla mer utrustning och bättre utbildad personal;

- Inlemma klimatförändringarna som en naturlig del av den långsiktiga samhällsplaneringen.

Nyckelord: Vietnam, klimatförändringar, anpassning, socioekonomiska scenarier

Summary

Vietnam is ranked among the top countries of risks of impacts from climate change. This implies that the whole Vietnamese society have to adapt to a changing climate. This report describes a climate change adaptation project conducted in Nguyen Binh district in northern Vietnam. The aim of the project was to help the district of Nguyen Binh to identify challenges and adaptation options in the face of a changing climate.

Municipal climate adaptation planning often requires cross-sectoral decisions, which is in contrast to practice in most places. We therefore opted to work with participatory scenario planning. A socio-economic scenario provides a brief description of future possible socio-economic conditions of the Nguyen Binh district. In this project we used a step-by-step process to develop and apply socio-economic scenarios in order to inform local climate change adaptation planning.

Three different scenarios describing different possible futures for Nguyen Binh in the year 2023 were developed. The first scenario emphasized the ability of Nguyen Binh to cope relatively well with the situation despite the fact that the economic developed has slowed down. The second scenario focused on a development path towards more of eco-tourism. In the last scenario Nguyen Binh had gone through a rapid industrialization including extensive mining industry. With these scenarios as a "test bench", challenges and adaptation options were identified. The key adaptation options identified were:

- Plan for climate change information campaigns;
- Keep up with what is happening at higher levels concerning local climate change projection;
- Develop a flexible approach to forestry management, where strategies for protecting virgin forests are combined with strategies for planting new tree crops as well as for integrating agriculture and forestry on the same land;
- Investigate both the possibilities for an advanced alarm system andthe possibility to receive more equipment for rescue operations with better training and practice for the staff;
- Incorporate climate change in long-term societal planning.

Finally, it should be underlined that the three scenarios developed should not be considered as comprehensive pictures of the future of Nguyen Binh in the sense that one of these will materialize. Instead, these scenarios should be taken as inspiring illustrations of possible developments and different parts of different scenarios could be used in the future planning of the district.

Keywords: Vietnam, Climate change, adaptation, socio-economic scenarios.

Contents

1   Introduction

Climate change poses new challenges to future societies. Planners have always taken into account the fact that weather conditions are changing over the year and from year to year. But now – and increasingly so in the future – planners must also acknowledge that the statistical properties of the weather, i.e. the climate, is changing. From a societal point of view climate change is a rather slow process and it is therefore necessary to envision and plan for the future in order to be able to adapt society to new climate conditions.

Although the historical responsibility for emissions of greenhouse gases is not distributed equally among nations and societies, a changing climate affects everybody. Adaptation to climate change, which has been defined as "a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented"[1], is therefore starting to take off in societies around the world. Local authorities play a crucial role in this, because it is at the local level that increasingly hot weather, stronger winds and more intense precipitation will be experienced. Thus local authorities will have to deal with more patients at local hospitals, more damage being paid to residents for damage to houses and crops and a greater need for repair to roads and other infrastructure due to landslides and flooding.

It is generally recognised that the impacts of climate change are dependent on future climate conditions, as well as future socio-economic conditions. This could include changing conditions in land use, health status of the population, educational level, infrastructures the economy etc. This has been recognised for quite a while now, and 20 years ago a report by the Intergovernmental Panel on Climate Change[2], IPCC, stated that climate change *impacts* are recognised as the "[...] difference [...] between socio-economic conditions projected to exist without climate change and those projected with climate change" (Carter et al. 1994, p. 26).

Climate change poses two challenges to society. First, society must be changed so that it emits less greenhouse gases. It is emissions of greenhouse gases that are the main cause of climate change, hence one usually talks about anthropogenic

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[1] See more at: http://www.vcccar.org.au/climate-change-adaptation-definitions#sthash.7JgMvfx0.dpuf

[2] IPCC is a international body for the assessment of climate change. IPCC reviews and assesses scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change and its impacts. It was established by the United Nations Environment Programme and the World Meteorological Organization in 1988 to provide the world with a scientific view on the current state of knowledge in climate change and its potential impacts.

climate change. This was also one of the main conclusions of the IPCC assessment report issued in 2007 (IPCC 2007):

> *Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.*

The second challenge is that society has to *adapt* to climate change. How much, when and how are still open questions, but it is safe to say that some adaptation must take place since there will with certainty be some climate change.

This report is about the second of these challenges: adapting society to a changing climate. More specifically, this report is about challenges to the Nguyen Binh district in northern Vietnam in the face of climate change. These challenges need to be identified and assessed in order to enhance the capability of Nguyen Binh's local planners to adapt society. This report describes the application of a climate adaptation planning tool – *socio-economic scenarios* – in the district of Nguyen Binh.

This report is structured as follows. In the next section we provide basic information about climate change in general and its impacts in Cao Bang province in particular. Section 3 describes the methodology utilised in this project. The results of the work in Nguyen Binh are presented in section 4, while a concluding discussion and recommendations are provided in section 5. More detailed information, e.g. working material during the process, is presented in appendices.

2 Climate change in Vietnam and Cao Bang Province

2.1 Explaining climate change

So, what is climate change? We have already stated above that climate is the statistical properties of the weather, so it follows that climate change must be about changing statistical properties of the weather. A typical weather parameter is the temperature on June 30th 2013 at 14:00 in Cao Bang city. Another weather parameter is the total precipitation in Cao Bang city on June 30th 2013. When climatologists talk about changing statistical properties they are e.g. talking about averages over 20 or 30 years. These are the types of time periods necessary for ruling out the rather substantial variations that can take place from one year to another.

Another important climate parameter is variability, which is a measure of e.g. how much a parameter is varying from year to year. Consider the following two hypothetical series of temperature at 14:00 June 1st at the same location:

Series 1									
1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
22°C	20°C	18°C	19°C	20°C	21°C	20°C	22°C	20°C	18°C

Series 2									
1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
15°C	17°C	23°C	20°C	26°C	28°C	16°C	18°C	17°C	20°C

It can easily be seen that these two time series have the same average temperature (20°C) but that the variation from year to year is much larger in series 2. There are several variability measures that can capture this difference between the two series.

In essence, climate change implies that both averages and the variations in many climate parameters will change. The most well-known example of changing averages is that the surface temperature of the earth is increasing. Today, the mean surface temperature of the earth is approximately 0.8°C higher than in the preindustrial level and this is expected to increase in the coming decades (IPCC 2007). How much the temperature will increase is very difficult to predict, since

climate change is surrounded by deep uncertainty. In its fourth assessment report, the IPCC indicated a span from +1.8°C to 4.0°C degrees as a global average (IPCC 2007). It is important to note that these figures are averages, and the temperature increase will vary across the globe. Figure 1 depicts how the temperature will increase until the period 2090-2099.
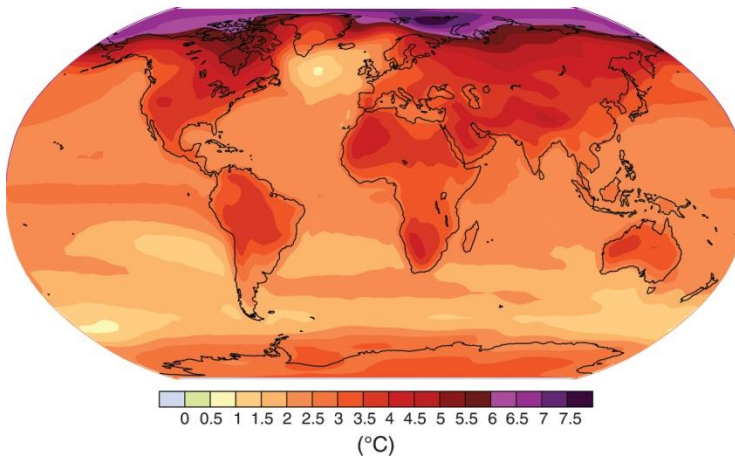

Figure 1: Temperature increase between the period 1980-1999 and 2090-2099. The calculations shown in this map are based on a medium level of emissions of greenhouse gases (source: Figure SPM6 IPCC AR4 Synthesis report; IPCC 2007).

Climate change will also lead to changes in the frequency, intensity, spatial extent, duration and timing of extreme weather. Already today we can see that some weather extremes have changed as a result of anthropogenic influences. In the terminology of a recently published IPCC report (IPCC 2012), it is likely that anthropogenic influences have led to an increase in extreme daily minimum and maximum temperatures at the global scale and there is medium confidence that anthropogenic influences have contributed to intensification of extreme precipitation at the global scale. Furthermore, it is likely that there has been an anthropogenic influence on increasing extreme coastal high water due to an increase in mean sea level.

Projecting future changes in e.g. the frequency and intensity of extreme weather is a difficult task. However, projected changes in climate extremes under different scenarios of greenhouse gas emissions do not strongly diverge in the coming two to three decades. At the same time, these changes are relatively small (on this time scale) compared with the natural climate variability, see Figure 2. For longer projections, towards the year 2100, model uncertainty as well as uncertainty with regard to emissions levels dominate. In any case, in the IPCC report (IPCC 2012) a number of statements are made, e.g. it is stated that it

is virtually certain that increases in the frequency and magnitude of warm daily temperature extremes and decreases in cold extremes will occur in the 21st century at the global scale and it is very likely that the length, frequency and/or intensity of warm spells or heat waves will increase over most land areas. Increased intensity, duration and frequency of extreme weather events will pose a serious threat to many parts of society, today and increasingly so in the future.
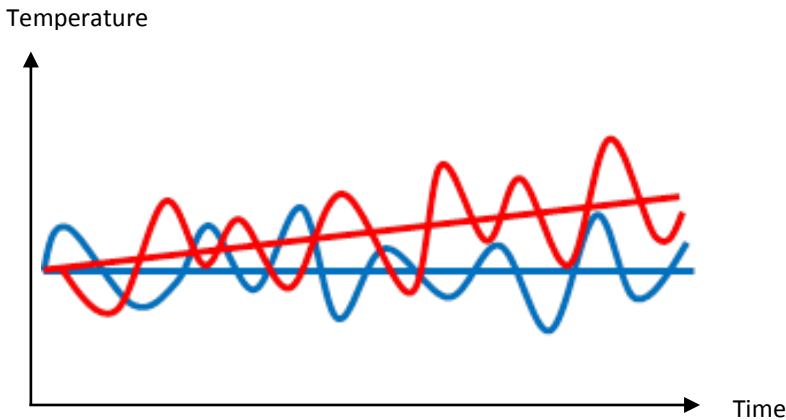

Figure 2: Schematic diagram showing the changes in a climate variable, e.g. temperature, over time. The blue line shows the temperature without climate change and the red line shows the temperature with climate change. The straight lines show the corresponding averages. It is evident from the diagram that for shorter periods it is difficult to tell whether a certain temperature is due to natural variability or climate change.

2.2   Climate change in Vietnam and Cao Bang

Over and over again, Vietnam is ranked among the top countries in terms of risks of impacts from climate change. Most often this has to do with the fact that a large proportion of the population is living in low-elevation coastal zones. In a report from the World Bank (Dasgupta et al. 2009), where the impact of rising sea levels was investigated, Vietnam was ranked in the top five most affected countries worldwide. In terms of population affected, Ho Chi Minh city was ranked in the top five in an investigation of 136 key port cities worldwide (Nicholls et al. 2008). Another highlighted risk in Vietnam is tropical cyclones (Imamura and Dang Van To 1997).

These warning signals have triggered interest within Vietnam in further investigating the issue. In 2009 the Ministry for Natural Resources and Environment in Vietnam published official climate scenarios for the period 2020

to 2100 (MONRE 2009)[3]. As described above, the magnitude of future climate change will depend on the rate of emissions of greenhouse gases, so the Ministry's scenarios are based on three different levels of future emissions, one low emissions scenario (called B1 in the IPCC terminology, see Nakicenovic et al. 2000), one medium scenario (B2) and one high emissions scenario (A2). Hence the projections, i.e. the climate scenarios, depict three different levels with regard to future climate change. Information regarding changes in temperature and precipitation are provided for Vietnam's seven climate zones. Table 1 shows the expected changes in temperature until 2100 for these seven zones.[4]

Table 1: Changes (increases) in mean annual temperature in Vietnam by 2100 relative to the period 1980-1999 for three levels of greenhouse gas emissions: low (B1), medium (B2) and high (A2).

	B1 (low)	**B2 (medium)**	**A2 (high)**
North West	1.7°C	2.6°C	3.3°C
North East	1.7°C	2.5°C	3.2°C
North Delta	1.6°C	2.4°C	3.1°C
North Central	1.9°C	2.8°C	3.6°C
South Central	1.2°C	1.9°C	2.4°C
Central Highlands	1.1°C	1.6°C	2.1°C
South	1.4°C	2.0°C	2.6°C

As Table 1 shows, there are great differences between the different emissions scenarios. The increases in temperature for the high (A2) scenario is almost double than in the low (B1) scenario. This reflects the huge uncertainty surrounding climate change (and this only reflects one uncertainty, i.e. the amount of greenhouse gases that will be emitted in the coming decades). Table 1 also indicates that the northern part of Vietnam will experience more severe increases in temperature.

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[3]Since the completion of this project it has come to the knowledge that there now exist update climate scenarios at province level.

[4] The climate scenario based on medium emissions levels of greenhouse gases (B2) was used in a report on climate change and its potential effects in the Cao Bang region, initiated by the Cao Bang People's Committee and published by its Department of Natural Resources and Environment in coordination with other concerned agencies (Cao Bang People's Committee 2011).

Table 2 shows the expected changes in annual precipitation from the period 1980-1999 until 2100 for the three scenarios. For all regions and for all scenarios, an increase in precipitation is expected, but the most severe changes are expected to take place in the northern regions.

Table 2: Changes (increases) in annual precipitation in Vietnam by 2100 relative to the period 1980-1999 for three levels of greenhouse gas emissions: low (B1), medium (B2) and high (A2)

	B1 (low)	B2 (medium)	A2 (high)
North West	4.8%	7.4%	9.3%
North East	4.8%	7.3%	9.3%
North Delta	5.2%	7.9%	10.1%
North Central	5.0%	7.7%	9.7%
South Central	2.2%	3.2%	4.1%
Central Highlands	1.0%	1.4%	1.8%
South	1.0%	1.5%	1.9%

It should be noted that these two tables only show annual averages for temperature and precipitation increase and that climate change will in general be very different depending on season. For climate change adaptation, it is therefore of great importance to subdivide these figures according to the different seasons. Fortunately, the report by the Ministry for Natural Resources and the Environment provides such detailed information and Table 3 shows seasonal information for the North East region, in which Cao Bang is located.

Table 3: Mean temperature changes (increases) in the North East region of Vietnam relative to 1980-1999. In cases with an interval, the lower figure represents the low emissions scenario (B1) and the higher figure the high emissions scenario (A2).

	2030	2040	2050	2060	2070	2080	2090	2100
Dec-Feb	0.9°C	1.2°C	1.4-1.5°C	1.7-2.0°C	1.9-2.3°C	1.9-2.8°C	2.0-3.3°C	2.0-3.8°C
Mar-May	0.8°C	1.1°C	1.4-1.5°C	1.6-1.8°C	1.7-2.1°C	1.8-2.6°C	1.8-3.0°C	1.8-3.5°C
Jun-Aug	0.5°C	0.6-0.7°C	0.8°C	0.9-1.0°C	1.0-1.2°C	1.0-1.5°C	1.1-1.8°C	1.1-2.1°C
Sep-Nov	0.7°C	1.0-1.1°C	1.3°C	1.4-1.7°C	1.6-2.1°C	1.7-2.4°C	1.7-2.9°C	1.7-3.4°C

Table 3 clearly shows the huge seasonal variations expected. For example, while the winter temperature (Dec-Feb) is expected to increase by 2.0-3.8°C, the summer (Jun-Aug) temperature is only expected to increase by 1.1-2.1°C by 2100. This shows the importance in trying to go beyond the mean temperatures given in Table 1. Greater variation between summer and winter is one aspect of climate change in Cao Bang province. This is further underlined when studying changes in precipitation, as shown in Table 4.

Table 4: Mean changes (increases and decreases) in precipitation in the North East region of Vietnam relative to 1980-1999. In cases with an interval, the lower figure represents the low emission scenario (B1) and the higher figure the high emissions scenario (A2).

	2030	2040	2050	2060	2070	2080	2090	2100
Dec-Feb	1.1%	1.6 – 1.5%	1.9%	2.1–2.4%	2.3–3.0%	2.5–3.5%	2.5–4.2%	2.5–4.9%
Mar-May	-1.3%	-1.8– -1.7%	-2.2%	-2.4– -2.8%	-2.7– -3.4%	-2.8– -4.1%	-2.9– -4.9%	-2.9– -5.6%
Jun-Aug	3.7%	5.1– 4.9%	6.3%	7.1– 7.9%	7.8– 9.8%	8.1– 11.8%	8.3– 13.7%	8.3– 16.1%
Sep-Nov	0.9%	1.2%	1.5%	1.7– 1.9%	1.9– 2.4%	1.9– 2.8%	2.0– 3.3%	2.0– 3.8%

The most severe changes are expected in the summer season and seasonal variations become even more important with regard to precipitation. The figures given in Table 2 for the period up to 2100 show an increase from 4.8% (low

scenario) to 9.3% (high scenario). However, Table 4 shows this to be divided into a *decrease* in spring precipitation and a substantial increase in summer. This aspect of climate change in the Cao Bang region, i.e. increased seasonal variations, is very important to take into account in climate change adaptation planning.

In collaboration with Australian scientists, the Vietnam Institute of Meteorology, Hydrology and Environment (IMHEN) and Hanoi University of Science (HUS) are currently developing a new set of climate change scenarios for Vietnam.[5] In this work, high-resolution projections for various regions in Vietnam will be produced. An important part of the project will be a number of outreach activities in order to disseminate the results of the project.

2.3   Nguyen Binh district and possible impacts of climate change

The district of Nguyen Binh is located in Cao Bang province in North East Vietnam. Cao Bang is a poor mountain province which plays an important role in protecting watershed ecosystems. The province's topography consists of high hills, rocky mountains and low plateau. Sharply sloping land is a key characteristic of the landscape in Cao Bang. The complex topography has led to diversified agriculture, but it is difficult to develop more large-scale agricultural systems. Problems with erosion and landslides and the fact that it is complicated and expensive to build infrastructure have hindered economic development in the province.

Nguyen Binh is a highland district located in the west of Cao Bang province. The area is mountainous and there are four main seasons; winter with fog and snow in the high mountains, springs that can be dry, a warm summer with plenty of precipitation due to the monsoon and a short autumn where temperatures and precipitation decrease. Among the challenges facing the district are illegal mining, floods and landslides as well as hail and whirlwinds and lack of roads that can be used by motor vehicles. Most inhabitants in the district depend on small-scale farming and in the plans for the future (Nguyen Binh Master Plan) agricultural production is planned to increase as are revenues from the mining industry and the forestry sector. In our conversations with district representatives when planning for the scenario work, our impression was that communication regarding impacts of climate change between the provincial and district level could be improved and that knowledge about climate change and its impacts at the district level was poor while there was a demand for more information.

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[5] See csiro.au/en/Organisation-Structure/Flagships/Climate-Adaptation-Flagship/Vietnam-Climate-Projections-Project.aspx

The major expected impacts of climate change in Cao Bang, as summarised in a report by the People's Committee's Department of Natural Resources and Environment, are as follows: Longer periods of heat waves could lead to droughts and forest fires. More uneven rainfall can lead to more severe erosion, landslides and flooding, which could damage infrastructure (e.g. roads) and the agricultural sector. Another risk is increased intensity and frequency of thunderstorms and tornados. A warmer climate might also increase the risks of animal and plant diseases.

3 Methodological approach: Using socio-economic scenarios for assessing climate change-related challenges

The overall aim of this project was to help the district of Nguyen Binh in planning for a changing climate. As we have seen above, this includes identifying and assessing challenges, i.e. possible impacts, from climate change. We have also seen that the impacts of climate change are not only dependent on the type of changes in climate under discussion, but also on the nature of future society. Furthermore, municipal climate adaptation planning often requires cross-sectoral decisions, which is in contrast to practice in most places. We therefore opted to work with participatory scenario planning in our efforts to help Nguyen Binh plan for a changing climate.

A scenario in the context of this study provides a brief description of future socio-economic and climate states of a geographical region. In this project we used a step-by-step process to develop and apply "bottom-up" socio-economic scenarios in order to inform local climate change adaptation planning in Nguyen Binh. Our approach emphasised the involvement of local stakeholders from Nguyen Binh in the development of the scenarios.

The main aim of scenario planning is to inform decision-makers in the face of uncertainty. This is operationalised in several ways. The scenarios can reveal challenges, both opportunities and threats, related to different directions of development for society. Furthermore, the scenarios can be used as a test bed for potential adaptation measures and may also stimulate the development of new adaptation measures by highlighting potential future conditions.

The methodology used in Nguyen Binh closely followed the methodology developed by Carlsen et al. (2013)[6]. It consists of three working phases and one phase for evaluation:

Phase 1: Framing a scenario process

This first phase should define the overall aim of using socio-economic scenarios. The method allows for three different types of application: Identification of future challenges, both opportunities and threats, related to climate change and different directions of development for society; identification of options for climate change adaptation and assessment of options.

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[6] For an application including cost-benefit analysis, see Baard et al. (2012).

Phase 2: Developing scenarios

Once the framing is decided, the next step is to develop the scenarios. This is done in five steps:

2.1 Choosing the time frame. For identifying challenges and adaptation options, a time frame of at least 20-50 years is recommended in order to focus on the long-term planning issues, but shorter time frames might be suitable for specific planning problems.

2.2 Choosing climate scenario(s). The scenarios can be seen as consisting of two parts. One part describes the future climate (regional climate scenarios), and the other part the socio-economic scenarios. For shorter time scales, these parts can be treated as relatively independent of each other and it may suffice to have one climate scenario. As the uncertainty in climate projections increases with time, more climate scenarios will typically be needed for longer time frames.

2.3 Defining a focal question. The purpose of a focal question is to focus the development of the socio-economic scenarios in such a way that they become relevant for the users.

2.4 Creating key drivers and states. Once the focal question is defined, the next step is to construct the building blocks of the scenarios, the so-called socio-economic drivers. The drivers can be interpreted as answers to the focal question. In this step it is often a good idea to use workshops, since this helps facilitate interactivity, as well as establishing legitimacy for the scenarios. For each driver, a number of possible states are then constructed, i.e. a possible outcome of the particular driver in the relevant time frame.

2.5 Constructing scenario narratives. This step is concerned with the construction of the socio-economic scenarios. The first thing to do is to prioritise the most uncertain and most important drivers. Focusing on uncertainty increases the likelihood that the scenarios as a set cover a broad range of possible socio-economic futures and hence enhance the identification of future challenges and options with regard to climate change. Given the drivers and associated states, a scenario is then constructed by choosing one state for each of the drivers, see Table 5 for an illustration. The scenarios should be chosen so that they are relevant, plausible and challenging. For each scenario, a short narrative (500-600 words) is written.

Table 5: Socio-economic drivers, states and scenarios. The shaded cells represent a scenario. In this table, there are 54 possible scenarios (3*2*3*3). In practice, the set of possible scenarios is limited by the fact that there are impossible or implausible combinations of states (source: Carlsen et al. 2013)

Driver 1	Driver 2	Driver 3	Driver 4
State 1A	State 2A	State 3A	State 4A
State 1B	State 2B	State 3B	State 4B
State 1C	✕	State 3C	State 4C

Phase 3: Using the scenarios

In the general methodology described by Carlsen et al. (2013), three different usages of the scenarios are described:

- *Identification of future challenges.* This is the most common application of the scenario tool. The purpose is to increase awareness among local and regional planners and decision-makers of the challenges (opportunities and threats) of climate change.

- *Identification of adaptation options.* Given challenges, an actor must identify adaptation options (or strategies) to cope with the challenges. The analysis may have to be concentrated on one or two societal sectors, in order to get a sufficiently detailed analysis.

- *Assessment of adaptation options.* This application assesses different adaptation options for different future scenarios. The assessment can use methods like cost-benefit analysis or environmental impact analysis (see Baard et al. 2012).

In all real projects utilising the scenario tool, this process has to be adjusted in order to tailor it to the local circumstances.

Phase 4: Evaluation

The methodology also includes an evaluation phase. Before the report describing the project is finalized the participants should be given the opportunity to evaluate the whole process including a draft of the report. The evaluation of the Nguyen Binh scenario project is described in appendix 3.

4 Results

In the Nguyen Binh project, we operationalised the scenario methodology described in section 3 according to the process depicted in Figure 3.
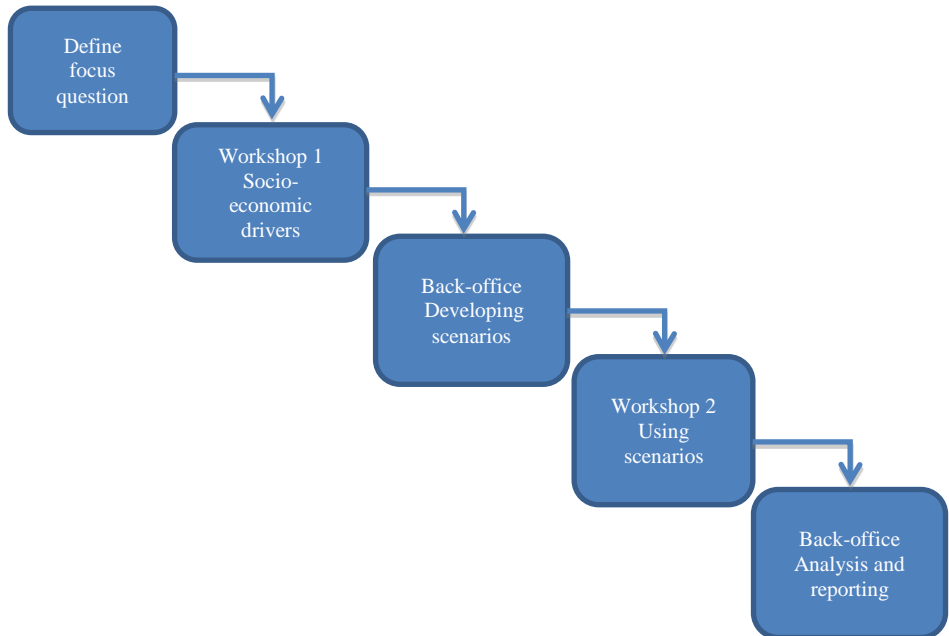

Figure 3: The working process in the scenario project in Nguyen Binh.

Apart from preparation work, the process started with an introductory meeting with the aim of defining the focus question for the process. In this meeting representatives from FOI, WARECOD and the district of Nguyen Binh discussed and agreed on the working process and the focal question. The focal question was defined as:

> *What socio-economic drivers are important for the ability of Nguyen Binh to deal with the impacts from future climate change?*

In this meeting we also discussed application of the scenario tool. It was decided that the tool should be used for identification of future challenges and identification of adaptation options.

4.1 Building three future socio-economic scenarios for Nguyen Binh

First workshop

The purpose of the first workshop was to lay out the necessary building blocks for the construction of two or three socio-economic scenarios. In this workshop, 13 representatives from different municipal sectors in Nguyen Binh, e.g. health, agriculture, the armed forces and forestry, participated. In order to come up with building blocks for the socio-economic scenarios, the participants were asked to provide proposals of socio-economic drivers in relation to the focal question defined above. These drivers were generated in a structured brainstorming session facilitated by the researchers from FOI and WARECOD, see illustration in Figure 4. In this phase, each participant came up with non-criticised proposals.

Figure 4: Representatives from the district of Nguyen Binh working together with FOI and WARECOD personnel to find socio-economic drivers in relation to the focal question.

In total, 48 ideas for drivers were generated and these were grouped ('clustered') into 19 clusters, see Appendix 1. The participants were then asked to prioritise among these 19 clusters of ideas. The participants assigned votes to the different proposals based on two aspects: i) how important is the driver with respect to the focal question? and ii) how uncertain is the future development of a certain

driver? Because the scenarios were intended to explore critical uncertainties, the variables voted most important and most uncertain were then further analysed in the back-office work, see further below. Figure 5 depicts the results of this voting.

Uncertainty		0	1	2	3	4	5	6	7
					Crime				
8	Disaster reduction								
7		Water							
6									
5		Capacity bld		Land use					
4		Poverty red.						Budget	
3			Awarness		Education				
2		Industry, Ene.							
1			Planning	Waste					
0		Outside supp	Infrastr.	Natural res.			Forestry	Health, Agriculture	
0	1	2	3	4	5	6	7	Importance	

Figure 5: Position of the drivers in the uncertainty-importance table.

As can be seen from Figure 5, there were no drivers that were highly ranked both with regard to importance and uncertainty. The most important clusters with their associated ideas were:

- **Budget**
  Increase budget for environmental protection (at district level)
  Mobilise investments from outside the district

- **Health**
  More well-educated people in healthcare
  Increase capacity in ensuring health
  Strengthen the healthcare system
  Increase efforts to enhance human health

- **Agriculture**
  Develop crops resistant to new climate
  Line irrigation channels with concrete
  Increase clean technology in agriculture
  Change species, plants and animal to utilise water resources
  Use less chemicals in agriculture "one for each type, not multiple use"
  Enhance work to prevent disease among plants and animals

- **Forestry**
  Enhance forest protection
  Increase the forest cover
  Work for forest fire protection

The following clusters were ranked at the top with regard to uncertainty:

- **Crime**
  Reduce crime and disorder

- **Disaster reduction**
  Have plans to respond to extreme weather
  Develop alarm system for weather events
  Have a rapid action group for rescuing people

- **Water**
  Increase the system for clean water
  Build reservoirs to store water in the mountain areas

- **Land use**
  Land use planning, fundamental infrastructure, land
  New plan for people living in high mountains and far away
  Resettle people living in high-risk areas

- **Capacity building**
  Increase capacity for leadership
  Enhance organisation of society

Building scenarios back-office

The starting point for constructing socio-economic scenarios was the results from the first workshop. For each of the prioritised variables, a number of associated future states were assigned. As an example, Table 6 shows the three states that were constructed for the socio-economic driver 'Land use'. In this work, complementary data was extracted from the Master Plan of Nguyen Binh.[7] In some cases quantitative data from the Master Plan and the socio-economic report for 2012 were used as a basis for extrapolating into the time perspective used for the scenarios, i.e. 10 years.

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[7] The Master Plan describes the efforts of Nguyen Binh regarding socio-economic development 2007-2020.

Table 6: The three states for the driver 'Land use'.

The majority of people who lived in high risk mountain areas in 2013 have been resettled to other safer areas. Families have been compensated in a satisfactory manner and have resettled peacefully. Some families have continued farming, while others have established themselves in industry.	New plans for people living in high mountain areas have been implemented. They have been given support (extensive advisory services) for sustainable and robust agriculture. For example, crops and trees are growing together. This system mitigates the risk of erosion and enhances productivity as well as robustness in economic terms.	Continued malpractice in agriculture and forestry in the high mountain areas is resulting in extensive soil erosion. Slash and burn practices continue, resulting in high vulnerability to extreme weather events.

These three states represent three different outcomes of the driver land use, cf. Table 5. In this way, states were constructed for the prioritised drivers. In some cases, for more certain drivers, there is only one state. As described above, a socio-economic scenario is defined as one state for each driver. In the back-office work, numerous combinations of states were assessed with regard to plausibility and relevance. In this way, three scenarios describing possible future socio-economic conditions of relevance to the issue of adapting Nguyen Binh to a changing climate were constructed: Coping well with limited resources, Nguyen Binh as a major eco-tourism destination and Rapid industrialisation with its pros and cons. The written narratives of these scenarios are presented below.

Scenario 1: Coping well with limited resources

- *45 000 people. Better roads.*
- *Lower economic growth than expected. Budget double that of 2013.*
- *Low crime rate and high awareness of climate change and its impacts. Efficient search and rescue teams but no advanced communication system.*
- *No resettlement of people in risk prone areas.*
- *Farmers in high risk areas are now combining trees and crops on sloping fields for soil conservation and higher productivity.*
- *Minority people receive state support for better sanity. Otherwise waste, sewage and drinking water systems function as 10 years ago.*
- *Forest cover has improved, more protected areas.*
- *Increase in agricultural production and better market access.*
- *Moderate improvements in education. Environmental protection classes.*
- *Health situation improved.*

In Nguyen Binh there is now (2023) 45 000 people as opposed to 40 000 people in 2013. The main roads in the district (34, 202 and 212) have been dramatically improved and it is possible to reduce travel times between for example Nguyen Binh town and the Cao Bang city compared to 2013. These investments have been made possible due to support from the government (road 34) and the province (roads 202 and 212).

The budget of the district did not increase as much as expected in 2013 due to the prolonged global recession. There has been a slight slow-down in economic activity in the whole province which, however, has had a faster economic growth than most other regions in the world, between 7 and 8 % per year. Also, because of the economic downturn resources from outside has not been mobilized as foreseen in 2013 and district budget is "only" doubled 2023 compared to 2013 (not adjusted for inflation).

Although unemployment has not been reduced, crime rate is low due to strong social control and propaganda. As the issue of climate change and its impacts in Vietnam has received the same kind of attention as HIV

nationally, the Cao Bang province has taken this very seriously since there are lots of experiences of extreme weather events. All levels of society have been engaged to create high awareness. With use of the limited resources, the plans for search and rescue teams are now efficiently implemented. The responsible teams are training regularly for different types of extreme weather events. The awareness of duties among the authorities and armed forces is high. The only way to communicate information about extreme weather events with people is, however, TV and radio.

The high awareness of climate change has spilled over to planning and new plans for people living in high risk areas (such as steep mountains and flood prone areas) have been implemented. These people have been given support (extensive extension) for a sustainable and robust agriculture in the areas where they live. For example, crops and trees are now grown together (agro-forestry) and trees are planted in rows across sloping fields. This system mitigates the risk for erosion and enhances productivity and farm income. Substantial state resources have been offered to help minority people to build toilettes for better sanity but only some have responded due to ongoing economical constraints. For the rest of society the waste and sewage system is organized as it was a decade ago. Also, due to limited resources, supply of drinking water works the same as it did in 2013

Forestry management has been improved through increased community involvement and the forested area now covers 60 % of the total land area of the district (as opposed to 50 % in 2013). This increase has mainly been achieved by planting trees such as bamboo, anise, cardamom and tapioca. In addition, there has been an increase in protected forest areas by 10 % compared to 2013. The pristine forest is now declared a national park. All these achievements were made possible through the involvement of villagers who now receive support to plant and protect the forest, even from forest fires.

Agriculture production has increased faster than the population in the past decade and the availability of grain per capita is now 470 kg as opposed to 2013 when it was only 440 kg per capita. The production of cash crops has also increased and the number of buffaloes and cows is up with 20 % and 60 % respectively compared to 2013. Canal systems have been amended with concrete and extension services (which have been improved) encourage use of compost use in farming. Many farmers have switched to high yield crops such as hybrid corn and rice and trade of agricultural

products is now less troublesome than before due to the improved roads.

The education system has got some increase resources since 2013. The equipment and education level of teachers are somewhat better, but still some kids are not attending schools as they live in remote areas. However, a new subject has been introduced in school: Environmental protection including climate change and adaptation.

The health situation in the district is however improved nowadays compared to 2013. The ratio of doctors per 10 000 inhabitants is now 10 doctors as opposed to 2013 when it was six. Concerning maternity care, all pregnant women are taken care of at clinics and all inhabitants have access to primary health care. New ways of treating people are also tried out, such as using traditional medical herbs and at the same time there is propaganda to improve awareness of self-care by well-trained practitioners at the village levels. Thanks to the state, poor people in the mountains now have access to 100% health insurance and among those people in particular several NGO-funded health projects are being implemented targeting women and girls.

Scenario 2: Nguyen Binh as a major eco-tourism destination

- *45 000 people. Better roads.*
- *Growth in economy, budget is now three times bigger than in 2013.*
- *Investments in the tourism sector by private entrepreneurs (eco-tourism). Support from People Committee and the Province.*
- *Increased budget for environmental protection.*
- *People in mountains practice integrated ridge farming with trees and crops to lessen erosion risks and landslides. Enhanced productivity.*
- *Somewhat better education system. Classes in environmental protection and climate change.*
- *Increased agricultural production.*
- *High awareness about the risks of climate change at all levels.*
- *Alarm system for extreme weather events based on mobile phones, individual and tailored communication.*
- *Increased forest area, more protected areas.*
- *Looting sometimes a problem during extreme weather events with evacuation.*
- *New waste and sewage collection system with cleaner urban areas and mining sites.*
- *Improved water supply and health care system.*

In Nguyen Binh there is now (2023) 45 000 people as opposed to 40 000 people in 2013. The main roads in the district (34, 202 and 212) have been dramatically improved and it is possible to reduce travel times (e.g. Nguyen Binh and Cao Bang city). These investments have been made possible due to support from the government and the province.

Economy has grown in Nguyen Binh since 2013 and the district now has a budget that is three times the size of the budget in 2013 (not adjusted for inflation). The annual growth rate has been 11 % and part of that growth can be attributed to an increase in investment in eco-tourism via private entrepreneurs. This development is supported by the People Committees of the province and the district. As a result of this budget increase, there is less poverty compared to 2013 due to increased job opportunities in the tourism sector. Examples of activities are guided trekking in the mountains and

lodging in remote villages. In many case minority people takes part in this development, e.g. as guides and at cultural events and as providers of lodging. On average, there are 70 tourists per day in the district, and their economic contribution is equivalent to about 0.4 dollars per capita and day (all year) now which corresponds to an average increase in GDP per capita with 40 % as compared to 2013.

Several other improvements have also been made in the district. For example, the budget for environmental protection has been increased proportionally. New plans for people living in high mountain areas have been implemented. Villagers have been given support (extensive extension) for a sustainable and robust agriculture in the mountains. Intercropping trees and annual crops in ridge farming is encouraged and applied widely in the district. This system mitigates the risk for erosion and enhances productivity as well as robustness in economic terms.

The education system has got some increased resources since 2013. The equipment and education level of teachers are somewhat better, but still some kids are not attending schools as they live in remote areas. However, a new subject has been introduced in school: Environmental protection including climate change and adaptation.

During the period 2013 to 2023 agriculture production in the district increased faster than the population and the availability of grain per capita is now 470 kg as opposed to 2013 when it was only 440 kg per capita. The production of cash crops also increased during the same period and the number of buffaloes and cows is up with 20 % and 60% respectively compared to 2013. Many farmers now cultivate high yield crops such as hybrid corn and rice and trade of agricultural products is now less troublesome than before due to the improved roads. However, with a changing climate there are risks for diseases such as foot and mouth disease but due to enhanced use of disease prevention the spread of such diseases is somehow contained.

The government of Vietnam is nowadays paying a lot of attention to climate change, financing national propaganda campaigns to enlighten people and especially farmers and forests owners of how they can adapt to more extreme weather events.

The province of Cao Bang is well aware of climate change and has tailored climate change information for the districts and there is a high awareness of climate change among official and several NGOs are active. In addition,

there is a rather advanced alarm system for extreme weather based on the mobile telecommunications infrastructure. Information can be tailor-made for each village (evacuation points) and the system is not based on a point of contact in each village. Instead every house has, or has been given, a mobile phone that can be powered by solar cells and huge responsibility for evacuation is given to the family. The plans for search and rescue project that existed in 2013 are now more efficiently implemented but as the use of the alarm system has increased, rescue teams are only used in very serious cases, or when tourists need to be rescued.

The knowledge about adaptation to climate change has also spread in the forestry sector, where management has been improved through increased community involvement and the forested area now covers 60 % of the total land area of the district (as opposed to 50 % in 2013). This increase has mainly been achieved by planting trees such as bamboo, anise, cardamom and tapioca (dong giềng), plants that can sustain the changing climate. But there has also been an increase in protected forest areas by 10 % compared to 2013 and the "pristine forest" is now declared a national park. All these achievements were made possible through the involvement of villagers who now receive support to plant and protect the forest, even from forest fires who risk being more severe now as the dry season is drier than before. However, looting is sometimes a problem during extreme weather events. People are afraid of being evacuated because of risk of looting. In some cases authorities demand evacuation, but still some people refuse to leave the area. Sometime police have to use force in order to evacuate people.

In other areas there are however public satisfaction. Especially the new waste collection system is appreciated resulting in a cleaner urban environment and cleaner mining sites. Organic waste in urban areas is collected and used for biogas production reducing the need for firewood and deforestation. Also plastic waste is taken care of and sent off to Cao Bang for energy recovery. Designated slaughter zones in all communes also contribute to the cleanliness of urban areas and a new plant for cleaning sewage water by the help of crops such as sugar canes is being tried out in NB. Also the water supply has been improved both with regards to quality and reliability. The increasingly dry period during February to May is being handled by storing water during other seasons with more rain and a water purification plant is being constructed in Nguyen Binh.

The health situation in the district is improved compared to 2013. Examples are that the ratio of doctors per 10 000 inhabitants is now ten as opposed

to 2013 when it was six. Other improvements are also substantial, the number of children with malnutrition is down to 15 % (as opposed to 2010 when it was 22 %) and all children are fully vaccinated. At the same time, there is propaganda to improve awareness of self-care by well-trained practitioners at the village levels and the district hospital has been improved to the standard of a poly clinic.

Scenario 3: Rapid industrialization with its pros and cons

- *45 000 people. Better roads.*
- *Strong economic growth, budget of district 4 times larger than in 2013.*
- *Investments in industry (mines, processing of agricultural products) from outside.*
- *Resettled people from high risk areas now employed or farming.*
- *Increased production in agriculture.*
- *High awareness of climate change risks.*
- *More forested and forest protection.*
- *Poor search and rescue operation, looting sometimes.*
- *Low crime rate in urban areas.*
- *Problems with waste, water and sewage despite efforts.*
- *Better health and somewhat better education.*

In Nguyen Binh there is now (2023) 45 000 people as opposed to 40 000 people in 2013. The main roads in the district (34, 202 and 212) have been dramatically improved and it is possible to reduce travel times between for example Nguyen Binh town and Cao Bang city compared to 2013. These investments have been made possible due to support from the government (road 34) and the province (roads 202 and 212).

Economy has grown strongly during the last decade in Nguyen Binh (average 15% per year) and the district now has a budget that is four times the size of the budget in 2013 (not adjusted for inflation). Part of the growth can be attributed to foreign investments in the industry sector together and some foreign aid. As the result of this budget increase several

improvements have been made in the district. For example, the majority of people in high risk areas have been resettled into safer areas and families have been compensated for their move. While some of those families have continued farming, others work in the rapid developing industry sector where mining and processing of agricultural products play key roles.

During the period 2013 to 2023 agriculture production in the district increased faster than the population and the availability of grain per capita is now 470 kg as opposed to 2013 when it was only 440 kg per capita. The production of cash crops also increased during the same period and the number of buffaloes and cows is up with 20 % and 60% respectively compared to 2013. Many farmers now cultivate high yield crops such as hybrid corn and rice, and trade of agricultural products is now less troublesome than before due to the improved roads. However, with a changing climate there are risks for diseases such as foot and mouth disease but due to enhanced use of disease prevention the spread of such diseases is somehow contained.

The government of Vietnam is nowadays paying a lot of attention to climate change, especially with regards to negative impacts for industry development. The government is financing national propaganda campaigns to enlighten people and especially farmers and forests owners of how they can adapt to more extreme weather events. For example, there are now pilot plots for drought resistant crops financed by the state. The province of Cao Bang is well aware of climate change and has tailored climate change information for the districts and there is a high awareness of climate change among official and several NGOs are active in the area.

The knowledge about adaptation to climate change has also spread in the forestry sector, where management has been improved through increased community involvement and the forested area now covers 60 % of the total land area of the district (as opposed to 50 % in 2013). This increase has mainly been achieved by planting trees such as bamboo, anise, cardamom and tapioca, plants that can sustain the changing climate. But there has also been an increase in protected forest areas (by 10 % compared to 2013) and the "pristine forest" is now declared a national park. All these achievements were made possible through the involvement of villagers who now receive support to plant and protect the forest, even from forest fires who risk being more severe now as the dry season is drier than before. However, the existing plans for disaster and rescue operations are still not implemented as they should which constitutes a challenge to the district.

The authorities and the armed forces are not very well aware of their duties and lack regular training. As a result people are not very satisfied and there are lots of complaints. Looting is sometimes a problem, especially during extreme weather events and people are afraid of being evacuated. Authorities try to force evacuation with varying results. However, in the urban areas crime rate is relatively low due to efforts by the local police.

In other areas there are also some public discontent. Especially the waste collection system, despite improvements, is overburdened by the influx of more household waste and new streams of waste and sewage water from industry. New projects are being implemented do deal with the situation such as collecting organic waste in urban areas and use it for biogas production, but on a small scale. An improvement is designated slaughter zones in all communes and a new experimental plant for cleaning sewage water by the help of crops such as sugar canes in Nguyen Binh supported by foreign aid. Although the water supply has been improved both with regards to quality and reliability the increased demands for water for industrial use challenge the district. The increasingly dry period during February to May is being handled by storing water during other seasons with more rain and a water purification plant is being constructed in Nguyen Binh.

The health situation in the district is improved compared to 2013. Examples are that the ratio of doctors per 10 000 inhabitants is now ten as opposed to 2013 when it was six. Other improvements are also substantial, the number of children with malnutrition is down to 15 % (as opposed to 2010 when it was 22 %) and all children are fully vaccinated. At the same time, there is propaganda to improve awareness of self-care by well-trained practitioners at the village levels and the district hospital has been improved to the standard of a poly clinic. Also education has improved with more qualified teachers than before and more equipment in schools. A new subject has been introduced - environmental protection - and some schools have their own environmental projects in close cooperation with the divisions of agriculture and forestry of the peoples committee.

4.2 Using socio-economic scenarios for identifying challenges

Once the scenarios had been constructed, it was time to start using them. A second workshop was therefore organised.

Second workshop
The second workshop had two purposes: to identify future challenges for the Nguyen Binh district in connecting with climate change and to identify adaption options, i.e. strategies that could mitigate the impacts of climate change in the district. In the second workshop 11 representatives from Nguyen Binh participated. To a large extent the two workshops had the same participants, which is preferable since the same people laid out the basis for the scenarios and used the scenarios.

The second workshop started with a presentation of the working procedure of the day, the back-office work and a summary of the scenarios, see illustration in Figure 6. After this, all participants were given time to read the three scenario narratives.

Figure 6: Presentation of three scenarios during the second workshop.

In the ensuing discussion, participants were given the opportunity to comment on each of the three scenarios. Regarding the first scenario –Coping well with

limited resources – there was a discussion on the level of education. It was questioned whether it was realistic that children in remote areas would not attend school. It was decided to erase this from the scenario in the coming discussion on challenges. It was also decided that the new subject written into the scenario, Environmental protection, including climate change and adaptation, would not be part of ordinary education, but would be a course outside the standard curriculum.

The scenario Rapid industrialisation with its pros and cons was much discussed. First, some points needed clarification: Increasing number of forest fires due to climate change and budget increases meant more resources. It was decided that the designated slaughter zone should only be at the district level. The increase in number of cows was adjusted from 60% to 45%. It was also stated that in this scenario it would have been realistic for all children below the age of five to have been vaccinated against eight diseases. There was also a discussion on the importance of developing a market for agricultural products. In this scenario, industrial trees like pine trees and bamboo should increase. A perhaps more severe overall comment was that mining is contradictory to current policy. However, this comment was not taken into account in the ensuing discussion, since these are only scenarios of *possible* development of the district.

After this discussion and adjustments to the scenarios, the participants voted on two scenarios that should be considered in the group work. After this vote, scenarios 2 and 3 survived, i.e. Nguyen Binh as a major eco-tourism destination and Rapid industrialisation with its pros and cons. The participants were then divided into two groups working with each of the scenarios.

Starting with the eco-tourism scenario, one challenge identified was that the demand for fresh water would increase. This would result in a conflict between the demand from agriculture and tourism. One strategy discussed for coping with this problem could be to build water reservoirs in the mountains and also pipelines. Another option could be to build tanks close to Nguyen Binh town. Another problem could be that an increasing dry season (due to climate change) would result in a less beautiful landscape. More tourism, together with climate change, would imply more forest fires. Actions to consider for coping with the increased risk of forest fires include encouraging local people to protect the forest and putting up information signs in high-risk areas. A specific challenge in the nexus between more tourist and more forest fires would be the problem in rescuing these people. They are not knowledgeable about all trails or how one should behave in the forest. More heat waves could be a threat to the tourist industry in this scenario. One possible option here would be to build simple cooler houses in the mountains where tourists could rest. One severe impact on tourism would be landslides. These could increase travel times and possibly injure people. There should be local rescue teams in this scenario, both to rescue people and also to do some repair work.

In the other scenario retained in the vote, Rapid industrialisation with its pros and cons, one challenge here is that extreme rain, floods and landslides affect workers, while industrial waste and sanitation can also be affected. Options to mitigate these problems included post-control, to follow up on rules and regulation with regard to e.g. environmental protection. Companies who close mines should be responsible for restoring the site. Another problem is that many extreme weather events destroy roofs. An obvious option here is to build stronger houses, especially roofs. As in the other scenario retained in the vote, more forest fires are expected. This group discussed training of people as one possible option. Better equipment would also be good. Heavy rain could flush slaughter waste into the environment (by floods). There should therefore be requirements for sewage treatment at slaughter sites. Droughts might imply higher pollution concentrations in rivers from mines. This could impact on villagers who use water. Mines should therefore not be located upstream from villages. Rain and drought cause diseases, especially among children and the elderly. An adaptation option here is to increase public information, e.g. that people should stay inside when it is very hot. There could also be an alarm system for extreme weather events. For animals, it is important to stay inside when it is very cold.

5   Discussion and recommendations

The aim of this project was to help the district of Nguyen Binh to plan for a changing climate. The tool utilised in this study – socioeconomic scenarios – is in general relatively time- and resource consuming. This work was however, performed with relatively little resources: two half-day workshops and approximately one person-month workload for preparation and back-office work. This amount of work would not suffice to reach a final answer to the question of what adaptation option to employ. However, it can provide an overview of the pros and cons of thedifferent options and give further directions for climate adaption work.

We believe using the scenario planning tool as utilized in Nguyen Binh is an effective way of communicating the challenges in relation to a changing climate. Climate change adaptation is a cross-sector societal planning issue and one of the advantages of scenario planning is that this is explicitly dealt with by including civil servants from different departments in the process. The two workshops clearly showed that the scenario planning process facilitated a free, but structured, discussion of challenges across different societal sectors. During the workshops everybody participated actively in the joint work.

One of the main messages of the scenario work was that in order to cope with the impacts of climate change, Nguyen Binh needs to embrace uncertainty, not only with regard to climate change but also with regard to societal development. The scenario process facilitated the construction of three different views of how the society could develop in the future and this is in stark contrast to usual societal planning in Nguyen Binh. We experience almost no difficulties in communicating the philosophy of working with alternative paths to the future development.

Of course, there are in theory an infinite number of possible ways society could develop in the coming decades. In this work we constructed three scenarios in order to grasp the major trends of importance for the ability of Nguyen Binh to deal with the impacts of climate change. It should be underlined that these three scenarios only represent *possible* development path for the society, and the set of scenarios should not be interpreted as a prognosis such that *one* of these will materialise. The point is that these three scenarios taken together should illustrate important aspects of the societal development that should be considered in the planning of Nguyen Binh's future.

Based on the scenario development process and the scenario analysis we draw the following conclusions regarding challenges and adaptation options for the district of Nguyen Binh.

Given that the future in Nguyen Binh might develop in several different ways as is exemplified in the three future socio-economic scenarios it is important to find

robust adaptation solutions i.e. solutions that may work in all scenarios. Below are some challenges identified for Nguyen Binh district with the help of the material presented so far together with some proposals for robust adaptation options.

- *Succeeding spreading information about the impacts of climate change*. In all three socio-economic scenarios, success in adapting to climate change depended upon successful information campaigns about climate change. In all scenarios, such information campaigns were carried out in schools and through adult education people at all levels were reached; village, commune and district levels. From these findings, we draw the conclusion that knowledge about climate change today is poor but highly needed. A robust adaptation options is therefore to *already now plan for climate change information campaigns* drawing on experiences from other areas such as HIV information.

- *Getting access to good climate change scenarios for the district* including information about extreme weather events. In all three scenarios, successful adaptation depends upon the access of information about how the climate and weather will evolve in Nguyen Binh. Producing this information cannot be done in the district, so they must rely on authorities at province and national levels. An adaptation option for Nguyen Binh is however to *keep up with what is happening at higher levels concerning local climate change projection, to read the material produced as well as to communicate demands for information.*

- *Using forests in a more efficient and climate adapted way*. In all three scenarios, forestry plays an important role, both for lessening impacts of more extreme weather, such as landslides and inundation (through better forest cover on sloping land) as well as for economic development. The strategies for achieving this goal differ however, in one scenario, people now cultivating in the mountains have been (peacefully) resettled, in the other two scenarios, methods to cultivate that mitigate erosion have been introduced. A robust adaptation option in view of these possible developments is *to develop a flexible approach to forestry management, where strategies for protecting virgin forests are combined with strategies for planting new tree crops as well as for integrating agriculture and forestry on the same land.* There should be preparedness to use all three approaches in the future and the mix of measures will depend upon development path.

- *Enhancing the capacity of the current rescue organization.* The rescue organization has a crucial role to play in all three scenarios given the development of climate change with more extreme weather events. In

one scenario (Major tourist destination) its operations are geared at rescuing tourists mostly while rescuing local people is mainly self-organized due to an advanced alarm system. In the other two scenarios the rescue services work more or less like today, but better. A robust adaptation option, given these different possible development paths, is to build a flexible rescue organization that can respond to different socio-economic developments. Examples of such flexibility is to *investigate both the possibilities for an advanced alarm system while investigating possibilities to receive more equipment for rescue operations with better training and practice for the staff.*

- *Incorporate climate change in long-term societal planning.* The material clearly shows that the challenges and what adaptation options that are preferable differ between the three scenarios. This highlights the need of incorporating a changing climate in the societal planning processes of Nguyen Binh. In today's master plan, the issue of climate change is not included. When dealing with climate change in societal planning it is necessary to adopt a long-term perspective, i.e. decades. In these time-perspectives it is impossible to predict the development of society it is therefore necessary to consider multiple future possibilities, e.g. via the utilization of socio-economic scenarios. Since we know that climate change is coming, it is therefore a robust adaptation option for Nguyen Binh to *develop new long-range societal planning tools including climate change impacts, for example via the incorporation of scenario planning in the Master Plan process.*

As a final word we would like to point out that all of these adaptation options should undergo some kind of assessment regarding cost and benefits. This could be done qualitatively by comparing theenvironmental, social and economic consequencesof the adaptive options, thus increasing the likelihood for decisions that ensuring sustainability. A more refined approach would be to perform quantitative approaches such as cost-benefit analysis (Baard et al. 2012) in which the different adaptation options are evaluated by the consequences they create. The idea is to weigh the monetised benefits of an option against its monetised costs and choose the option that maximises the difference between the two.

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Appendix 1: Socio-economic drivers

The list below shows the list of drivers and their clustering according to the result of workshop 1. In the parenthesis is shown the prioritisation according to importance (first figure) and uncertainty (second figure). In the case a + sign is given, this indicates that there was a voting on an individual driver rather than on the whole cluster.

Budget (7,3+1)
Increase budget for environmental protection (at district level) (0,1)
Mobilise investments from outside the district

Health (7,0)
More well-educated people in health care
Increase capacity in ensuring health
Strengthening the health care system
Increase work for enhancing human health

Agriculture (7,0)
Develop crops resistant to new climate
Concrete the channel for irrigation
Increase clean technology in agriculture
Change species, plants and animal to utilise water resources
Use less chemicals in agriculture "one for each type, not multiple-use"
Enhance work to prevent decease among plants and animal

Forestry (6,0)
Enhance the forest protection
Increase the forest area
Good work in forest fire protection

Land use (4,5)
Land use planning, fundamental infrastructure land
New plan for people living in high mountain and far away
Resettle people living in high risk areas

Waste and sewage (4,1)
Support minority people to build toilettes for better sanity
Processing of collected waste
Build slaughter zones(??)

Reasonable use of natural resources (4,0)
More efficient use of natural resources (land, minerals, water)

Education (3,2+3)
Increase education system
Obligatory education on climate change in schools

Awareness raising (3,3)
Increase awareness and responsibility for environmental protection
Using planning process for increasing awareness among the people
Produce propaganda document(s) on climate change
Communicate this workshop to local people
Rise awareness of local people of climate change

Planning (3,1)
Increase tourism – less dependent on industry
Cooperation between different sectors on extreme weather events and forest fires

Infrastructure (3,0)
Strengthening the roads
Increase the telecommunication system
Increase road standard at commune level

Water (2,7)
Increase the system for clean water
Build reservoirs to store water in the mountain areas

Poverty reduction (2,4)
Erase hunger and combat poorness
Reduce unemployment – more opportunities to find work

Crime (1,11+4)
Reduce crime and disorder (0,4)

Industry (2,2)
Improve technology in product processing
Encourage people not to illegal mining

Energy (2,2)
Using biogas so you are not taking the wood for energy

Support from the outside (2,0)
The province should change investments appropriate for climate change

Capacity building (2,5)
Increase capacity of leadership
Enhance organisation of society

Disaster reduction (1,8)
Have plans to respond to extreme weather
Develop alarming system for weather events
Should have rapid action group for rescuing people

Appendix 2: Prioritised drivers and associated states

1. Agriculture

- Agriculture production is slightly increased.
Of which:
+ grain production increase by 20% (2% - 3%/year)
+ stable food per capita: 450kg/per
+ production of cash crops (vegetable, soybean, tobacco, tapioca) will be moderately increased
+ number of buffalo: increase by 15% (2%/year)
+ number of cow: increase by 40% (5%/year)
+ number of pigs: increase by (4%/year)
+ number of poultry: increase by 5%/year
- Pilotly grow some drought - resistant crops from State - funded projects.
- Concretize irrigation canal systems
- Encourage cropping areas using compost
- Capacity building for agricultural extension officers.
- Areas for high production crops will be increased by 2%, concentrated in the lower parts of Nguyen Binh
- With assumption of improving infrastructure systems (such as roads), trading with outside district will be increased, especially in terms of agricultural inputs (seeds, fertilizers, technology) as well as outputs (local special products from bamboo, tobacco, tapioca, etc.)
- Several new diseases spreads out due to extreme weather events.
- Disease prevention and control in both plants and animals has been strengthened.

2. Budget

2A.
Economic growth has been strong the last decade in the whole province. The average growth per year has been 13%. In addition to this, resources from outside district have been mobilised through development cooperation thanks to states concern for improving human rights conditions. As a result the budget for the Nguyen Binh district has become four times larger (15% annually) in ten years. Even the budget for environmental protection has been increased proportionally.

2B.
The economy has continued to grow as the same rate as last decade, i.e. 11% per year. This is partly due to Chinese investments in the industry sector and foreign aid. As a result the district budget has increased almost three times bigger than in 2013.

2C.
There has been a slight slow down in economic activity in the whole
province. The average growth rate per year has shrunk to something
between 7 and 8 %. Resources from outside has not been mobilised. As a
result the district budget is now doubled compared to 2013.

3. Health

- Ratio of doctors per 10000 inhabitants is 10 doctors
- Reduce children mal-nutrition down to 15%.
- 100% children will have 7 types of vaccinations (polio, measles,
tuberculosis, hepatitis B, whooping-cough, diphtheria, tetanus)
- Encourage using traditional medical herbs in treatment combining with
other medicines.
- 100% pregnant women are taken care of at clinic stations with regular
checking.
- 100% inhabitants get primary health care.
- Strengthen capacity to cope with seasonal diseases/sicknesses and
epidemics, diseases/illnesses caused by ex. weather events, especially
marginalized and vulnerable groups.
- Marginalized and vulnerable groups (ethnic minorities + the poor) received
100% health insurance.
- Improve awareness and capability of individuals in self-care.
- Improve the district hospital to meet standard as a poly-clinic one. Every
commune has a national standard clinic station with one doctor. Medical
equipments will be provided to all commune clinic stations and TinhTuc
hospital.
- Capacity building for health care practitioners at village level through
trainings.
- More NGO - funded projects in trainings and supporting campaigns on
disease prevention (HIV/AIDS, malaria), women and girls in general and
maternal health care in particular.

4. Forestry

- Community-based forest management has been strengthened through
allocating more forest area to households.
- Coverage areas achieves 60% and decrease transferring forest areas into
other land use types, especially areas of forest turn into maize fields.
+ Areas of production forest has been increased focusing on industrial trees
such as cinnamon, anis, cardamom, bitter tea.
+ Protected forest area has increased by 10%.
- The budget to support villagers in planting and protecting forests has
increased.
- The pristine forest will become a national park to promote both tourism and

conservation.
- Forest protection will be strengthened, especially in controlling forest fire and illegal logging (by encouraging tight cooperation between local armed forces and forest rangers).

5. Crime

Crime rate is low. (poverty reduction has succeded. Unemployment is rather low. Strong social control. (Propaganda.)

Looting is a considerable problem during extreme weather events. People are afraid of being evacuated because of risk of looting. In some case the authorities demand evacuation, but still some people refuse to leave their homes. Sometime police have to use force in order to evacuate people.

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14. Disaster reduction

| *The high tech state:* There is a rather advanced warning system for extreme weather that is based on the mobile telecommunication infrastructure. Information can be tailor-made for each village (e.g. evacuation point). This infrastructure reaches almost all parts of the district, including remote villages. This system is not based on a point of contact in each village, instead in case of an expected XW event the authorities send out messages (SMS) to all grown ups (all people have mobile). The mobile | *Low tech but well organized* The plans for search and rescue project that existed in 2013 are now efficiently implemented. The responsible teams are training regularly for different types of extreme weather events and they have plenty of practise and experiences. The awareness of duties among the authorities and armed forces is high. There is no alarm system in place (expect TV). | *Not very well functioning* Existing plans are not well implemented. In case of an emergency different groups are not well coordinated. Neither the authorities and the armed forces are well aware of their duties. Furthermore they lack practise and experience since there is not regular training. People are not very satisfied with the situation and there are lot of complains. There is no alarm system in place (except TV). |

phones can be charged with solar cells. Huge responsibility for the individual and the family.		

6. Land use

Resettlement A majority of people who lived in high risk mountain areas 2013 have been resettled to other more safer areas. Families have been compensated in a satisfactory manner and have resettled peacefully. Some families have continued farming, while other have established themselves in the industry.	New plans for people living in high mountain areas have been implemented. They have been given support (extensive extension) for a sustainable and robust agriculture. For example, crops and trees are growing together. This system mitigate the risk for erosion and enhances productivity as well as robustness in economic terms.	Continued mal-practise of agriculture and forestry in the high mountain areas resulting in extensive soil erosion. Slash and burn practises continues resulting in high vulnerability to extreme weather events.

12. Capacity building

Problems with corruption has decreased substantially in the last decade. This is partly due to increased salaries to civil servants as well as training and education and propaganda. As a result, among other things, it has become easier for authorities to implement plans because it is difficult to bribe authorities.	Hugely corrupted society. In relative terms civil servants earn less than a decade ago. Very little training and education for civil servants. Low status for these jobs. In order to compensate for this development punishment for violation of the law has been more severe. Authorities also tries to enhance the organisation of society.	There is still problem with corruption, similar to the situation ten years ago.

7. Waste and sewage

Substantial resources have been used to help minority people to build toilettes for better sanity. Well-managed landfills have been established locally. For the rest of society the waste and sewage system is organised as it was a decade ago.	Waste collection and sewage system have been improved in urban areas. There are separate collection of organic waste and composted and used for biogas production. Plastic waste is collected and incinerated at a power plant in Cao Bang. This facility is a common resource for the whole province. In the city of Nguyen Binh a system for using the sewage water for crops production has been established. Designated slaughter zones with concrete floor has been built in some communes.

8. Natural resources

11. Supply of drinking water

The supply of drinking water has been improved, both with regards to quality and reliability, especially in the urban areas. Water is stored under during the dry season to guarantee supply during the dry season. A water purification plant has been built in Nguyen Binh.	In the high mountain areas reservoirs for store water has been built. This water is mainly for the local people and irrigation during the dry season.	Nothing has improved since 2013 concerning supply of drinking water.

9. Education

The education system in the district has been improved. There are more qualified teachers and more equipment in schools. Almost all kids attend primary school and 50% attend	The education system has got some increase resources since 2013. The equipment and education level of teachers are somewhat better, but still some

kinder garden 3-5 years. A new subject has been introduced in school: Environmental protection including climate change and adaptation. Some schools even has their own environmental projects in close cooperation with the divisions of agricultural and forestry of the Peoples Committee.	kids are not attending schools as they live in remote areas. However, a new subject has been introduced in school: Environmental protection including climate change and adaptation.

13. Poverty reduction

The Chinese way A lot of jobs have been created in the industry sector due to Chinese investments in mining industry. As a result there is less poverty in the district.	Less poverty compared to 2013 due to increased job opportunities in the tourism sector. This sector has seen a relatively positive development due investment in eco-tourism via private entrepreneurs. This development is supported by the People Committee of the province and the district. Examples of activities are guided trekking in the mountains. In many case minority people take part in this development, e.g. as guides and cultural events and lodging in villages.	The level of poverty in the district is the same as ten years ago. Unemployment has not been reduced since there is no more opportunities to find jobs.

10. Awareness of climate change

The issue of climate change and its impacts in Vietnam has received the same kind of attention as HIV. This has resulted in national champaing of information that are tailored to the	The state of Vietnam is not very active in creating awareness of climate change. The province however shows some interest in the issue but most of the activities

special circumstance in each province. The Cao Bang province has taken this very seriously since there are lot of experiences of extreme weather events and all levels of society for have been engaged to create high awareness.	aretaken at the district level. The engagement in the districts in Cao Bang is uneven. In Nguyen Binh climate change receive some attention and there is a climate change coordinator designated by the People's Committee.

15. Roads

The main roads in the district (34, 202 and 212) has been dramatically improved. Nowadays there in much less problems with landslides that interrupts the traffic. It is also possible to reduce travel times between for example Nguyen Binh city and the capital of Cao Bang. These investments have been made possible due to support from the government (road 34) and the province (202 and 212).

16. Population

Population has increase at the same rate as previously, i.e. roughly 1% annually. The total population in the Nguyen Binh district is 45 000.

Appendix 3: Evaluation

The following questionnaire was distributed to participants in the scenarios project in Nguyen Binh. In addition to a numerical verdict, respondents could also give written comments.

Instructions: Please fill in this questionnaire and leave it to any of the seminar organisers. *Your answers will be completely anonymous.* **THANK YOU FOR YOUR CONTRIBUTION!**

1. What is your overall impression of the scenario project in Nguyen Binh?
       Answer on a scale from 1 to 5 where 1 is very bad and 5 is very good.

       1   2   3   4   5

2. Did you find the aim of the scenario project easy to comprehend?
       Answer on a scale from 1 to 5 where 1 is not at all and 5 is very easy.

       1   2   3   4   5

3. Have the scenario project help you in raising your awareness about the challenges in connection with climate change?
       Answer on a scale from 1 to 5 where 1 is not at all and 5 is very much.

       1   2   3   4   5

4. Did you experience the participatory working procedure utilized during the two workshops useful?
       Answer on a scale from 1 to 5 where 1 is not at all and 5 is very useful.

       1   2   3   4   5

5. Did the socioeconomic scenarios provide insights into the vulnerability of different types of future societies to the impacts of climate change?
       Answer on a scale from 1 to 5 where 1 is not at all and 5 is very much.
       1   2   3   4   5

6. Did the socioeconomic scenarios stimulate your interest in climate change?

Answer on a scale from 1 to 5 where 1 is not at all and 5 is very much.

1   2   3   4   5

7. Do you believe socioeconomic scenarios could be useful in the Master Plan work of Nguyen Binh?

Answer on a scale from 1 to 5 where 1 is not at all and 5 is yes very useful

1   2   3   4   5

In total 14 answers to the questionnaire were handed in. The average verdicts for the seven questionsare provided in the table below.

Question	1	2	3	4	5	6	7
Average	4,4	3,7	4,5	4,6	4,2	4,7	4,6

In general the responses were positive. It is noteworthy that the question regarding the aim of the process (no. 2) got the least positive response from the respondents. Obviously the aim of the project could have been better communicated in the beginning of the process. In the written comments it was noted that parts of the process were difficult to understand. The relatively high score for question number 7, regarding the potential usefulness of scenarios in the Master Plan, indicates that the aim of the project was better comprehended after the process was finalized. This was also one of the questions that got most written answers in the questionnaire, e.g. that one of the respondents expressed the hope the there soon will be a project implementing scenarios in thelong term planning of Nguyen Binh. The question that got the highest score was number 6, i.e. whether the process stimulated interest in climate change. In the written comments it was stated by two respondents that the district should care more about climate change.

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