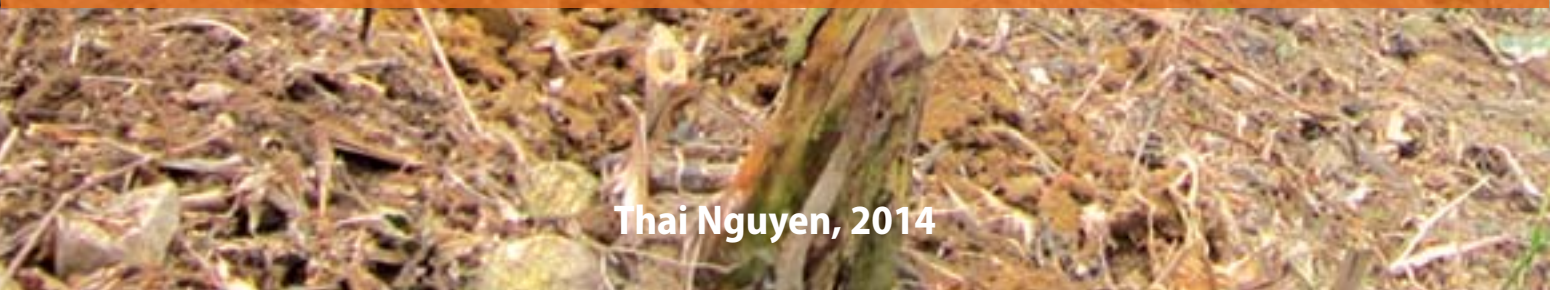
AGRICULTURE AND FORESTRY RESEARCH & DEVELOPMENT
CENTER FOR MOUNTAINOUS REGION (ADC)

GUIDELINE

INDIGENOUS KNOWLEDGE IDENTIFICATION AND USE IN COMMUNITY BASED ADAPTATION PRACTICES



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ACRONYMS AND ABBREVIATIONS

ADC	Agriculture and Forestry Research &Development Center for Mountainous Region
CARE	CARE International in Vietnam
CC	Climate Change
CBA	Community based adaptation
CCA	Climate change adaptation
EM	Ethnic Minorities
IPCC	Intergovernmental Panel on Climate Change
IK	Indigenous knowledge
MONRE	Ministry of Natural Resources and Environment
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

ABSTRACT

Climate Change (CC) adaptation is the task of the society; of all authority levels, all agencies and organizations and people from all walks of life. Measures for coping with CC have been introduced in terms of policy, technical and infrastructure aspects. Encouragement of indigenous knowledge (IK) use to adapt to CC is among the activities under the CCA strategy/ action plan of the concerned ministries, agencies and provinces. Vietnam National Strategy on Climate Change (2011) emphasized the increase in the use of IK in measures to adapt to CC.

Indigenous knowledge introduces its high adaptability to the environment, in the area where it was formed, interacted and developed. IK is the quintessence of a long process of observation, experience gain from daily activities, agricultural and-forestry practices, and management of natural resources and community, which comes from community dwellers' hard working, being gradually finalized and transferred from generations to generations. Therefore, the application of IK in CCA is the key to success for a sustainable livelihood development, especially for the ethnic minorities (EM).

This Guideline on "indigenous knowledge identification and use in community based adaptation practices" helps readers better perceive the roles and values of IK to the EM community in CC adaptation, which is one of the optimal measures for EM to adapt to CC., The Guideline is structured in the following parts:

PART 1: GENERAL INTRODUCTION TO CLIMATE CHANGE

Climate change refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (IPCC, 2007). According to the Ministry of Natural Resources and Environment (MONRE), during the last 50 years (1951-2000) the annual average temperature in Vietnam has increased of about 0.50C on a national scale. The overall temperature is projected to increase in almost all areas of Vietnam in the 21st century.

In Vietnam, the most vulnerable sectors to CC include: Agriculture and food securities, water resources, health care. The most vulnerable areas are coastal and mountainous areas. The most vulnerable people are the poor, women, children and ethnic minorities. The northern mountainous area is among the most vulnerable regions to CC as the majority of the people in the area are ethnic minorities, living of agriculture, and present the poorest proportion of the population.

Currently, Vietnam has deployed its solutions and measures to adapt to CC with different approaches including the community based adaption to CC, which is a process towards community, based on the priorities, demands, knowledge, and capacity. Communities are also empowerred to develop their own adaptation plan. This is likely a sustainable and appropriate direction, however, it calls for resources..

PART 2: INDIGENOUS KNOWLEDGE IN CLIMATE CHANGE ADAPTATION (CCA)

The nature of Indigenous knowledge

- It's based on experience: IK was formed in the course of life, by experiencing and drawing lessons.
- It's being reviewed over centuries: The screening process is never ending along with the ups and downs of life.
- It adapts to cultural and environmental identifications in the way that is suitable with the natural environment and social communities. It reflects the co-regulation, one of a common feature of the culture (which hypothesizes that communities living in similar natural conditions will share common cultural characteristics).
- It's dynamic and always changing: IK is not a permanent structure; integrations always go on after a self-development process or the acculturation (Mai Thanh Son et al, 2007).

The roles and values of IK in CCA measures

- The diversification in crop/livestock system contributes to improvement and maintenance of eco-system services, strengthen the adaptability, and reduce the community vulnerability to CC. Indigenous crops/livestock are more resilient to extreme weather events, bearing fewer diseases than new varieties, intensive farming and rearing requirements are not high, thus they are optimal for community residents, including the poor.
- IK helps people live with self-sufficiency and self-determination. It makes them feel less dependent on external factors, hence they can reduce the vulnerability to CC.
- Farmers are likely familiar with indigenous techniques, they can understand, adapt and maintain such techniques better than the newly introduced ones from outside, and as a result, experience and voice of the community can be promoted properly.
- IK provides more solutions/options to CCA. Local residents have more community-based choices to adapt to CC rather than relying on external factors (i.e. new varieties, modern techniques) (ADC, 2013) [1].

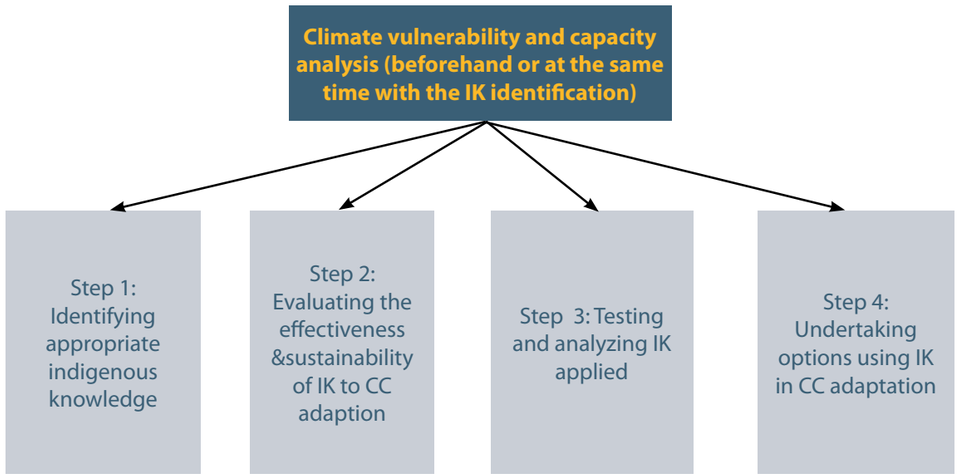
PART 3: THE METHODS AND TOOLS USED TO IDENTIFY IK APPLIED BY THE COMMUNITY BASED ADAPTATION PRACTICES

Process to identify indigenous knowledge based production options adapting to climate change

Determination of production options using indigenous knowledge to adapt to CC based on community participation, is in fact the process to identify the climate resilient livelihoods focusing on agriculture and use of indigenous knowledge. This usually goes along with the climate vulnerablility and capacity analysis. The process can be flexibly implemented into 2 ways:

(1) Firstly, to conduct the CVCA and secondly, to further study the identification and use of IK in the community based adaptation production options: following this, the study on IK can be extensive and focused, but it does require comprehensive human and financial resources.

(2) Second, it is possible to combine the CVCA to make it in a single step by integrating the form of questions related to IK in the CVCA process. This method saves resources and brings results sooner, but it lengthens the identification process and the discussions are diverse so the method is in need for flexible coordination.



Step 1: Identifying appropriate indigenous knowledge

- Identify information and experiences in the community/area by working directly with the community.
- Note down all the information and experiences relevant to the identified issues.
- Evaluate the collected information in terms of the relevance, applicability, efficiency and so on.

Example: Indigenous varieties, farming techniques or pest control measures.

Step 2: Evaluating the effectiveness & sustainability of IK to CC adaptation

- IK is not always useful. Especially in terms of its adaptability and viability to CC. In some cases, IK based practices may harm the course of sustainable development. It is thus pivotal to choose the ones that are beneficial for CCA.
- Evaluate IK in CCA by seeking to understand the reasons why people rely on IK to adapt to CC impacts, and how the IK responds to CC impacts. For example, one might ask:
- How adaptable the local varieties/techniques are in relations to the extreme weather events (drought, prolonged cold spell, etc.) and what are the advantages compared to other common varieties? Who (men or women) participate in the whole farming/rearing process? Does this participation consume much laboring? Is there any way to assign tasks suitable for either women or men to avoid burdening on either of them?
- If suitable, IK is considered as a CCA approach. The IK is worth implementing in view of the benefits it may bring to the community in CCA and sustainable development.

Step 3: Testing and analyzing IK applied

- Usually, even the IK is assessed as effective; a lot more still needs to be done. Improvements will enhance the IK effectiveness, in other words, certain small changes can bring up the efficiency of the whole system.
- The testing can be research, local trials, field research, etc.
- Experiencing to combine the IK in an efficient and flexible way with new scientific and technological knowledge to enhance the value of IK in CCA.
- If the IK is effective, but yet unable/no need to improve, then apply it in a proper way.

Step 4: Undertaking IK based options to adapt to CC

- After collecting and identifying their value in CC adaptation, IK will be applied in the local practices.
- By adopting IK in CCA practices, local people will find it easier to apply and replicate the options on their own.
- Experience of the community will be promoted, which enhances the community's autonomy in CCA.

Part 4: Good practices on promoting the use of indigenous knowledge for improved climate resilience of livelihoods

Presently there are many such activities practiced by communities proved to be effective. This document introduces two practices on indigenous varieties and techniques in CCA, especially appropriate with the northern mountainous area, comprising: Drought tolerant ginger, medicinal intercropped with banana and drought tolerant mung bean growing.

Part 5: Conclusions and recommendations

IK has proved its role in community based adaptation. Combining scientific knowledge and IK appropriately enhances the effectiveness in adaptation activities. To make these practices sustainable, incentives and financial resources to practice, study, document, archive and replicate in suitable conditions are the keys. Local socio-economic programs as well as development and poverty reduction programs (Program 135, new rural areas, loan support program of Social Policy Bank, vocational training programs) need support from initiates to use IK in community based adaptation and joint venture to share, mutually support to better adapt to climate change.

FOREWORDS

Indigenous knowledge (IK) is a broad and precious knowledge treasure of all ethnic groups all over the country, which constitutes one of the elements of cultural identity of each ethnic group in particular and of Vietnamese culture in general. In agricultural and-forestry production and natural resource management, IK plays an important role in maintaining and developing techniques suitable with the specific economic, cultural, social and custom conditions of each local area, and region, especially in the light of CC impacts are clearly perceived today. Agriculture and forestry Research & Development Center for Mountainous Region (ADC) – affiliated to Thai Nguyen University of Agriculture and Forestry has spared no effort in working with the EM communities in the mountainous northern provinces in general and in Bac Kan province in particular to introduce various measures for CCA, thereby reducing CC impacts on the people' livelihoods. Specifically, they include numbers of options on agriculture practice in view of CCA, which have been promoting their effectiveness, receiving positive responses from local communities. Therefore, research and applying IK in the context of CC impacts play crucial roles in community's sustainable development.

During data and information collection and document compilation, the authors have received valuable technical assistance and comments of experts from CARE International in Vietnam, Vietnamese non-governmental organizations (VNGOs), and local authorities of the provinces of Bac Kan, Yen Bai, Phu Tho, Ha Giang and colleagues. However, since mistakes are unlikely to be completly avoided, we would like to ask the audience to read and comment so that this document can be more completed.

Lastly, ADC would like to sincerely thank CARE International in Vietnam for their financial and technical assistance, non-governmental organizations in Vietnam, local authorities of the provinces of Bac Kan, Yen Bai, Phu Tho, Ha Giang and colleagues for their valuable supports during the course of implementation, their providing providing of evidence have helped us complete the Guideline on "indigenous knowledge identification and use in community based adaptation practices".

We hope that this document is an useful reference for the relevant agencies, organizations, particularly, the research institutions, non-governmental organizations in Vietnam and specialized departments and agencies; and individuals in their research, development and undertaking the options to adapt to climate change as well as the studies towards the roles and values of IK in CCA in the local provinces across the country.

THE AUTHORS

INTRODUCTION

Climate Change (CC) adaptation is a task for the society; of all levels, agencies, organizations and people. Measures for adapting to CC have been introduced in terms of policy, as well as technical and infrastructural aspects. Encouragement of indigenous knowledge (IK) use to adapt to CC is among the activities under the CCA strategy/action plans developed by the concerned ministries, agencies and provinces. Vietnam National Strategy on Climate Change (2011) also emphasized the use of IK in climate change adaptation measures.

Indigenous knowledge (IK) is a broad and precious knowledge treasure of the indigenous communities in a certain area. Compared to the contemporary technical systems (so called new technical systems from the outside), IK outweighs the technical system from outside with its outstanding features i.e. IK introduces its high adaptability to the environment in the area where it was formed, interacted and developed. IK is the result of a long process of observation, experience gains from challenges (including natural disasters), withdraw experience from daily activities, agro-forestry practices, and management of natural resources and community. These experiences come from community dwellers' hard work, being gradually finalized and transferred to the next generations. Therefore, application of IK in CCA is the key to success for a sustainable livelihood development, especially for the EM.

IK hence has a pivotal role in CCA. However, documents to guide the identification and assessing the importance of IK in CCA are lacking in Vietnam. In that light, this guideline will provide our readers with more information on the roles and values of IK to the EM communities in CCA and consider it as one of the optimal measures to adapt to CC of EM.

Information and data for preparation of this document are collected in the provinces of Bac Kan, Phu Tho and Yen Bai. The report additionally has some references to studies of ADC and secondary documents provided by other agencies and organizations.

Intercropping of drought tolerant ginger, medicinal plants and banana on sloping land - © Ha Thi Hoa

PART 1
GENERAL INTRODUCTION TO CLIMATE CHANGE

1.1. Overview of Climate Change

1.1.1. Weather

Weather is the collection of states of the meteorological factors that occur in the atmosphere at a specific period of time, such as sunshine or rain, hot or cold, damp or dry, etc.

1.1.2. Climate

Climate is the average state of the weather in a certain area, i.e. a province, a country or a continent based on history data series (by month or back to millions of years ago, usual evaluation is 30 years – according to the World Meteorological Organization - WMO).

1.1.3. Climate change

According the Intergovernmental Panel on Climate Change (IPCC; 2007), Climate change refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. CC may be caused by the natural processes within the climate system, or due to the impacts from outside, or due to the impact of human, which frequently change the composition of the atmosphere or land use.

According to the report of Ministry of Natural Resources and Environment (MONRE), over the last 50 years (1951-2000), the annual average temperature increased about 0.5^0C on a national scale. As a common trend, the temperature continues to increase in most of the regions in Vietnam in the 21st century. Different CC scenarios are introduced by MONRE, such as the increase of the average temperature in Vietnam in the 21st century in table 1.1.

Table 1.1: The increase in the yearly average temperature (°C) compared with period 1980-1999 as per medium emission scenario (B2)

Region	Timelines of the 21st century								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
Northwest	0,5	0,7	1,0	1,3	1,6	1,9	2,1	2,4	2,6
Northeast	0,5	0,7	1,0	1,2	1,6	1,8	2,1	2,3	2,5
Red River Delta	0,5	0,7	0,9	1,2	1,5	1,8	2,1	2,2	2,4
North Central Coast	0,5	0,8	1,1	1,5	1,8	2,1	2,4	2,6	2,8
South Central Coast	0,4	0,5	0,7	0,9	1,2	1,4	1,6	1,8	1,9
Central Highlands	0,3	0,5	0,6	0,8	1,0	1,2	1,4	1,5	1,6
South	0,4	0,6	0,8	1,0	1,3	1,6	1,8	1,9	2,0

(Source: Ministry of Natural Resources and Environment, 2009)

According to medium emission scenario B2: At the end of the 21st century, yearly average temperature can increase with 2.6^{0}C in the Northwest; 2.5^{0}C in the Northeast; 2.4^{0}C in the Red River Delta; 2.8^{0}0C in the North Central Coast; 1.90C in the South Central Coast; 1.6^{0}C in the Central Highlands, and 2.0^{0}C in the South compared to the average temperature during the period of 1980 - 1999.

According to a report of the World Bank, Vietnam is one of the five countries that are mostly affected by CC in the 21st century. El Nino and La Nina Southern Oscillation have had increasing affects on Vietnam. CC has actually increased the forcefulness of natural disasters i.e. typhoons, floods and droughts, especially in the northern mountainous region.

1.1.4. Signs of Climate change

- The warming of the atmosphere and the Earth in general.
- The change in the composition and quality of the atmosphere, which causes harmful impacts to the living environment of humans, plants and animals on Earth.
- Sea level rise due to glacial melt causing flooding and inundation in low-lying lands and small islands in the ocean.
- The movement of climate zones, which have existed for thousands of years in different regions of the Earth. These movements are threatening the survival of many species of plants and animals, as well as ecosystems and human activities.
- Changes in the intensity of the activities of the atmospheric circulation, the water cycle in nature and other biogeochemical cycles.
- Changes in the biological productivity of ecosystems and in the quality and composition of the hydrosphere, biosphere and geosphere.

Various signs of CC in Vietnam

- Temperature: According to the observation data gathered for the last 50 years (from the years 1951 to 2000) the average annual temperature in Vietnam has increased with about 0.5^{0}C. In recent years, the number of sunny days has increased in many areas, mostly remarkable in provinces of the South, which is in line with the trend of rising temperatures.
- Cold spells: With the trend of global warming and CC, in recent years fewer cold spells hit the country while the intensity and occurrences are more adverse than usual. The most recently unusual manifestation of the climate change is that cold spells tend to shift to the East and therefore increasingly affecting the South of Vietnam, yet with not-so-great intensity.

Figure 1.1: Flooding in the northern mountainous area. Source: Internet

- Tropical depressions and typhoons: Typhoons in Vietnam usually begin in May and end in December. However, the recent years' records show that typhoon seasons tended to end a little later (until January or February in the next year). Moreover, the orbits of some typhoons with stronger intensity have shifted to the South and many of them show some unusual orbits, differing from the regularities of tropical depression and typhoons that have previously impacted Vietnam.

1.2. The CC impacts in the northern mountainous area

In Vietnam, the sectors identified as vulnerable to CC are Agriculture and Food Security, Natural Resources, and Health Care. Vulnerable regions mostly consist of coastal and mountainous areas. The most vulnerable groups of people are poor, women, children and ethnic minorities. Most of the people living in the northern mountainous provinces are EM. Their incomes are primarily based on agriculture activities. This region is considered as the country's poorest area. The poverty rates in the year of 2010 were high among the surveyed provinces of Bac Kan, Phu Tho and Yen Bai; 32.1%, 19.2% 26,5%, respectively. It is therefore possible to infer that northern mountainous areas are significantly impacted and is one of the most vulnerable areas in regards to CC. The following section introduces analyses on the impacts of CC on important sectors.

1.2.1. Climate change impacts in agriculture sector

1.2.1.1. Impacts on cultivation

Agricultural production plays an important role in the life of EM in northern mountainous area. CC impacts cultivation through several aspects:

CC impacts the reduction in area of arable land, affecting the crop productivity

The northern mountainous area is characterized by complex terrain with little arable land area. Some signs of CC such as land slide, flash floods, droughts have reduced the livelihood capital of local people, especially those defined as poor.

According to the report of Cho Moi District People's Committee, Bac Kan province, in the year of 2011, rice and maize area of the district was totally lost due to drought, up to 400 ha. In Na Ri district during 2011 ginger crop in 10 ha out of 40 ha was damaged, rice crop was suffered from drought in 427 ha right at the flowering time, causing the loss of 70 % of total yield.

Floods in the year of 2005 were the most serious compared to all floods occurred from 1970 to the most recent. The flood innudated the entire Pha Kha field (3 ha), Phu Nham commune, Van Chan district, Yen Bai province. The water level was 1m deep, up to 3^{th}-4^{th} of the stilt house's floor. Sandy soil overflowing 50% Ta Tiu field area (total area of 2 ha) in Phu Nham commune, Van Chan district, Yen Bai province. In the same year, yielding in 20 ha rice growing area of the village was completely lost (Nam Han 3 village, Phu Nham commune, Van Chan district, Yen Bai province).

In 2007, heavy rains lasted for 5 days causing serious flooding which damaged Nong Truong reservoir, thereby burying 1.2 ha of rice cultivation along Chua spring. The households mostly affected were Ms Hoang Thi Khoai's – 3,500m^2; and Mr. Hoang Van Tiep's – 600 m^2. Floods and rains also innundated a number of households (Ms Phung Thi Chanh's, Mr Ha Van Tram's, Mr Hoang Van Dien's, Mr Dinh Van Thang's) residing along the spring during 3 days (Nam Han 3 village, Phu Nham commune, Van Chan district, Yen Bai province).

Strong cold spells caused extensive damaged to rice production and other crops

A cold spell in 2008 in the northern mountainous area destroyed about 100,000 ha of rice growing area, and the total lost was estimated at about 30 million USD (Oxfam International in Vietnam, 2008)[26]. Extreme weather events affected not only the rice growing area but also the fruit and vegetable production. Research findings in Tan Son district, Phu Tho province show that changes in the weather were displayed by the change of flowering of some species, i.e. usually, apricot flowers bloomed in every November lunar calendar, but in the year of 2010, it was flowering sooner, at the end of October, while it was until 15^{th} January lunar calendar in the year 2012.

CC causes soil degradation

Worsened droughts are due to increase in the rainfall variability that causes a shortage of rainfall, combined with heat waves, which makes water more inclined to evaporate. Impacts of drought to agriculture production are considered the most serious and risky circumstances in that crop failures are inevitable. This means that the land areas degraded by frequent and prolonged droughts will in some cases no longer be cultivatable. Soil degradation changes the land use patterns, which leads to changes in the distribution of plants and a reduction of the productivity. Drought tends to increase with different levels in different climate zones.

- Increased temperature alters the growth of plants, crop seasons and crop distribution (Adejuwon, 2004)[10], thereby the yield and quality of crops are reduced (Dow & Downing, 2007)[16], especially the food crops. Increased temperatures reduces the natural water supplied for the plants, affecting the area of arable land and crop quality. In particular, due to the nature of the terrain, the natural water resources become less available due to rising temperatures in the northern mountainous area, making the sitution in this area more serious than elsewhere.
- Increased rainfall (quantity, time and changeability) causes flooding in many low-lying areas (Rex et al., 2007) [27]. Research findings in the provinces of Lao Cai and Bac Kan show that subsistence inundation caused significant impacts to agricultural production.
- In general, vectors and pests thrive in the high temperature with sufficient water supply condition. Hence the global warming may extend the distribution of diseases and pests on crops. The climate is thus likely to be warmer in the winter, which may allow the egg/pupa of insects suriving over winter and as a result, cause diseases during growing seasons. Focus group discussion results show that the diseases in crops have been indentified as one of the consequences of CC impacts.

CC through rising temperatures and extreme weather events has interrelatedly impacted the yield and the quality of the crops. Research results in Na Ri and Cho Moi districts, Bac Kan province; Van Chan district, Yen Bai province and Tan Son district, Phu Tho province have shown that CC impacts may be reduced from 30% to 100% crop yield, which in time causes food insecurity and chronic poverty. For example, drought reduced the yielding of hilly maize crops, before the year 2000, planting 1kg of maize seeds allowed harvesting of 360kg maize. The spring maize yield was reduced from 450kg to 300kg – focus group discussion in Na Don village – Thanh Vanh commune).

1.2.1.2. Impact on livestock

A series of causes can be identified as the culprits of livestock diseases. Proving a causal relationship between CC and livestock diseases is not straightforward. Many studies speculated that CC is one of the important causes of diseases of livestocks (Thornton et al., 2007; Thornton & Mario, 2008)[23,24]. Research findings in the northern mountainous province show that diseases have been more frequent in recent years. Group discussions of people in Na Ri district, Cho Moi district of Bac Kan province; Tan Son district of Phu Tho province; Van Chan district of Yen Bai province realized that diseases of cattles and pigs have become more repeated, especially in those recent years and even among the vaccinated animals. Changes in rainfall could also exacerbate the spread of diseases in wet years. While the poor mountainous people have little chance to access veterinary services, outbreaks of animal diseases have increased the mortality of cattle and poultry (Gorforth, 2008)[20].

1.2.2. Impacts on forestry

In addition to farming and livestock, CC also impacts the forestry production, forests and the environment of these. The relationship between CC and forestry are intertwined, which means that it is difficult to distinguish the cause from the effect.

Unreasonable exploitation and utilization of forest show the way to CC. CC also contributes to an increase in natural disasters, through phenomenas such as droughts, floods, and landslides causing extensive damage to the forest production.

Impacts of CC on forestry is found through different aspects:

- Extinction risk or declination of some flora species as they are not able to keep up with the volatile climate extreme factors, such as such as high temperatures and humidity. This regards species such as Aquilaria malaccensis, Fokienia hodginsi, Cupressus torulosa, Sindora siamensis etc.
- Increased temperature, especially higher maximum temperatures, combined with prolonghed heat waves increases the risk of forest fire, especially in dry season.
- Prolonged heat and rainless periods slow down the growth, or cause death, to new plantations.

- These changing climate conditions are opportunities for pests and diseases to become rampant.
- In the areas where the soil moisture reduced due to shortage of rainfall and increase in evaporation, decidous and drough tolerant forests grow stronger. Temperature increasing trend varies the boundaries between the primary and secondary forests;

1.2.3. Impacts on livelihoods

CC increases the posibility of outbreaks of diseases in plants and livestock. Futhermore, when diseases strike, markets tend to reject the livestock products (resulting in price shrinking or not sold). This causes severe losses for farmers, especialy the poor who rely primarily on livestock.

Strong cold spells occurred in the northern mountainous area in 2008 and killed more than 60,000 cows and buffalos, including 18,760 from Lao Cai province (Oxfam International in Vietnam, 2008)[26], causing severe economic consequenses in the local area.

Strong cold spells in early 2008 with temperatures down to 100C, together with rain, killed 3,000 cows and buffalos and damaged 1,000 ha of rice growing area of the district. Cold weather addtionally killed 2,000 cows and buffalos in 2012. Damages by Brown planthopper (Nilaparvata lugens) in 2008 were recorded in 400 ha of rice, which reduced yield to 50-60%. Local flooding in the district in 2005 killed 32 people. Cat Thinh commune was worstly damaged. There were 300 ha of agricultural land buried by sand and gravel, and the flooding intensity remained serious in subsequent years but on smaller areas, mostly on flats (Division of Agriculture of Van Chan district – Yen Bai province, 2013).

Since 2000, many changes in weather and climate were recorded i.e. strong cold spells, droughts, heavy rains associated with major floors and plants/livestock diseases have frequently occurred and have caused severe losses and consequenses: In the year 2000, food-and-mount epidemic in cattle erupted in 12/16 towns and communes (total infected animals were 817 including 48 died); In the year 2007, Brown planthopper damaged Spring rice growing areas at the rippening phase affected more than 200 ha of rice growing area in the whole district area. Before 2000, Brown planthopper habitually damaged the rice during the reproducing phase, but since 2005 and until now, it started to damage the rice crops at their vegetative phase, also, worns (Mythima separata, Cnaphalocrosis medinalis) damaged the rice leaves on an extended area. In the year of 2008, cold spell killed 500 cows and buffalos in the whole district area. During 2010-2011, prolonged cold spell killed 367 cows and buffalos. While in 2011, the whole rice and maize area of 400 ha was completely lost due to drought. Thus, District Division of Agriculture pursuated the local people to grow crops like groundnuts, soybeans and green beens on the drough area (Division of Agriculture of Cho Moi district -Bac Kan province, 2013).

Frequent flooding caused serious damages in the district area in general. Heavy rains accompanied by heavy flooding in May 2009 caused crop failure, losses of houses, and aquaculture. The district's damages included 57 ha of rice completely lost; 2 ha of rice buried, yielding of 100 ha of rice affected and 155 ha of maize totally lost. It was estimated that total loss caused by floods and rains in the whole district was around 5 billion VND (Division of Agriculture of Cho Moi district -Bac Kan province, 2013).

1.2.4. CC impacts on people and the ethnic minorities

Aside from impacts on agricultural production, CC negatively impacted on various aspects of life and health, houses, assets, income and access to social services, that helps to improve the knowledge of northern mountainous ethnic minority people.

Natural disasters in the northern mountainous region is increasing with growing frequency and intensity. According to Vietnam national natural disaster risk reduction report (2005), in 10 years from 1994 to 2003, 453 people died and went missing, 277 people were injured and thousands of people affected psychologically and economically; Total damage to infrastructure was estimated up to 1,700 billion VND.

Intercopping of taro, pachyrrhizus and maize to adapt to drought condition in slopping land - © Bui Tuan Tuan

Along with the direct impacts, CC imposes indirect impacts such as isolation and access limitation of product consumption markets, hindering the access of people to the social welfare services, thereby exacerbating the vulnerability. For example, after the natural disease, both men and women have to spend time and energy to recover their family life. Men often assume heavy laboring while women overall work harder due to their traditional roles in the family. Yet the contribution of women is not duly appreciated due to so-called "no name stuff" that exagerates the viewpoint that women are responsible for family duties. Since women spend most of their time on family, not much time and opportunity is left for accessing the community activities and the social benefits of these. Adversely it reduces the role of women in their family and society. Children are vulnerable too, the fact that kids cannot go to school during and after the disasters is common in the northern mountainous provinces. The Northern mountainous region has a higher poverty rate than the national average, and CC exacerbates the poverty by reducing productivity, especially in agriculture practices, and thereby reducing the disaster coping capacity. Moreover, market access restrictions confine the income diversity activities. The activities, represent the practices to adapt to CC, help people become more resilient to CC impacts on natural resources, as using natural resources represent the main source of income of mountainous populations.

CC impacts limit the local sources of income, for instance, reducing arable land area, thereby reducing income. To overcome such incidents, many households choose to migrate to the big cities in search for employment. However the migration can bring about negative influence on the family and social relationships. Usually men looking for jobs in the big cities could increase the vulnerability of their households, reducing the resilience to CC impacts since only women and children are left at home.

Impacts of CC are not the same among the social groups. Research on the vulnerable groups and reasons bears important meaning in proposing appropriate CCA measures. Poor

households usually rely on agriculture production as the main source of income, unforturnately, it is analyzed that agricultural production is most vulnerable to CC impacts. Poor households often do not have multiple income generation activites, and therefore the ability to diversify sources of income in order to mitimize the CC impacts is also low. Furthermore, their recovery from disaster impact is slower than the others in the community. It is especially more difficult to strenghten the resilience for the woman-headed poor households while the current policies fail to spend special priority on this group.

1.3. Climate change adaptation

1.3.1. Concept

The climate has been changing; causing potential and adverse impacts on the development, thus, adaptation to CC becomes all the more important. Adaptation is a very broad concept and in the field of CC, the term is used in many cases.

According to the Intergovernmental Panel on Climate Change (IPCC): Adaptation refers to the degree of any adjustment in practices, processes or structures of systems to projected or actual changes of climate to reduce the impacts or/and take advantage of opportunities if possible. Adaptation can be spontaneous or planned and can be carried out in response to or in anticipation of change in conditions.

A study of Burton (1998) [12] suggests that: Climate adaptation is a process by which people reduce the adverse effects of climate on health, life and use opportunities favored by environment. Here, adaptation means how to reduce the impacts of CC, taking advantage of the favor if possible.

According to Thomas (2007) [22]: Adaptation means passively modifying or actively responding or preparing, in the sense of reducing and improving the adverse effect of CC.

Thus, CC adaptation is to adjust natural system or human system to the changing circumstances or environment, aiming at reducing vulnerability to CC due to existing or potential CC and take advantage of all opportunities available.

1.3.2. Types of CCA

There are numerous CCA measures in response to CC. The Fourth assessment report of Intergovernmental Panel on Climate Change (IPCC, 2007) [22] mentioned and described 228 different adaptation methods. Commonly the methods are categorized into 8 groups, as follows:

i. Acceptance of loss: Other adaptation methods can be compared to a basic response "do nothing", rather than bearing or accepting the damages and losses. In theory, acceptance of lost occurs when the impacted party is not likely to succumb in any way (for example in the very poor communities, or in the places where the price to be paid for the adaptation activities is higher than the possible risks or damages and losses).

ii. Sharing of loss: refers to sharing of losses among a large community. This adaptation occurs in a traditional community or a society of high and sophisticated technology. In a traditional society, many existing mechanisms are in place to share losses among extended communities, such as among households, relatives, villages or similar small communities. Moreover, the highly developed great communities share their losses through community aid, which is, restoring and reconstructing using public funds. Sharing of losses can also happen through insurance systems.

iii. Altering the risk: In a certain extent, one can control the environmental hazards. For some "natural" phenomena such as flood or drought, suitable measure is flood control (by dam, canal and dike). CC progress can be slowed down by reducing greenhouse gas emissions and at the last stake is to stabilize greenhouse gas in the atmosphere. Under the United Nations Framework Convention on Climate Change (UNFCCC), such mentioned methods are regarded as the mitigation of CC and differ from adaptation measures.

iv. Preventing the effect: This is a system of various methods used to adapt step by step and prevent the impacts of the changes and the uncertainties of climate. For example in the agriculture sector, changes in crop management such as increased irrigation, applying more fertilizers, pests and insects control.

v. Changing the usage: While CC hazards make it impossible to continue the economic activities or make it risky to execute, one can alter the way he/she practices them. For example, farmers can turn to employ drought tolerant crop varieties, or at least to switch to the ones with lower moisture demand.

vi. Altering the location/relocation: A stronger response is to change location/relocate the economic activities. Pros and cons analysis should be made prior to this, for example altering the major crops and farming areas to more convenient and sustainable ones, in response to drought.

vii. Research: The process of adaptation can be developed by research in the fields of new technologies and new methods of adaptation.

viii. Education, information and encouragement of behavior change: A different approach is to disseminate knowledge through public communication campaigns and education to change behaviors. Previously, these activities were less prioritized, but their importance has increased over time due to the need to cooperate with the many communities, sectors and regions in CCA.

Thus, adaptations are seen in both natural and human's socio-economic system. The importance of adaptation to CC is to fit with the natural condition and economic capacity and customs of the people in different regions.

1.4. Community based Adaptation

1.4.1. Community based Adaptation in Vietnam

Community based adaptation (CBA) is an important approach in responding to CC, especially in developing countries. CC impacts are different in each location, subject and livelihood. Therefore, only when we act on the basis of community can we understand the direct impacts of CC to the people and hence be able to design appropriate solutions that bring benefits to the the people and their community.

CBA is a process of acting toward community by considering the specific priorities, needs, knowledge and capacity of the community. In this process, they are empowered to develop their own plan to adapt to climate change. At the same time, CBA seeks to address the impacts of CC on the livelihoods and reduce their vulnerability by using IK and scientific and technological knowledge.

In Vietnam, the national programs and policies, i.e. the National Target Program on Responding to CC (2008), encourages and supports CBA practices, however, specific guidance and support are needed to deploy the activities effectively.

1.4.2. Community based adaptation framework

CC is one of those many challenges that the poor has to face. In order to be able to reduce the vulnerability effectively, the CCA should be part of the overall responses to CC and aiming at building the resilience to serious shocks and stresses that they have to cope with.

Traditional measures to response to CC impacts such as construction of dike system, canals, flood regulation and control facilities and weather forecasts are being actively applied. Nevertheless, the existing CC adaptation strategies will change the concept of adaptation from passive countermeasures to more proactive interventions by considering the potential impacts of CC as important guide tools for planning policies. This is different from the traditional way of "seeing and waiting" in regards to responding to impacts of CC.

Community based adaptation requires integrated approaches, combining IK and advanced strategies to address the vulnerability while strengthening the adaptation capacity to respond to new challenges and changes. CBA relates to four strategies:

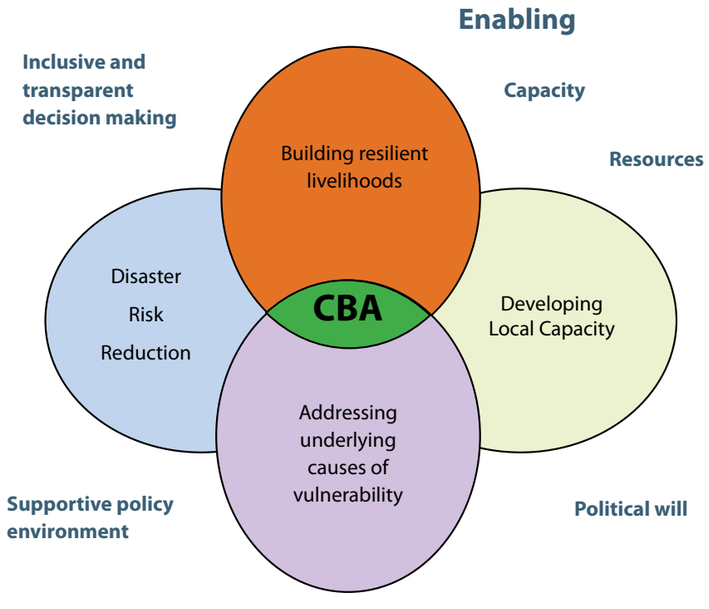
i) Promoting resilient livelihood strategies together with diversification of sources of income and strengthening capacity in planning and risk management;

ii) Disaster risk reduction strategy to reduce impacts of the natural disasters on the vulnerable households and individuals;

iii) Strengthening capacity for local civil society and governmental agencies so that they can better support the communities, families and individuals in their effort to respond to CC.

iv) Policy advocacy and social mobilization to address the root causes of the vulnerability, such as poor governance, lacking control over resources or limited access to basic services

Figure 1.2: Community based adaptation approaches, CARE (2009)



1.4.3. Lessons learnt and challenges in CBA

Lessons learn:

- To build capacity for staff and for partners require time.
- Tools and methods should be adjusted to suit with the context, especially while working with ethnic minority people in remote areas.
- Understanding the underlying causes of vulnerabilities and the vulnerabilities of different groups needs complementary solutions.
- Studying and analyzing further to assess the adaptability, for example assessing the local plant species, models, seasonal crops and varieties resilient to unfavorable climate conditions.
- We are still learning; and adaptation activities remain at their early stage – and it can be too early to make assessment at community level.

Challenges:

Although CBA has been recently developed, yet some lessons were learnt in terms of integrated approaches, a combination of IK and scientific knowledge and so on. All the while, certain challenges are seen in terms of the reliability of the sources of information and data on CC, quality of consultation process in CBA, replication of good practices as well as inspection and evaluation.

Type of local community participation:

i) **Passive participation:** Participants are informed about what has happened and what will happen. Such information will be provided by the local authorities or from projects deployed in the localities, but without listening to the feedbacks of the community. The information brought to share belongs to the outside experts.

ii) **Participation by providing information:** People participate by answering questions raised by field researchers in questionnaires or other similar tools. Local people have no chance to participate in the process of finding out the results as well as verifying the accuracy.

iii) **Participating through discussion:** Participants take part in discussion and scientists/ investigators listen to their points of view. The scientists will locate the problems and find solutions, maybe with some small alterations after taking in people' feedbacks. Yet, this type of community consultation does not include the political decision making process and the scientists are not bound to consider the views of the community.

iv) **Participation with material motivations:** People participate by providing resources (i.e. labor) in return for food, cash or similar values. Several field research projects fall into this category in which people lend some land areas to scientists without participating in the trials, which means that they rarely gain experiences or learn from the trials. Therefore, it is often seen that people end up breaking the commitment if there are no material motivations available.

v) **Participation in certain functions:** People participate by joining in the groups set up in the way that is appropriate to the requirements set out earlier by the projects. This participation does not happen right from the planning stage of the projects, but often after the important decisions have been made. This mode depends much on the external objects rather than the communities themselves.

vi) **Interactive participation:** Community participation is planned from the beginning of the project preparation. Thus people can make decisions related to the action plan, and establish a new local administration – or strengthening capacity for the current one. It acts towards the interdisciplinary study methods - i.e. to consider different perspectives, adopting integrated research processes and structures. This group represents the community decision, thus, ensuring the community to have impact in maintaining the structure and implementation of policies.

Drought tolerant mung bean - © Luu Van Thanh

PART 2:
INDIGENOUS KNOWLEDGE IN CLIMATE CHANGE ADAPTATION

2.1. Indigenous knowledge

2.1.1. Definition

Today the concept of IK, or local knowledge, is defined in many different ways, depending on the professional field or intention. While many different concepts are used, IK is always a system of specific knowledge of a local community regarding how the community interacts with the natural environment. In this Guideline, 'IK' and 'local knowledge' is used exchangeably.

UNESCO defines that IK as following; *"Indigenous knowledge or local knowledge refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. That was part of the total of the culture, knowledge system including languages, naming and classification, usages of natural resources, production, rituals, spiritual values and viewpoints... The knowledge was the basis for decisions making in multifaceted daily practices such as hunting, plant gathering, fishing, farming and animal husbandry, food production, water conservation, health care and adaptability to social and environmental changes. Moreover, contrary to the formal knowledge, IK was orally passed down from one generation to the next and was rarely recorded".*

Le Trong Cuc et al (1999) [6], *"Local knowledge is accumulated through close interaction with nature, under selective pressure over the biosphere evolution and gradually become a cultural tradition".*

Ngo Duc Thinh regards local knowledge as "folk knowledge" and that it is "human experience accumulated during long period of time to adapt and change the natural and social environment, serving the material and spiritual interests for themselves" (Ngo Duc Thinh: Regional culture and Vietnam cultural partition, H, 1996) [8].

In general, it can be understood that: *IK (or local knowledge) is a system of knowledge that people in a community accumulate and develop based on their experience, proven by practice; and is constantly changing to adapt to the environmental, cultural and social aspects of the community.*

2.1.2. The nature of Indigenous knowledge

- It is based on experience, meaning that IK is formed in the course of life by experiencing and drawing lessons.
- It is constantly being reviewed over centuries: The process is never ending and is affected by different factors of life.

- It adapts to cultural and environmental identifications in a way that is suitable with the natural environment and social communities. It reflects the co-regulation, one of a common feature of the culture (which hypothesizes that communities living in similar natural conditions will share common cultural characteristics).
- It is dynamic and always changing: IK is not a permanent structure; integrations always go on after a self-development process or the acculturation (Mai Thanh Son et al, 2007).

2.1.3. Types of IK

According to Anon, (1999) IIRR [25], IK can be classified into the following types:

Information

Information system of trees which could be intercropped in the same farming area or certain indicators of vegetation. Stories and messages were transmitted by chisel marks, carves or being written on bamboo sheet under folk forms, traditional information exchange system.

Engineering technology

IK includes farming and livestock techniques and seed storage methods, food processing, cures for people and livestock and poultry.

Belief

Belief plays a fundamental role in livelihoods, health care and in environmental management. Sacred forests (ghost forests) were protected for cultural and belief-related reasons. These reasons could sustain large basins full of energy. Religious festivals are good opportunities to supplement food and nutrition for local residents, as their daily rations are limited.

Tools

IK is shown through farming, harvesting tools, cooking tools and the activities related to these tools.

Materials

IK is shown in the traditional building materials, materials for household appliances as well as traditional handicraft.

Experience

Experience was accumulated through farming practices, introduction of new seeds and raw materials for endemic farming system. Many special treatment methods were cumulative through use of local plants.

Biological resources

IK is expressed through the process of selecting breeding and seeds.

Human resources

Experienced "expert" i.e. herbalist, blacksmith can be considered as representatives of IK. IK of this type can be found at the local organizations, such as family lines, groups of wise and old persons and heads of family lines, sharing groups or mutual help group.

Education

Traditional knowledge transfer, training for apprentices, learning through observations and experiments on site.

2.2. The roles and values of IK in community based CCA measures

- The diversification in crop and livestock systems contributes to improvement and maintenance of eco-system services, strengthens the adaptability to CC and reduces the community vulnerability. Indigenous crops and livestocks are more resilient when it comes to extreme weather events, bearing fewer diseases than new varieties. Also, intensive farming and rearing requirements are fewer, which means that they are optimal for community residents, including those defined as poor.
- IK guides people in terms of self-sufficiency and self-determination. It makes them feel self-reliant, less dependent on external factors and they can hence reduce their vulnerability to CC.
- Farmers are likely familiar with indigenous techniques, they can understand, adapt and maintain such techniques better than the newly introduced ones from the outside, and as a result, experience and voice of the community can be promoted properly.

Drought tolerant mung bean - © Bui Tuan Tuan

IK provides more solutions and options to CCA. Local residents have more community-based choices to adapt to CC rather than relying on external factors (i.e. new varieties, modern techniques) (ADC, 2013) [1].

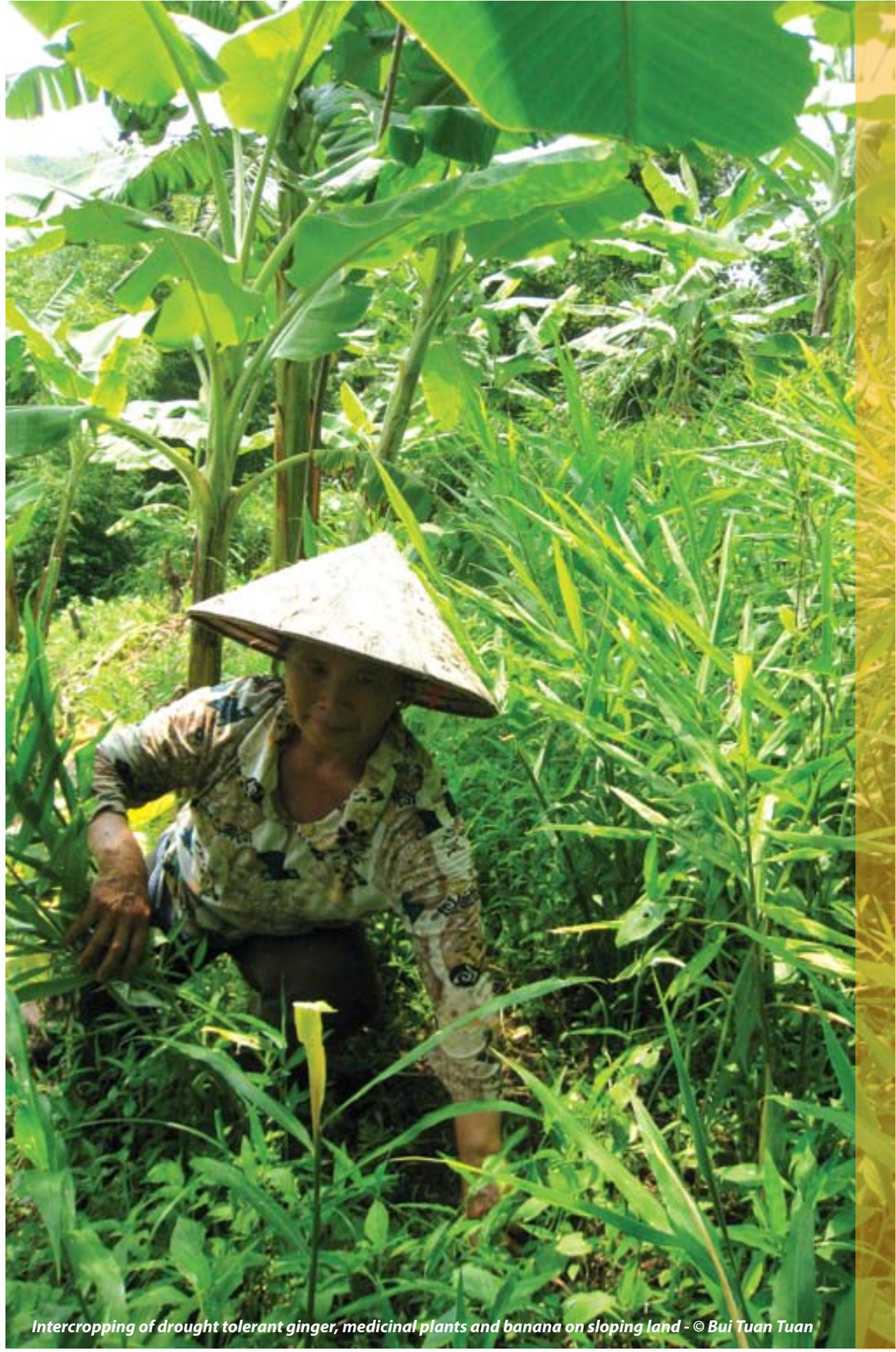
2.3. Indigenous knowledge in agriculture practices to adapt to CC

Climate change adaptation is an emerging phrase in the media and the activities of programs and projects in Vietnam, as well as in the northern mountainous provinces. CCA activities were formed, accumulated and passed on for many generations. Livelihoods of EM are mainly based on agricultural practices and IK therefore plays an important role in the agriculture sector and its development in adapting to CC.

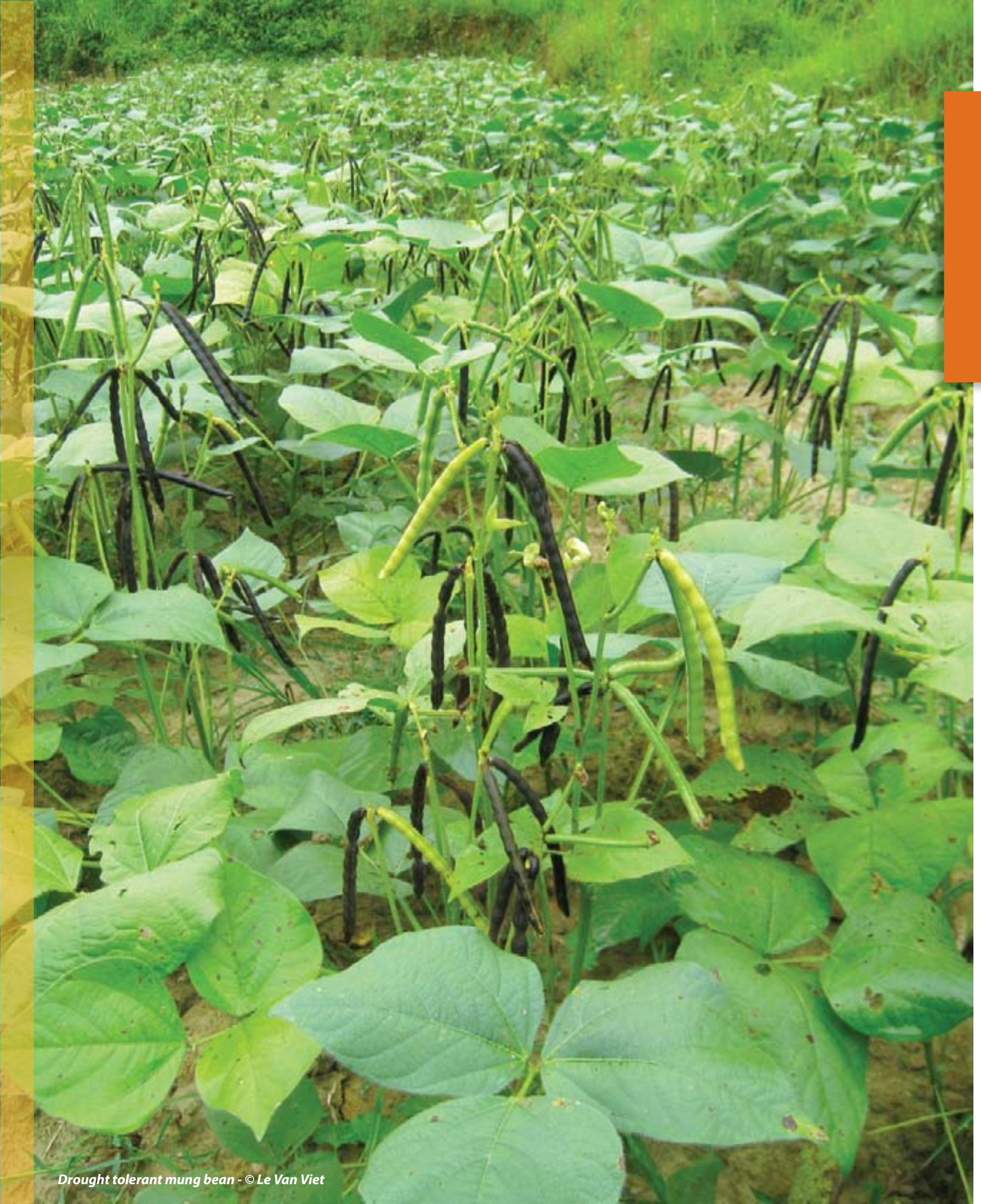
Currently, IK is commonly applied in agricultural practices by applying indigenous plant and livestock varieties. Vu Van Liet et al (2011)[7] indicate that the Thai community in northern mountainous region was making use of indigenous varieties, specifically 7 kinds of food plants, 7 kinds of food crops, 13 kinds of vegetables, 7 kinds of poultry and 9 kinds of cattle. It is appreciated that the northern mountainous communities are managing and utilizing

a group of diverse and valuable crops and livestock in view of their high tolerance to the adverse events. For example: The Tay community in Bac Kan province was employing 20 indigenous crops and livestock varieties. These indigenous varieties are an important part of the production system, as people become increasingly resilient to impacts of extreme weather events.

IK is also applied in many farming techniques to be able to adapt to extreme weather events. As farming is concentrated on steep terrains in mountainous area, many traditional technical measures have been applied to reduce soil erosion due to heavy rains. These are, for example, the creation of terraced fields, arranging rock into contour line, maintaining natural grass along contour line and intercropping to cover the ground. The irrigation and water retention techniques in complex hilly and mountainous terrains have been applied in many EM communities such as wheels, water sweep buckets, water pipes made of bamboo, digging wells in the field to keep water and so on. These have helped in avoiding dryness and drought. Especially, the knowledge on growing according to season and climate and weather forecasting in unfavorable conditions have helped the EM community to mitigate losses due to natural disasters. For example, the Dao said "When you see buffalos running home from forest where they are grazing, it is surely that because the sign of heavy rains that cause big flood. Or that water in a pond turns mossy green means that heavy rains will be coming in the next 2-3 days...". IK makes the EM community's agriculture practices sustainable over many generations.



Intercropping of drought tolerant ginger, medicinal plants and banana on sloping land - © Bui Tuan Tuan



Drought tolerant mung bean - © Le Van Viet

PART 3:
METHODS AND TOOLS USED TO IDENTIFY INDIGENOUS KNOWLEDGE IN COMMUNITY BASED CLIMATE CHANGE ADAPTATION PRACTICES

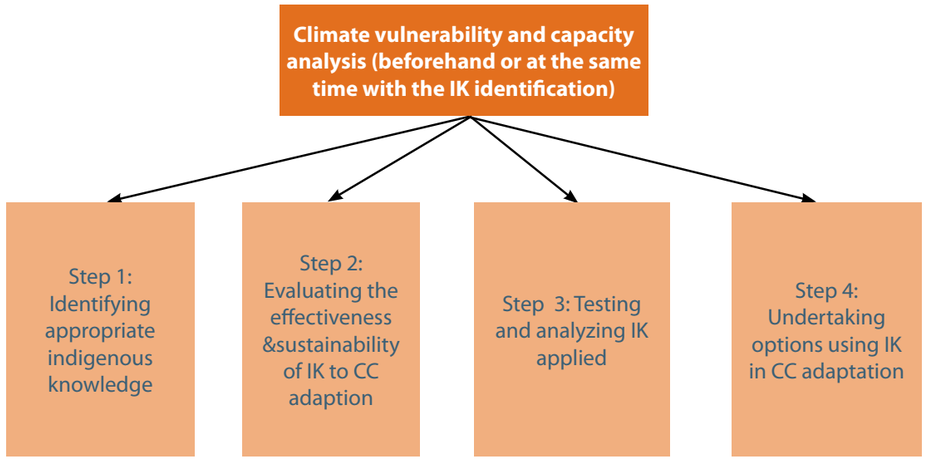
3.1. Tools to collect IK for community based adaptation options

Determination of production options using indigenous knowledge to adapt to CC based on community participation is the process to identify the climate resilient livelihoods focusing on agriculture with indigenous knowledge. This usually goes along with the climate vulnerability and capacity analysis (CVCA). The process can be flexibly implemented in two ways:

(1) Firstly, to conduct the CVCA and secondly, to further study the identification and use of IK in the community based adaptation production options: following this, the study on IK can be extensive and focused, but it does require comprehensive human and financial resources.

(2) Second, it is possible to combine the CVCA to make it in a single step by integrating the form of questions related to IK in the CVCA process. This method saves resources and brings results sooner, but it lengthens the identification process and the discussions are diverse so the method is in need for flexible coordination.

Step 1: Identifying appropriate indigenous knowledge



- Identify information and experiences in the community/area by working directly with the community.
- Note down all the information and experiences relevant to the identified issues.
- Evaluate the collected information in terms of the relevance, applicability, efficiency and so on.

  Example: Indigenous varieties, farming techniques or pest control measures.

Step 2: Evaluating the effectiveness & sustainability of IK to CC adaptation

- IK is not always useful. Especially in terms of its adaptability and viability to CC. In some cases, IK based practices may harm the course of sustainable development. It is thus pivotal to choose the ones that are beneficial for CCA.
- Evaluate IK in CCA by seeking to understand the reasons why people rely on IK to adapt to CC impacts, and how the IK responds to CC impacts. For example, one might ask:
- *How adaptable the local varieties/techniques are in relations to the extreme weather events (drought, prolonged cold spell, etc.) and what are the advantages compared to other common varieties?* Who (men or women) participate in the whole farming/rearing process? Does this participation consume much laboring? Is there any way to assign tasks suitable for either women or men to avoid burdening on either of them?
- If suitable, IK is considered as a CCA approach. The IK is worth implementing in view of the benefits it may bring to the community in CCA and sustainable development.

Step 3: Testing and analyzing IK applied

- Usually, if the IK is assessed as effective; it is still possible for improvement. Improvements will enhance the IK effectiveness, in other words, certain small changes can bring up the efficiency of the whole system.
- The testing can be research, local trials, field research, etc.
- Experiencing to combine the IK in an efficient and flexible way with new scientific and technological knowledge to enhance the value of IK in CCA.

- If the IK is effective, but yet unable/no need to improve, then apply it in a proper way.

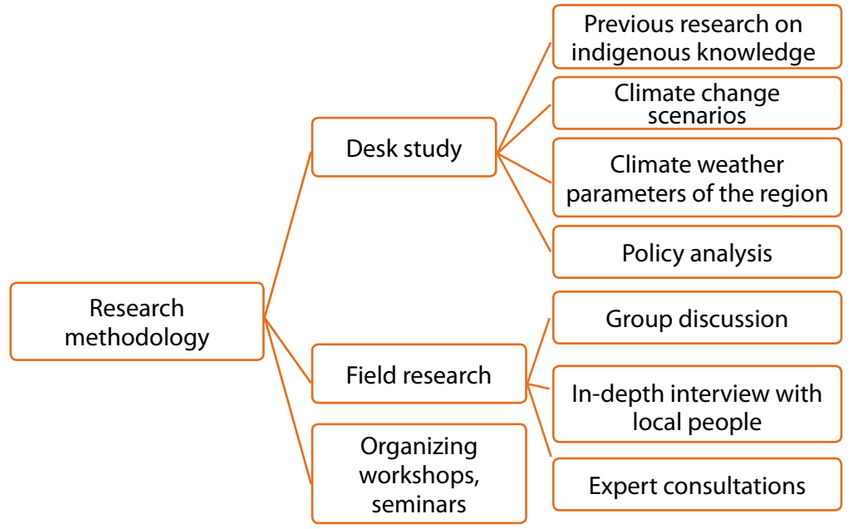
Step 4: Undertaking IK based options to adapt to CC

- After collecting and identifying their value in CC adaptation, IK will be applied in the local practices.
- By adopting IK in CCA practices, local people will find it easier to apply and replicate the options on their own.
- Experience of the community will be promoted, which enhances the community's autonomy in CCA.

3.2. Tools to collect IK for community based adaptation

3.2.1. Methodologies

Figure 3.1: Diagram of research methodologies



3.2.1.1. Secondary data collection

- From previous study reports on IK
- CC scenarios and meteorological data (temperature, precipitation) by year (minimum 30 years).
- Inherit the study results on IK regionally and globally (literature review, IK values)
- Policy analysis of relevant government documents to identify the gaps and directions.

3.2.1.2. Primary data collection

- By using Participatory Rural Apppraisal methods (PRA), which consisted of several techniques such as household survey, group discussion and observation.
- Household survey: Household sampling, combination of survey and in-depth interviews
- Group discussion: Selecting a group representing the community to discuss
- Observation: Combine with transect walk, interviews to verify information.

3.2.2. Tools to collect IK for CCA

3.2.2.1. Topographic cross section survey

Objectives:

- Transect walk is a useful tool to grasp the information on indigenous knowledge and experience about the use land and other natural resources (Figure 3.2).
- Difficulties and solutions performed by the local people.

Guidance for collecting information:

- Discuss with the key informants – who are knowledgeable and are willing to provide information from the local survey (land, topography, distribution of crops/livestock, difficulties and advantages). Both men and women should be involved in the discussions. In case of reluctance or shyness, it is possible to separate the women and men into two groups.
- Identifying map on a route map to survey using transect walk tools.

Information to be collected which is listed/synthesized in the Table 3.1 and 3.2

- The advantages and disadvantages of the local community
- Natural conditions (soil and terrain)
- Distribution of crops/livestock by terrain and soil
- Expressions of CC, natural disasters and locations usually affected by disasters (drought, floods, landslides etc)
- Indigenous varieties of crops/animals?
- Features of the plants and livestock, and their adaptability to the local conditions
- Experience that applies in farming and raising practices
- The bases for arranging crops and livestock?
- Why do people arrange their crops and livestock patterns as they do?

Figure 3.2: Transect walk in Na Hiu and Lang San villages, Na Ri district, Bac Kan province

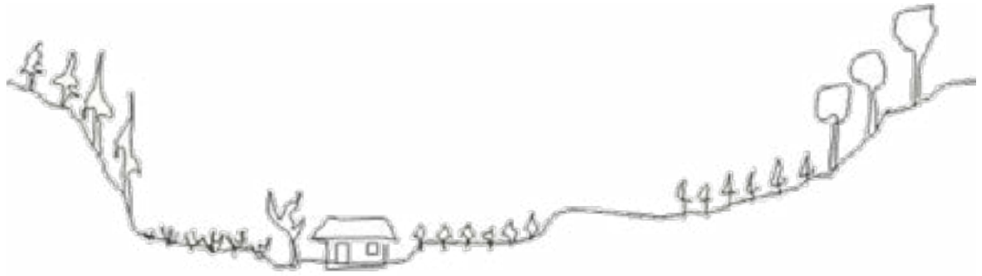
Table 3.1: Distribution of crops by terrain/soil

	Natural forest	Terraced field	Home garden	Tea field	Barren land	Upland field	Planta-tion
Natural condition	Black soil, good condition, mixed with gravel, slightly acidic	Yellow, 25cm thick, bad quality, slightly acidic	25cm thick black, mixed with sand and gravel, bad quality, slightly acidic	Greyly black, 35cm thick, good, acidic, steep gradient	Yellowish, 20cm thick, bad quality, impoverished, acidic, steep gradient	Mixed with sand and gravel, bad quality, acidic, steep gradient	
Crop/ livestock distribu-tion	Main species: Cinnamon, oak, bamboo	Rice, maize, soybean, peanut…	Main fruit trees: peach, plum, persim-mon, litchi, pomelo, banana.	Timber Tea of local variety	Fallowing, grass and shrubs are rampant	Maize, cassava, bean, local varieties	Local Melia, Acacia …
Phenom-enon of climate change, natural hazards		Droughts, heat waves, strong cold spells	Heat waves, strong cold spells	Droughts, heat waves, strong cold spells	Land slide	Drought, strong cold spells	Droughts, heat waves, strong cold spells
Difficulties	Water shortage	Water for watering unafford-able	Small area, good seedlings are lacking	Poor processing tech-niques, consump-tion market is lacking		Good seedlings and fertilizer are lacking. Strong erosion	
Measures to be taken	Intercrop-ping herb-al trees under the canopy	Planting local drought resistant varieties					

Table 3.2: IK by arable soils/terrains

Type of land/ terrains	Types of crops / livestock	Farming techniques	Used in	Origins	CCA characteristics
Natural forest land	Bamboo, , Chukrasia tabularis, Styrax tonkinensis, Cardamom	Mixed planting		Invented by local people	Maintain the moisture for soil, erosion control
Upland field	Ginger, maize, Pachyrrhizus erosus	Intercropping maize with soybean	50 years	Invented by local people	Increasing the ground cover, livelihood di-versification, increasing soil improvement

Figure 3.3: Transect diagram in Na Hiu village, Lang San commune, Na Ri district, Bac Kan province



3.2.2.2. Disasters and crop distribution mapping

Objectives

- Identify the areas and resources that are at risk of natural hazards, and CC (Figure 3.4)
- Specify the crop/livestock distribution by area (the crop/livestock distribution diagram)
- Indentify the indigenous farming techniques
- Get to know the farming techniques for each area/terrain
- Know the way people adapt to CC and natural disasters.

Information collection method

- Drawing diagram of disaster, catastrophes and the distribution of crops and livestock

Figure 3.4: Layout of Dong Vang

Layout of Dong Vang village - © Ha Thi Hoa

Figure 3.5: Drawing layout of Mai Lap commune, Cho Moi district, Bac Kan province

Drawing layout of Mai Lap commune, Cho Moi district, Bac Kan province - © Nguyen Van Dap

Questions for guiding discussion and information collection

- Types of soils, terrains?
- Manifestations of CC (rising temperatures, high rainfall in rainy seasons, and less in the dry season …) and natural disasters (storms, floods, droughts, cold spells and damaging cold…). How is the occurrence trend of natural disasters in the last 30 years?
- What types of natural disasters frequently happens?
- Which area is most affected? What have people been doing to adapt to natural disasters/ CC for a long time? What do men usually do? What do women usually do? Why? Does it need to do differently? If it does, then what should women and men do to better support each other?
- What crops should people plant on each type of terrain?
- Why do you do farming like that?
- How does such farming practices take effects in CCA?
- Where do people learn this arrangement from? (Have people invented this? or who guided them?).
- Effects of the plant/animal in the option?
- What types of crops can be intercropped? Why?
- What types of crops cannot be intercropped? Why?

Fill the information in Table 3.2 above

3.2.2.3. Seasonal and natural disaster calendar

Objectives

- Collecting information on indigenous varieties of crops/livestock
- Adaptation features of the crops/livestock to CC
- Arrangement of seasonal crops
- Basis for Arrangement of seasonal crops
- Weather forecasting experience, basis for prediction/forecasting
- Measures to adapt to natural disasters/diseases
- Comparing the experience of arrangement of seasonal crops with the seasonal farming calendar introduced by the state agency for similarities and differences

Guide to collect information

- List the varieties of crops and livestock in the locality?
- Planting calendar of varieties in the locality? (draw a diagram of seasonal calendar)
- How long have such varieties been adopted in the area? The origins of the varieties?
- Among the said varieties, what types are the indigenous ones? Local names?
- Characteristics, values of the varieties in adapting to CC?
- Experience in arranging seasonal calendar, what is the basis for doing so? Has the recent season shifted and if it has, what has the shifting been like?

- What are the extreme weather events in the area?
- When do the extreme weather events happen (starting time and ending time)?
- How do the local people forecast the natural hazards/weathers? Do men experience things differently from women? If both of them come up with some predictions, whose predictions are seriously considered? From the actual results, which ones are right and is there any change in viewpoint in the subsequent seasons?
- What is the basis for making weather prediction/forecasting? Is the experience in weather predictions/forecasting still relevant today?
- What are the solutions undertaken by people to prevent and protect themselves from natural disasters, adapting to CC? Women or men, who are proposing or making the decisions? Are the measures taken differently by men versus women?
- Basis for selecting crop seasons and arranging crops/livestock structures?
- At what time in a year did diseases in crops and animals in the area occurre?
- How do people control the diseases? Do they use pesticides? who makes these decisions - men or women? Does the decision-making increase or decrease the credibility of the decision maker?
- Do people grow insecticide trees?

Fill the information in Table 3.3, Table 3.4 and Table 3.5

Figure 3.6: Seasonal calendar of Dong Vang village

Month / Crops/ Livestock	1	2	3	4	5	6	7	8	9	10	11	12
Rice		Pests					Dis-eases					
Corn		Natu-ral disas-ters										
Cassava												
Sweet potato												
Bean												

Tháng / Cây trồng	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
Tea		Pests										
Livestock												
Pig		Dis-eases									Dis-eases	
Chicken		Dis-eases									Dis-eases	
Duck		Dis-eases									Dis-eases	
Buffalo												
Fish												
Weather												
Drought												
Ice rain												
Flood												

Figure 3.7: Seasonal crop calendar of Nam Dan commune

Month	1	2	3	4	5	6	7	8	9	10	11	12
Upland field	Corn mixed with pumpkin: Corn mixed with canna Soybean Villages located near windy pass planting one month sooner Winter corn Groundnut Cassava planted in March, mixed with taro Cana planted in March, harvested end of the year, can be used for livestock and sell Grass for livestock											
Field	Corn mixed with soybean... Rice Winter corn											
Garden	Banana, pepper, plum, pea, peach all year round. Cana with large area (400m^2) Vegetables Pumpkin mixed with melon, green bean, loofah … Local vegetables, onion and other types of vegetables Taro, ginger											
Natural disas-ters due to CC	Cold spell Drought Heavy rain + flood + erosion Mist Heat Red ant on groundnut Caterpillar, sting bug, grey caterpillar anobium borer Soybean/groundnut Corn Corn anobium borer, sting bug, anobium borer Rice blash											
Recom menda tions	Upland field: Taro mixed with corn, corn mixed with soyabean, pumpkin Banana mixed with corn, soyabean Field: Water is not easy: Pumpin mixed with corn.											

Table 3.3: Information on the plant and livestock varieties, characteristics of adaptation to CC

Name of plants/ livestock varieties	Local name	Origins	Since when the varieties were in used in the locality (years)	Productiv-ity/Income	Characteristics of adaptation to CC
Soybean varieties	Thúa nà	Indigenous	Over 60 years	Equivalent to new DT84 varieties	Good drought tolerant, thick shell, not likely cracking in the field
……..	……..	…….	……	……..	……

Table 3.4: Types of diseases and control measures

Type of disease	Appearance time *(considering the timing, crop season, changes compared to before..)*	Control measures	Characteristics of measures
Helopetis theivora	Around July-August at the reproductive stage	Soaked cloths with urine and plugged in the rice field when the bugs climb in the cloths, cover and burn	No need pesticides, reduction of emissions causing environmental pollution and CC
Grey worm damaging maize	At the vegetative stage	Intercropping with cabbage/vegetables to feed the worm to reduce the damages on maize	No need pesticides, reduction of emissions causing CC Less laboring requirements
	…….	……...	……

Table 3.5: Weather forecast experience and seasonal crop arrangement

Type	Experience	Characteristics of adaptation to CC
Flood forecasting	Bamboo shoot rooting robustly with white color is the sign of numerous floods. Crabs in a spring climb up to the banks are the sign of an upcoming big flood.	Avoid the impacts of extreme weather phenomenon, reducing the vulnerability of the community. *Example: No farming in the fields where are close to spring since there is a threatening risk of season lost due to flood*
Seasonal crop arrangement	When Melia flowers blooming, sowing mung bean.	Avoid cold and drought at the beginning of season (Melia as the temperature and humidity indicator plant)
	...	...

3.2.2.4. Individual interview and group discussion aggregated by male and female groups

Objectives

- Collect information on indigenous crops/livestock (indigenous varieties, local names, characteristics of adaptation to CC)
- Farming and caring techniques, their adaptabilities to CC impacts.
- Tending and pests control for crops/livestock
- Crops distribution on different types of soils
- Experience in weather forecasting and disaster risk preparedness.

Figure 3.8: Group discussion in Ta Tiu village, Van Chan district, Yen Bai province

Methods/contents of interviewing

General information about the interviewees: Table 3.6: Information about the interviewees; Table 3.7: Information of in-dept interviews.

Table 3.6: General information of the interviewee

Full name of interviewee: .....

Group: .....

Sex: .....

Ethnic group: .....

Full name of interviewer: .....

Table 3.7: Contents of interview

Information to be collected	Questions to gather information	Recording/synthesizing information
Indigenous plant varieties	What kind of plants are planted at your houses and in the area? How long have these plants been planted in the area? What kinds of seeds/seedlings are you planting? Where do the seeds/seedlings come from? (indigenous varieties or newly adopted ones). What are the features of the locally grown plant varieties compared to other places? What are the local names of such varieties?	Filling full information regarding varieties: types of crops, scientific name, local names, origins, applying time in the local area; Varieties' traits, growth duration; adaptability to CC. *Example: dull seeded green mung bean variety, good drought tolerance, short growth period, less suffered from pests and diseases, easy to care, no need intensive farming, improving soil. Seeds are small and aromatic, market favorite products.*
Selecting and processing seeds	How do local people choose varieties? What traditional methods are used to preserve and treat the seeds? Does the seed selection and preservation have any difficulty? Who guides you in how to select, preserve and treat the seeds like that? Since when do have such methods of seed preservation and treatment been used?	Specify how to preserve and treat the seeds; materials used by local people to preserve the seeds and the effectiveness of the preservation; Starting time of adopting this method in the local. *Example: Using Melia leaves and lime to preserve maize seeds from rotten. The lime and Melia leaves can limit the rotten process.* *The species have been adopted for more than 70 years.*
Planting and tending techniques	Where are the seeds/seedlings planted? How do the people select soil? (what characteristics is it based on). How to grow such types of plant? How do people take care of the trees? Is fertilizer used? What kind of fertilizer is popular? What is the proportion? The tending is conducted in what time of the year? Which are the specific elements used to determine the time that the plants need caring? Are these plants intercropped with others? Which plants can be intercropped together and which cannot? Why? How do people arrange seasonal crops? Is it similar to the agricultural calendar introduced by the government? Why? Has any indicator plant been observed to arrange seasonal crops?	Note down Traditional soil selection methods; indicators for selecting soil and planting time, tending; since when the method had been applied; how to combine the crops in the same area. Specific method for one specific crop How the IK based measures resilient to CC?
Pests control	Difficulties in pest control? What kinds of popular pests? How did people control them? Was there application of chemical substances? Did people apply any special methods to control pests? What materials were used to control pests? Were pesticide trees planted? What species (local names)	Note down Pests: Traditional pests control methods; Materials used; natural enemy species (local names if applicable); Time/origin of the method. *Example: Intercropping with cabbage/ vegetables to feed the worm to reduce the damages on maize.*

Review on plants/ livestock and utilization	How did people evaluate the varieties? People use such species for what purposes? Which parts of the bodies were used? What species were used as medicines for humans and animals? Where does the knowledge about the trees come from? What criteria are applied by local people to evaluate and select the varieties in the farming systems?	Note down Values of the trees Medicinal plants, if any Criteria for selection of trees
Weather forecasts and natural hazards prevention	How do extreme weather events occur in the area? Based on what experience do the local people make predictions of weather as well as extreme weather events? Since when is the prediction/ forecasting adopted? Does it remain relevant? Why? What do people do to control extreme weather events? What do people do to recover the damages/losses after extreme weather events	Note down Bases for making forecasting/ prediction of extreme weather events (indicator plants/animals) Preciseness of the method Traditional ways of people to adapt to extreme weather events.

3.2.2.5. Tabulating analysis/synthesizing of information regarding community based CCA options in use of indigenous knowledge

Target

- Analyze, generalize and propose climate resilient livelihoods options applying indigenous knowledge.
- Identify the target groups who have the necessary skills to deploy livelihood options
- Name the difficulties and advantages in the deployment of livelihood options

Table 3.8: Analysis/synthesis of the proposals on on community based climate change adaptation options with indigenous knowledge

Proposed options:	Features (examples)
Forestry plants (if any) Indigenous varieties Other varieties	Adapting to drought, cold, water conservation
Agricultural crops Indigenous varieties Other varieties	The sources of the varieties are locally available, adapting to drought/cold/heating
Tree arrangement	Intercropping/overlapping
Techniques Indigenous Modern	Time of sowing based on local experience to avoid unfavorable weather conditions for plants
Deployment seasons	Spring crop, Summer-autumn crop, winter crop
Area	Upland area >600m (prone to cold weather), area between 400-600m high (prone to drought), low-lying area (prone to frost)…
Economic effectiveness	Higher incomes with stable markets
Institutional and policy appropriateness	Consistent with the local livelihood development support policy
Cultural and social appropriateness	Consistent with the local people' customs, increasing the solidarity and mutual assistance
Adapting to CC	Adapting to the increasing temperature, season changes,
Environmental effectiveness	Reducing soil degradation

Intercropping of drought tolerant ginger, pachyrrhizus and banana on sloping land - © Bui Tuan Tuan

PART 4:
GOOD PRACTICES ON PROMOTING THE USE OF INDIGENOUS KNOWLEDGE FOR IMPROVED CLIMATE RESILIENCE OF LIVELIHOODS

4.1. Agriculture production practices applying IK in the northern mountainous area

4.1.1. Intercropping of drought tolerant ginger, medicinal plants and banana

Figure 4.1: Ginger, medicinal plants intercropped with banana in Mai Lap commune, Cho Moi district, Bac Kan province - © Bui Tuan Tuan

4.1.1.1. Status quo before intervention

It was monoculture maize farming on hills, eroded soil, degraded soil, soil washout, and water depletion. Maize farms have low yield or loss due to drought, average yield gain of 250-300 kg /ha. In 2010, 80% of hill maize area loosed 40% productivity due to droughts.

4.1.1.2. Selection criteria

The options to be selected should represent the adaptation and mutual support between the crop systems, farming techniques in different terrains under the typical agriculture production system of the area to adapt to CC impacts. The options should be the farming systems adapting to adverse weather phenomena

such as droughts and local erratic weather. Specific categorization is tabulated below (the categorizing is referred to the criteria on Climate resilient livelihoods developed by CARE International in Vietnam [14]).

Table 4.1: Selection criteria for ginger, herbal plant mixed with banana option

Criteria	Features
Economic aspect	- Products consumed locally. - Low investment (spending for tending, harvesting, ect) - Diversifying people' livelihoods in addition to livestock, growing rice, cassava, maize, forests. - Employing local plant varieties which people are familiar with in terms of techniques and knowledge, so they can ask each other about how to grow and tend for the trees. Thus, investments for seeds, science and technology and techniques are low
Institutional aspect	- Considered as poverty reduction plants/options. - Consistent with the current policies of the central and local governments, helps to develop goods oriented agro-forestry products. - Local authorities solicit funds from the governmental programs to support people buying seeds and expand the farming area.
Cultural-social aspect	- Locally available varieties are employed. - Adapt indigenous techniques - Banana trunks are crosscut before planting, easy to handle, limit water loss. - Appropriate with all target groups, including the illiterate. - Does not require much time. - Building capacity for the participants, especially women and vulnerable groups. - Men and women alike understand and know how to deploy the option
Climate change	- Diversifying livelihoods, increase the adaptability to CC for the community, reducing risks in production. - Adapt to the increasing drought in terms of time and intensity.
Environment	- Crops are diversified, vegetation cover is intensified that help increase water holding capacity, and limit soil erosion. - Increasing the coverage, and CO2 absorption

4.1.1.3. Project's interventions

- Converts the crop species grown in the area to ginger, medicinal plants mixed with drought tolerant banana with indigenous farming techniques, all come from the local supply. (cutting cross banana trunks before planting, easy to transport and reduces water loss)
- Project's role: support a survey to assess the impacts of CC to agro forestry production in the area; the needs of people, designs the option structure, provides technical training and raises awareness to the community on CC, provides seedlings at the initial stage and monitors the farming techniques, organizes study tours and meetings/workshops.
- Roles of local government and mass organizations: Advocates and mobilizes people/ union members to participate in the project, along with the project to select the option participants, organizes community supervision.
- Roles of participants (farmers): complies with the agreements, commitments and the deployment plan and acts as co financier to the option implementation
- Co-financing principle is applied for the implementation of the option:
  - Local people: contribute labor, fertilizers, part of costs of seedlings,..
  - Project: Provides training, part of costs of seedlings, monitoring and technical assistance, and facilitate market connections..
- Combining indigenous knowledge and modern technical measures in cultivation:
- Applying IK in production:
  - Before planting banana trees, crosscutting the banana trunks to limit evaporation to increase the adaptability to drought and reduce the transportation costs. Plant cutting method is used.
  - Planting trees along contour lines
  - Mixing with other crops
- Applying new science and technology
  - Improvement of soil quality by applying micro-organic fertilizers produced by the local people themselves.
  - Planting trees along contour lines.
  - Preparing contour lines.

4.1.1.4. Evaluation of the effectiveness

- Economic aspect:
  - The products are consumed locally, at the time when banana price peaks in the market, the fruit becomes so sought after that the traders come to the garden to cut the banana themselves.
  - Economic efficiency of the option is shown in Table 4.2

Table 4.2: Economic efficiency of the option

Input material costs/1,000m²			
Items	**Quantity**	**Unit price**	**Total (VND)**
Banana seedlings (tree)	200	7.000	1,400,000
Ginger seedling (kg)	100	15.000	1,500,000
NPK fertilizer (Kg)	100	5.000	500,000
Total			**3,400,000**
Revenue			
Banana seedlings (tree)	200	7,000	1,400,000
Banana fruit (kg)	360	6,000	2,160,000
Ginger (kg)	500	8,000	4,000,000
Total			**7,560,000**
Profit			**4,160,000**

(Source: ADC, 2014)

- Participants have very good chances to apply the knowledge they gained through training and lessons learnt from the option itself/group meetings to make up their own production. Thanks to that the investments for seedlings, techniques and technologies can be significantly reduced.

- Institutional aspect:
  - Development of the option is appropriate with the local socio-economic development strategy towards agricultural commodities.
  - The local authorities use budget from the government's development programs to support the people to scale up the option.
  - The households support seedlings for each other, and lend the land area to expand the option in an area where it is convenient for learning and sharing. Altogether they build a path to access the option implementation area.
- Cultural-social aspect:
  - Local people participate in the deployment of the option (men, women, poor households, etc), local authorities and professional agencies, whereby enhancing the communication process between the local authorities and people.
  - Strengthening technical capacity for local residents and local staff in agricultural production through training courses to help them take initiatives in production.
  - There is synchronization between IK and technical science, thereby facilitating the replication and sustainability. For example, crosscutting the banana trunks before planting, and calculating the time for the tree to shoot and to develop fruits around April - May (when there is surge in banana prices).
  - High income from the option helps poor households escape poverty, and improve the living conditions, i.e. children can have their breakfast before going to school, higher spending for daily consumption, mobile phones for women.
  - Enhancing the roles of women in the livelihood related decision-making, they can make decision on how to use the incomes from the option. Maybe for expanding the planting area in the next year.
- Climate change aspect:
  - Through the option, the target groups are involved in the CC impacts assessment regarding the impacts on agricultural production in the area, they propose new CCA options, and participate in many training sessions on CC. They recognized the increasing CC occurrences and adverse impacts of CC on agricultural production, which need to have integrated solutions from local people and governments. The participation of the community in analyzing and identifying adaptation measures is an important precondition for a sustainable and successful adaption.
  - The target groups come to know that diversification of crops is among the measures to mitigate risks on agricultural production due to CC impacts.
  - Intercropping between banana and ginger/medicinal plants helps better adapt to the increasing drought condition in Bac Kan province in the CC context. By discussing with the people, it is speculated that the increasing trend of temperature does not affect the option since the trees grow stronger and the fruits rip quickly under scorching sun and high temperature.
  - Shorter and warmer winter make it more favorable for banana trees to grow, reducing the development of fruits, and the fruits look better.
  - Banana trees are less affected by unseasonable rains or changes in seasonal precipitation.
  - However, the occurrence of prolonged strong cold spells likely affect the trees, it may cause the leaves to wilt and turn yellow. Nonetheless, during the trial, there was almost no damage during the strong cold spell that hit this area.
  - Shifting the crop pattern to adapt to the changes of climate is essential to the local socio-economic development.
- Environmental aspect:
  - Compared to the monoculture maize farming, the option grows trees all year round without vacant period, with 7-10 year business cycle (can be as many as 15 years with good care) which helps increase the coverage, reduce runoff erosion and maintain moisture for the soil and improve the underground water sources for production.
  - Combining multiple trees in the same area helps limit weeds, thereby reducing the need for pesticides.
  - Agricultural and livestock residues and the wastes from the option are made use to make compost and provide humus for the option, restrain the burning of byproducts causing smoke and dust...

4.1.1.5. Advantages and difficulties of the option deployment

- Advantages:
  - The local ginger variety has good quality. The market demand for the products is high, thus it is easy to sell in the local market.

- Banana fruit market has potential as well, with many local buyers
- Local people are very familiar to and experienced in planting (they have already grown the plants on a small scale) as well as in preservation and storage.
- The policies at provincial, district and communal levels always encourage people to shift their plant structure, increasing the efficiency of land use, avoid fallowing land, greening the barren land and hills.

- Difficulties
  - Transporting seedlings, fertilizers and products is one of the most difficult activities due to the steep terrain.
  - Accessing the sources of funds is needed in order to replicate the option. However, the accessing is limited. Therefore, incentives should be in place to use and mobilize funds from relevant development projects and programs (some of them are Program 135, program 30A, provincial socio-economic development program).
  - Target buyers of the banana products are traders but they can be hard to predict. The future stability is not guaranteed due to a lack of a clear perspective on market needs.

4.1.2. Drought tolerant green been option

4.1.2.1. Status quo before intervention

The land consisted of spring rice cropping areas with low productivity or seasonal failures due to droughts. For years, tens of hectares of land suffered from drought. In 2010, more than 17 ha of rice growing area failed. The average income after deduction of costs was about 12-15 million VND /ha.

The soil is degraded and exhausted due to droughts and the overdose of chemical fertilizers and pesticides.

Livelihood burdens were thus placed more on women.

4.1.2.2. Selection criteria

The option shows the adaptation and mutual support among the plant system, farming techniques in different terrains of the typical agriculture system in the CCA areas. The identified option is the farming system adapted to adverse weather events i.e. drought and the diversity of local weather.

Dull seeded green mung bean variety with small sized seed (local variety) is employed in the option. Mung been is planted in late March and it has a short growing duration of around 70-75 days before the time of harvesting. This means that the land is freed in time for the next seasonal crops. Mung beans need a small amount of water in the growing and developing process, and it is thus suitable with the areas prone to drought or water scarcity during spring rice cropping season. The residues (roots, stems and leaves) are the good organic nitrogen rich fertilizer, which is likely to help reduce the amount of chemical fertilizer for rice crops.

Specific categorization is tabulated below (the categorizing is referred to the criteria on climate resilient livelihoods developed by CARE International in Vietnam [14])

Figure 4.2: The drought tolerant green bean growing in Thanh Van commune, Cho Moi district, Bac Kan province

Drought tolerant mung bean - © Luu Van Thanh

Table 4.3: Criteria to select drought tolerant green bean option

Criteria	Features
Economic aspect	- Low investment costs, suitable with poor and average households. - Products consumed locally. - Diversifying peoples livelihoods to increase income in the context of climate change. - Employing local plant varieties that people are familiar with in terms of techniques and knowledge, so that they can ask each other how to grow and tend for the trees. Thus, investments for seeds, science and technology and training are low.
Institutional aspect	Local governments encourage people to shift the plant pattern on the agriculture land area where is prone to drought in spring crop. - If people plan to to develop green been trees they can multiply seeds themselves. - Target groups are willing to share their experiences.

Cultural-social aspects	Use of local varieties. - Planting season is based on local experiences (when Melia flowers bloom), limiting the adverse effects of weather on the tree growth. - Soil preparation, tending the crops and preparing seeds for the next crops are made based on IK of the participants. - Appropriate with different target groups. - Not care-demanding and are therefore not creating additional work for people, especially women. - Both men and women understand and know how to deploy the option. - People may help each other in seedling and techniques.
Climate change	- Resilience to drought. - Short growth period, freeing up soil for seasonal rice crop.
Environment aspects	- Suitable with different types of soil, and possible to improve soil. - Help to reduce farming/livestock residues. - Reduction of chemical fertilizers and pesticides. - Improve the soil and increase the moisture, humus contents.

4.1.2.3. Project's interventions

- Growing green bean based on monoculture or mixed with drought tolerant maize, on fallow or single rice cropping land areas. Local variety of dull seeded green mung bean is employed.
- Combination of IK and new techniques.
  - The farmers are following the current technical procedures with some alterations to accommodate regional specific IK:
  - The variety is dull seeded green mung bean. The crop is pest resistant and can adapt to external adverse conditions.
  - The cropping season has been postponed to late March when the soil is moist and the weather is getting warmer. This is done in order to avoid multiple resowing and crops developing vigorously.
  - In the growing period, at the signs of bug (Aphididae homoptera), straw ash is applied to deplete them, which is saving costs for buying pesticides while maintaining the product safety.
  - Mung bean seeds are preserved and stored by straw ash or dried Melia leaves. For preparing seeds for next crops in perspective of high germination rate, mung bean is mixed with straw ash and kept in clay pots.

4.1.2.4. Evaluation of the option's efficiency

- Economic aspect:
  - High market demand, especially good sales during local holidays, the prices are negociable but at average prices in the commune.
  - Buyers trust the product quality and the fact that the bean is free from preservatives and pesticides.
  - At the present, consumption of the products is smooth, most of the buyers are communers.
  - Economic efficiency of the option is expressed in table 4.4.

Table 4.4: Economic efficiency of drought tolerant mung bean option

Costs for input materials/1000m²			
Items	**Quantity**	**Unit price**	**Total (VND)**
Seed	2.5	55,000	137,500
Nitrogenous fertilizer (N)	10	12,000	120,000
Phosphate fertilizer (P)	45	5,000	225,000
Potash fertilizer (K)	9	14,000	126,000
Total			**608.500**
Revenue (VND)			
Mung bean	120	45,000-50,000	**5,400,000**
Total			**5,400,000**
Profit			**4,791,500**

(Source: ADC – Thai Nguyen University of Agriculture and Forestry, 2014)

- Skill and technology aspects
  - The people are experienced in growing mung bean and maize, used to grow mung bean in field and flat for agricultural crops only, making use of the advanced knowledge and techniques to access and gain economic values.
  - Previously people grew mung bean on upland fields or on agriculturalal crop growing fields, while they dared not to grow on rice crop soils in fear of influencing the seasonal rice crop and making the trees unable to bear fruits. To day, as a result of the option, it is more likely that mung beans can be grown in rice crop land areas while shifting the spring rice growing land area to growing mung beans, which are more profitable.
- Institutional aspect:
  - People lend land to each other to implement the option.
  - Local authorities encourage the shifting of rice growing land area, which was usually suffered from drought to grow other crops, including mung bean. This practice is integrated in the annual socio-economic development plans and they thus allocate the financial funds from relevant poverty reduction programs to support replication of the option.
  - Total mung bean growing land area in the commune is about 26 ha

Intercropping of drought tolerant ginger, medicinal plants and banana on sloping land - © Bui Tuan Tuan

- Cultural-social aspect:
  - Helps to promote the indigenous values (seeds, farming techniques) in the process of the option deployment, the effect of the option shows that IK is valuable in facilitating the community to joint with the local authorities to find solutions in adapting to CC.
  - The target groups (men, women, even illiterate) can learn and replicate the option in their own land area without problems.
  - Men and women work together to solve the obstacles and challenges due to CC impacts (i.e. in the process to evaluate the CC impacts on community, deployment of the option adapting to CC with the participation of men and women).
  - The option employs knowledge and skills of local people combined with new technical measures. These are easily comprehended by the target groups. There are as many as 284 households participating in the option.
  - The option does not require much time and does not create more work for family members, especially for women (there is no need to spend much time to work on the option and all family members can jointly work with the option: weeding, fertilizing two times, picking leaves from time to time).
  - In the communes where industries and services have not yet developed, agricultural development towards diversification of products and improvement the agricultural product quality are imperative to the farmers in creating jobs and are therefore bringing more income for subsistence farmers..
- Climate change adaptation aspect:
  - Mung bean, like all legumes, has high adaptability across a lot of different types of soil. All single rice cropping land areas can grow mung bean.
  - Mung bean is a short period crop (growing period is around 70-75 days), in the sowing period only a small amount of water is needed to keep the seedlings moisture. Generally the crop does not require as much resources as other crops do, such as rice and maize. The mung bean is therefore considered a drought tolerant plant. The crop can be harvested in a short period of time, yet it is not affected by late rain as in the case of soybean, it allows freeing the land area to prepare for transplanting rice. In addition to soil improvement due to the root is able to fix nitrogen in soil, the stems and leaves can be dumped on the spot to make good quality organic fertilizer for the rice.
- Environmental aspect:
  - The results of the option show that: Rice grows better in the fields where mung bean used to grow than in the field without mung bean growing. Since the mung bean contributes stems and leaves to make fertilizer, growing mung bean in the same field means that the field is preparing for another time of growing. Weeding and fertilizing, which increase the fertility of the soil, also increase the coverage to limit soil washout. This means that the soil is more moist and fertilized.
  - People use manure/organic compost (made of farming and livestock residues) to improve the soil quality before growing. Another round of fertilizing will be subsequently applied in accordance with the technical guidance, thereby the plants can use the maximum amount of fertilizers in the soil and the coverage helps keeping the fertilizers inside the soil and from running away due to rain.

4.1.2.5. Advantages and difficulties in performing the option

- Advantages:
  - All types of rice cropland and fallow land can grow mung bean.
  - Mung bean of local varieties has a good quality (aromatic, tasty and savory), The mung bean is favored by the market. In the project area, mung bean is very popular in the families to prepare food during traditional holidays.
  - Local people are very familiar and experienced in planting (they already grow the plant in a small scale) as well as in seed preservation and storage.
  - The policies at provincial, district and communal levels always encourage people to shift their plant structure, increasing the efficiency of land use, reducing the fallow land area in spring season due to water scarcity and diversifying crops to mitigate the negative weather impacts on the productivity.
  - The people wish to develop some options adapting to drought on rice cropland area to have additional income.
- Difficulties:
  - How to manage the cattle grazing status quo is one of the largest difficulties. After harvesting rice, cattle are grazed freely. If the mung bean growing option in spring season is deployed, the village should develop its regulations for cattle protection and management.
  - Local residents have not yet considered agricultural development as household economic development solution in rural and mountainous areas. Some of the participants are not really enthusiastic; they attend in hope of getting support from the project and the local government.
  - Many households wish to replicate the option themselves and thus enhancing their access to sources of funds is needed. However, the current access to fund source is limited. Therefore, incentives should be in place to use and mobilize funds from relevant development projects and programs (some of them are Program 135, program 30A, provincial socio-economic development program).

Intercopping of taro, pachyrrhizus and maize to adapt to drought condition in slopping land - © Bui Tuan Tuan

PART 5
CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

IK is an important national resource for development process and it can provide less expensive solutions and encourages people's participation. IK has a high sustainability as well. Such development projects/programs can strongly engage people to participate since they are suitable, understood by people so that they know what and how they should implement certain activities. Therefore, IK is the basis of success. Another important feature of IK is that it always adapts to the changes in the environment. The local communities are aware of localizing the imported practices proved to be appropriate and beneficial to them. This should be taken into consideration when designing community-based policies and projects, more specifically, there should be a harmony between the IK of the communities and scientific knowledge.

With the mountainous terrain and limited access to information and applied science and technology. IK is considered as a pivotal factor by the mountainous ethnic minority people especially those in the northern mountainous area. IK is found everywhere in their daily life, economic activities, weather and natural disaster forecasting, seasonal calendar, etc. The IK is one of the most important factors deciding the existence and development of communities.

Therefore, measures should be in place to maintain and promote IK, especially that it is valuable in sustainable development of the communities, i.e. experience in production, weather and natural disaster forecasts, indigenous crop and livestock varieties or the values with scientific meanings, genetic conservation of the indigenous crops and livestock, etc.

5.2. Recommendations

Central level

1. Currently there are a number of policies on CCA refer to community-based adaptation. But these are general, and therefore not able to encorage and support the local application. Therefore, in the national programs and policies, there should be specific viewpoints and guidance to support the initiatives.
2. The policies should encourage the use of indigenous varieties and techniques along with the advanced science and technology to generate sustainable development and conservation of genetic resources and knowledge to use for modern scientific studies.

3. There are no clear financial mechanisms in place to support the development of IK based livelihoods adapaed to CC. Therefore, the national policies need to allocate financial resources to support such initiatives. One of the possible solutions is incorperating IK ideas and initiatives in the national socio-economic development programs. Other development and poverty reduction policies should also be integrated to support the deployment, replication such as options on combining new science and technology and IK. It is required to have policies/research programs in place to learn about the conservation and use of IK in the community and regard it as the adaptation measures of EM..

Local authorities

1. Need to raise awareness about CC and community based adaptation using IK, firstly to the related staff.
2. Integrating ideas and initiatives using local knowledge in the socio-economic development program of the locality. Other development and poverty reduction policies in the area should also be coordinated to support the deployment and replication of the livelihood options adapting to CC using IK and scientific knowledge.
3. Need to invest in systematic and scientific studies on IK, adaptation and mitigation of CC in the local context. Encourage the selection and use of indigenous varieties and seedlings that produce high yielding and high market demand, suitable with the land conditions, farming techniques of local people and adapting to CC.
4. Encorage the use of local varieties and techniques along with advanced science and technology to generate sustainable development and conservation of genetic resources, knowledge to serve for modern scientific studies to demonstrate the roles and importance of IK to the community.
5. Have incentives and mechanisms in place to suport the production development adapting to CC using IK (especially credits from Social Policy Bank or poverty reduction program)
6. Document invest in development and support the replication of feasible initiatives on CCA and mitigation for the local people.

Communities

1. It is needed to maintain and promote IK in the communities, especially the one with important roles in economic development while adapting to CC, i.e.e seedlings of indigenous origins, traditional farming methods or experience in forecasting weather and crop seasons, etc.
2. Encourage the establishment of groups and teams to mutually support in production activities adapted CC using IK and effectively use of credit in community based CCA activities.

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