“When the toad speaks its going to rain”

Livelihoods and Climate Change in lakeside communities of Ba Be National Park, Vietnam

Robert Nurick
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To the memory of Stephen Schneider
11 February 1945 – 19 July 2010
who provided the inspiration for this work

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TABLE OF CONTENTS

SUMMARY

Background

This report documents the findings of two weeks of community engagement in villages in Ba Be National Park in Vietnam, in February 2010. The focus of the engagement was environmental change and the impacts these changes were having on the ability of local people within the National Park to sustain their livelihoods. Current and future adaptation strategies were also the subject of the engagement process. Villagers shared their perceptions about changing weather patterns and discussed the linkages between climate change, livelihoods and adaptation strategies. Emerging from this discussion was the identification of local indicators for forecasting the weather.

Effective adaptation to climate change is fast becoming an urgent issue that needs to be addressed, particularly in developing countries. Households and communities in rural areas of developing countries, especially the poor, are most vulnerable to the impacts of droughts, erratic and unpredictable rainfall patterns, floods and other extreme weather events. They are the least able to adapt to these environmental shocks and hazards. Whilst farmers have specialised knowledge and a wealth of experience in managing their local environment, increasing unpredictability of seasons and rainfall is creating great challenges for them.

In development projects more generally, top-down approaches have proved to be inadequate, failing to produce appropriate solutions for local people. Successful strategies for adaptation to climate change for households and communities in developing countries will have to be grounded in local people's knowledge, expertise and involvement (Rojas Blanco, 2006). Adaptation strategies will also need to be designed within the broader context of strategies that promote sustainable development. Households and communities in areas vulnerable to climate change already have to deal with a whole array of issues as part of their on-going life. Floods, droughts, pests and disease outbreaks and crop failure are part of everyday reality for many communities in developing countries. Changing climate adds an additional layer of complexity onto this landscape. Discussions of climate change need to be framed within the context of current priorities and survival strategies.

Differing intra-household perspectives and priorities also need to be taken on board when designing strategies. The challenge for practitioners is to support and work with communities in a participatory and inclusive way, facilitating a process of co-learning between external experts and local people. Not only is such a process required for designing and implementing adaptation strategies, but also for monitoring and predicting changing weather patterns.

Climate models and the data they produce typically focus at regional or national levels. This is of little practical use at the community level. The challenge will be to design monitoring systems at the local level that can be used to facilitate effective design of adaptation strategies and be scaled up and integrated into the scientific community's monitoring systems. Local people have sophisticated weather forecasting systems grounded in observing changes in meteorological conditions, lunar cycles, and animal behaviour. Farmers use these indicators to predict changing seasons and plan farming strategies. More research is needed to systematically appraise these locally-based weather forecasting systems; identifying community-based indicators for weather forecasting and to evaluate these over time.

Introduction to National Park and Lakside Communities

Ba Be District is situated in Bac Kan Province in northern Vietnam. The area is mountainous, and populated predominantly by the Tay people, the largest ethnic minority in Vietnam.

Traditional land tenure regimes and control and access to natural resources amongst the Tay and other ethnic minorities in the highlands were based on communal ownership. The landscape of the Tay communities was made up of forests, household gardens, grazing lands and cultivated land comprising wet and dry fields, terraced fields and shifting cultivation fields. Tenure arrangements evolved through local custom and history. Private, or semi-private ownership, was limited to fields in the valleys.

From the 1950s through to 1988, the collectivisation of agricultural land impacted on traditional tenure relations. During this period land was formally owned by the State and allocated to cooperatives and collectives for access and use. Farmers had no rights on deciding how land could be used; they were workers for the cooperatives. However, in the more remote northern areas many cooperatives were never fully established so traditional community based customs and rules continued to manage tenure relations. The Land Law of 1993 formally abolished communal ownership of land and allocated fully transferable land use rights to households, individuals and organisations.

Today, the formal institutional arrangements for the management of forests has been devolved from the State that allows for forest land allocation for permanent use by organisations, households and individuals. For the Tay people living in northern Vietnam, forests represent an important asset to be utilised for securing livelihoods. Forests are a particularly important asset for newly arrived households and the poorer households within communities who have not been able to acquire lowland fields. The livelihood strategy for these households is to generate a surplus from upland crop cultivation that can then be used to purchase livestock and lowland fields.

Ba Be National Park was established in 1992 as part of the government's aim at conserving biodiversity in the country. From 1999 to 2004, Ba Be

National Park was the beneficiary of a multi-million dollar UNDP/GEF Project; its focus was to build local capacity to implement integrated conservation and development programmes through the participation of local communities and government sector agencies.

Since 1992, the management of the park has followed the classic protected areas model. Attempts have been made to resettle upland communities, intensify lowland agriculture and to promote off-farm enterprises. In regard to the forests in the park, local people have lost formal control of these, an asset central for sustaining livelihoods (Zingerli, 2001).

A total of nine villages are located within the National Park, however, the focus of this research was upon the four lakeside villages. Approximately 1,022 people, predominantly from the Tay ethnic minority group, live in 225 households within these four villages. The main livelihood activities are derived from agrarian activities, fishing, tourist boat trips and tourism.

Aims and Objectives

The overall aim of this research is to gain an insight and understanding of:

- Rural livelihoods in the lakeside communities of Ba Be National Park;
- Challenges that households, and different household members, have in sustaining those livelihoods;
- Local perceptions of changes to climate over time, and any impacts that these changes have had on livelihood strategies

A second aim is to discover the local systems for weather forecasting used by local people.

Our Approach

The Sustainable Livelihoods Framework was used for this study. This framework provides an analytical tool for analysing the impacts of environmental shocks and hazards, including those arising from changing climate, on rural livelihoods. The Sustainable Livelihoods Framework conceptualizes households as having a bundle of assets or capital entitlements (Scoones, 1998). These are: natural, social, financial, physical, human capital. For example, natural capital may be land, forests and fisheries, Social capital refers to relationships within households and between households and communities, membership of formal and informal groups. Financial capital relates to savings, access to credit and income. Physical capital includes livestock, machinery and buildings. Human capital depends on household members, education levels, knowledge, access to labour (Stewart Carloni and Crowley, 2005). Households use these assets in various combinations in developing strategies for sustaining livelihoods.

External institutions and government policies can either act positively to enable households to access assets, or negatively by disabling access to assets. For example, government policies to enclose common lands for commercial agriculture may deny access to households that used the land for grazing livestock. Policies designed to provide credit at low rates of interest enable households to access financial resources for household enterprise or farming. Policies to provide non-formal education for children while working on farms or tending livestock may enable households to increase their human capital. Group membership institutions such as farming cooperatives may enable households to access physical capital such as livestock, tools and technology. Membership of women's organisations may enable households to access human capital for market gardening.

In addition to external institutions and government policies, the vulnerability of households to shocks and events also impacts on their capital assets and hence their ability to sustain livelihoods. For example, the impacts of environmental shocks and hazards such as floods, pest outbreaks and drought on household strategies to sustain livelihoods, will depend on the degree of vulnerability of the household to the shock or hazard. For example, a household will be extremely vulnerable to a flood that results in the loss of its rice crop if it has little or no other assets, and therefore few options for an alternative livelihood strategy.

For this research, investigating the impacts of climate change and households' adaptation to climate change was carried out within the context of the Rural Livelihoods Framework. Changing climate results in additional environmental shocks and hazards for households. The vulnerability to these shocks, together with the institutional and policy context will determine households' adaptation strategies and their ability to sustain their livelihoods.

A team of four researchers was trained in participatory research methods and the framework described above. The training comprised an initial two-day workshop in Hanoi followed by two reflection and review days. The team was mentored and supported to conduct focus groups and workshop session with different groups within the four lakeside communities. At the end of each day, the team came together to debrief the information generated from each session.

Who We Spoke With

From 26 January to 5 February 2010 the research team facilitated twenty-one workshops and spoke with 182 people. The characteristics of livelihood assets as well as the differences in these between households and village communities were also explored. The intra-household relationships were also discussed revealing gender and age differences in activities and strategies. The vulnerability of households to environmental change was assessed, and government policies and institutional structures relating to environmental management were reviewed.

Discussions also focused on local perceptions of changing climate, how this had changed over time, and the impacts that this had on the livelihood strategies for different households. Conversation also covered the degree of vulnerability to climate change and how this affected households' livelihood assets and adaptation strategies. The institutions that enabled households to deal with environmental change including climate change were also identified and reviewed. Workshop participants were also facilitated to identify and evaluate local indicators for weather forecasting.

A final workshop was held to feedback findings and initial analysis to representatives from the lakeside communities and local government departments. The purpose of this workshop was also to verify our findings and deepen the analysis.

What People Told Us

Natural capital provides the foundation for livelihoods in each of the lakeside village communities. Access to and use of cultivation land, fish and forest provide the resources for households to sustain their livelihoods. However, in the case of the four lakeside villages, access to natural resources is also limited by the presence of the National Park which legally restricts households to certain areas and also to the types of resources they can harvest and use.

The main livelihood activity for the majority of households is farming, livestock breeding and husbandry. Other livelihood activities of significance include fishing, boat transportation (both tourist and local), collection of non-timber forest products (NTFPs) and tourist homestay accommodation. Other activities include fuelwood collection and timber collection for house construction and maintenance.

Crops cultivated include rice and maize. Rice is primarily for home consumption. Hybrid maize is used for fodder, and some may be sold. Households cultivate a small amount of traditional variety maize for household consumption. Sweet potato, cassava and to a limited extent soya beans are also cultivated for home consumption. Vegetables are primarily grown for sale to be consumed by tourists. Fruit trees have been planted and are tended by households including guava, apple, banana, jackfruit and grape fruit. Some households grow a wide variety and rely upon them for a greater proportion of their household income than others.

All farming households have access to a buffalo and plough to prepare the land for sowing. Poor households who do not own a buffalo share them through kinship relationships. Few households have physical assets such as mechanized ploughs. Many households have access to irrigation pumps and those that don't also share through kinship relationships.

After farming, fishing is the most significant livelihood activity for lakeside households. Around a third of households have a member who is a full-time fisher. Small fish are generally kept for household consumption, whilst larger fish are sold to passing fish merchants on motorcycles or

transported to local markets for sale. Most households will conduct some degree of fishing with the catch being used for home consumption to supplement other sources of protein e.g. eels and shrimp.

Boats and nets are the physical capital needed for fishing in addition to a number of varieties of bamboo traps (made from locally available resources) used to catch eels and shrimp. All households have either small wooden or metal canoes for transportation and fishing purposes. The construction of canoes from wood is now prohibited within the National Park and all replacement canoes much be constructed of metal.

Fishing takes place all year round. During the winter months of December to February, less fish are caught because of the cold weather, and nets with smaller mesh size are cast. At other times of year the mesh size is greater. From April to May pregnant fish are observed throughout the lake and lay eggs in a number of locations in the lake. During May and June fishing takes place both night and day, and during August and September the greatest number of fish are caught.

Forests represent an important natural asset for households. Firewood, timber and non-timber products e.g. mushrooms, bamboo (shoots, traps, construction materials) are derived from this source. Firewood is collected for home cooking and space heating, and a considerable amount is consumed to cook food for pigs. Some may be sold at local markets. Timber for roof construction and building is also collected for domestic use and for sale. When cash is needed for emergencies, or for special events, such as weddings and funerals, the household will sell timber cut from the forest.

Households that are able to generate a surplus from their natural capital assets, will purchase livestock. Buffalo, cows, pigs, chickens and ducks are bred and reared by households. These represent physical capital assets and a source of income.

Boat transportation is an important source of income for about 60 households. Transporting tourists around the lake and as a means of local transportation is a key revenue source for those households. (Some boats on the lake are owned by people who do not live in the lakeside villages.)

Young people (18 to 25 year olds) also migrate away from the communities to work and send remittances back to their families. Some work in factories within Vietnam and others go abroad, e.g. to Taiwan.

Within the household, livelihood activities are conducted by different members. Women are responsible for farming, collection of forest products and households chores. Both boys and girls assist their mothers with these tasks. Fishing by women is limited to the streams and close to the banks of the river. Women are responsible for selling all fish caught by household members, at the local market. Men fish in the lake, harvest banana stems for pig fodder, and construct and repair houses.

Policies and Institutions

Households' capital assets, and with them, the activities carried out to secure livelihoods, are mediated by the institutional arrangements – the rules, regulations and norms – that govern their access and use. It is these arrangements that determine 'the rules of the game'. Internal, or local, institutions evolve over time, influenced by history and custom. External institutions are those set up by the State at the commune, district, province or national level. These too, evolve over time with changing political regimes and priorities and goals of the State.

The most significant change in institutional arrangements governing control and access to natural capital for households in the lakeside communities has been the establishment of the National Park in 1992. The National Park Management Board was established as the implementing agency for the rules and regulations governing the National Park. In particular, the rules governing households' access and use to the forest has changed radically. Forests in the Park are classified as either Strict Protection Zone (SPZ) areas or Ecological Rehabilitation Zone (ERZ) areas. In the SPZ all activities not directly related to biodiversity conservation are prohibited. In the ERZ, upland crop cultivation of rice, maize and other crops, felling of trees for timber for house construction and canoes, fuelwood and NTFP harvesting are prohibited. However, the Management Board permits harvesting of NTFPs, fuelwood and timber for household construction and repairs for domestic consumption only, for lakeside villages. Households have been awarded contracts to manage and protect the EPZ forest areas.

The rules and regulations that govern the fisheries resource of the lake and the connecting rivers and streams combine both external institutional structures and local institutional arrangements. Since 1992 the rules governing lake use have been the responsibility of the National Park. In 2007, a new lake management regulation was introduced, limiting fishing hours, gear usage and prohibiting the use of motorboats for fishing. Other rules governing the use of the lake include a ban on fish farming and sand mining. Informal local institutional arrangements influence access and use of aquatic resources in the rivers and streams entering and flowing from the lake; these resources are exclusively for each village that is located by the river or stream.

In April 2004, fishermen and boat owners, Ba Be National Park Management Board and District and Commune leaders, established the Ba Be Lake Management Cooperative (BBLMC), with responsibility for managing the sustainable use of the lake's resources, as well as for providing boat transportation tourism services.

Financial institutions enable individuals to access credit facilities for farming, livestock rearing and off-farm enterprises such as weaving. Credit facilities are provided to farmers through the Bank for Social Policy (Bank for the Poor) and the Agricultural Bank. The Bank for Social Policy, a government institution, provides loans at below market interest rates. These loans are disbursed mainly through the Farmer's Union, Women's

Union and Youth Union. Individuals may only access loans if a member of a union, and the individual union group they are a member of will act as guarantor for the loan. The Agricultural Bank provides loans at commercial rates of interest. Women's Union members can obtain loans for agricultural purposes from the Bank for Social Policy.

In 2002, new higher yielding varieties of rice and maize were introduced. The new varieties were accompanied by new technologies for cultivation – inorganic fertilizers and pesticides, and polythene sheeting to protect seedlings from cold and pests. Extension services to encourage and train farmers in the new technologies were provided through the District level Department for Agriculture and Rural Development and the Commune Farmer's Union. Village Assistance Funds and Agricultural Seed Banks have been established to support agricultural intensification.

There is an array of government institutions at the provincial, district, commune and village levels that provide support to individuals and households in the event of environmental shocks and hazards such as floods and droughts.

The organisation responsible for coordination is the Committee for Flood and Storm Control. This is the umbrella government organisation responsible for mobilising the district and commune level emergency services – army, commune militia, Youth, Farmer's and Women's Unions, and other district level organisations – when bad weather conditions are forecast or extreme climatic events have occurred. The emergency services will implement evacuation and response plans in the case of flooding or natural disaster. The district level organisations, in turn, will direct/ instruct their counterpart organisations at the commune level, that in turn, will relay information and direction to village level institutions.

Historical perspective

Settlement of some lakeside communities took place initially in the 1940s and the others, in the early 1960s. Older people recalled that grandparents had had a connection with the area in the past, having lived in the area either seasonally or temporarily to take advantage of the lake for fishing. Most of the villages were initially established with between six and eight households.

Shifting cultivation agriculture accounted for extensive loss of forest over the period 1975 to 1985. In the early stages of village development upland extensive cultivation was the only form of agriculture. In the late 1970s with the end of the war with the USA, there was a large expansion of cultivated land as the population rapidly increased. This resulted in extensive clearing of upland forest areas between 1978 and 1980. At this time wetland rice cultivation commenced on the wetland and floodplain areas surrounding the lake.

In 1979, members of the H'mong ethnic community began to migrate to the upland areas, fleeing the Chinese incursion into neighbouring Cao

Bang Province. 400 households had arrived by 1986. In 1995, 200 H'mong households were offered financial incentives to resettle in southern Vietnam. In 2005, an attempt to resettle the remaining 200 households outside the National Park to neighbouring communes failed and the majority of these households migrated back to the upland areas of the National Park.

While it was observed that there has been a marked reduction in deforestation within the National Park, participants believe that the rates of deforestation in the forest upland areas immediately outside the Park boundaries have increased significantly.

Over the decades local people have experienced significant environmental events. Floods have been a regular phenomenon dating back to 1949, the earliest recollection of a large flood. In the past, floods were relatively predictable and households had warning about their arrival. However, in more recent years floods do not follow a predictable pattern, occurring now at anytime of year, and much more rapidly. In the past, the water level of the lake would rise over a few days, providing a warning to lakeside communities that a flood was imminent. Today, the flood can occur overnight. The process of deforestation that has been observed over the decades is thought to be contributing to the increasing frequency, faster peak flood times and severity of flooding. Lack of vegetative cover on the uplands increases the rate of overland flow carrying sediment into the drainage lines and valleys below.

Other environmental events associated with the increased intensity of flooding include the increased rate and volume of sediment deposition in the lake and adjoining rivers, higher turbidity in the lake and overbank deposition of sediment on the high floodplains. In the past, after heavy rains and flooding, turbidity levels would remain high for three or four days. Nowadays, turbidity levels remain high for much longer. The 'doors of the lake' (where rivers and streams flow in and out of the lake) are silting up and this, according to local people, is accentuating the severe flooding that they are now experiencing. Evidence of these changes is highlighted by the change observed in the depth of the lake. It was reported by local fisherman that in 1963, the depth of the middle section of the lake was 80m. In 2010, the depth in the same location was 23m. Local people also reported that in some places the floodplain used for rice cultivation has extended into the lake by 400m over the period 1978-2010.

The changing pattern of flooding has impacted on agricultural land high on the flood plain adjacent to the rivers. In recent times flooding has resulted in claylike sediment being deposited on cultivated land up to 1m thick. Some villages have experienced bank erosion and loss of cultivated land as a result of flooding. For example, the channel of the Nang River at one village has widened from 20m in 1975, to 35-40m in 1986, to 50m in 2009.

As part of the collectivisation programme, the Ba Be District Fishing Cooperative was active from 1960 to 1979. Fish were used for the war

effort as well as for domestic consumption. Although the Fishing Cooperative ceased operation in 1979, extraction of fish has continued to an increasing extent.

Data indicates that there has been a significant decline in fish production over the decades (Nguyen Trong Hiep, 2001; Ngo Sy Van, 2005). Fishing households also reported changes in fish behaviour over the years. In the past, spawning occurred at specific times of year i.e. in April/ May. In 2008, there was a significant 'out of season' flood in October. Pregnant fish were caught during this time. In December 2009, the same phenomenon was observed with fish spawning. In late 2007/ early 2008, it was reported that there had been a mass death of fish.

Perceptions of climate change

Local people perceive that rainfall patterns are less predictable today, with rain falling at all times of year. The climate appears to be getting warmer: hail storms no longer occur, drought is a more frequent phenomenon than in the past, and, today, the cold spells during winter are less severe than in the past.

Climate change, vulnerability and livelihood dynamics

Flooding has the most widespread impact on livelihoods for the lakeside communities. The immediate impacts result in illness and disease for people and livestock; significant damage to houses, crops and fields; contamination of drinking water; destruction of roads that results in children being unable to attend school.

The siltation of the lake, in turn, has resulted in loss of fish species and decline in overall fish stocks as critical egg laying beds have been covered by sediment. This results in greater fishing activity, and for some households, becoming more involved in the tourism sector. The increased use of diesel for boats for tourism has resulted in pollution of the lake with extensive oil films observed on lake plants and fresh water snails and mollusks observed to have diesel residue inside their shells.

The loss of crops and cultivated land leads to an increase in fishing activity and greater reliance on unsustainable fishing techniques and methods as households seek alternatives sources of livelihood, which further compounds the decline in fish stocks.

There was broad consensus that the increased severity of flooding is due to deforestation and general loss of vegetative cover in the upland areas. There was a general perception that has been as a result of rapid population increase, the migration of people to the upland areas fleeing the Chinese incursions into northern Vietnam in 1979 and overall lack of enforcement of resource management rules. The establishment of the National Park has also contributed to the upland deforestation; there has been accelerated deforestation in the areas immediately surrounding the protected area. The natural resources of the National Park are now facing

ever-increasing pressures as the availability of natural resources outside the Park becomes exhausted.

The changing rainfall regime observed by local people adds another layer of complexity and vulnerability to rural livelihoods. Nowadays, rain occurs at anytime throughout the year, and with it the risk of flooding.

Whilst the introduction of hybrid crops has resulted in higher yields, the new varieties require use of pesticides and inorganic fertilizers. This has resulted in pollution of waterways, as well as suspected health impacts for farmers. The pollution of waterways has led to pollution of the lake, and with it, impacts on fish stocks and contamination of locally available potable water. The health impacts of chemicals used by farmers have had gender impacts as women are both the users of the chemicals and responsible for caring for sick household members.

Farmers reported that the warmer weather and increasing incidence of drought has also impacted on agricultural practices. Crop yield tend to improve with the warmer weather, yet during drought the yields of hybrid varieties decrease, as they are not as well adapted as local cultivars to changes in local conditions. Further, with the increasing temperature pests are more prevalent; hybrid maize is particularly susceptible to pests. Farmers respond to this by increasing pesticide use. Drought has also resulted in the appearance of fissures in land and loss of vegetation on hillsides, compounding the problems of flooding and erosion. Drought also increases the risk of forest fires, and with it deforestation and loss of upland vegetative cover. Drought has serious impacts on people's livelihoods. It results in a lack of fodder, loss of food stores, a reduced supply of water for people, for livestock and for irrigation leading to loss of crops and stress for livestock.

The extreme cold events result in the loss of human food stores and livestock fodder, the death of livestock, and adverse impacts on people's health. The new varieties of rice are particularly susceptible to extreme cold and households therefore risk losing these crops during the cold spells. Households traditionally allowed buffalo and cows to seek their own shelter from the elements in the caves in the upland areas and under the forest canopy. However, with the creation of the National Park, buffalo are prohibited from entering these areas. The cold spells also have differentiated gender impacts; women are tasked with collecting firewood for space heating as well as caring for the sick members of the household.

<u>Enabling and disabling institutional change</u>

The creation of the National Park in 1992 has had a significant impact on households' access and use of natural capital assets. Households are no longer able to cultivate upland farms, nor collect timber and non-timber products from the forest areas. This has gender impacts: men now have to travel further to collect timber for building and sale; for women and children access to firewood and non-timber forest products become limited. This event represents a disabling policy for lakeside communities.

Households that are particularly vulnerable to this institutional change are those that have little wetland farmland and few income generating options for raising revenue to purchase household requirements and diversify livelihood strategies.

For some households and individuals the creation of the National Park has enabled employment opportunities: local people are employed to protect and manage the forests through the National Reafforestation Programme – Programme 661. For others, income generation opportunities arise through engagement in the tourist sector through boat transportation (for motorised boat operators), offering accommodation to tourists and through performance of tradition dance and music.

The agricultural intensification project represents an enabling policy initiative that has given households the opportunity to increase crop yields and generate a surplus that they can sell and purchase household needs. However, the effectiveness of these activities has been limited over time as the required ongoing technical training was not provided.

The new varieties of rice and maize have also enabled farmers to change to cropping practices in response to changing rainfall patterns. The new varieties have allowed for shorter cropping cycles and farmers plant a month earlier than they did in the past to avoid their crops being damaged by rains and subsequent floods shortly before harvest. The shorter cropping cycles have also enabled farmers to cultivate two crops of rice and maize each year. Consequently, farm output has increased significantly. However, the success of the new varieties relies on new technologies, i.e. pesticides, inorganic fertilisers and polythene sheeting to protect seedlings from the cold. It was reported that some of the poorer households cannot afford to purchase the sheeting, nor have the labour to cover the growing rice, thereby undermining the potential of their crop.

An enabling institutional environment is provided by the Bank for Social Policy that offers credit at below market rates of interest to individuals that are members of the unions; enabling access to credit for farming, livestock rearing and off-farm income generating activities, e.g. food production and weaving.

Farmers are also able to adapt to changing climatic conditions through their choice of crops. Maize is more drought resistant than rice and doesn't require irrigation. If the rains do not come when expected, farmers will opt to plant maize rather than rice on the floodplains. The new varieties of maize, whilst drought resistant and having shorter cropping cycles, are not favoured by households as a food source. This is in contrast to traditional varieties that were cultivated primarily for home consumption. The new variety of maize is cultivated primarily for fodder and for sale. This provides households with an alternative strategy for fodder provision for cows and buffalo that previously would have foraged for food in the upland areas. However, this change increases the vulnerability of poorer households to food insecurity. Households are now much more dependent on the market economy for purchasing food requirements, as they have lost a significant source of household food

supplies with the substitution of traditional maize with the new variety. Furthermore, the issue of food insecurity is also compounded by the tendency to monoculture agriculture. Crop failure leaves households, particularly poorer households with less diversified livelihood options, more vulnerable.

Flooding and deposition of sediment on wet rice fields further leads to substitution of maize for rice. In one village, rice could not be cultivated for three years as a result of deposition of clay-like substrate on the fields – maize was planted instead.

Households that are not able to generate sufficient crops to meet household needs will resort to other livelihood options such as fishing for home consumption and for sale. The declines in fish stock that have been experienced over the years means that smaller fish are taken than in the past, and households are forced into practices that are not conducive to sustainable fisheries. Fish are caught during the breeding season and eggs are taken from breeding areas, pregnant fish are not released after being caught, and destructive fishing methods are utilised to maximise the catch and kill non-target species in the process.

For households for which fishing is the main source of livelihood, changes to fishing practices and technology have occurred in response to dwindling fish stocks. Net mesh is smaller, nets are wider and are left in the water for longer periods. These practices put further pressure on fish stocks. Informal arrangements between villages governing fishing rights, and the creation of the Ba Be Lake Management Committee represent strategies to promote sustainable use of fish resources. Despite local fishers' attempts to regulate fishing with bans on egg harvesting and exclusion areas during breeding seasons, lack of enforcement by responsible authorities results in continued extraction.

Fishing households are particularly vulnerable to flooding. During a flood fishers are unable to fish until the turbidity has decreased sufficiently (now after 3 to 4 days, whereas previously 1 to 2 days). For households that sustain livelihoods primarily from fishing, rice cultivation is considered a safety net in case of failure to catch fish. For households that do not have this safety net livelihoods are compromised and assets decline. Men of these households may travel to cut timber and firewood for sale. However, the distances they need to travel have increased due to the prohibition on resource extraction from National Park forests.

Households that are particularly vulnerable to climate changes and shocks such as flooding are those that already experience food insecurity and have many children and have only one parent able to work (single parent households or those with a parent too sick to work). Poorer households whose homes are not made of concrete are vulnerable to extreme climatic events. These households tend to have their homes located below the flood water levels. Within the household it is children and elderly men and women that are most vulnerable. Adverse weather conditions impact on people's health, for example, the warmer more humid weather leads to mould and damp that penetrates into home, leads to respiratory

problems; during cold periods poorer households suffer acutely as women have neither labour to collect, nor cash to purchase, firewood for space heating.

Monitoring climate change

Planning for livelihood security and the options that individuals and households choose to achieve this requires good information about weather patterns and the trends in these over time. With such information local people and organisations can anticipate changes and adapt farming, fishing and environmental and livelihood management plans accordingly.

Local people reported that they received weather forecasts from three sources: the radio, watching television and from their own local experience. They were of the view that the most reliable source of information was derived from their local experience, because the forecasts made on both the radio and television were aimed at the provincial or Central North Vietnam scale and didn't provide specific forecasts for Ba Be National Park or Ba Be Lake with its own special climatic variability. Consequently, these forecasts were not very accurate or useful in assisting individuals and households in planning their work and lifestyle activities.

Many older members of the community shared their knowledge and expertise on local indicators for monitoring the weather or climate. These indicators are based on observing plant, animal and meteorological behaviour. Examples of local indicators for different weather events include:

Indicators for rain

Frogs croak at night: heavy rain within one or two days

Plants rise to lake surface and blue in colour: rain is approaching

Indicators for storms/ strong winds

Loris monkey calls: there will be a strong wind

Sun is red in colour either in late afternoon or early morning: storm with strong winds are forecast in the following few days

Indicators for drought

Ants observed in a dense group moving down the walls at the end of the rainy season: drought in the following season

Moon has a bronze/ red outer circle: drought in 5 to 10 days

Indicators for extreme cold

Sau tree has many fruit: it will be extremely cold and cold will last longer than usual

Colour of lake changes from blue to black: cold

Indicators for flood

The plants of the riverbank bear much fruit that ripens at same time: significant flooding

The water hen nests high above the ground: flood

The indicators that were regarded as being of most use for environmental management were those that were easy to see, known by all, easy to

hear, grounded in local experience and easy to remember, accurate, observed often, and easy to understand.

Conclusions

The community engagement process in lakeside villages of Ba Be National Park revealed insights into local people's rural livelihoods, and the challenges and opportunities that they face in sustaining their livelihoods. The findings also highlighted community views on changing climate and how these perceived changes impacted on environmental change and livelihood strategies. A further outcome of the research was the initial development of a system for assessing local climate change, using locally based indicators for weather forecasting.

The lakeside communities of Ba Be National Park are some of the poorest in Vietnam. Population increase has been attributed as the driving factor accounting for environment decline, loss of biodiversity and deteriorating livelihood outcomes. However, analysis of livelihood dynamics and environmental change though an institutional lens, provides a deeper understanding of the causal factors of the changes taking place in the rural livelihood system. Within this framework population increase becomes a symptom of institutional failure rather than the primary cause of environmental and livelihood decline.

The declines in fish stocks in the lake have been monitored since the early 1960s. Much fish was extracted during the Vietnam war, and during the 1980s to the present day, fishing methods and practices reflect the lack of effective rules and regulations that govern fisheries management. The major concern for fishing communities around the lake is their inability to manage and restrict access to eggs, breeding grounds and fish stocks to meet urban demand. Further decline in fish species and composition has resulted from sedimentation and sludge deposited in lakes and tributaries, and pollution from chemical fertilizer and pesticide run off.

The establishment of the National Park in 1992 has had profound impacts on rural livelihoods. Traditional forest management regimes have been replaced with one that excludes local people from harvesting timber and other non-timber forest products. This has resulted in illegal extraction from protected forests as well as widespread deforestation in the upland areas bordering on the protected areas. Flooding, an increasingly extreme and frequent event in the lakeside catchment is attributed to deforestation, itself a direct consequence of an ineffective and inappropriate management regime.

Creation of new institutions have been designed to promote policies of intensification and commercialization of agriculture, off-farm revenue generating activities, tourism and paid employment as guards and custodians of the protected area. Livelihood outcomes for households have varied depending on access to capital and decisions made about livelihood strategies.

For those households that have access to credit, wetland farmland and physical assets, agricultural intensification has brought income generating opportunities and increased food security. Households with physical capital such as motorboats and accommodation have benefited from tourism, offering transport and 'homestays'. However, for those households that lack these capital assets, livelihood outcomes have deteriorated; households respond by selling livestock and intensifying fishing efforts, thereby compounding pressure on fish stocks and aquatic environmental quality. Household members may also migrate in search of work.

Within the household, livelihood outcomes have varied with changing policies and institutions governing access and use of capital assets. Women are particularly vulnerable to the changing institutional environment. They and their children are responsible for collecting firewood and non-timber forest products – medicinal plants, mushrooms and other wild foods. Prohibition from protected forests means that they risk sanctions if caught collecting from these areas, and have to travel greater distances to forests outside the strict protection zone. Women are the primary carers in the household for the ill and infirm. During the winter months, the lack of cash to purchase firewood for space heating impacts on the elderly and children. Women are also affected by agricultural intensification – at risk from potential health impacts of chemicals, and responsible for purchasing and implementing the technologies required for successful cultivation.

Rural livelihood strategies and outcomes have been profoundly influenced by the changing policy and institutional framework. In addition, changing weather patterns perceived by local people, are adding an additional layer of complexity to livelihood strategies. Increased severity and frequency of flooding has been compounded by changing rainfall patterns observed by local people; warmer weather and drought has led to increased prevalence of pests and reduced yields of hybrid varieties.

The findings revealed the detailed local knowledge that older individuals have in regard to monitoring changes in the weather. Local people have an array of indicators to forecast rain, storms and strong winds, drought, extreme cold, flood, and changes in the weather. These indicators are based on changes in: behaviour of birds, fish, snakes, butterflies and animals; patterns of plant flowering, and meteorological phenomena. Local people use these indicators as a management tool, assisting them in decisions about where and when to fish, when to plant and harvest crops, and when to protect livestock and buildings from extreme weather events.

Whilst these indicators have been and continue to be used as a tool for environmental management, the accumulated knowledge that the older generation has is not being passed down to the younger generation. In addition, the findings suggest that the reliability of some of the indicators is not as high as it was it in the past, which may also be itself an indicator that climate change is leading to a change in animal and plant behaviour, and meteorological patterns.

Local people were not part of the decision to create the National Park in 1992. This was a national level initiative with international support. However, people living within and around the park are those that have been most affected by this decision. The current institutional structure for managing the Park – the National Park Management Board – comprises representatives from District and provincial government departments. Local people are informed about the decisions made on management of Park, for example, the ban on the use of motorboats for fishing in 2007.

Recent evidence from a review of evaluations of protected areas for biodiversity conservation highlights the importance of local stakeholders and communities having ownership of the management and decision-making process, if long-term conservation goals are to be realized (ECG, 2010). For Ba Be National Park, enabling local stakeholders and communities to be part of the management structures and facilitating their sense of ownership of the process is an essential step for ensuring the long-term sustainability of the Ba Be lake and its environs. Engagement with the H'mong becomes part of the process of inclusion of local stakeholder and communities. However, this would represent a particular challenge as the settlement in the upland areas by H'mong households is illegal.

Representation and involvement of local communities needs to be embedded at all levels of decision-making from the NPMB through to the Ba Be Lake Management Committee, and at the village level, in design of village development plans. External agencies – government and non-government alike – should take on the role of enablers for communities to take on the management and ownership of their resources, establishing appropriate funding mechanisms and making information readily available (ECG, 2010).

This research suggests that the decline in environmental quality and the increasing pressure on rural livelihoods is accentuated by changes to weather patterns that have been observed by local people. If these perceptions of change are confirmed, the need to develop institutional structures that will promote sustainable use and achieve long-term biodiversity conservations goals, becomes the more urgent.

Supporting and building local people's capacity to manage their environment in the context of institutional and environmental change, is an important part of a sustainable livelihoods and biodiversity conservation strategy. This research has revealed the importance and the richness of local people's indicators for monitoring changes in the weather and the significant influence this has on their environmental management strategies. In an era of climate change, integrating such indicators into wider regional climate monitoring systems becomes an important element in designing adaptation strategies at the local and regional levels.

BACKGROUND TO THE RESEARCH

This report documents the findings of two weeks of community engagement in villages in Ba Be National Park in Vietnam. The focus of the engagement was environmental change and the impacts these changes were having on the ability of local people within the National Park to sustain their livelihoods. Current and future adaptation strategies were also the subject of the engagement process. Villagers were also facilitated to share their perceptions about changing weather patterns and to discuss the linkages between climate change, livelihoods and adaptation strategies. Emerging from this discussion was the identification of local indicators for forecasting the weather.

This research developed from discussions held with staff at the Institute of Environmental Studies, University of New South Wales in Sydney, Australia, in March 2009 with the late Professor Stephen Schneider, the renowned climatologist and contributor to the Intergovernmental Panel on Climate Change (IPCC) assessment reports.[1] As a member of the IPCC Working Group he highlighted the need for detailed information on local community perceptions on climate change and locally based indicators for monitoring climate change to inform the IPCC Fifth Assessment Report in 2012 (Schneider, 2009). His observation reflects an emerging discussion in the literature around the need to shift the focus of climate change modeling from a solely top-down approach to an approach that includes as comparably important, a local community focused approach (see for example, Van Aalst *et al*, 2008).

Effective adaptation to climate change is fast becoming an urgent issue that needs to be addressed, particularly in developing countries. For example, in Africa and Asia it is predicted that agricultural production will be adversely affected by changing weather patterns. This, compounded by population increase, is likely to exacerbate hunger in Africa, and lead to food shortages in Asia (IPCC, 2007).

Households and communities in rural areas of developing countries, especially the poor, are most vulnerable to the impacts of droughts, erratic and unpredictable rainfall patterns, floods and other extreme weather events. They are the least able to adapt to these environmental shocks and hazards. Not only do they reside in the most geographically vulnerable areas, but also they are most dependent on the local natural resource base for sustaining their livelihoods. Whilst farmers have specialised knowledge and a wealth of experience in managing their local environment, increasing unpredictability of seasons and rainfall is creating great challenges for them when taking decisions on when to plant, manage and harvest their crops. The health of livestock, an integral part of the farming system, is also being undermined by drought and

[1] Professor Schneider visited the University of New South Wales to present the public lecture 'Climate Change: Trade off or complement?' To access the lecture go to:
http://www.youtube.com/watch?v=hv6m409FauU&feature=player_embedded

increasing incidence of disease. The loss of livestock compounds the cycle of poverty, as households have few assets to fall back on, do not have insurance to cover against such events, nor do they have alternative ways of securing their livelihoods (Reid *et al*, 2009).

In development projects more generally, top-down approaches have proved to be inadequate, failing to produce appropriate solutions for local people. "Many efforts to reduce poverty have failed or proved to be unsustainable because they have not fully understood local institutions and the way that they influence the livelihoods of the poor" (Stewart Carloni and Crowley, 2005).

Successful strategies for adaptation to climate change for households and communities in developing countries will have to be grounded in local people's knowledge, expertise and involvement (Rojas Blanco, 2006). "Growing dissatisfaction with the top-down scenario-driven approach has led to the search for adaptation methods relevant at the local scale, and ways to work from the bottom-up" (van Aalst *et al*, 2008:167).

Adaptation strategies will also need to be designed within the broader context of strategies that promote sustainable development. Households and communities in areas vulnerable to climate change already have to deal with a whole array of issues as part of their on-going life. Floods, droughts, pests and disease outbreaks and crop failure are part of everyday reality for many communities in developing countries. Changing climate adds an additional layer of complexity onto this landscape. Discussions of climate change need to be framed within the context of current priorities and survival strategies.

Differing intra-household perspectives and priorities also need to be taken on board when designing strategies. Tanner *et al* (2009) found in the Philippines that farmers (men) were concerned with pests, women's concerns focused on gambling, drugs and alcohol misuse, and children identified environmental impacts of poor management of natural resources, and global environmental problems as their major worries. In Malawi, women advocated for crèche facilities, family planning support, access to loans and credit, training and free health care, over support for agriculture. They argued that without childcare and support to start up enterprises they would be unable to adapt to the impacts of climate change (Jennings and McGrath, 2009).

The challenge for practitioners is to support and work with communities in a participatory and inclusive way, facilitating a process of co-learning between external experts and local people. "…communities, scientists, and development workers need to learn, analyse, and plan action in partnership, but that communities need to be in the driving seat" (Reid *et al*, 2009). Not only is such a process required for designing and implementing adaptation strategies, but also for monitoring and predicting changing weather patterns. Effective monitoring systems for climate change provide important data for adaptation planning.

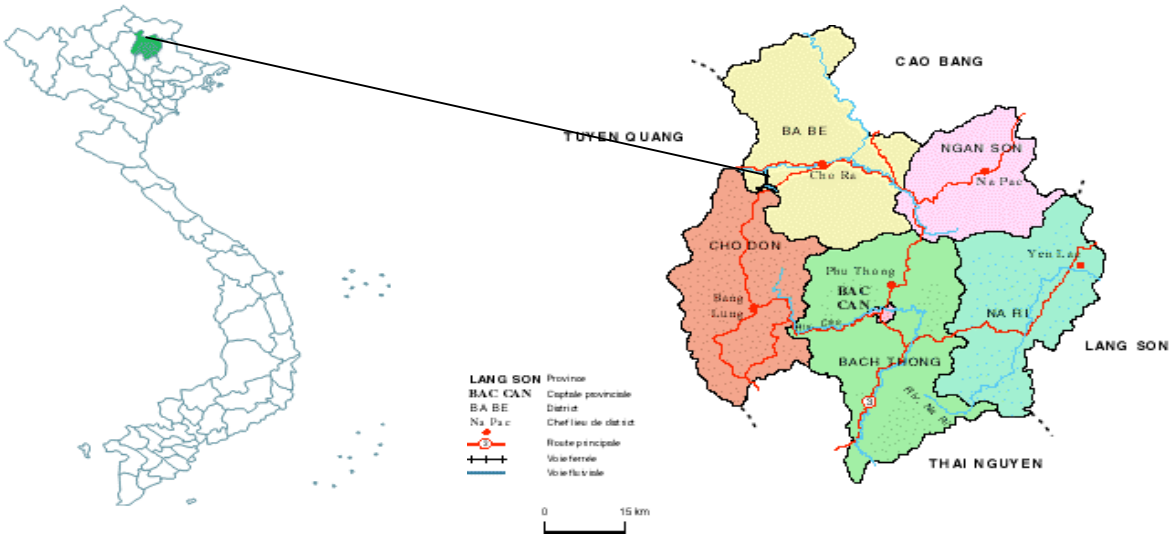
Climate models and the data they produce typically focus at regional or national levels. This is of little practical use at the community level. The challenge will be to design monitoring systems at the local level that can be used to facilitate effective design of adaptation strategies and be scaled up and integrated into the scientific community's monitoring systems. Fraser *et al* (2006) argue that community empowerment can be enabled through using local knowledge as the starting point in research and then using western scientific tools and models as a means of extending the local findings to a wider area.

Local people have sophisticated weather forecasting systems grounded in observing changes in meteorological conditions, lunar cycles, and animal behaviour. Farmers use these indicators to predict changing seasons and plan farming strategies accordingly (see for example, Sherwood and Bentley (2009) and Berger *et al* (2009)). More research is needed to systematically appraise these locally-based weather forecasting systems; identifying community-based indicators for weather forecasting and to evaluate these over time.

INTRODUCTION TO BA BE NATIONAL PARK AND THE LAKESIDE COMMUNITIES

Ba Be District comprises 26 communes and is situated in Bac Kan Province in northern Vietnam (see Map overleaf). The area is mountainous, and populated predominantly by the Tay people, the largest ethnic minority in Vietnam. The ethnic communities of Nung, H'mong and Dao also reside in the district. The main source of livelihood security comes from agrarian activities.

Traditional land tenure regimes and control and access to natural resources amongst the Tay and other ethnic minorities in the highlands were based on communal ownership. For the Tay, communal land referred to common land held by several villages. The landscape of the Tay communities was made up of forests, household gardens, grazing lands and cultivated land comprising wet and dry fields, terraced fields and shifting cultivation fields. Tenure arrangements evolved through local custom and history. Private, or semi-private ownership, was limited to fields in the valleys. Throughout feudal dynasties and the French colonial era, the influence of central government control on these tenure relations was limited to wet field cultivation through the levy of taxes (Vuong Xuan Tinh, 2001).



Source:PRCF (2010)

From the 1950s through to 1988, the collectivisation of agricultural land impacted on traditional tenure relations. During this period land was formally owned by the State and allocated to cooperatives and collectives for access and use. Farmers had no rights on deciding how land could be used; they were workers for the cooperatives. However, in the more remote northern areas many cooperatives were never fully established so traditional community based customs and rules continued to manage tenure relations. The *Doi Moi* and the Land Law of 1988, aimed at decentralization of land thereby allowing farmers the right to use their land as they saw fit. The subsequent Land Law of 1993 formally abolished communal ownership of land and allocated fully transferable land use rights to households, individuals and organisations.[2] Implementation of the new policy was achieved through the granting of certificates for agricultural land use right – 'Red Book' – and for forest land use right – 'Green Book'. "On the one hand, the 1993 Land Law and the 1998 revisions reinstate certain elements of traditional land use, namely granting of land use rights to farmers. On the other hand, these laws strengthen the State's control over land through the recognition of the legal land use rights, granting land use right certificates (Red Book) and taxation. Never before in the history of Vietnam's highlands has an administration had such tight control over land as it has now" (Vuong Xuan Tinh, 2001:268).

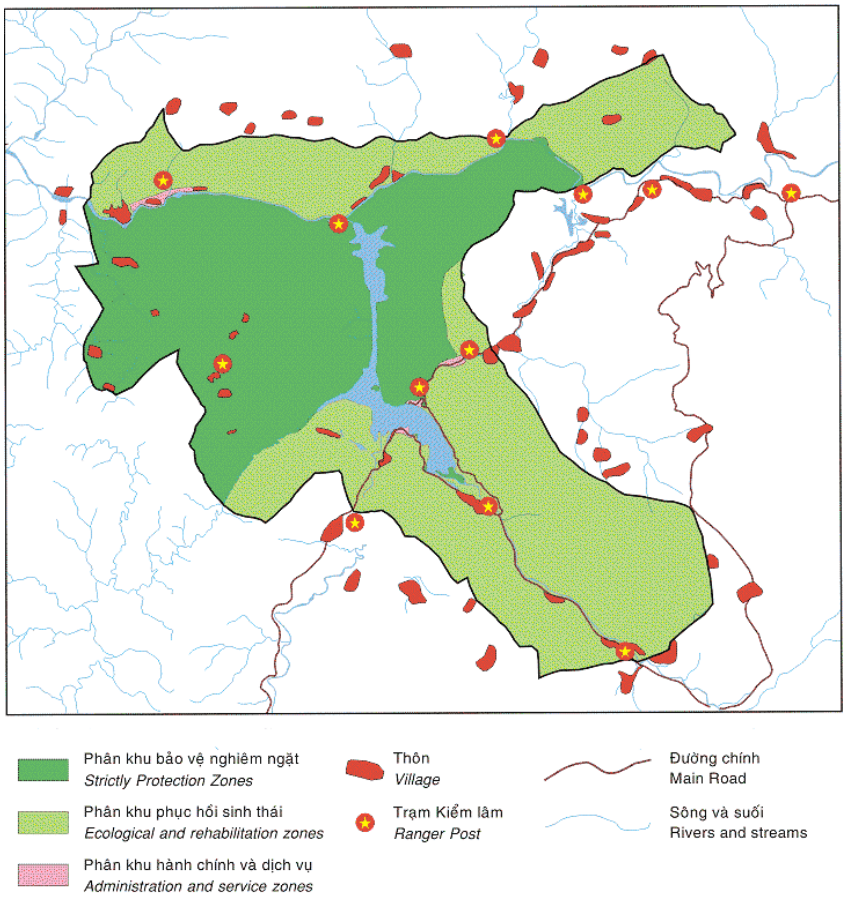
Today, the formal institutional arrangements for the management of forests has been devolved from the State through Decree No. 163/1999/ND-CP that allows for forest land allocation for permanent use by organisations, households and individuals. Three classifications of

[2] Under the criteria for organisations, a community does not qualify as an eligible organisation (Vuong Xuan Tinh, 2001).

forest have been established, and the classification determines the management purpose, the ownership and the formal institutional arrangements; they are special-use, protection and production forest. In the case of protection and production forest, the local institutional arrangements for management and use of forest areas is determined through local negotiation between households, communities and communes (Zingerli, 2001).

For the Tay people living in northern Vietnam forests represent an important asset to be utilised for securing livelihoods. Forests are a particularly important asset for newly arrived households and the poorer households within communities who have not been able to acquire lowland fields. The livelihood strategy for these households is to generate a surplus from upland crop cultivation that can then be used to purchase livestock and lowland fields. The crops grown in the upland fields include rice, maize, fruit trees and vegetables. Poorer households cultivate upland maize to supplement their rice consumption (Zingerli, 2001).

Ba Be National Park is located within the Nam Mau Commune of Ba Be District (see Map below).



Source: PARC (2004)

The Park was established as a Special Use Forest in 1992 as part of the government's aim at conserving biodiversity in the country. In 2008 there were 30 declared National Parks in Vietnam, either managed by the national government (five), or provincial governments (25) through National Park Management Boards (Decision 186/2006/QD-TTg: Regulation on Forest Management). The 1995 Biodiversity Action Plan identified Ba Be National Park as having high priority for funding because of the biodiversity value of its large lakes (McElwee, 2001).

Ba Be National Park is classified as a provincially managed Special Use Forest and derives its primary source of funding from the Provincial budget. At the moment Ba Be National Park also receives small funding for conservation activities from a variety of international donor sources.

From 1999 to 2004, Ba Be National Park was the beneficiary of a multi-million dollar UNDP/GEF Project titled "Protected Areas Management for Resource Conservation (PARC)". The PARC project is designed to re-plan large areas of the highlands. "According to project documents the PARC concept is "based on the modified landscape ecology approach to conservation of biological diversity in fragmented habitats impacted by anthropocentric activities of varying intensities. Thus, the PARC site will consist of a network of linked core areas for strict protective measures integrated into a matrix of human-resource areas. This entire landscape, consisting of a mosaic of core, buffer, multiple-use, regeneration zones will comprise the PARC site"" (McElwee, 2001:16). Its focus was to build local capacity to implement integrated conservation and development programmes through the participation of local communities and government sector agencies.

Since 1992, the management of the park has followed the classic protected areas model. Attempts have been made to resettle upland communities, intensify lowland agriculture and to promote off-farm enterprises. In regard to the forests in the park, these are classified as 'special use' forest areas, and, in contrast to the 'production' and 'protection' forest categories described above, local people have lost formal control of these, an asset central for sustaining livelihoods (Zingerli, 2001).

A total of nine villages are located within the National Park, however, the focus of this research was upon the four lakeside villages. Approximately 1,022 people, predominantly from the Tay ethnic minority group, live in 225 households within these four villages. The main livelihood activities are derived from agrarian activities including land cultivation (rice and maize), livestock breeding and husbandry, fishing, tourist boat trips and, for 19 households, tourist homestays.

Hybrid maize and rice varieties were introduced in 2000 and have largely replaced local varieties. Application of inorganic fertiliser is now required for hybrid varieties in addition to the use of chemical pesticides. Livestock rearing and husbandry is an important source of income for households who rear buffalo, cattle, goats, pigs and poultry (mainly chickens, but also ducks and geese). Fishing in the lakes is also a significant activity for

most households. However, decline in lake fisheries productivity in the past 20 years has significantly reduced the number of fishermen who derive their primary source of income from fishing. This has resulted in a change towards obtaining livelihoods from off-farm activities including tourist and lake transportation and offering home stay accommodation and services to tourists. (Le Van Phuc and Dine 2009).

The Nam Mau Commune and the villages within it are classified as being a 'poor' commune and therefore eligible to participate in the Government Programme No. 135 (from June 2010, Programme No. 136) The 135 Programme is a World Bank funded project that seeks to alleviate poverty and promote infrastructural development in 1,715 of the poorest mountainous and remote communes in the country (Government of the Socialist Republic of Vietnam, 1998; Vietnam Development Report, 2000).

The PARC project funded a wide variety of village level projects to encourage sustainable livelihoods that both balance economic development and biodiversity conservation, ranging from livestock breeding and husbandry, training village para-veterinarians, eco-tourism, agroforestry, introduction of crop intensification, and activities to stimulate off-farm enterprises such as training courses in knitting traditional cloth, wine production and traditional food production (UNDP, 2009).

In October 2009, The People Resources and Conservation Foundation (PRCF) completed a project aimed at "strengthening the Ba Be Lake Management Committee to identify and address key lake resource management and conservation needs, while promoting sustainable livelihoods in lakeside villages". Key outputs from this project included: drafting of strategic management directions for Ba Be Lake and Lakeside Management Strategy 2010-2020 and Actions 2010-2015; Participatory Village Development Plans (four lakeside villages); establishment of self-help groups including pig breeding and chicken/ duck raising; establishment of a small revolving fund credit project with the Nam Mau Commune Women's Union; draft Sustainable Fishing Management and Lake Management Regulations; preparation of a short to medium term Agroforestry, Agriculture and Livestock Action Plan (PRCF, 2009).

AIMS AND OBJECTIVES

The overall aim of this research is to gain an insight and understanding of:

- Rural livelihoods in the lakeside communities of Ba Be National Park;
- Challenges that households, and different household members, have in sustaining those livelihoods;
- Local perceptions of changes to local climate over time, and any impacts that these changes have had on livelihood strategies

A second aim is to discover the local systems for weather forecasting used by local people, and to make an initial assessment as to whether these indicate a changing climate.

A third aim is to build capacity within the PRCF in participatory research methods.

Specifically, the objectives of the research are to:

- Describe activities that comprise livelihood systems in the communities
- Appraise the strategies that household members employ to sustain livelihoods
- Assess the challenges that households face in sustaining livelihoods
- Identify local perceptions of climate change and impacts to livelihoods and quality of life
- Reveal local indicators for weather forecasting
- Train PRCF staff in participatory research and mentor and support staff to carry out data collection and analysis
- Present recommendations for future development work, particularly in relation to climate change adaptation, by the PRCF in the lakeside communities

OUR APPROACH

For adults and children, households and communities, vulnerability to environmental shocks is part of everyday life. The impacts of climate change are just one of many challenges that people have to face; floods, droughts, erratic rainfall, pests and disease are common hazards faced by those living in rural areas of the developing world. Climate change represents another layer of risk on top of the already risky environments that rural households and communities have to manage, and plan for livelihoods strategies.

Consequently, the approach used to investigate the impacts of changing climate on people's lives and the strategies they employ to adapt to new conditions needs to be contextualised within a broader framework of analysis. It is not appropriate to conceptualise climate change in isolation,

as a discreet and separate phenomenon. The threat of climate change is one of several risks that households and individuals need to manage in order to sustain their livelihoods. In other words, strategies to adapt to climate change (one of many environmental hazards) and other challenges, such as ensuring food security or poverty alleviation, converge to the same point – security of livelihoods and assets to ensure people's wellbeing (Reid *et al*, 2009).

There is much experience in the field of disaster management and relief, particularly in the non-government (NGO) sector. The approaches used come under the generic title of Community Risk Assessment (CRA). CRAs are designed to assess local vulnerabilities to environmental shocks and hazards (e.g. flooding, cyclones and drought) and local capacity to deal with such disasters. A central feature of CRAs is on their use of Participatory Appraisal (PA) methods designed to "…diagnose vulnerabilities, assess a community's risk priorities, and work together with the people to devise ways of increasing their capacities to resist hazard impacts" (van Aalst *et al*, 2009:166).

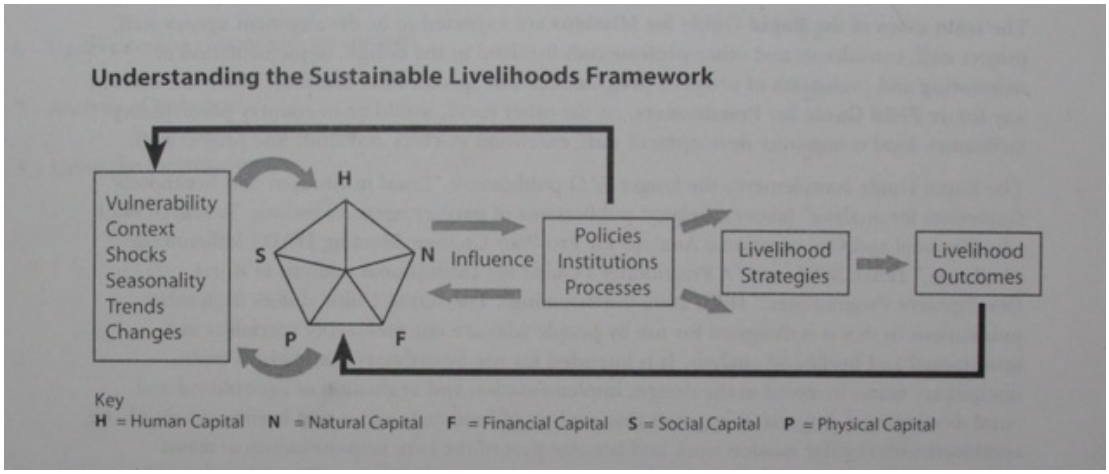
For this study we will use the Sustainable Livelihoods Framework that provides an analytical tool for analysing the impacts of environmental shocks and hazards, including those arising from changing climate, on rural livelihoods. The Sustainable Livelihoods Framework is based on the work of Scoones (1998).

The Sustainable Livelihoods Framework conceptualizes households as having a bundle of assets or capital entitlements. These are: natural, social, financial, physical, human capital. For example, natural capital may be land, forests and fisheries, Social capital refers to relationships within households and between households and communities, membership of formal and informal groups. Financial capital relates to savings, access to credit and income. Physical capital includes livestock, machinery and buildings. Human capital depends on household members, education levels, knowledge, access to labour (Stewart Carloni and Crowley, 2005). Households use these assets in various combinations in developing strategies for sustaining livelihoods.

External institutions and government policies can either act positively to enable households to access assets or negatively by disabling access to assets. For example, government policies to enclose common lands for commercial agriculture may deny access to households that used the land for grazing livestock. Policies designed to provide credit at low rates of interest enable households to access financial resources for household enterprise, or farming. Policies to provide non-formal education for children while working on farms or tending livestock may enable households to increase their human capital. Group membership institutions such as farming cooperatives may enable households to access physical capital such as livestock, tools and technology. Membership of women's organisations may enable households to access human capital for market gardening.

In addition to external institutions and government policies, the vulnerability of households to shocks and events also impacts on their capital assets and hence their ability to sustain livelihoods. For example, the impacts of environmental shocks and hazards such as floods, pest outbreaks and drought on household strategies to sustain livelihoods, will depend on the degree of vulnerability of the household to the shock or hazard. For example, a household will be extremely vulnerable to a flood that results in the loss of its rice crop if it has little or no other assets, and therefore few options for an alternative livelihood strategy.

The figure below illustrates the Rural Livelihoods Framework model described above.



Source: Stewart Carloni and Crowley (2005:2)

For this research, investigating the impacts of climate change and households' adaptation to climate change will be carried out within the context of the Rural Livelihoods Framework. Changing climate results in additional environmental shocks and hazards for households. The vulnerability to these shocks, together with the institutional and policy context will determine households' adaptation strategies and their ability to sustain their livelihoods.

A team of four researchers recruited by PRCF was trained in participatory research methods and the framework described above. The training comprised an initial two-day workshop in Hanoi followed by two reflection and review days.

The team was mentored and supported to conduct focus groups and workshop session with different groups within the four lakeside communities. At the end of each day, the team came together to debrief the information generated from each session.

WHO WE SPOKE WITH

Over the eleven day period from 26 January to 5 February 2010 the research team facilitated twenty-one workshops and spoke with 182 people. Each workshop ran for 1.5 to 2 hours. The table below outlines the workshops, the gender mix in each, the research focus and facilitation technique used for each workshop.

Workshop	Participants	Question/ focus	Method
1	2 female 1 male	Institutional analysis	Venn diagrams
2	1 female 3 male	Problems associated with climate change	Pair wise ranking matrix
3	1 female 2 male	Historical perspective	Timeline
4	2 female 1 male	Farming practices and changes over time	Seasonal calendar
5	9 female	Environment and livelihoods	Village mapping
6	5 male	Historical perspective	Timeline
7	6 female 2 male	Fisheries management & indicators for weather forecasting	Lake mapping
8	9 female	Intra-household division of labour	Seasonal calendar
9	1 female 4 male	Indicators for weather forecasting	Matrix
10	1 female 5 male	Fisheries management & indicators for weather forecasting	Lake mapping
11	16 female	Issues around climate change	Network diagram
12	12 female 7 male	Historical perspective on environmental change	Mapping and ranking matrix
13	4 female 4 male	Evolution of the river	River mapping
14	3 female 8 male	Indicators for weather forecasting	Matrix
15	4 female 8 male	Community visioning	Drawing
16	14 female	Income and expenditure	Pie charts
17	6 female 9 male	Land tenure relationships	Resource tenure mapping
18		Indicators for weather forecasting	Matrix ranking
19	1 female 10 male	Income generation	Action planning grid
20	2 female 8 male	Community visioning	Drawing
21	3 female 8 male	Feedback and verification	Network diagram & Verification matrix

The purpose of each session was to gain an insight into different activities and aspect of livelihood strategies. The characteristics of livelihood assets as well as the differences in these between households and village communities were also explored. The intra-household relationships were also discussed revealing gender and age differences in activities and strategies. The vulnerability of households to environmental change was assessed, and government policies and institutional structures relating to environmental management were reviewed.

Discussions also focused on local perceptions of changing climate, how this had changed over time, and the impacts that this had on the livelihood strategies for different households. Conversation also covered the degree of vulnerability to climate change and how this affected households' livelihood assets and adaptation strategies. The institutions that enabled households to deal with environmental change including climate change were also identified and reviewed. Workshop participants were also facilitated to identify and evaluate local indicators for weather forecasting.

A final workshop was held to feedback findings and initial analysis to representatives from the lakeside communities and local government departments. The purpose of this workshop was also to verify our findings and deepen the analysis.

WHAT PEOPLE TOLD US

The analysis of rural livelihoods and climate change presented in this section is based on the data collected from each workshop. The analysis and interpretation of that data is made by the author. Any misinterpretation of what was said is solely the responsibility of the author.

Rural Livelihoods

Natural capital provides the foundation for livelihoods in each of the lakeside village communities. Access to and use of cultivation land, fish and forest provide the resources for households to sustain their livelihoods. However, in the case of the four lakeside villages, access to natural resources is also limited by the presence of the National Park which legally restricts households to certain areas and also to the types of resources they can harvest and use.

The main livelihood activity for the majority of households is farming which includes crop cultivation, livestock breeding and husbandry. Other livelihood activities of significance include fishing, boat transportation (both tourist and local), collection of non-timber forest products (NTFPs) and tourist homestay accommodation. Other activities include fuelwood collection and timber collection for house construction and maintenance.

Crop cultivation occurs on lowland floodplains immediately adjacent to Ba Be Lake, floodplains along the Nang River and a number of tributaries directly entering the Lake. Cultivation also takes place on upland slopes (forest and cleared). However, these areas are limited in extent and area by the boundaries of the National Park's Strict Protection Zone.

Crops cultivated include rice and maize with some lesser crops such as sweet potato, cassava, vegetables also grown. Two crops of hybrid "wet" rice are grown annually and are predominantly grown on lowland floodplains with occasional dry traditional rice cultivars grown on the upland slopes when wet rice crops fail. Pesticides and fertiliser are applied to the hybrid rice varieties. The seasonal calendar for crop cultivation is shown overleaf.

The rice is primarily for home consumption. Maize kernels and leaves are used for fodder. The leaves are also used for fodder. Both may also be sold at the local market to raise income when cash is needed.

Households still cultivate a small amount of traditional variety maize for household consumption. Local people indicated that they preferred to eat this variety rather than the hybrid variety because of the local variety's superior taste. Traditional maize is only cropped once annually from February (planting) to July (harvesting). Pesticides and fertilisers are not applied to the local variety maize.

Sweet potato, cassava and to a limited extent soya beans are also cultivated for home consumption. Vegetables are primarily grown for sale to be consumed by tourist visitors. Fruit trees have been planted and are tended by households including guava, apple, banana, jackfruit and grape fruit. However, some households grow a wide variety and rely upon them for a greater proportion of their household income than others.

All farming households have access to a buffalo and plough to prepare the land for sowing. Poor households who do not own a buffalo share them through kinship relationships. Few households have physical assets such as mechanized, petrol driven, ploughs. Many households have access to petrol powered irrigation pumps and those that don't also share through kinship relationships. In one village a communal bamboo water wheel is used for irrigation; village residents are communally responsible for its operation and maintenance.

	Spring rice	Summer rice	Maize (1st crop)	Maize (2nd crop)
December	Land preparation for seedlings		Land preparation	
January	Seedling germination; Preparation of cropping land		Planting	
February	Transplant rice seedlings to fields		Tending	
March	Tending crops		Tending	
April	Tending crops		Tending; Harvest maize leaves	
May	Harvesting	Land preparation for seedlings	Harvest corn	
June	Harvesting	Seedling germination; Preparation of cropping land		
July		Transplant rice seedlings to fields		Land preparation
August		Tending crops		Planting
September		Tending crops		Tending
October		Harvesting		Tending
November		Harvesting		Tending; harvest maize leaves
December				Harvest maize

After farming, fishing is the most significant livelihood activity for lakeside households. Around a third of households have a member who is a full-time fisher. Small fish are generally kept for household consumption, whilst larger fish are sold to passing fish merchants on motorcycles or transported to local markets for sale. Most households will conduct some level of fishing activity with the catch being used for home consumption to supplement other sources of protein e.g. eels and shrimp. Some fish will be dried and sold to tourists visiting the lake. Shrimp are grilled, steamed and fried and in one particular village a famous shrimp paste known as 'Mam Tep' is produced and sold to tourists at local markets.

Boats and nets are the physical capital needed for fishing in addition to a number of varieties of bamboo traps (made from locally available resources) used to catch eels and shrimp. All households have either small wooden or metal canoes for basic transportation and fishing purposes and are considered to be the local equivalent of "*like owning a bicycle*". The construction of canoes from wood is now prohibited within the National Park and all replacement canoes much be constructed of metal.

Fishing takes place all year round. During the winter months of December to February, less fish are caught because of the cold weather, and nets with smaller mesh size are cast. At other times of year the mesh size is greater. From April to May pregnant females are observed throughout the lake and lay eggs in a number of locations in the lake. During May and June fishing takes place both night and day, and during August and September the greatest number of fish are caught. The main species caught are Catfish, a number of species of Carp and Sharpbelly (Ca Muong).

Forests represent an important natural asset for households. Firewood, timber and non-timber products e.g. mushrooms, bamboo (shoots, traps, construction materials) are derived from this source. Firewood is collected for home cooking and space heating, and a considerable amount is consumed to cook food for pigs. Some may be sold at local markets. Timber for roof construction and building is also collected for domestic use and for sale. When cash is needed for emergencies, or for special events, such as weddings and funerals, the household will sell timber cut from the forest.

Households that are able to generate a surplus from their natural capital assets, will purchase livestock. Buffalo, cows, pigs, chickens and ducks are bred and reared by households. These represent physical capital assets and a source of income.

Boat transportation is an important source of income for about 60 households. Transporting tourists around the lake and as a means of local transportation is a key revenue source for those households. (Some boats on the lake are owned by people who do not live in the lakeside villages.)

Young people (18 to 25 year olds) also migrate away from the communities to work and send remittances back to their families. Some work in factories within Vietnam and others go abroad, e.g. to Taiwan.

Within the household, livelihood activities are conducted by different members. The tables overleaf show which activities are carried out by different household members, differentiated by age and gender.

Female activities by age	Home maintenance	Farming	Fishing	Livestock	Forest products	Boat transport	Migration
Young girls	Attend school and assist with food preparation	Help carry harvest home and help plant crops Occasionally assist to harvest rice/corn	Catch snails & clams from shore	Girls older than 12 know how to tend livestock i.e. feed, bath, identify when ill (but not diagnose). Clean pig sty	From 11 to 12 yrs old accompany women to collect firewood Carry 2 - 3 branches, one meter in length.		
Women	Prepare meals Household chores: cleaning, washing and tidying Attend to the garden	Do most of the work: spray pesticide; seedling germination; field preparation with oxen plough; transplant seedlings to field, tending, harvesting and husk rice Harvest all fruit from trees	Stay close to village Fish in streams and lake shallows Fish for smaller fish, shrimp, snail and clams Responsible for selling all fish caught by family at the market	All women go to forest to collect vegetables, and plant some in their gardens to feed pigs Slice banana stems Prepare and cook pig food and clean pig sty	Often go alone to collect firewood and carry home Collect only branches and carry 15 - 20 branches each 1m in length; Collecting mushrooms and other NTFPs	Women only use the wooden/ metal boats for fishing	18-25 yr old migrate to find work in Vietnam and abroad, send remittances home
Elderly women	Tidy and clean house Child care Might cook fish or shrimp	Bring harvest outdoors on sunny days to dry and turn it over Remove corn off the cob		Tend buffalo, bring them to the forest or fields in the morning, return in the afternoon and tether them			

Male activities by age	Home maintenance	Farming	Fishing	Livestock	Forest products	Boat transport	Migration
Young boys	Attend school and assist with food preparation	Help plant crops	Allowed to fish independently at the lake Boys under 10 years old fish in streams and catch small fish and shrimp		From 11 to 12 years old, accompany women to collect firewood Carry 2-3 branches, one meter in length		
Men	Construct and repair house (roofs and walls)	Few men assist wives to irrigate fields If own a mechanical plough will plough fields Some will assist in spraying pesticide and transport harvest from fields to home Build and maintain waterwheel Plant perennial fruit trees	Often go fishing on lake Construct and repair boats Buy and repair fishing nets	Harvest banana stems for pig food Often carry manure to field Maintain pig sty	Occasionally collect timber & firewood	Men only use motorised boats	18-25 year olds migrate to find work in Vietnam and abroad and send remittances home
Elderly men	Assist younger men to repair house Might cook fish or shrimp	Protect drying crops from being eaten by chickens and ducks House security function		Tend buffalo, bring them to the forest or fields in the morning, return in the afternoon and tether them (not all elderly men will do this. Dependent on whether wife is still alive.)			

Fisherwomen in lake

Motorised transportation boat

Photos: Robert Nurick

Woman preparing rice field

Mother and son threshing corn

Photos: Melanie Argimon

Traditional knitting loom

Pigs feeding on straw

Photos: Uong Sy Hung/ Thai Thi Ngoc Tram

Policies and institutions

Households' capital assets, and with them, the activities carried out to secure livelihoods, are mediated by the institutional arrangements – the rules, regulations and norms – that govern their access and use. It is these arrangements that determine 'the rules of the game'. Internal, or local, institutions evolve over time, influenced by history and custom. External institutions are those set up by the State at the commune, district, province or national level. These too, evolve over time with changing political regimes and priorities and goals of the State.

The most significant change in institutional arrangements governing control and access to natural capital for households in the lakeside communities has been the establishment of the National Park in 1992. The National Park Management Board was established as the implementing agency for the rules and regulations governing the National Park. In particular, the rules governing households' access and use to the forest has changed radically. Before 1992, under the collectivisation policy, cooperatives and collectives made up of individuals from the communities would have had access to the forests to collect timber and firewood and non-timber products, e.g. wild foods and medicinal plants, and to practice swidden cultivation of upland local varieties of rice and maize. As was discussed in the earlier section, many cooperatives and collectives in the remote northern parts of Vietnam were not fully implemented, such that traditional communal forest and forest resource tenure relationships would have provided the *de facto* institutional arrangements.

Terrestrial forest protected areas under Vietnamese Law are referred to as "Special-Use Forests" (SUFs) and include a number of SUF classifications such as National Park, Nature Reserve and Species and Habitat Conservation Areas. Within the Ba Be National Park SUF, there are three defined sub-zones: Strict Protection Zone (SPZ); Ecosystem Rehabilitation Zone (ERZ); Functional/ Administration Zone. The rules governing the access and use of the three sub-zones are set at the National level and implemented through the Management Board, which in turn are overseen by either National or Provincial government depending on the protected area's national management status.[3]

In the SPZ all activities not directly related to biodiversity conservation are prohibited. In the ERZ, upland crop cultivation of rice, maize and other crops, felling of trees for timber for house construction and canoes, fuelwood and NTFP harvesting are prohibited. However, the Management Board permits harvesting of NTFPs, fuelwood and timber for household construction and repairs for domestic consumption only, for lakeside villages. Further, in the ERZ from 2010, the Management Board has allocated more than 5,000 ha of forest land under "Green Book" contracts to 766 households within the National Park communities to manage and protect the forest areas on its behalf (BBNP and Birdlife International

[3] The National Park Headquarters complex is the only area of functional/ administration sub-zone in the Ba Be National Park.

(2010)). These "Green Book" contracts are funded by the National Government's soon to be completed (2010) Five Million Hectare Reforestation Programme (661 Programme), which aims to increase the amount of forest throughout the country to 43% by 2010. Individuals with Green Book contracts must follow regulations set by the National Park and are permitted to collect forest products to a limited extent for domestic consumption. Under the 661 Programme, local people under contract receive payments for their forest management and protection services. Since 2003 the payment per hectare per annum received by households has steadily increased.

Entry to the SPZ is prohibited, and only those with contracts are permitted to enter the ERZ. Enforcement and monitoring of the rules is the responsibility of the mobile ranger force and guard units (Grieser, 2003).

Prior to 1997, farmers were allocated wetland paddy rice fields through the Nam Mau Commune Agriculture Collective. In 1993, the collective system was replaced with the decentralization process brought in by the 1993 Land Laws. Households were granted full transferable rights to the agricultural land that they had been cultivating as members of the Nam Mau Commune Agricultural Collective. Each farmer with a legitimate claim was allocated 'Red Book' land ownership certificates.

The rules and regulations that govern the fisheries resource of the lake and the connecting rivers and streams combine both external institutional structures and local institutional arrangements. From 1960 to 1979 members of the District level Fishing Cooperative (a collectivised District level institution established to harvest fish resources to supply the war effort) fished Ba Be Lake, in addition to subsistence and livelihood fishing by lakeside village communities. This cooperative was disbanded in 1979.

Since 1992 the rules governing lake use have been the responsibility of the National Park. In 2007, a new lake management regulation was enacted by the Province, restricting fishing hours, gear usage and prohibiting the use of motorboats for fishing.[4] Other rules governing the use of the lake include a ban on fish farming and sand mining.

Informal local institutional arrangements influence access and use of aquatic resources in the rivers and streams entering and flowing from the lake. The lakeside communities have informal agreements with each other relating to access to and use of the resources is exclusively for each village that is located by the river or stream.

In April 2004, fishermen and boat owners from the villages that surround Ba Be Lake, in cooperation with Ba Be National Park and District and Commune leaders, established the Ba Be Lake Management Cooperative (BBLMC), with responsibility for managing the sustainable use of the lake's resources, as well as for providing boat transportation tourism services.

[4] It was reported that the regulations were enacted with little consultation with the communities most affected by its implementation (Dine, 2010)

At present the BBLMC has approximately 54 members who come from villages within the National Park. The BBLMC has a board comprising six members: three from the National Park, two from the People's Committee of Nam Mau Commune, and one from the People's Committee of Khanh Ninh (Ba Be National Park, 2005).

Financial institutions enable individuals to access credit facilities for farming, livestock rearing and off-farm enterprises such as weaving. Credit facilities are provided to farmers through the Bank for Social Policy (Bank for the Poor) and the Agricultural Bank. The Bank for Social Policy, a government institution, provides loans at below market interest rates. However, these loans are disbursed mainly through the Farmer's Union, Women's Union and Youth Union. Individuals may only access loans if a member of a union, and the individual Union group they are a member of will act as guarantor for the loan. The Agricultural Bank provides loans at commercial rates of interest.

Women's Union members can obtain loans for agricultural purposes from the Bank for Social Policy. However, the loan application must be countersigned by the husband, and both are responsible for paying back both loan and interest. The loan is guaranteed by the village level Women's Union. In other words, if the woman and her husband default on the loan the village level union is responsible for repaying the loan.

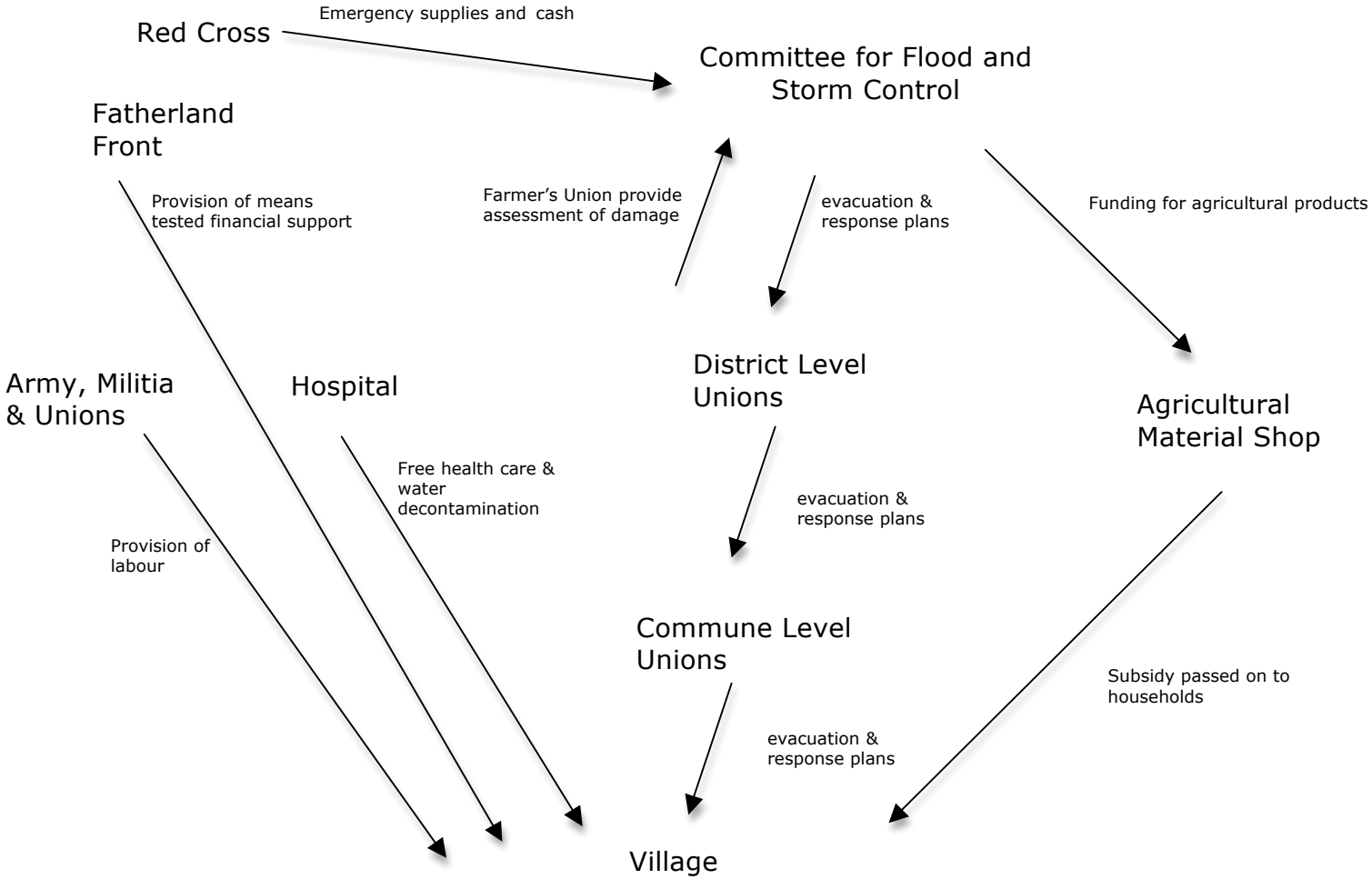
In 2009, the PRCF commenced a small revolving credit fund with the Commune Women's Union. Women who are members of the Union are eligible to apply for loans; loans have been disbursed for income-generating activities such as the provision of seed funding for the Women's Union Revolving Fund Self-Help Group (PRCF, 2009).

In 2002, the PARC project introduced new higher yielding varieties of rice and maize, and introduced new technologies for cultivation – inorganic fertilizers and pesticides, and polythene sheeting to protect seedlings from cold and pests.

Extension services to encourage and train farmers in the new technologies were provided through the District level Department for Agriculture and Rural Development and the Commune Farmer's Union. Village Assistance Funds and Agricultural Seed Banks have been established to support agricultural intensification (UNDP, 2009).

There is an array of government institutions at the provincial, district, commune and village levels that provide support to individuals and households in the event of environmental shocks and hazards such as floods and droughts. The diagram overleaf shows the links between these institutions.

Institutional Mechanisms for Providing Support after Floods and Natural Disasters



The organisation responsible for coordination is the Committee for Flood and Storm Control. This is the umbrella government organisation responsible for mobilising the district and commune level emergency services – army, commune militia, Youth, Farmer's and Women's Unions, and other district level organisations – when bad weather conditions are forecast or extreme climatic events have occurred. The emergency services will implement evacuation and response plans in the case of flooding or natural disaster.

The district level organisations, in turn, will direct/ instruct their counterpart organisations at the commune level, that in turn, will relay information and direction to village level institutions.

At the District level, the Farmers' Union is responsible for evaluating the extent of the damage caused after the event and submitting its report to the Committee for Flood and Storm Control. The Committee officially requests financial and relief support from the government. Part of the financial resources allocated from government is used to subsidise agricultural inputs sold by the Agricultural Material Shop (a state enterprise company, 51% government owned) to farmers.

The Red Cross Association provides emergency supplies of food and clothes and will also provide cash to the most vulnerable households. This support is disbursed through the Committee for Flood and Storm Control.

The District hospital will provide free medical treatment in the case of natural disasters and will also send staff to villages to aid relief efforts and to treat contaminated water for household consumption, when required.

The Fatherland Front means tests households to determine the highest priority households to receive financial support. The financial support distributed by the Fatherland Front is generated through a contribution of one day's salary by each government staff member in the country.

The army, commune militia and Youth, Women and Farmers' Unions provide support through their labour to protect property and livestock and to repair, for example, damaged buildings, fencing and other infrastructure.

Historical perspective

The timeline overleaf provides the historical context for present day livelihoods and the discussion on local people's perception to climate change, vulnerability and livelihood dynamics, which are the focus of the following sections.

Settlement of some lakeside communities took place initially in the 1940s and the others, in the early 1960s. Older people recalled that grandparents had had a connection with the area in the past, having lived in the area either seasonally or temporarily to take advantage of the lake for fishing. Most of the villages were initially established with between six and eight households.

Swidden – shifting cultivation agriculture – accounted for extensive loss of forest over the period 1975 to 1985. This intensified after the influx of H'Mong people (see below). In the early stages of village development upland extensive upland cultivated was the only form of agriculture. Crops grown included maize, rice, cassava and vegetables.

In the late 1970s with the end of the war with the USA, there was a large expansion of cultivated land as the population rapidly increased. This resulted in extensive clearing of upland forest areas between 1978 and 1980. At this time wetland rice cultivation commenced on the wetland and floodplain areas surrounding the lake.

In 1979, members of the H'mong ethnic community began to migrate to the upland areas, fleeing the Chinese incursion into neighbouring Cao Bang Province. 400 households had arrived by 1986. With the creation of the National Park, the government attempted to resettled the predominantly H'Mong upland communities. In 1995, 200 H'mong households were offered financial incentives to resettle in southern Vietnam. In 2005, an attempt to resettle the remaining 200 households outside the National Park to neighbouring communes failed and the majority of these households migrated back to the upland areas of the National Park.

While it was observed that there has been a marked reduction in deforestation within the National Park, participants believe that the rates of deforestation in the forest upland areas immediately outside the Park boundaries have increased significantly.

Support to farmers for agricultural intensification originally came from the PARC project in 2002, with the introduction of high yielding crop varieties and the technologies required for these. In 2007, under the Government's Programme 135, irrigation systems were upgraded.

Timeline of significant events

1945:	Settlement of villages commenced
1949:	Large flood
1960:	Ba Be District fishing cooperative established
Early 1960s:	Establishment of lakeside villages – maize, cassava, upland rice and fishing
1963:	Depth of Lake 2 measured 80m
1971:	large flood
Late 1970s:	Rapid population increase with end of war Wet rice cultivation commenced in floodplains below villages;
1978-2010:	Floodplain land used for rice cultivations has expanded into the lake – in places by 400m
1978-1980:	Extensive slash and burn in upland forest and around lakeside villages
1979:	H'mong arrive – fleeing Chinese incursion Fishing cooperative disbanded after end of American war
1980-1986:	H'mong continue to arrive and settled in three villages (of 400 households) in the upland areas
1986:	Largest flood on record
1992:	National Park established
1993:	Prohibition of upland crop cultivation
1995:	200 H'mong households relocated to south Vietnam and received financial incentive to move
2002:	Drought PARC project introduced new variety of hybrid maize; new varieties of rice; pesticides, fertilisers and polythene covers for seedlings
2004:	Ba Be Lake Management Cooperative established
2005:	Relocation of remaining 200 households to neighbouring commune, but they returned Significant loss of wetland crops as a result of flooding
2007:	Ban on the use of motorboats for fishing in the lake Programme 135 upgraded the irrigation systems 82 transportation boats operating on lake
2008:	Unexplained death of many fish, Ca Chep (Common Carp) and Ca Muong (Sharpbelly) Winter: 45 days of extreme cold Three H'mong households in upland forest were destroyed by landslide Drought, flood, landslide and river bank erosion
2009:	Large flood July/ August large amount of Carp fish died
2010:	60 transportation boats operating on the lake Depth in Lake 2 measured at 20m Programme 30A commenced in Nam Mau Commune

With the creation of the Park, many rules and regulations have been introduced governing the management of the natural environment (discussed in the previous section). The Ba Be Lake Management Cooperative was established in 2004 as part of this process, to manage both the lake resources and lake activities. By 2010, there were 60 transportation boats operating on the lake, managed by the committee.

Over the decades local people have experienced significant environmental events. Floods have been a regular phenomenon dating back to 1949, the earliest recollection of a large flood. In the past, floods were relatively predictable and households had warning about their arrival. However, in more recent years floods do not follow a predictable pattern, occurring now at anytime of year, and much more rapidly. In the past, the water level of the lake would rise over a few days, providing warning to lakeside communities that a flood was imminent. Today, the flood can occur overnight. The process of deforestation that has been observed over the decades is thought to be contributing to the increasing frequency, faster peak flood times and severity of flooding. Lack of vegetative cover on the uplands (through deforestation and soil cultivation practices without appropriate sediment conservation techniques on steep hillslopes), reduces water infiltration and soil water retention and increases the rate of overland flow carrying sediment into the drainage lines and valleys below.

Other environmental events associated with the increased intensity of flooding include the increased rate and volume of sediment deposition in the lake and adjoining rivers, higher turbidity in the lake and overbank deposition of sediment on the high floodplains. Local people reported that because of upstream catchment deforestation and reduced upland vegetative cover, rain water had a higher capacity to entrain and transport top soil down slope (often in large sheets or through rapidly forming rills) and cause land slides. The majority of this top soil ends up as sediment in the rivers, streams and the lake, and during periods of lower flow, gradually moves downstream as large sediment slugs. This has resulted in a higher level of turbidity observed in the lake. In the past, after heavy rains and flooding, turbidity levels would remain high for three or four days, Nowadays, turbidity levels remain high for much longer. The 'doors of the lake' (where rivers and streams flow in and out of the lake) are silting up and this, according to local people, is accentuating the severe flooding that they are experiencing nowadays. Evidence of these changes is highlighted by the change observed in the depth of the lake. It was reported by local fisherman that, in 1963, the depth of the middle section of the Lake 2 was 80m. In 2010, the depth in the same location was 23m. Local people also reported that in some places the floodplain used for rice cultivation has extended into the lake by 400m over the period 1978-2010.

The changing pattern of flooding has impacted on agricultural land high on the flood plain adjacent to the rivers. In recent times flooding has resulted in claylike sediment being deposited on cultivated land up to 1m thick. Some villages have experienced bank erosion and loss of cultivated land as a result of flooding. For example, the channel of the Nang River at one village has widened from 20m in 1975, to 35-40m in 1986, to 50m in 2009.

As part of the collectivisation programme, the Ba Be District Fishing Cooperative was active from 1960 to 1979. Fish were used for the war effort as well as for domestic consumption. Although the Fishing

Cooperative ceased operation in 1979, extraction of fish has continued to an increasing extent.

Data indicates that there has been a significant decline in fish production over the decades, from 36 tonnes and 42 tonnes in 1960 and 1962 (Mai Dinh Yen, 1992) down to 7 tonnes in 2005, with a reduction in yield from 85 kg/ha/yr in 1961 to only 15 kg/ha/yr in 2000 (Nguyen Trong Hiep, 2001; Ngo Sy Van, 2005). Local people estimated that fish stocks have declined by around 70% over the last 30 years.

Fishing households also reported changes in fish behaviour over the years. In the past, spawning occurred at specific times of year i.e. in April/ May. In 2008, there was a significant 'out of season' flood in October. Pregnant fish were caught during this time. In December 2009, the same phenomenon was observed with fish spawning.

In late 2007/ early 2008, it was reported that there had been a mass death of fish. The fish species that died were the Common Carp (*Cyprinus carpio L*), an introduced species, locally known as Ca Chep (formerly a high economic value species prior to overfishing), and the Sharpbelly (*Hemiculter leucisculus*), locally know as Ca Muong (currently a species of high economic value).

Perceptions of climate change

The discussion in the previous section revealed local people's perceptions on environmental change that has been occurring in the area, as well as their recollections of the socio-economic and institutional changes that have taken place. Overlaying this analysis are perceptions of the extent of climate change and the contribution that such change is having on the socio-economic and environmental changes observed.

Participants in the workshops identified five climatic variables: rain, hail, drought, extreme cold and strong winds. The table below summarises local people's assessment of the changes that have taken place to each of these variables over time.

Climatic variables	Past	Present
Rain	Rain from April to August Floods occurred in May and June Extremely rare to experience heavy rains in December or January	Rain no longer follows regular patterns Floods are observed in every month of the year, including December and January Rains now occur during the dry season winter months of November to January
Hail	Hailstorms were a regular annual event Largest hail in living memory occurred in 1954 with stones 10 to 15 cm in diameter.	Hailstorms are rare and hailstones are very small. Last recorded incidence of hail experienced in lakeside villages was in 2004
Drought/ warmer weather	Drought was experienced, however, didn't last longer than two months at a time	Drought frequently lasts longer than two months In 2009 the drought lasted from June to December. The drought was broken by three days of continuous rain causing localised flooding
Extreme cold	Cold snaps occurred Extreme cold event with frost and ice observed on roofs during winter 1986; 20 buffalos died in the commune	The cold is not as serious as before Winter of 2008, the cold was extremely serious but no frost; 45 days in a row of extreme cold was experienced Many buffalo in other areas died but not those around the Lake
Storms/ strong winds	One village frequently received strong winds during Autumn from the NNE	Strong winds still blow from NNE in autumn, however, on a number of occasions these have been very powerful removing roofs of houses.

To summarise, rainfall patterns are less predictable today, with rain falling at all times of year. The climate appears to be getting warmer: hail storms no longer occur, drought is a more frequent phenomenon than in the past, and, today, the cold spells during winter are less severe than in the past.

Climate change, vulnerability and livelihood dynamics

The diagram overleaf illustrates the impacts that climatic variables – hail, storm/ strong wind/ rain/ cold and drought – have on environmental resources and rural livelihoods.

Flooding has the most widespread impact on livelihoods for the lakeside communities. The immediate impacts result in illness and disease for people and livestock; significant damage to houses, crops and fields; contamination of drinking water, and destruction of roads. Impacts also include siltation of the lake and rivers, and children being unable to attend school. The siltation of the lake, in turn, has resulted in loss of fish species and decline in overall fish stocks as critical egg laying and macrophytes beds frequented by small fish, have been covered by sediment. This results in greater fishing activity, and for some households, becoming more involved in the tourism sector (and to a lesser extent for general transportation). The increased use of diesel for boats for tourism has resulted in pollution of the lake with extensive oil films observed on lake plants and fresh water snails and mollusks observed to have diesel residue inside their shells.

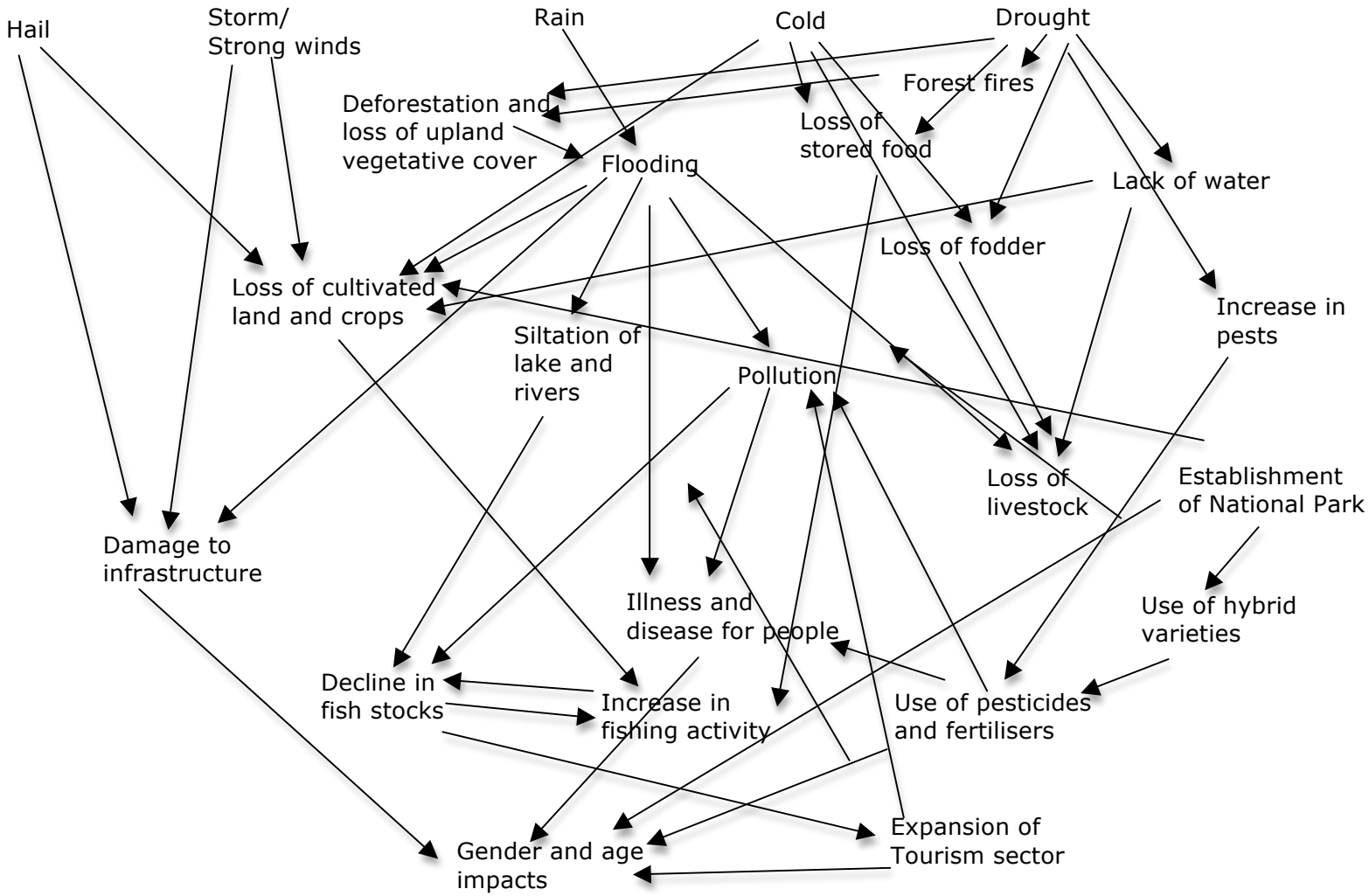
Illness and disease has disproportionate impacts on women, who are responsible for caring for sick and infirm household members. The loss of crops and cultivated land leads to an increase in fishing activity and greater reliance on unsustainable fishing techniques and methods as households seek alternatives sources of livelihood, which further compounds the decline in fish stocks.

In 1986, the largest flood on record resulted in erosion of land with fields being washed away, claylike sediment being deposited on agricultural land (up to 1m thick in places) that reduced productivity for three years. In one village a house and cooperative shop were destroyed. When the road was washed away vehicles were prevented from entering or leaving the area.

There was broad consensus that the increased severity of flooding is due to deforestation and general loss of vegetative cover in the upland areas. There was a general perception that has been as a result of rapid population increase, the migration of people to the upland areas fleeing the Chinese incursions into northern Vietnam in 1979 and overall lack of enforcement of resource management rules by responsible authorities. The establishment of the National Park has also contributed to the upland deforestation. Whilst it was observed that the rates of deforestation in the SPZ have reduced, there has been accelerated deforestation in the areas immediately surrounding the protected area. The natural resources of the National Park are now facing ever-increasing pressures as the availability of natural resources outside the Park becomes exhausted.

The changing rainfall regime observed by local people adds another layer of complexity and vulnerability to rural livelihoods. Nowadays, rain occurs at anytime throughout the year, and with it the risk of flooding.

Network diagram highlighting dynamics of climate change, vulnerability and livelihood activities



The PARC project introduced high yielding crop varieties as a strategy for promoting agricultural intensification and rural incomes. Whilst resulting in higher yields, the hybrid varieties require use of pesticides and inorganic fertilizers that also add to the costs of production. This has resulted in pollution of waterways, as well as suspected health impacts for farmers. The pollution of waterways has led to pollution of the lake, and with it, impacts on fish stocks and contamination of locally available potable water. The health impacts of chemicals used by farmers have had gender impacts as women are both the users of the chemicals and responsible for caring for sick household members.

Farmers reported that the warmer weather and increasing incidence of drought has also impacted on agricultural practices. Crop yield tend to improve with the warmer weather, yet during drought the opposite occurs with hybrid varieties less well adapted as local cultivars and reduced yields. Further, with the increasing temperature pests are more prevalent, for example, local people reported that there has been an increasing incidence of flies and mosquitoes. In particular, high yielding maize is particularly susceptible to a worm that burrows into the stems and cobs. Farmers respond to this by increasing pesticide use and applying stronger pesticides. This then impacts on pollution of the Lake and increases health hazards for farmers. Drought has also resulted in the appearance of fissures in land and loss of vegetation on hillsides, compounding the problems of flooding and erosion. Drought also increases the risk of forest fires, and with it deforestation and loss of upland vegetative cover. Drought has serious impacts on people's livelihoods. It results in a lack of fodder, loss of food stores, a reduced supply of water for people, for livestock and for irrigation leading to loss of crops and stress for livestock.

The extreme cold events result in the loss of human food stores and livestock fodder, the death of livestock, and adverse impacts on people's health. Households traditionally allowed buffalo and cows to seek their own shelter from the elements in the caves in the upland areas and under the forest canopy. However, with the creation of the National Park, buffalo are prohibited from entering these areas. Gender impacts include increased work for women who are responsible for collecting firewood for space heating as well as caring for the sick members of the household. The new varieties of rice are particularly susceptible to extreme cold and households therefore risk losing these crops during the cold spells.

Strong winds and hailstorms lead to loss of crops, damage to homes and infrastructure (e.g. electricity cables and roads). These have the impacts on livelihood activities described above.

The diagram overleaf summarises the relationships between shocks, trends and changes that are experienced by the lakeside communities, households' access and use of capital assets, the institutions that mediate their use, and the livelihood strategies that households choose.

The creation of the National Park in 1992 has had a significant impact on households' access and use of natural capital assets. Households are no longer able to cultivate upland farms, nor collect timber and non-timber products from the forest areas. This has gender impacts: men now have to travel further to collect timber for building and sale; for women and children access to firewood and non-timber forest products become limited. This event represents a disabling policy for lakeside communities. Households that are particularly vulnerable to this institutional change are those that have little wetland farmland and few income generating options for raising revenue to purchase household requirements and diversify livelihood strategies.

For some households and individuals the creation of the National Park has created employment opportunities: local people are employed to protect and manage the forests through the National Reafforestation Programme – Programme 661. For others, income generation opportunities arise through engagement in the tourist sector through boat transportation (for motorised boat operators), offering accommodation to tourists and through performance of tradition dance and music.

The agricultural intensification project introduced by the PARC project represents an enabling policy initiative that has given households the opportunity to increase crop yields and generate a surplus that they can sell and purchase household needs. However, the effectiveness of these activities have been limited over time as the required ongoing technical training was not provided.

The new varieties of rice and maize have also enabled farmers to change to cropping practices in response to changing rainfall patterns. The new varieties have allowed for shorter cropping cycles and farmers plant a month earlier than they did in the past to avoid their crops being damaged by rains and subsequent floods shortly before harvest. The shorter cropping cycles have also enabled farmers to cultivate two crops of rice and maize each year. Consequently, farm output has increased significantly. However, the success of the new varieties relies on new technologies, i.e. pesticides, inorganic fertilisers and polythene sheeting to protect seedlings from the cold. It was reported that some of the poorer households cannot afford to purchase the sheeting, nor have the labour to cover the growing rice, thereby undermining the potential of their crop.

Shock, trends, changes

Changing rainfall patterns

Drought/ warmer weather

Pests and insects

External pressure on fish resources

Flood

Capital assets

Natural Capital
Loss of upland farmland and forest
Decline in fish stocks

Increases in financial capital through access to credit and employment and selling surplus crops and livestock rearing

Social Capital
Informal rules over fishing rights
Reciprocal support relations
Gender and age roles

Human capital
Health

Physical capital
Irrigation systems
Pumps
Ploughs
Homes and buildings

Policies/ Institutions

Creation of National Park

PARC project

Greater integration with market economy

Establishment of Ba Be Lake Management Cooperative

Mass Union membership

Programme 661

Programme 135/136, 30A

Credit institutions

NPMB regulations on fishing gear and fishing times

NGO initiatives

Livelihood Strategies

Sell livestock

Sell timber and firewood

Travel further for firewood, timber and NTFPs

Engage in tourism

Paid employment for forest management & protection

Intensify agriculture

Introduction of new farming technologies & cultivars

Shorter cropping cycles

Substitute maize for rice in drought periods

Engage in fishing
Change in fishing gear
Harvesting of eggs and pregnant and smaller fish

Livelihood Outcomes

Lack of resources for some households

Increased output/ sell surplus

Increased food insecurity

Increased cash incomes

Lack of access to new technical innovations and knowledge

Limited access to market information

An enabling institutional environment is provided by the Bank for Social Policy that offers credit at below market rates of interest to individuals that are members of the Farmers' or Women's Union. Membership of a union enables access to this credit for farming, livestock rearing and off-farm income generating activities, e.g. food production and weaving. PRCF has also commenced a small-scale low interest rate revolving credit fund targeted at village members of the Women's Union. However, for those women that are not members of the Union, this source of credit is not available. Upgrading of the irrigation systems under Programme 135 also represents an enabling policy facilitating farmers to maximise crop yields.

Farmers are also able to adapt to changing climatic conditions through their choice of crops. Maize is more drought resistant than rice and doesn't require irrigation. If the rains do not come when expected, farmers will opt to plant maize rather than rice on the floodplains. The new varieties of maize, whilst drought resistant and having shorter cropping cycles, are not favoured by households as a food source. This is in contrast to traditional varieties that were cultivated primarily for home consumption. The new variety of maize is cultivated primarily for fodder and for sale. This provides households with an alternative strategy for fodder provision for cows and buffalo that previously would have foraged for food in the upland areas. However, this change increases the vulnerability of poorer households to food insecurity. Households are now much more dependent on the market economy for purchasing food requirements, as they have lost a significant source of household food supplies with the substitution of traditional maize with the new variety. Furthermore, the issue of food insecurity is also compounded by the undiversified range of agricultural crops under cultivation within the area. If all the staple crops fail or have low productivity yield for a number of years, this leaves households, particularly poorer households with less diversified livelihood options, more vulnerable.

Flooding and deposition of sediment on wet rice fields further leads to substitution of maize for rice. In one village, rice could not be cultivated for three years as a result of deposition of clay-like substrate on the fields – maize was planted instead.

Households that are not able to generate sufficient crops to meet household needs will resort to other livelihood options such as fishing for home consumption and for sale. The declines in fish stock that have been experienced over the years (discussed above), means that smaller fish are taken than in the past, and households are forced into practices that are not conducive to sustainable fisheries. Fish are caught during the breeding season and eggs are taken from breeding areas, pregnant fish are not released after being caught, and destructive fishing methods are utilised to maximise the catch and kill non-target species in the process.

For households for which fishing is the main source of livelihood, changes to fishing practices and technology have occurred in response to dwindling fish stocks. Net mesh is smaller, nets are wider and are left in the water for longer periods. These practices put further pressure on fish stocks.

Informal arrangements between villages governing fishing rights, and the creation of the Ba Be Lake Management Committee represent strategies to promote sustainable use of fish resources. Despite local fishers' attempts to regulate fishing with bans on egg harvesting and exclusion areas during breeding seasons, lack of enforcement by responsible authorities results in continued extraction from outsiders and application of unsustainable fishing methods and practices.

Fishing households are particularly vulnerable to flooding. During a flood fishers are unable to fish until the turbidity has decreased sufficiently (now after 3 to 4 days, whereas previously 1 to 2 days). For households that sustain livelihoods primarily from fishing, rice cultivation is considered a safety net in case of failure to catch fish. For households that do not have this safety net livelihoods are compromised and assets decline. Men of these households may travel to cut timber and firewood for sale. However, the distances they need to travel have increased due to the prohibition on resource extraction from the SPZ and EPZ (timber and firewood for home consumption is only permitted from the EPZ).

Households that are particularly vulnerable to climate changes and shocks such as flooding are those that already experience food insecurity and have many children and have only one parent able to work (single parent households or those with a parent too sick to work). Poorer households whose homes are not made of concrete are vulnerable to extreme climatic events. These households tend to have their homes located below the flood water levels. Within the household it is children and elderly men and women that are most vulnerable. Adverse weather conditions impact on people's health, for example, the warmer more humid weather leads to mould and damp that penetrates into home, leads to respiratory problems; during cold periods poorer households suffer acutely as they have neither labour to collect, nor cash to purchase, firewood for space heating. Women are disproportionately affected by poor health within the household as they are the ones primarily responsible for caring for sick household members, and for the acquisition of firewood for domestic purposes.

Monitoring climate change

Planning for livelihood security and the options that individuals and households choose to achieve this requires good information about weather patterns and the trends in these over time. With such information local people and organisations can anticipate changes and adapt farming, fishing and environmental and livelihood management plans accordingly.

Local people reported that they received weather forecasts from three sources: the radio, watching television and from their own local experience. They were of the view that the most reliable source of information was derived from their local experience, because the forecasts made on both the radio and television were aimed at the provincial or Central North Vietnam scale and didn't provide specific forecasts for Ba Be National Park or Ba Be Lake with its own special climatic variability. Consequently, these forecasts were not very accurate or useful in assisting individuals and households in planning their work and lifestyle activities.

Many older members of the community shared their knowledge and expertise on local indicators for monitoring the weather or climate. The tables presented in the following sections show the indicators for each climate change event – rain, storms/ strong wind, drought and extreme cold (there were no indicators for predicting hail) – as well as those that indicate a 'change in the weather' more generally, and those that specifically indicate that flooding is imminent. In each table that follows, the first column records the number of workshops in which that particular indicator was identified. In addition, the tables indicate the level of reliability (high, medium, low) of each indicator, for which an assessment was made by participants based upon their local knowledge.

At the final feedback and verification workshop the indicators were presented. Participants were asked to confirm/ verify these indicators. The last column in the tables presented below provides the results of this verification exercise and assessed as either agreed, disagreed, or not known. Where no information on either reliability or verification was collected, n.d. – 'no data' is recorded.

Indicators for Rain

No of times identified	Indicator	Technique for forecasting rain	Reliability	Verification
1	Mountain Hawk Eagle *Spizaetus nipalensis*	Hawk perched on a tree branch calling: rain for a prolonged period	High	Agreed
3	Frogs	Frogs croak at night: heavy rain within one or two days	Medium to High	Agreed
1	Frogs	Frogs are observed migrating to ponds to lay eggs: rain within a week	n.d.	n.d.
1	Termites	Termites observed flying everywhere: rain within a day	Medium to High	Agreed
1	Dragonfly	Dragon fly swarming: rain within one or two hours	Medium to High	Agreed
1	Snub-tail Maccaque	Monkey retreats to cave: rain within a day	High	Not known
3	Black ants	Ants migrating to roof spaces with or without eggs: heavy rain/ flood/ storm	High	Not known
1	Chicken	Chicken wings drooping low to the ground, as if they are tired (in summer): rain with two or three days	Medium	Agreed/ Not known
2	Moon	Moon observed with black circle surrounding it: rain with a week	Medium	Agreed
1	Myna bird	Birds bathe in streams: rain within three hours	High	Agreed/ Not known
1	Bones of carp fish	Bones kinked in the middle: rain in the middle of the month Bones kinked at the end: rain at end of the month	n.d.	Disagreed/ Not known
2	Fish	Fish jumping and landing on their side: rain is coming	n.d.	n.d.
3	Cobra snake	Cobra swimming across the lake from one bank to another: heavy rain within two to three days	High	Not known
1	Aquatic plants/ algae	Plants rise to lake surface and blue in colour: rain is approaching	n.d.	n.d.
1	Fish	Many fish are caught at night: rain within one or two days	n.d.	n.d.
1	Fish	Presence of many fish swimming close to the surface: rain within one or two days.	n.d.	n.d.
1	Bird	Bird (species not recorded) is heard calling loudly in the forest: it is about to rain	n.d.	n.d.

Indicators for Storms/ Strong Winds

No of times identified	Indicator	Technique for forecasting storms/ strong winds	Reliability	Verification
1	Loris monkey	Monkey calls: there will be a strong wind	High	Not known
1	The sun	Sun is red in colour either in late afternoon or early morning: storm with strong winds are forecast in the following few days	Medium	Agreed
1	Clouds	Yellow clouds (like colour of chicken fat): storm or strong winds within one or two days	Medium (in the past high)	Agreed

Indicators for Drought

No of times identified	Indicator	Technique for forecasting drought	Reliability	Verification
1	Bird	Unnamed bird singing: drought during the forthcoming dry season	High	Not known
1	Black ants	Ants observed in a dense group moving down the walls at the end of the rainy season: drought in the following season	Medium to High	Agreed
1	Hawk	Hawk screeches: drought	High	Agreed
1	Color of the lake	Lake is blue: drought	n.d.	Agreed/ Not known
1	Cay Bo (local tree)	Leaves have small round holes: drought	n.d.	Not known
1	Tho Cuoc bird	Nests are low to the ground: drought	n.d.	n.d.
2	Moon	Moon has a bronze/ red outer circle: drought in 5 to 10 days	Medium to High	Agreed

Indicators for Extreme Cold

No of times identified	Indicator	Technique for forecasting cold	Reliability	Verification
2	Colour of the Lake	Water changes from blue to black: cold Lake appearance of boiling with black bubbles coming to surface, and surface appears to have a thin film on it: extreme cold predicted to last longer than usual	n.d.	Agreed
1	Lunar calendar	When the lunar calendar has a month repeated (i.e. in 2010 there are two months of December): it will be cold	Low	Not known
3	Sau Tree *Dracontomelon duperreanum*	Sau tree has many fruits (bears fruit in August/ September): it will be extremely cold and the cold will last longer than usual	Medium (in the past high reliability)	Agreed

Indicators for Change in the Weather

No of times identified	Indicator	Technique for forecasting change in the weather	Reliability	Verification
1	The elderly	Elderly feel headache and tired, back pain: the weather will change	High	Agreed/ Not known
1	Ca Muong (Sharpbelly fish)	The Ca Muong form large schools (usually in small schools): weather will change the following day	Medium	Agreed/ Not known
1	Ca Me fish	The Ca Me behave very erratically, they swim on the surface of the lake, and movement is felt on the surface of the lake: weather will change the following day	Medium	Agreed/ Not known
1	Hawk	Hawk flies and calls when it is raining: it will be sunny soon	Medium	Agreed

Indicators for Flood

No of times identified	Indicator	Technique for forecasting flood	Reliability	Verification
1	Moss	Water plant and moss (Tao) form into clumps and flow with the current: flood within a week	High	Agreed
1	Fish	Fish jump on the surface abnormally: flood	High	Agreed
	Black ants	Black ants moving in a queue up the walls of a building towards the roof: flood	High	Agreed
4	The plant of the riverbanks (Xuong Ca) and Mat Ca tree	If the fishbone tree bears much fruit that ripens at the same time: significant flooding Fruit of plants are white (usually fruit is milky in colour): flood	High	Agreed
1	Eugenia (Voi) (variety of tea)	Many fruit (in April): significant flood	High	Agreed
1	State of the water	Few fish observed in a flooded area: flood waters will rise much higher the following day	High	Agreed/ Not known
1	White breasted water hen *Amauromis phoenicurus* (Tho Cuoc bird)	If farmers observe eggs hatching in rice fields during October (close to harvesting time of second rice crop for the year) this will be interpreted as a sign to harvest rice immediately before an impending flood within the next three days. Whereas if eggs of this bird are observed to hatch in May or June (close to harvesting time of first rice crop of the year) it will be interpreted that rains and flood will occur later in the season	n.d.	Agreed/ Not known
1	Butterflies	Butterflies lay eggs in areas which are close to the surface of the water: flood	n.d.	Not known
1	Tho Cuoc bird	Nest high above ground: flood	n.d.	Not known

Criteria for selecting indicators

Clouds, bird, frog, white-breasted water hen, mountain hawk eagle and fish indicators were identified by workshop participants as being easy to observe and familiar to most villagers. Although these indicators were not necessarily considered to be the most accurate, their advantage is that they can be easily observed and could be used as part of a local forecasting system. Indicators such as the cobra snake were not regarded as being as useful for local people as the behaviour (i.e. swimming across the lake) was a rare event and observed only by a small number of people.

During the final feedback and verification workshop, participants were asked to identify criteria based upon their local knowledge for selecting local indicators that could form part of a local weather forecasting system. Establishing such a system would provide valuable data that could be integrated into more conventional forecasting systems at the at the district and provincial levels. A systematic monitoring system for local indicators would provide a planning tool for local people and, over time, provide information to help in the assessment of the degree and extent of climate change occurring in Vietnam and the region.

The criteria that participants considered important in deciding which indicators should form part of a local forecasting system were those that are:

- Easy to see
- Known by all
- Easy to hear
- Grounded in local experience and easy to remember e.g. ancestral experience, from life experience, heard from grandfathers; from poems and folk songs; grandparents' and elders' experience
- Accurate
- Observed often
- Easy to understand

Conclusions

The community engagement process in lakeside villages of Ba Be National Park revealed insights into local people's rural livelihoods, and the challenges and opportunities that they face in sustaining their livelihoods. The findings also highlighted community views on changing climate and how these perceived changes impacted on environmental change and livelihood strategies. A further outcome of the research was the initial development of a system for assessing local climate change, using locally based indicators for weather forecasting.

The lakeside communities of Ba Be National Park are some of the poorest in Vietnam, with subsistence farming, forest management and fishing the main livelihood activities. Population increase has been attributed as the driving factor accounting for environment decline, loss of biodiversity and deteriorating livelihood outcomes. However, analysis of livelihood dynamics and environmental change though an institutional lens, provides a deeper understanding of the causal factors of the changes taking place in the rural livelihood system. Within this framework population increase becomes a symptom of institutional failure rather than the primary cause of environmental and livelihood decline.

The declines in fish stocks in the lake have been monitored since the early 1960s. Much fish was extracted during the Vietnam war, and during the 1980s to the present day, fishing methods and practices reflect the lack of effective rules and regulations that govern fisheries management. The major concern for fishing communities around the lake is their inability to manage and restrict access to eggs, breeding grounds and fish stocks to meet urban demand. Further decline in fish species and composition has resulted from sedimentation and sludge deposited in lakes and tributaries, and pollution from chemical fertilizer and pesticide run off.

The establishment of the National Park in 1992 has had profound impacts on rural livelihoods. Traditional forest management regimes have been replaced with one that excludes local people from harvesting timber and other non-timber forest products. This has resulted in illegal extraction from protected forests as well as widespread deforestation in the upland areas bordering on the protected areas. Flooding, an increasingly extreme and frequent event in the lakeside catchment is attributed to deforestation, itself a direct consequence of an ineffective and inappropriate management regime.

Creation of new institutions have been designed to promote policies of intensification and commercialization of agriculture, off-farm revenue generating activities, tourism and paid employment as guards and custodians of the protected area, as alternative livelihood strategies to ones based primarily on local natural resource management. Livelihood outcomes for households have varied depending on access to capital and decisions made about livelihood strategies.

For those households that have access to credit, wetland farmland and physical assets, agricultural intensification has brought income generating opportunities and increased food security. Households with physical capital such as motorboats and accommodation have benefited from tourism, offering transport and 'homestays'. However, for those households that lack these capital assets, livelihood outcomes have deteriorated; households respond by selling livestock and intensifying fishing efforts, thereby compounding pressure on fish stocks and aquatic environmental quality. Household members may also migrate in search of work.

Within the household, livelihood outcomes have varied with changing policies and institutions governing access and use of capital assets. Women are particularly vulnerable to the changing institutional environment. They and their children are responsible for collecting firewood and non-timber forest products – medicinal plants, mushrooms and other wild foods. Prohibition from protected forests means that they risk sanctions if caught collecting from these areas, and have to travel greater distances to forests outside the strict protection zone. Women are the primary carers in the household for the ill and infirm. During the winter months, the lack of cash to purchase firewood for space heating impacts on the elderly and children. Women are also affected by agricultural intensification – at risk from potential health impacts of chemicals, and responsible for purchasing and implementing the technologies required for successful cultivation.

Rural livelihood strategies and outcomes have been profoundly influenced by the changing policy and institutional framework. In addition, changing weather patterns perceived by local people, are adding an additional layer of complexity to livelihood strategies. Increase severity and frequency of flooding has been compounded by changing rainfall patterns observed by local people; warmer weather and drought has led to increased prevalence of pests and reduced yields of hybrid varieties.

The findings revealed the detailed local knowledge that older individuals have in regard to monitoring changes in the weather. Local people have an array of indicators to forecast rain, storms and strong winds, drought, extreme cold, flood, and changes in the weather. These indicators are based on changes in: behaviour of birds, fish, snakes, butterflies and animals; patterns of plant flowering, and meteorological phenomena. Local people use these indicators as a management tool, assisting them in decisions about where and when to fish, when to plant and harvest crops, and when to protect livestock and buildings from extreme weather events.

Whilst these indicators have been and continue to be used as a tool for environmental management, the accumulated knowledge that the older generation has is not being passed down to the younger generation. In addition, the findings suggest that the reliability of some of the indicators is not as high as it was it in the past, which may also be itself an indicator that climate change is leading to a change in animal and plant behaviour, and meteorological patterns.

Local people were not part of the decision to create the National Park in 1992. This was a national level initiative with international support. However, people living within and around the park are those that have been most affected by this decision. The current institutional structure for managing the Park – the National Park Management Board – comprises representatives from District and provincial government departments. Local people are informed about the decisions made on management of Park, for example, the ban on the use of motorboats for fishing in 2007.

Recent evidence from a review of evaluations of protected areas for biodiversity conservation highlights the importance of local stakeholders and communities having ownership of the management and decision-making process, if long-term conservation goals are to be realized (ECG, 2010). For Ba Be National Park, enabling local stakeholders and communities to be part of the management structures and facilitating their sense of ownership of the process is an essential step for ensuring the long-term sustainability of the Ba Be lake and its environs. Engagement with the H'mong becomes part of the process of inclusion of local stakeholder and communities. However, this would represent a particular challenge as the settlement in the upland areas by the 400 or so H'mong households is illegal.

Representation and involvement of local communities needs to be embedded at all levels of decision-making from the NPMB through to the Ba Be Lake Management Committee, and at the village level, in design of village development plans. External agencies – government and non-government alike – should take on the role of enablers for communities to take on the management and ownership of their resources, establishing appropriate funding mechanisms and making information readily available (ECG, 2010).

This research suggests that the decline in environmental quality and the increasing pressure on rural livelihoods is accentuated by changes to weather patterns that have been observed by local people. If these perceptions of change are confirmed, the need to develop institutional structures that will promote sustainable use and achieve long-term biodiversity conservations goals, becomes the more urgent.

Supporting and building local people's capacity to manage their environment in the context of institutional and environmental change, is an important part of a sustainable livelihoods and biodiversity conservation strategy. This research has revealed the importance and the richness of local people's indicators for monitoring changes in the weather and the significant influence this has on their environmental management strategies. In an era of climate change, integrating such indicators into wider regional climate monitoring systems becomes an important element in designing adaptation strategies at the local and regional levels.

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