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Sustainable Livelihoods and Biodiversity in Developing Countries

**Livelihoods and Biodiversity Futures:
Building Scenarios for the T rraba River Basin,
the Greater Kruger Park, the Warana River Basin, Ba Be
National Park and Na Hang Nature Reserve**

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Authors:

Alexander L; Aurora H; Ernesto V and Betsy C.

UNIVERSIDAD NACIONAL

Email: alope@una.ac.cr
Telephone: (506) 2562 41 63

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I. Why scenarios?

A scenario is a description of how the future may unfold based on if-then proposition and typically consists of a representation of an initial situation and a description of the key driving forces and changes that lead to a particular future state. Thus, these scenarios are stories about the future that are designed to test the mental maps that stakeholders hold. But perhaps most importantly for scenario projects involving many different stakeholders, they can be used to create a shared space for dialogue about an issue, in our case about sustainable livelihoods and biodiversity in water systems. Scenarios differ from forecasts in that they always come in sets – two, three, or more equally plausible, relevant, and challenging versions of a possible future. A forecast is based on a single interpretation of the best information we have about the present as it is extrapolated into the future. Scenarios offer multiple versions of an unknowable future.

In this project the steps that are going to be considered for scenario building are the following:

A description of current tendencies: That will show the state of art in the case study area. It will provide the main elements that allow us to understand the current situation.

A description of driving forces. These are the determinants that influence future development in the case study area. As an example, the driving forces of greenhouse gas emission scenarios include the assumed changes in population and economic growth.

A description of changes. This is the step in the future development of the environment and livelihood in the case study area. This is how driving forces are assumed to develop and interact among them, and how these interactions affect the state of the case study area?.

A description of an image of the future. A narrative description of the end-state of a scenario.

This report focuses on the first two steps (current tendencies and driving forces). It should be said that the information is very much based on the case studies reports and other documents that have been provided and discusses with the other case study partners. Thus, this reports presents the current tendencies and drivers of the Ba Be National Park and Na Hang Nature Reserve (Vietnam), The Greater Kruger Area (South Africa), The Warana river basin (India) and The Grande de Térraba river basin (Costa Rica).

II. The Grande de Térraba River Basin (Costa Rica)

2.1 Background and current situation

The Grande de Térraba River Basin is located in the Southern Pacific region of Costa Rica, near the Panamanian border and is the largest catchment area in the country, covering 10% of the nation's total area. The Térraba Basin is a zone rich in biodiversity, protected by the establishment of national parks, reserves and designated wetlands areas.

Today, the inhabitants of the Térraba Basin struggle with rising poverty and dependence on extraction-based economic systems requiring intensive use of natural resources, such as agriculture, subsistence farming, and extensive livestock production. In recent years tourism has become an important source of employment as well. Some of the most important factors affecting possible environmental changes in the basin include urbanization, plans for construction of a hydroelectric plant, and the development of extensive agriculture (pineapple and palm oil production). In this sense, the communities within the Grande de Térraba River Basin must confront economic, social and environmental challenges in order to achieve sustainable management of the natural resources that form the basis of their way of life.

The land within the Grande de Térraba River basin was transformed during the 20th Century by large-scale clearing or elimination of natural forest cover in order to convert it for extensive livestock activities and, to a lesser degree, for agricultural use. A process of land conversion that has taken place all over the Osa Peninsula.

Now days, a total of 18 protected areas are located within the Grande de Térraba River basin, making up 37.4% of the catchment's territory. The most significant protected areas within the Grande de Térraba Basin are national parks, allowing only conservation activities, scientific investigations and tightly regulated tourism. The Parque Internacional La Amistad (International Friendship Park), located within the upper and middle sections of the basin, is the largest protected area within the catchment, with its Costa Rican side stretching from the limits of Chirripo National Park to the Panamanian border, including a large portion of the Talamanca Mountain Range

In the lower portion of the Térraba basin, water sources are protected by the Térraba-Sierpe National Wetlands, located at the outlet of the Térraba and Sierpe rivers on the south Pacific seaboard, specifically between the districts of Puerto Cortes, Sierpe and Palmar located within the county of Osa. The Térraba-Sierpe National Wetlands has a great biological variety that supports the subsistence of surrounding communities. Currently, this area forms an important cultural part of today's indigenous communities, specifically the Boruca who visit the area once a year during the dry season in order gather shells from which they make dyes used in the creation of craft items.

The wetlands are also important to the non-indigenous communities living in and around the park area who depend on raising livestock and the extraction of shellfish species like piangua, (*Anadara tuberculosa*), boludo (*A. similis*), chucheca (*Grandiarca grandis*), mussels (*Tagelus peruvianus* y *Modilus capax*), inflated marsh clams (*Polymesoda inflata*), common clams (*Protothaca asperrima* y *P. Grata*), and toothed donax or bean clams (*Donax dentifer*) (Sierra et al, 2003).

According to data projections prepared by the National Statistics and Census Institute (Instituto Nacional de Estadística y Censos -INEC), the estimated population within the Grande de Térraba River Basin for 2008 was 267,172 inhabitants, with 53% located in the county of Perez Zeledón and the rest distributed throughout the municipalities of Osa, Buenos Aires and Coto Brus. Census data from 1973, 1985 and 2000 shows that the Basin has experienced population growth of approximately 50.6% over the past 35 years. It is important to note that the Grande de Térraba River Basin is home to around 40% of Costa Rica's indigenous population, with five distinct indigenous groups: the Cabecar, Bribri, Grande de Térraba, Brunca, and Guayami. The indigenous population in the area of study is concentrated within the Buenos Aires and Coto Brus counties (MIDEPLAN, 2003). According to 2008 population data, the distribution of genders is fairly equal within the area of study: 50.7% male and 49.3% female.

In socio economics terms, the 17,7% of Costa Rica's population lives in a state of poverty; the Brunca Region is the poorest socioeconomic area of the country where 35.7% of inhabitants can be defined as "poor," almost double the national average. 22.6% of the Brunca Region's population lives at the poverty-line unable to meet their basic needs (housing, education and health) and 13.1% of inhabitants subsist in extreme poverty (MIDEPLAN 2003).

Wages within the Grande de Térraba Basin are among the lowest in the country, with an average monthly income of around USD \$150. The national average for monthly income is USD \$554 (MIDELAN 2008). This disparity reflects the quality of employment available within the area of study, where benefits and job stability are volatile or nonexistent.

2.2 Driving forces for the Grande de Térraba River basin

As it was said driving forces are the determinants that influence future development in the case study area. Thus, this part attempts to make an analysis of the main drivers of the basin of each case study. Those drivers have been chosen taken into account the current and potential impact that they have or could have on livelihood and biodiversity in the Grande de Térraba River basin. The main drivers identify are: Agricultural development (mainly pineapple plantation), the construction of Diquís hydroelectric project and the real estate development in the coastal zone.

a. Agriculture development: Pineapple Production as a driver

The Grande de Térraba River catchment area has been historically used for agriculture, especially extensive farming, which, over the years, has altered the natural landscape of the zone. The main productive activities in the area of study include primary sector crops like bananas. However, from 1984 on there has been some diversification of agriculture, including coffee production in Coto Brus, oil palms in Osa, as well as pineapple and sugar cane in Buenos Aires. Thus, pineapple plantations encompass a huge area in the river basin and without any doubt could be considered an important driver in the future of the river basin having an important impact on the livelihood of people living in the middle basin.

The industrial production of pineapple began during the 1930's under the Costa Rican Banana Company (Compañía Bananera de Costa Rica). In 1959 pineapple crops were planted in the counties of Alajuela, San Carlos and San Isidro El General. Starting in 1962, property values in Alajuela began to rise, creating an opportunity for development in the southern region of Costa Rica, as a lower-cost alternative for farming with good soil conditions for pineapple crops, leading to the establishment of the Southern Pineapple Company (Compañía Piñera del Sur) in Buenos Aires during the same year.

Between 1963 and 1970 the quantity of pineapple planted increased by 67% due to the creation of the American Pineapple Company (Compañía Piñera Americana) and Southern Pineapple (Piñera del Sur), together with the implementation of technical improvements that enabled production of export-quality crops. The National Agriculture and Livestock Census of 1973 reported 738 hectares of pineapple, ten years later, in the Census of 1994; pineapple cultivation in Costa Rica had grown to 2,474 hectares, of which 259 were located in the Brunca Region (UNED, 1994).

The Pineapple Development Corporation, PINDECO S.A., was founded in 1979 as a subsidiary of the Del Monte Corporation and eventually took over the Southern Pineapple Company, administering the production and export of pineapple in the totality of the Southern Region of Costa Rica. In 1985 the Brunca Region together with the Huetar Norte Region contained 70% of the total area dedicated to pineapple production in the country. By 1989 PINDECO produced around 65% of the pineapple in Costa Rica. Starting in 1990 the company transformed from simple production and began purchasing portions of the export crops from local independent growers. In this arrangement local farmers provided labor and land, while PINDECO provided machinery and other technology also guaranteeing the purchase of the crops produced (Quijandría, Berrocal y Pratt, 1997).

The pineapple industry in the Brunca Region currently accounts for about 21% of national production, with a total of 10,815 hectares of plantations and has gone from its place as the number one zone for pineapple production to the fourth largest producer in today's national market. It is important to note that all production within the area of study continues to be dominated and administered by PINDECO.

Unfortunately the social impacts of the expansion of the company have not been positive; due to PINDECO's large market share, small and medium sized producers have no incentives to grow pineapple for export, leading them to sell their lands to larger companies.

Labor rights in pineapple production are very inconsistent as many companies do not respect the rights of workers in regards to shift hours and benefits, (companies often opt for high employee rotation, less than 3 months, in order to legally avoid these obligations), resorting to the figure of "contractors," or intermediaries who hire temporary workers for the pineapple plantations for little pay. These practices have created a backlash in the form of organizations like the Front Against PINDECO Expansion (Frente de Lucha en Contra de la Expansion de PINDECO), FLP, which has led legal battles and resolutions against the company in the name of better working conditions (Acuña, 2005).

In general, productive activities within the Grande de Térraba River Basin threaten serious environmental impacts due to the concentration on intensive monoculture which requires large amounts of agrochemicals and pesticides, as well as intensive irrigation in the case of pineapple, sugar cane, and other crops.

b. Infrastructure and the Diquís Hydroelectric Project

The Diquís Hydroelectric Plant, PHED, will be the largest dam in Central America, with a reservoir measuring about 6,815 hectares, of which 800 hectares are currently classified as indigenous territories, meaning that approximately 1,100 people must be relocated to higher ground within the basin in order for the project to go forward (ICE, 2009).

The Costa Rican Institute of Electricity, (Instituto Costarricense de Electricidad - ICE), ICE, has indicated in plans for the project that approximately 1,130 inhabitants from 10 communities must be partially or completely relocated in order for the hydroelectric plant to be constructed and operated.

The Diquís Project has budgeted financial compensation for those displaced, but the cultural and social attachment of these inhabitants to their lands remains a significant factor of opposition to the project, with many claiming that their identity would be lost if they were forced to be relocated (ICE, 2009). On the other hand, the project has potential for positive impacts in other communities

such as Buenos Aires, Jalisco, Paraiso, San Carlos, Caña Blancal and Palmar Norte, among others, due to staff requirements for worker camps, mobilization of vehicles and heavy machinery, as well as other opportunities that could provide much needed employment and support to areas where economic activities are currently stagnant and where new investment is required in order to create stability and development on a small scale (ICE, 2009).

In terms of employment, studies indicate that the construction of the dam and plant would generate approximately 3,500 jobs. However, this quantity would diminish significantly once the construction process was finalized, leaving behind few options for future employment opportunities (ICE, 2009).

Consequences for agriculture in the Basin with the construction of the Diquís Hydroelectric Project would be concentrated mainly in modifications of land-use. Agricultural and livestock production would be most affected by the flooding of certain areas used for permanent and seasonal crops, as well as grazing zones for cattle.

c. Real Estate Development (Immovable Property Development, Fixed Capital Development)

The case study area has been greatly impacted by real estate development along the Costeña Ridge, being this considered another driver due to its potential future impact in the case study area. From January 2007 to September 2008 the amount of construction permits granted has grown 202%, from around 100 per year to over 735 construction projects in a span of approximately 20 months. This real estate “boom” is indicative of a lack of control and regulation on the part of Osa’s municipal government (Redondo y Villalobos, 2008).

By 2001 Osa was fourth in terms of new construction projects within the basin, however by 2008 it is second only to Perez Zeledon. A significant increase in the number of new buildings can also be observed in the county of Osa in the period from 2003 to 2004, further demonstrating the sharp increase in real estate development.

Number of constructions made within the Terraba river basin 2001-2008					
Years/ and Country	Perez Zeledon	Buenos Aires	Osa	Coto Brus	Costa Rica
2001	1 303	145	60	181	30 580
2002	990	223	270	191	27 213
2003	876	241	83	180	30 404
2004	1 171	226	392	225	31 949
2005	1 631	392	352	250	33 061
2006	1 622	301	360	238	34 150
2007	2 028	293	446	451	39 471
2008	2 030	260	467	467	38 011

A main concern is the trend of ownership passing to foreign investors through the purchase of lands by developers or international real estate firms looking to build large scale residential complexes or hotels which constitute an abrupt and extreme change in land-use and demand on natural resources, often without the necessary civil infrastructure (potable water, sewer, electricity, roads, et cetera).

Social problems provoked by this style of development include the migration of inhabitants (sellers) to other areas in the periphery of the Brunca Region, where they must seek low-paying employment with few labor rights and benefits, widening the socioeconomic gap and lowering social development indicators within the region.

Redondo and Villalobos (2008) identify as the principal causes of the unchecked development and social-environmental problems in the area of study: the loss of credibility of governmental institutions such as the Ministry of Environment, Energy and Telecommunications (Ministerio de Ambiente, Energía y Telecomunicaciones), MINAET and the Technical Secretariat of Environment (Secretaría Técnica Ambiental), SETENA, as well as local municipal governments, as well as inequity in the application of the law which has apparently privileged foreign investors with expedited construction permits and lax inspection of projects.

III. The Greater Kruger Area (South Africa)

3.1 General background and current situation

The Greater Kruger study site falls within the Vhembe District Municipality of the Limpopo Province of South Africa. More specifically, the case study site (and associated chosen villages) falls in the northern part of the Province where the villages that make part of this study follow the flow of the Mutale River, starting upstream with Tshiavha village near Lake Fundudzi and ending with Beleni Village close to the Pafuri Gate of the Kruger National Park. Limpopo Province is one of the nine provinces of South Africa and is situated in the most northern part of South Africa. The Limpopo River valley forms the border between the province and its international neighbours: Zimbabwe, Botswana and Mozambique (PGDS, 2004). The case study communities form part of the Vhembe District Municipality. There are four local municipalities that make up the Vhembe District Municipality; these are: Makhado, Musina, Mutale and Thulamela. The most important local municipality for the South African case study is the Mutale local municipality as most of the case area falls within its jurisdiction, and to a lesser extent the Thulamela local municipality in the South.

Limpopo's total population was 5,226,761 in 2006. Vhembe makes up 23.88% of the total population of the Limpopo Province. The total population of the Vhembe District Municipality was approximately 1.24 million people in 2006. The population of Limpopo grew from 4,688,266 in 1996 to 5,226,761 in 2006. This represents a 1.1% annual growth rate during the ten year period. The population of Vhembe increased from 1,118,196 to 1,248,369, at a 1.1% annual growth during the same period. Vhembe therefore grew at the same rate as the province. The growth of the population is reasonable but needs to be accompanied by higher economic growth if poverty and unemployment are to be eradicated (LEA, nd).

The Limpopo River, which forms the contiguous border between South Africa and Botswana and between Zimbabwe and South Africa and passes through Mozambique before reaching the Indian Ocean, traverses a total distance of 1,750 km (UNESCO, 2006). The Limpopo River basin covers almost 14% of the total area of the four riparian states, South Africa (44%), Botswana (almost 20%), Zimbabwe (16%) and Mozambique (21%) and sustains economic livelihoods for many people in South Africa, Zimbabwe, Botswana, and Mozambique. The impetus is therefore on the four riparian states to manage the shared water resources properly. Of paramount importance to managing water in this area is therefore to ensure that the indivisibility of the resources is factored into the management of the shared water resource, and that special emphasis are given to the optimal use of this important water resource (Murovhi and Matlala, nd).

Since water from the Limpopo River basin is shared by four developing countries, competition among the water use sectors within the respective countries is often inevitable, especially during dry seasons. The Limpopo River basin forms the lifeblood of the mining industries (platinum, coal, copper, vermiculite, phosphate and diamond), private game reserves, national parks, agriculture, and other livelihood demands within the area. The competition dynamics of water resources in the catchment is, however, not solely due to transboundary competition. Large-scale commercial farming and small-scale farming, uneven rainfall patterns, agriculture and urban demand, as well as over-utilization and pollution by various sectors are part and parcel of the predicament (Claassen et al., 2005). The entire Limpopo catchment area is regarded an arid or semi-desert area where most rivers are only able to provide sporadic water supply for short periods of time each year. As such, the competition for water creates significant stress on the available resources.

One important element in the dynamic of the case study area is mining related to the Tshikondeni mine, which is an underground coal mine located 140km East of Musina. The mine operates since 1984 and currently employs more than 770 people from within a 80 km radius. With some 2 billion tons of reserves, the expansive Soutpansberg coal field which stretches across central Vhembe has only one mine: Exxaro's Tshikondeni colliery which produces hard coking coal for the South African steel industry. The mine produces 414ktpa of premium hard coking coal and is without doubt, the most important source of wage income in the region (Lahiff, 1997; EXXARO, 2010). It is estimated that Tshikondeni mine has a life span of less than 13 years.

Finally another element is the presence of The Kruger National park is one of the largest tourist attractions in South Africa and forms the eastern border of the study area. Makuya National park is another conservation area where tourists can do game driving and until recently hosted hunting concessions. These sites are however not easily accessible due to the poor road infrastructure of the Municipality. A lack of reliable energy and potable water also hinder the growth of the tourism industry. No database of all tourism centers exist, resulting in these centers not properly developed and marketed (IDP, 2007).

3.2 Driving forces

Again the drivers have been chosen taken into account the current and potential impact that they have or could have on livelihood and biodiversity in the Greater Kruger. The main drivers are: Poverty and socio economic stagnation mainly in the Vhembe District; migration flows; extensive agriculture development of smallholders and large scale commercial farmers and; water shortage by the excessive exploitation of the Limpopo river basin.

a. Poverty as a driver

The population of Vhembe is 98.74% black and other population groups are negligible. Given the history of South Africa (Apartheid), 99% of the people living in Vhembe can be classified as Previously Disadvantaged People. This population group is characterized by underdevelopment, poverty and lack of skills. The education that was administered (Bantu Education) was not of a high standard, and the areas in which black people lived did not receive basic services.

About 813,467 people are classified as poor, which amounts to 65.2% of the total population of Vhembe. This figure is too high and must be reduced significantly to meet the Millennium Development Goals of halving poverty by 2014. Poverty is most entrenched amongst Black People (65.9% live in poverty), followed by Coloureds (41.4% live in poverty) and Whites (7.1% live in poverty). Only 3% of Asians are poor. The unemployment rate for Vhembe District stood at 49% in 2006. It rose to this level from 47.7% in 1996. At the provincial level the rate of unemployment rose from 44.4% in 1996 to 45.1% in 2006. The rate of unemployment is unacceptably high both at the provincial and district level. It is also of concern that the rate is increasing instead of decreasing.

Almost thirty eight percent (37.74%) of the Vhembe population is below the working age, which is below the age of 15, while 4.8% is above the working age that is above the age of 65. This means that 42.54% of the population is legally dependent on the work force/ labor force, which makes up 57.46% of the population. In order for the working population to effectively support the percentage of the population that is not working, unemployment would have to be significantly reduced. Vhembe District is made up of a predominantly young population with 74.99% of the population being 35 years of age or younger. People are therefore at a good age to be trained and to acquire the skills necessary for the development of the economy.

While major efforts have been made in the country to improve the situation of the rural people of Venda, the study area can be described as relatively poor. Many of the small villages are sparsely populated and most of the people still live in traditional mud huts with thatched roofs. A few years ago, none of these villages had any basic water, schools, shops, and health services with no electricity, telephones, tarred roads, or public transport (Lahiff, 1997). Situations have improved somewhat over the last ten years. Some villages now have electricity and have access to basic services such as water and sanitation as well as local health clinics. Some villages now have schools, hospitals, tarred roads with limited public transport as well as telephones. Through the Reconstruction and Development Programme houses have also been introduced into some areas in the region.

In terms of employment opportunities, there are very scarce and due to the political background, many of the people living in the area do not have any education or formal skills training which further reduces employment options. For a long time government services and Tshikondeni coal mine were exceptions (Lahiff, 1997). Nowadays, the main sectors that employ people from the Vhembe District are government, agriculture, trade, construction, finance, mining and electricity. Formal employment in the tourism and conservation management industries is also growing as employment opportunity in the region (Personal Communication, LEDET and LTP, 2010). Apart from agriculture, mining and tourism are two of the most important economic sectors.

b. Migration flows from neighbor countries

Sharing borders with three African States also brings its own challenges. The socio-political situations in those countries affect South Africa as a whole but the impact is concentrated in Vhembe. Currently, many Zimbabweans cross to South Africa, seeking for services that cannot be found in their countries. This situation puts a lot of stress on the Vhembe District (LEA, nd).

A particular example of where Vhembe District felt the effects of Zimbabwe's dire socio-economic and socio-political situation was the spread of cholera from Zimbabwe into South Africa in December 2008. The South African health authorities managed and contained the disease effectively and were commended for their efforts by the World Health Organization (WHO).

It has to be considered for the future that a deterioration in the political situation of Zimbabwe could result in an increase of the migration flows of refugees seeking security and stability in the neighboring South Africa, it would be pressing the social, economic and institutional capacities of Vhembe and national authorities to attend its own challenges plus the increasing number of migrants and refugees.

c. Agriculture development of smallholders and large scale commercial farmers

Limpopo is one of the country's prime agricultural regions recognized for the production of a large variety of products and can be said that it is very likely that it will continue playing an important role for agriculture development in the near future. Three distinct climatic regions can be identified in the province which allows for the production of a wide variety of agricultural products (Oni et al., 2003). Limpopo Province is known for its livestock farming in the northern, drier parts, timber plantations in the southern areas, the Kruger National Park game reserve in the east, and for its fruit industry in the central zone (LEA, nd). Oni and co-authors (2003) explain the agricultural industry

of Limpopo Province in terms of its two distinct types of production systems e.g., the large scale commercial farming system, and the small holder farming system.

Of the total land area in Limpopo of 11 960 600 ha, farmland constitutes about 88.2%, while arable land comprises 14% (Trade and Investment Limpopo, 2008). StatsSA (2002) estimated that there were about 5000 commercial farming units in the Province. These large farms are well organized and occupy 70% of the most productive land, making use of the most technologically advanced production technologies.

The smallholder farms cover approximately 30% mostly situated in the former homeland areas. These small farming units of approximately 1.5 ha per farmer are characterized by a low level of production technology. These farms tend to produce primarily for subsistence and little marketable surplus. In 1995, there were approximately 519 000 smallholder farmers in Limpopo Province. Women constitute 80% of these smallholder farmers. In a more recent study, Statistic's South Africa (2002) indicated that in the year 2000 there were approximately 273 000 small-scale farmers operating in the former homeland areas of Limpopo Province. The Labor force Survey of 2007 (Aliber and Hart, 2009) found that approximately 1 million black people belonging to over 600 000 households were actively involved in agriculture in Limpopo. Of these, 69% were female. The survey also found that 96% of the people were involved purely for subsistence purposes.

Limpopo is a fertile area producing crops ranging from tropical fruits such as banana, mangoes, and cereals such as maize wheat, to vegetables such as tomatoes, onion, and potatoes (Oni et al., 2003). The region produces 75% of South Africa's mangoes, 65% of its paw-paws, 25% of its citrus, 25% of its litchis, 75% of its tomatoes, 54% of its macadamia nuts and about 60% of its avocados (Trade and Investment Limpopo, 2008). Limpopo province is also one of the largest producers in the country of guavas, bananas, papayas and tea and the second largest potato producer in the country (19% of total produce in SA). The Province is home to the largest cotton fields and produces gin, of the highest quality in South Africa.

Pre-feasibility studies indicate that peach and almond production is viable, and investigations into the viability of cassava and bamboo production have been conducted. New types of farming and further value-added processing of products as diverse as sugar, essential oils, catfish and goats are also on the horizon.

Limpopo has a viable forestry sector with commercial plantations covering 63 000ha and annual round wood production of about 680 000m³. About 90 000m³ goes to the mining sector (as mining timber). The growth of the mining sector in this province is expected to increase the demand for mining timber (Trade and Investment Limpopo, 2008).

Many previously disadvantaged farmers in the area are engaging in commercial agricultural operations. Donor or government sponsored projects often support these farmers through increased access to resources such as irrigation. Ziervogel et al (2006), reports that although there has been an increase in productivity among many of these farmers, they still face many limitations. A key limitation is the high climate variability of the area, characterized by numerous droughts and floods having occurred in past decades (such as floods in 2000, drought in 2002/2003). Other common stressors include restricted land availability, political instability, market fluctuations, globalization, and HIV/AIDS (Ziervogel et al., 2006).

In Vhembe region, subsistence farming and grazing is still the predominant form of agriculture along the lower reaches of the Luvuvhu Catchment. Subsistence farmland in this area is a mix of household plots, community gardens and livestock farming and comprises approximately 50 % of the agricultural land (Claassen et al., 2005). While land in the Mutale River Valley is very fertile and good for agriculture, large parts of the land falls under the tribal authorities which makes it difficult for development to take place, as the land tenure system is not favorable to commercial development (LEA, nd).

There are two commercial farmers' associations in the catchment i.e. the Levuvhu and Makhado Farmers' Associations. Cultivated agricultural land comprises 23% of the area of which 2.1 % is irrigated. Vhembe is a prolific fresh produce grower. Large scale commercial crops grown in the area are bananas, macadamia nuts, avocados, guavas, mangoes, citrus and litchis (Visser, 2003, Ziervogel et al., 2006). Vhembe is also in the process of becoming a base for lucrative exports of exotic trees and ornamental shrubs. No less than 4,4% of South Africa's total agricultural output, including 8,4% of the country's sub-tropical fruit and 6,3% of its citrus are produced in the Vhembe District (LEA,nd).

An increasing development of both, small and large scale commercial farmers, could create a direct impact to the natural resources and the specifically to the Great Kruger, resulting in erosion of the soil, reduction of the forest, contamination and reduction of the water sources. It also could result in better social conditions to a large proportion of the population of the region with its indirect consequences to the ecosystem.

d. The environment plays a role: Water competition and shortage in the Limpopo river basin

The study area falls within the Levuvhu / Letaba water management area within the larger Limpopo River Basin. The Limpopo River, which forms the contiguous border between South Africa and

Botswana and between Zimbabwe and South Africa and passes through Mozambique before reaching the Indian Ocean, traverses a total distance of 1,750 km (UNESCO, 2006). The Limpopo River basin covers almost 14% of the total area of the four riparian states, South Africa (44%), Botswana (almost 20%), Zimbabwe (16%) and Mozambique (21%) and sustains economic livelihoods for many people in South Africa, Zimbabwe, Botswana, and Mozambique.

The impetus is therefore on the four riparian states to manage the shared water resources properly. Of paramount importance to managing water in this area is therefore to ensure that the indivisibility of the resources is factored into the management of the shared water resource, and that special emphasis are given to the optimal use of this important water resource (Murovhi and Matlala, nd).

The following two issues are key to water management in the Province and within the basin (Claassen, et al., 2005):

- The quantity of water which relates to the imbalance between the supply and demand for water which in turn also speaks to the effect of floods and droughts;
- The water quality which speaks to the inappropriate land uses in the river valleys, the impact of fertilizers and pesticides as well as the high concentrations of pit latrines in certain areas

Since water from the Limpopo River basin is shared by four developing countries, competition among the water use sectors within the respective countries is often inevitable, especially during dry seasons. The Limpopo River basin forms the lifeblood of the mining industries (platinum, coal, copper, vermiculite, phosphate and diamond), private game reserves, national parks, agriculture, and other livelihood demands within the area.

The competition dynamics of water resources in the catchment is, however, not solely due to transboundary competition. Large-scale commercial farming and small-scale farming, uneven rainfall patterns, agriculture and urban demand, as well as over-utilization and pollution by various sectors are part and parcel of the predicament (Claassen et al., 2005). The entire Limpopo catchment area is regarded an arid or semi-desert area where most rivers are only able to provide sporadic water supply for short periods of time each year. As such, the competition for water creates significant stress on the available resources.

Finally, over utilization of water resources and pollution arising from high-density urban settlements, mining and other industrial development are seen to have an impact on the social, economic, political and natural environments downstream. Key water management problems in the Luvuvhu sub-area includes the presence of alien vegetation, over-utilization of the available resource to cater for all water requirements, and afforestation (DWAF, 2004).

IV. Warana river basin (India)

4.1 General background and current tendencies

The Warana river basin is part of the Krishna basin situated in the South West part of Maharashtra state in India. The river Warana arises in Sahyadri near Prachitgad close to Patherpunj and Mala villages in Patan Taluka of Satara District at an altitude of 914 M. and runs eastward to meet Krishna at an altitude of 548 m. River Warana is one of the right bank tributaries of mighty river Krishna and it joins the Krishna at Haripur near Sangli after flowing for around 150 km. The total area of the basin is around 2095 sq. km. The Eastern part of the basin is comparatively less rugged than Western part and possesses flat rolling topography. The basin falls in the rain-shadow zone of the Western Ghats and bears a temperature climate with three distinct seasons viz monsoon, winter and summer.

The basin is spread over nine Talukas of four-Districts, mainly Sangli and Kolhapur and some parts of Satara and Sangameshwar Districts. The Talukas it traverses are: Shirala, Walwa, Miraj Talukas of Sangli District and Shahuwadi, Panhala, Hatkanangale and Shirol Talukas of Kolhapur District, Patan Taluka of Satara District and Sangameshwar Taluka of Ratnagiri District of Maharashtra.

Apart from high altitudinal variation, as described the Warana basin also shows a high variation in rainfall especially between the Western to Eastern part. It falls steeply from 4000 to 600 mm and is characteristic of the rain shadow region of the Western Ghats in India. Experts regard this variation as the most important aspect in the variation of conditions across the basin, especially since it is also closely associated with variation in other biophysical characteristics that affects the entire pattern of biodiversity and livelihood within the basin area. It was therefore decided that for the purposes of the study, it was important to classify the basin area into distinctive zones for detailed study.

The basin can be divided into three distinctive zones and each zone encloses its own specific characteristics. The 1600 mm and 800 mm isohyets were chosen for the division for a number of reasons. Those isohyets also closely match the divisions based on slopes, soils and socio-economic conditions as well, as will become evident in the course of the discussion.

Zone 1 comprises the portion of the basin with a rainfall above 1600 mm. This zone comprises of the westernmost hilly part of the basin comprising the Western part of the Shirala Taluka from Sangli District and Western part of Shahuwadi Taluka from Kolhapur District. It includes the Chandoli National Park and the catchments of two large dams in the basin. Zone 2 comprises the portion of the basin with a rainfall between 1600 and 800 mm. It is the central part of the basin and can be treated as a zone of transition. Zone 3 comprises the portion of the basin with a rainfall less

than 800 mm. It comprises of the easternmost part of the basin which is low lying and plain and has fertile alluvial soils. Zone 3 is semiarid with high variability in annual rainfall on both the flanks of the river but also has much greater availability of irrigation because it lies in the command of the upstream dams and is also served by a number of lift irrigation schemes on the river itself. Zone 1 which forms the western part of the basin is mostly covered with forest, Zone 2, the central portion, has agricultural land along with wastelands; and Zone 3, the eastern part of the basin is predominantly agricultural land. (Census 2001):

Maharashtra is broadly classified into nine major agro-climatic zones and the Warana basin falls in the two agro climatic zones of Western Ghat Zone with an average rainfall of 3,280 mm and the Western Maharashtra Plain Zone with an average rainfall of 790 mm. Maharashtra is divided into eight administrative divisions – Konkan, Nashik, Pune, Kolhapur, Aurangabad, Latur, Amaravati and Nagpur. Warana basin falls in the Kolhapur division. In fact it is part of the broad region called the Western or Southern Maharashtra which is one of the most developed regions of Maharashtra and also a politically powerful one. Within the Kolhapur division, the Warana basin predominantly covers parts of two Districts, namely, Sangli and Kolhapur. In Sangli three Talukas (Taluka is one unit below the District for administrative purposes), namely, Shirala, Walva and Miraj, and in Kolhapur District four Talukas, namely, Shahuwadi, Panhala, Hatkanangale and Shirol are part of the Warana basin. In the case of some of these Talukas only part of them fall in the Warana basin. In total there are 305 villages in the basin.

The Warana dam is the major dam in the area with a height of approximately 77 m from the river bed. Its catchment area is around 301 sq km and it has gross storage capacity of 974.2 Mm³. Another important dam on Potphugi river (a tributary of Kadavi) is known as the Kadvi dam. There are also two smaller irrigation projects are in Paleshwar and Monoli.

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According to the 2001 Census there were 305 villages in the basin, up from 301 in the 1991 Census. The total population had grown from about 600,000 to over 700,000. Population density increases as we go from the West to the East within the basin Zone 1, the Westernmost portion of the basin had a population density of about 130 persons/sq km while Zone 3, the easternmost portion had a population density of about 530 persons/sq km. In terms of population growth, the average growth

rate is about 14%, with Zone 1 showing lowest and Zone 2 showing the highest growth rate between 1991 and 2001.

Table 3.1: Population of the Warana basin

Census Year	Zone	No. of villages	Area (ha)	No. of Households	Population	Males	Females
1991	Zone 1	80	64,666	15,459	77,363	36,772	40,591
	Zone 2	175	91,952	64,459	3,33,582	1,66,760	1,66,822
	Zone 3	46	44,236	39,106	2,05,956	1,05,643	1,00,313
	Total	301	2,00,855	1,19,024	6,16,901	3,09,175	3,07,726
2001	Zone 1	81	65,698	17,410	85,046	40,964	44,082
	Zone 2	178	90,899	77,915	3,85,196	1,95,614	1,89,582
	Zone 3	46	43,871	45,236	2,31,689	1,19,192	1,12,497
	Total	305	2,00,468	1,40,561	7,01,931	3,55,770	3,46,161

4.2 Driving forces

Three main drivers forces are identified in Warana river basin, they are: Improvement of the socio economic conditions of the population of zone 2 and 3; increasing emigration flows from zone 1 to a major cities and; agriculture development.

a. Improvement of the socio economic conditions of the population of zone 2 and 3

It is important to point out that even tough poverty is a current element in the basin, there is a tendency of improvement of socio-economic conditions mainly in zone 2 and 3. Thus, it is expected that this tendency will continue in the near future, therefore it is a key element when understanding how livelihood will develop in the basin. The socio economic condition in the basin shows very important advances thanks to an increasing investment in education facilities and health services. Other important condition that could facilitate this improvement is a more opened society to the integration of the lower castes.

Literacy has been growing in the basin, though total literacy has not been achieved, far from it. The census data for the basin show that literacy in the basin has increased from about 52% in 1991 to about 65% in 2001. However, the gap between male and female literacy is still very high. Male literacy rates were 64.4 in 1991 and 74.1 in 2001 while female literacy rates were 40.1 and 55.9 respectively. The gap is of the order of 20% in 2001 though it has come down from about 25% in 1991. There has been a significant growth in educational facilities in the basin between 1991 and 2001. What is interesting is that this growth has been weighted in favor of higher education. Thus the number of primary schools has grown by about 25%, middle schools by about 50%, high

schools by about 100% and graduate colleges by 200%. There is also the expected skewness between the distribution within the zones, with Zone 1 faring poorly as compared to the other zones. In fact there is indication that the difference between the zones is growing and not narrowing. The percentage of villages having access to middle schools in 2001 was 55, 75 and 98% in the Zones 1, 2 and 3 respectively.

In the case of Warana basin, as in the case of most parts of India, caste is an important part of the socio-economic-cultural spheres. In the Warana basin, the main caste groupings are: 1) Brahmins, though numerically few, as most of them are involved in non-land based livelihoods and have taken up jobs and professions in the cities (and also outside the country like the US for example) and in fact the first wave of this shift from the rural to the urban was when there was an anti-brahmin backlash following the killing of Mahatma Gandhi in 1947 as the killer was a brahmin; 2) Marathas and Kunbis (most of them are agriculturists and they form the middle castes below the Brahmins; 3) Other Backward Castes (OBCs) which includes groups like Dhangars (shepherds), in some places kunbis basically agriculturists, potters, carpenters and so on; and 4) Scheduled Castes (SCs) which are mainly the erstwhile untouchable castes like Chambhar, Mahar, Matang and so on and the SCs are together often called dalits (literally the oppressed). There are no Scheduled Tribes (STs), in the basin. They are basically the tribal population (sometimes they are also called the ethnic or indigenous communities), who are outside the caste system.

It may be seen that the scheduled castes and tribes form only a small proportion of the population in the basin. However, their proportion has grown. The SC population has grown from about 11% to about 12% while the tiny ST population has also grown from 0.2% to 0.3%. More significantly, there is also a shift between the zones, and of the SC and ST population, more and more of it is being concentrated in Zones 2 and especially 3. Being mainly agricultural laborers, the demand for labor in the Eastern zones due to irrigation and multi- seasonal crops seem to be drawing these sections to them.

The important thing to note here is that though caste based hierarchies have been legally abolished (for example untouchability has been legally abolished), caste based relations and customs still operate. For example access to natural resources, to a great extent, is determined by which caste you are born into. Marriages take place mostly within the same castes. There are still caste-based occupations and most of the people involved in menial jobs and the unorganised/informal sectors are people from the erstwhile untouchable castes.

b. Increasing emigration flows from zone 1 to a major cities

The Zone 1 economy is dominated by migration to the more developed towns, Mumbai, Pune and the like. Almost all farmers here are independent householders who work in their own fields, depend less on other labor except for critical periods and casual work. There are very few farmers who are large holders and who employ substantial amounts of permanent labor. There are also traditional methods like irjik or savad which are ways of co-operative labor in which neighbors or clansmen group together to work on each other's fields. This also means that there is even less demand for agriculture labor. There are very few opportunities for year round agricultural labor. There are also very few landless laborers. There is more of a push towards out-migration in the area. Almost every household has at least one member who may have migrated to a city.

There is a triple displacement pressure on the people of this zone as follows:

- Warana dam and mining: serious implications for the lives and livelihoods of the people as well as health of the forest.
- Chandoli Wildlife Sanctuary and National Park: about 32 villages affected (total population of about 8,000)
- Earthquake prone area: in 1993 there was series of earthquakes in this region; 20 villages fall in this earthquake prone region

Because large number of men has migrated to the cities, the burden of agriculture is borne by women and it is they who have to run the household. Women have to work hard in the fields and for the rest of the year have to spend time in foraging and fetching water etc. It is said that households from more prosperous villages do not give daughters in marriage to men from this region because they will have to work hard; but daughters from this region are readily accepted elsewhere because they work hard!

The men who have migrated get meager wages in the cities and can barely make their ends meet in the cities and send very little money home, though what they send is significant because it provides for a good portion of the non-food items the household buys. The men can get along in the cities because of institutions of the shared kholi (room) practice and the availability of khanavals (cheap dining services).

c. Farming and agriculture as the core element of the basin.

Farming is the main livelihood avenue for the people in the basin as agriculture has been the most important economic activity. Nearly 70 per cent of the working population is engaged in agriculture

—mostly as cultivators and may be about 8 to 10% would be agricultural laborers. Coarse millets like sorghum, bajri, groundnut and pulses are the main crops in the rainfed lands. Irrigated agriculture is dominated by sugarcane. Maharashtra, especially Southern Maharashtra, is known for the cooperative traditions. Many types and forms of cooperative institutions have come up and they have a very long history. For example there are producers' cooperatives (like the milk cooperatives), credit cooperatives, and processing cooperatives (like the sugar factories). In fact all the villages have these cooperative institutions and they have helped in greater collaboration and democratization.

Zone 3 (Zone 2 is transitional and shows features of both Zone 1 and 3) is the black cotton fertile soil tract in the open plains in the lower portion of the basin. Commercial farming is dominant. Sugarcane is the dominant cash crop though others like soybean, potato and the like are also taken. High levels of inputs like fertilizer and pesticides are used.

There is greater class differentiation here. There is a distinct class of rich farmers or capitalist farmers who are also in the process of accumulating more and more agricultural land. Irrigation percentage is high. There is employment available in agriculture almost all the year round. So there is a large class of poor farmers who also work as agricultural laborers. There is also a class of people who from more drought prone areas who have migrated to the area initially as seasonal laborers and have since then settled in the area. They own pieces of unproductive land in their original villages but rarely go back, except in cases where their lands have come under irrigation commands.

There are a number of MIDC (Maharashtra Industrial Development Corporation) managed Industrial Estates in areas nearby, many of them not in the basin but accessible to basin residents. There are sugar factories, dairy, and other cooperative businesses where too people find employment. In general, there is much more subsidiary employment in the region as compared to Zone 1. A working class based on these estates and factories is also growing. There are also people from other villages nearby who travel daily to the larger centers and commute back to their homes every day.

There are about 5 sugar factories in the basin. Most of the sugar factories have other related agro-industrial processing activities. In fact many of these sugar factories also have their own educational institutions and they could be called as the agro-industrial educational complexes. They not only provide employment, but act more like a growth centre within the rural areas. For example along with these complexes whole lot of ancillary and informal sector economical activities also begin which provide support service to the main industrial complexes. The factories are in the cooperative sector meaning they are owned by the farmer members who are primarily sugarcane producers.

These complexes have both positive and negative impacts on the rural life. In fact they are seen as “engines of development” (often unsustainable) in the rural hinterlands giving rise to high external input based (water, chemical fertilizers and pesticides, hybrid seeds, mono-culture and water intensive crops like sugarcane and so on). They are also centers of political power and in fact it is said that the political power in Maharashtra is in the hands of the “sugar lobby”. In fact the Warananagar industrial complex consisting of the Warana Sugar Factory and the Dairy complex, including the Warana cooperative Milk Production Sangh, along with its associated credit institutions and so on is a good example of this. In fact this is one of the better managed ones.

With the advent of large scale sugarcane cultivation and sugar factories in the early 1960s the economy of the region also underwent a change. An economy which was more subsistence based became one of cash economy and even to meet the daily requirements of food and other basic needs even the toiling peasants have to go through the market. This is especially true in the lower part of the basin. For example even a small holder takes sugarcane and sells it to the sugar factory and then buys the required food grains from the market to meet the food requirements.

Recently with greater and greater need for land from wind mills, resorts and mines there is the growth of a new and unhealthy sector in the region which has good wind sites, scenic spots and bauxite and iron ore deposits in plenty. This is the economy revolving around land as real estate with a chain of dalals (agents) that extends from the big companies to the small village operator who specializes in luring farmers, promising them various things and getting hold of title to land by hook or crook. In this process land that may cost the final user 500,000 to 700,000 Rs/acre (USD 11,000 to 16,000) may only be putting 20,000 to 40,000 Rs/acre (USD 450 to 900) in the hands of the farmer. Recorded transactions are often only the tip of the iceberg and it was estimated that one to two thirds of land title transfers could be fraudulent. The arguments used to entice farmers are very similar to the arguments used by companies to buy land and to ask the governments to acquire land for them. These lands are shown to be barren and unproductive and therefore worth disposing off.

V. Ba Be National Park and Na Hang Nature Reserve

5.1 Background information and current situation

The case study in Vietnam presented two areas to study, they are Ba Be National Park and Na Hang Nature Reserve. As mentioned in the Operational Plan of Ba-Be National Park and Na Hang Natural Reserve (2005) the Na Hang Nature Reserve is located in Tuyen Quang Province; by other hand Ba Be National Park is located in the northeastern part of Vietnam. Ba Be National Park administratively belongs to Bac Kan province and lies adjacent to Na Hang district (Tuyen Quang province) in the west and shares some land area of the buffer zone with Na Hang Nature Reserve. Ba Be National Park has a total land area of 7,610ha, with 85% of which are under forests. The park is divided into 3 functional zones that present with high-diverse ecology and landscapes. The park center is the Ba Be Lake that covers 500ha in area, stretching on a length of 8km and locating at an elevation of 150m above sea level. The deepest point of the lake was measured at 35m. This is a largest natural lake of the country and one of the largest in-land lakes of the world. Connecting to the lake is a network of streams and rivers and adjacent evergreen forests that fully cover ranges of limestone mountains, making the area a spectacular landscape. Since 1997, Ba Be National Park lied under the management of MARD.

“The Operational Plan of Na Hang Natural Reserve” (2005) pointed out that Na Hang Nature Reserve (Tat Ke- Ban Bung) was approved and tested by MARD (formerly the Ministry of Forestry) on April 16, 1994 at the Decision 849/KH. The Nature Reserve occupies 36,722 ha covering 05 communes (Vinh Yen, Son Phu, Con Lon, Khau Tinh and Thanh Tuong), forest land occupies more than 90% of the land area (forest land statistical 286/CP in 2000), except 1/4 forest area of Trung Khanh commune is managed by Na Hang NR (Reserve extension proposed area, but not yet approved by authorities).

Ba Be Lake become well known for tourism and annually attracts large number of in-country and oversea tourists who come for visits or relaxation. The lake keeps a vital role in promoting local transport. Here, boats are an important mean to link the transport between the east and the west sectors of the lake. The lake also provides local people a potential amount of aqua-products and plays an important role in flood control. It is clear that Ba Be Lake is economically and environmentally important for both the locality and adjacent areas.

When it comes to Na Hang , about 68% of the land area of the Nature Reserve is under tropical moist forest or old growth (primary) forest which has little change by human activities. Among these forests, 70% are growing on Limestone Mountains. Evergreen forests are mostly found growing on lower land area (Cox 1994). Fauna of the Reserve to date has not been fully

investigated. However, about 90 species of mammals, 263 species of birds, 61 species of reptiles and 35 amphibians' species have been listed. This indicates that the Na Hang Nature Reserve has a rich biodiversity.

5.2 Driving forces

Even though it is difficult to point out the same drivers for the two areas, it can be said that agriculture dependency, poverty and development of infrastructure development are the three common key drivers for the two areas. In the case of infrastructure, for instance we can see road development in Ba Be and dam construction (hydroelectricity) in Tuyen Quang, Na Hang. The explanation of such driver is taken from the Report entitle "*socio-economic situation of communes in the core and buffer zones of ba be national park and na hang nature reserve - vietnam*" by the ministry of agriculture and rural development and the national institute of agricultural planning and projection (2008).

a. Agriculture dependency: The impact in the buffer zone as well as in the core area of the protected areas

The main driver in both areas is agriculture development, people living in Na Hang and Ba Be have a strong dependency on agriculture and this is expected to continue in the near future. In both areas the main foods and income of residents comes from rice. Maize is the second important crop and this is grown by traditional methods. After digging holes, the farmers sow seed without watering (relying on precipitated water), fertilizer or pesticide. Just as rice, maize is often affected by flood.

In Na Hang, there are 2,113 households with approximately 10,992 people living in 61 villages belonged to 05 communes (Con Lon, Khau Tinh, Son Phu, Vinh Yen and Thanh Tuong). Among ethnic minorities, 5,682 people are Tay, 3,078 people are Dao, 814 people are H'mong and 1,347 people are Kinh. Ethnicity also includes Nung, Muong, San Chi, Cao Lan and Hoa who share with a very small number of population. The natural population growth rate of the communes inside the Reserve is 2% (Anon.2000). Ethnic groups have settled concentratively or separately in villages or hamlets. Agriculture producing, forest protection and plan.

The lives of local people are still poor and difficult. Their incomes are mainly from agriculture. The non-farm occupation and others are not developed. The total number of poor household in the region is 628 households, accounting for 33.19% of total households, of which 142 poor households

in Thanh Tuong Commune, 240 ones in Son Phu Commune, 148 ones in Con Lon Commune, and 98 ones in Khau Tinh Commune.

The total agricultural land area of the 5 communes is 1,438.64ha, taking 3.91% of natural land area (according to the inventory figures in 2000): include:

- Paddy cultivation (rice and others): 480,01 ha;
- Swidden agriculture lands: 325,93 ha;
- Annual plantation lands, age-old plan lands, livestock breeding lands: 677,7 ha.
- Special use and other lands: 2.297.26 ha.

Among those agricultural land per person is of 1,200m² and land for paddy cultivation is 500m² per person. However, some villages, especially those located in remote area, face land shortage or leave land fallow without making investment for intensive farming. Capital income (in rice equivalent) is 200-250kg/year per person. Besides, many households still rely on natural resource exploitation to support their livelihood as well as livestock and off-farm production has caused some pressures on forest protection and conservation.

b. Poverty as a driver

Poverty is also a common factor in these two areas, however the poverty rate in the Ba Be District is quite high in comparison with Bak Kan Province and with the average one of the whole country. This rate of the Ba Be District in 2005 was 69.44%. Up to 2008 it reduced to 51.14%. The average poverty rate of the communes in the core and buffer zones is 54.89%, 3.75% higher than one of the Ba Be District. Virtually, communes in the core and buffer zones have the high poverty rate, of which Cao Thuong and Nam Mau Communes have the highest ones of 80.59% and 79.33%, respectively. The poverty rates of the remaining communes are also high, e.g. Hoang Tri of 70.4%, Dong Phuc of 65.45%, and Khang Ninh of 64.68%, etc. (see table 9).

Some of the main reason explaining poverty in both zones are first, the lack of land production of rice and maize, so people try to expand their production area, even burning forest for cultivation if the authorities do not take control strictly. A second factor is the lack of knowledge and a third factor is capital shortage.

c. Infrastructure development: Road and dam building

Road network in those areas is a priority, but the access to some communes is still very difficult. For instance is hard to get to some Communes such as Hoang Tri and Cao Thuong. The road to People's Committee of Hoang Tri Commune of 4 kilometers in length is abrupt with rough stones.

In order to access to the commune, it has to cross the spring without bridge. The approach to this commune is only by the car with double span and high deck in the dry season and on foot in the rainy season. The road to People's Committee of Cao Thuong Commune has to cross the Lake by canoes.

Some important constructions in terms of roads have been done:

- Internal road network of Ban Phieng Hamlet – Cau Treo is upgrading.
- The hanging bridge of Phja Y, and internal road of Ngu Hamlet – Na Chai, in Cao Tri Commune are in construction.
- Two interior-field channels of Con Poong, hanging bridge of Na Don are in construction.
- Pac Chan Cave in Nam Cuong Commune is on survey and projection.
- A vehicle road was constructed to connect the district town with the lake through the park center.

The other item in term of infraestructre development is dam construction in Na Hang, Tuyen Quang province started in very large scale the electricity production with the dam on the Gam River. In the same way a succession of dams has been considered on the Lo and Gam rivers from just upstream of Tuyen Quang to upstream of Na Hang. As *stated in the "Gam river dam preliminary environmental impact assessment"* (2000) The dam was considered to impound an area of water of 57km² forming a long, narrow reservoir extending over 30kms up the valley of the River Gam and its tributary valleys. It would have an installed capacity of 300MW. The principal objectives of the project were:

1. To meet growing national demands for electricity and to ensure reliable supply
2. . To regulate river flows downstream contributing both to flood control and irrigation

In the first case, it should be considered that this dam was supposed to increased hydropower output. The north is also rich in coal resources and has significant investments in coal fired thermal generation. However, the south is an importer of electricity and both the southern and central areas have experienced power shortages especially during the dry season.

In the second case, the provincial capital of Tuyen Quang province, which has a population of approximately 40,000 people, is subject to regular flooding from the Gam River during the wet season. Flooding lasts between three and seven days, being this an annual problem. In sum, it is expected in the future more road development and more dam construction, both elements having a profound impact in people`s livelihood and biodiversity.

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