5 ASSUMED SECTOR DEVELOPMENTS

5.1 Introduction

The following presentation is an abstract of the key findings from the assessment of sector development trends and plans. A more detailed presentation of present status, plans and trends is given in Annex 1.

Efforts have been made to focus on the most relevant "driving forces" and projects that might have a synergetic effect on developments and impacts caused by the NT2 Project activities.

5.2 Hydropower

5.2.1 Introduction

The hydropower sector seems to be a thoroughly planned sector from an economic and the technical perspective. Over the last two decades, however, the definition of what is a feasible project and the principles of project ranking have changed substantially. Except for projects in Yunnan (China) and Sambor (Cambodia), it seems that none of the original plans for cascades of large power plants on mainstream Mekong are today considered realistic options.

The development in the 5-year perspective (2010) can easily be predicted. For most of the large projects to be implemented before 2010, the construction must have already started or the project must be in an advanced stage of project planning.

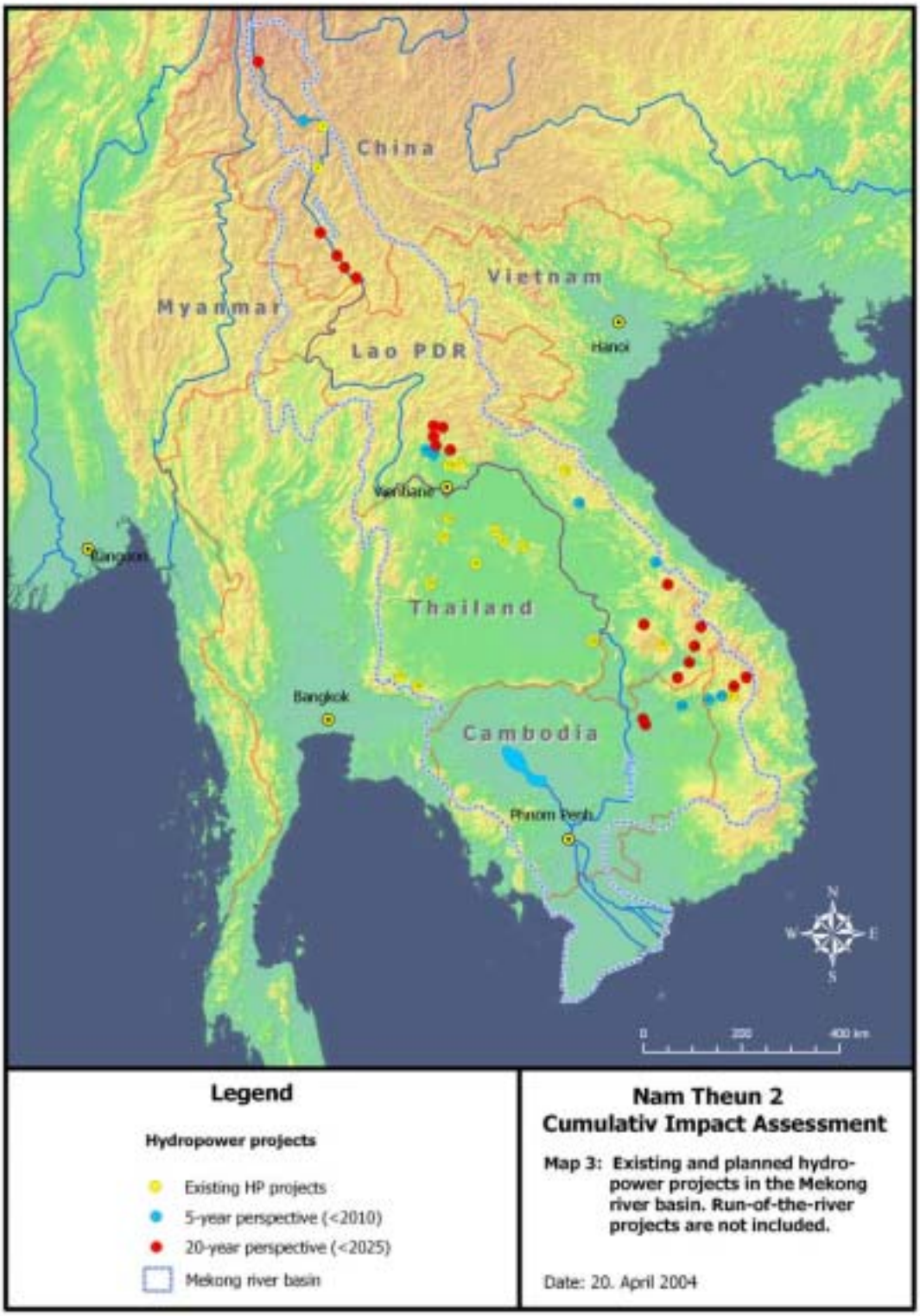
The 20-year (2025) situation is more difficult to determine with a reasonable level of precision. One problem is that the plans available to day have as a maximum a 2020 perspective. No official plans are available for the 2025 situation. If we consider, however, that as a general rule hydropower development plans tend to be over-optimistic, year 2020 perhaps represents an acceptable year for prediction of the CIA long-term scenario.

Even with elaborate development plans and strategies the final development and project sequence is uncertain. This is especially the case where development is largely dependent on trade agreements between the countries and on the participation of Independent Power Producers (IPP). The economic factors determining the price and the investment opportunities may change rapidly and thus influence the policy in the countries selling and buying energy.

The power development aimed at supporting national demand are easier to predict as this is more in the hands of the national electricity companies and is determined by long-term plans for electrification and estimates based on economic growth.

The hydropower developments are, in the CIA perspective, primarily relevant for changes in hydrology of the Mekong and on the Mekong tributaries influenced by NT2. The hydrologic impact on the Mekong is mainly caused by the reservoirs having the largest active storage, this being the main reason for an expected future change of water flow in the Mekong from wet season to dry season.

A large active storage has the potential of storing much water during wet season and supplying water during dry season. For hydropower plants a uniform water flow throughout the year results in the highest energy production.


China
Vietnam
Myanmar
Lao PDR
Hanoi
Vientiane
Rangoon
Thailand
Bangkok
Cambodia
Phnom Penh
N
W
E
S
0
200
400 km
Legend
Hydropower projects
Existing HP projects
5-year perspective (<2010)
20-year perspective (<2025)
Mekong river basin
Nam Theun 2
Cumulativ Impact Assessment
Map 3: Existing and planned hydro-power projects in the Mekong river basin. Run-of-the-river projects are not included.
Date: 20. April 2004

Power plants with no, or only daily, storage are called Run of River (RoR) projects. They might be operated in a way that changes daily or weekly water flow downstream but are not capable of influencing the seasonal flow pattern downstream.

The flow characteristics generated by simulations of existing and planned hydropower projects serves as input to the water balance calculations reported in Chapter 7. Assumptions, technical data and energy simulation methodology is presented in more detail in Annex 3.

5.2.2 Mekong Perspective

Yunnan, China

In Yunnan in the Upper Mekong, two hydropower plants already exist on the mainstream of the Mekong. According to available information no new power plants will commence operation before 2010 in China. However, construction has started on one of the two largest reservoir projects, the Xiaowan HPP, with an expected date of commercial operation just after 2010. Hence, the project has been included in the analysis for 2010 together with the existing projects. In the period 2010 to 2025, five large new plants are assumed to start operation including the 5500 MW Nuozhadu HPP, see Table 3.

Table 3: Existing and Planned Projects in Yunnan

No.[1]	Project	Year of commissioning	Installed capacity (MW)	Active storage (mill. m^3)
3	Manwan	1993-96	1500	257
4	Dachaoshan	2001-2004	1350	367
2	Xiaowan	2010-14	4200	9900
1	Gonguoqiao	2012	750	120
6	Jinghong	2013	1500	249
5	Nuozhadu	2014	5500	12300
8	Mengsong	Before 2025	600	-
7	Ganlanba	Before 2025	150	-

[1] Numbers in this table corresponds to numbers in Map 3. No. 1 is upstream of No. 2 etc.

Lao PDR

In Lao PDR in the Power System Development Plan, PSDP (Meritec and Lahmeyer, 2004) has recently studied and prioritised a long list of about 30 projects including both project for domestic consumption and for export. In this CIA study the hydrological calculations are based on projects listed in the Electricité du Lao (EdL) Generation Expansion Plan 2005–2020 and the PSDP priority export projects (Table 4).

Table 4: EdL Generation Expansion Plan (2004-2020) for Domestic Projects and the most promising Export Projects (PSDP).

No.[1]	Project [2]	Year of commissioning	Installed capacity (MW)	Active storage (Mill. m^3)
15	Nam Ngum 1[i]	1972-78 (export)	150	4714
22	Huoay Ho	1999 (domestic.)	150	480
16	Nam Leuk	2000 (domestic.)	60	123
14	Nam Lik	2009 (domestic.)	100	826
18	**Nam Theun 2**	**2010 (export)**	**1074**	**3510**
17	Theun Hinboun Ext.	2010 (domestic.)	105	2870
19	Xepon	2008 (domestic.)	74	361
11	Nam Ngum 3E	2011 (export)	580	983
12	Nam Ngum 2B	2012 (export)	183	150
10	Nam Ngum 5	2012 (domestic)	90	252
9	Nam Ngum 4A	2015 (domestic.)	55	337
13	Nam Bak 2B	2018 (domestic.)	116	119
21	Xe Kaman 3	2011 (export)	250	108
23	Xe Kaman 1	2014 (export)	468	3340
20	Xe Kong 5	2017 (export)	248	2210
25	Nam Kong 3	2016 (domestic.)	25	299
24	Xe Xou	2020 (domestic.)	59	1710

[1] Numbers in this table corresponds to numbers in Map 3.

[2] Run-of-river projects and small reservoirs are not included.

Existing Theun Hinboun and Xeset HPPs have not been included in the analysis because they are Run of River projects. Of the planned projects Nam Mang 3, Nam Pot, H. Lamphan Gnai and Xeset 2 have not been included because the reservoirs are small.

Thailand

To our knowledge no significant hydropower development is planned in the Thailand part of the Mekong catchment, neither in the short term nor in the long-term perspective. However, some large multipurpose reservoirs have been established over the last 40 years (Table 5). According to EGAT these dams have:

- Irrigated over 240,000 acres of rice paddies
- An average annual electric energy output of 902 GWh (among which Pak Mun contributes with 280 GWh and Lam Thanong with 400 GWh.
- Served as major freshwater fish breeding grounds.

[i] The Nam Ngum reservoir was established as early as 1972. The discharge records in Mekong have therefore been influenced by the operation of the reservoir. In the simulation of impacts on flow and water level in Mekong (see Chapter 7) the reservoir has been included in the baseline flow record, 1950-2001. To generate a "natural" baseline record, data on real operation (inflow and outflow of the reservoir over time) would have been necessary.

Table 5: Existing Projects in Thailand within Mekong Basin (EGAT 2004).

No.[1]	Project [2]	Year of commissioning	Installed capacity (MW)	Irrigation area (Ha)	Active storage (mill. m^3)
33	Nam Pung	1965	6	32000	122
30	Ubol Ratana	1966	25	40700	1695
34	Lam Phra	1967		10097	145
29	Nam Pao	1971		50416	1260
32	Sirindhorn	1971	36	24000	1191
27	Nam Oon	1973		29728	475
26	Huai Luang	1984		12800	113
31	Chulabhorn	1972	40	9600	145
33	Lam Takhong	2002	500	22000	320 / 10

[1] Numbers in this table corresponds to numbers in Map 3

[2] Run-of-river projects and small reservoirs are not included.

Pak Mun and Huai Kum are not included in the estimates on future water flow in Mekong since Pak Mun is a run-of-river project and Huai Kum has a small active storage.

Vietnam

A hydropower master plan is under preparation for Vietnam. Preliminary data from this study has been included here in addition to data from the "Se Kong – Se San and Nam Theun River Basins Hydropower Study" by Halcrow (1999). The projects are found on the major tributaries of Mekong, the Se San and Sre Pok rivers. The projects are listed in Table 6. The only project included in the short-term scenario would be the existing Yali.

Table 6: Existing and Planned Projects in Vietnam within Mekong Basin. (Hydro-power Master Plan 2004).

No.[1]	Project [2]	Year of commissioning	Installed capacity (MW)	Active storage (Mill. m^3)
37	Yali	1999	720	779
35	U. Kontum	Before 2025	220	123
36	Pleikrong	Before 2025	110	1022
39	Se San 4	Before 2025	330	470
40	D Xuyen	Before 2025	100	484
38	Ban Tou Srah	Before 2025	84	483

[1] Numbers in this table corresponds to numbers in Map 3.

[2] Run-of-river projects and small reservoirs are not included.

Existing Dray Ling is a run-of-river and the planned projects Se San 3 (273 MW), Se San 3A (100 MW), Boun Koup (280 MW), Srepok 3 (195 MW) and Srepok 4 (33 MW) all have small active storage. These have been excluded in the hydro-logical assessment.

Cambodia

Cambodia has identified some project alternatives on the Mekong and Mekong tributaries. However, it is uncertain if any of these projects are going to be constructed in the near future. The present alternatives have a low internal rate of return. Establishment of upstream reservoirs in Vietnam would however be beneficial for the projects in Cambodia. The original plans of the listed projects were controversial due to large shallow reservoirs requiring a substantial relocation of people. However, more recent studies (Halcrow, 1998) have identified new locations of dams with smaller reservoirs.

Table 7: Planned Projects in Cambodia within Mekong Basin.

No.[1]	Project [2]	Year of commissioning	Installed capacity (MW)	Active storage (Mill. m^3)
42	Lower Se San 2D	Before 2025	185	Not available
41	Lower Se San 2U	Before 2025	153	Not available
43	Lower Sre Pok 2	Before 2025	205	Not available

[1] Numbers in this table corresponds to numbers in Map 3.

[2] Run-of-river projects and small reservoirs are not included.

At this stage no priority or time schedule for implementation are available for these projects. Sambor is a planned run-of-river project on the Mekong main stream and therefore not included in the analysis.

Myanmar

No hydropower projects are expected to be constructed within the Mekong River Basin in the next 20 years.

5.2.3 Summary of 5-years and 20-years Power Development Plans

The sum of current active storage and the expected 2010 and 2025 situation total for all countries are presented in Table 8.

Table 8: Existing and Predicted Active Storage Volume (mill m^3) in the Mekong Basin.

	China	Lao PDR	Thailand	Cambodia	Vietnam	Total	NT2-portion
2004	624	5,194	5,529	N/A	888	12,235	-
2010	10,524	12,949	5,529	N/A	921	29,923	12%
2025	23,193	22,608	5,529	N/A	3,589	54,919	6%

The Nam Theun 2 project with 3510 mill m^3 of active storage will account for a larger portion of the total active storage in Mekong in 2010 (12%) than in 2025 (6%). The average discharge into the Mekong at the outlet in Vietnam is assumed to be 14,500 m^3/s or 460.000 mill.m^3 per year. Hence, the total reservoir regulation coefficient[ii)] would be 0.12 in 2025 referred to the Mekong outlet. The contribution of NT2 to this coefficient will be 6% of 0.12, i.e. 0.007, in 2025.

[ii)] The regulation coefficient (or regulation percent) is calculated by dividing total active storage upstream by total annual runoff.

The seasonal variation in flow would be reduced directly in relation to the up-stream regulation coefficient. For example, in the Mekong at the border between China and Lao PDR, the variation in seasonal flow, in percentage, would be drastically reduced, almost eliminating the seasonal difference. The same would happen in the larger tributaries of the Mekong, Nam Ngum, Nam Theun and Se Kong-Se San, whereas the Mekong itself in its downstream reaches would still have a distinct difference between dry season and wet season flow.

5.2.4 Local Perspective

In addition to NT2, in the short-term perspective, the extension of the capacity of Theun-Hinboun by 105 MW is foreseen. The construction of NT2 would accelerate the plans for NT3, since NT3 would compensate for the loss of production at the Theun Hinboun caused by the operation of NT2. The economical benefit of NT3 would increase after inauguration of NT2.

The plan is to extend Theun Hinboun by one unit, i.e. a 50% increase in installed capacity. In addition to this, the present THB Extension project consists of a dam equal to the dam proposed for NT3 (but without the power plant). Some alternatives of Theun Hinboun Extension have been evaluated in the PSDP and the conclusion is that the most viable project is an extension of THB by one unit and construction of Nam Theun 3 dam without the large power plant at the foot of the dam.

Apart from Theun Hinboun Extension there is no hydropower development expected before 2025 that might influence the hydrology of Xe Bangfai and Nam Theun – Nam Kading.

5.3 Transport

5.3.1 Introduction

The transport sector is a dynamic sector that will induce a number of other developments – positive and negative – and might add to the impacts caused by the NT2 Project construction activities, social changes and management initiatives.

It is expected that in the future transportation improvements will be regarded as a key factor for poverty alleviation and socio-economic development in Lao PDR and in the region. Today a major share of Lao PDR government funds is channelled into the transport sector, which receives around a quarter of the total overseas development assistance. Particular emphasis has been put on improving road links between the major towns in the country.

5.3.2 Regional Perspective

It is not considered a priority issue to analyse transport trends in the greater Mekong perspective as part of this CIA. One exception, however, is the plans for upgrading, or revitalisation, of river transport on some stretches of Mekong, and the potential effects of changes in river hydrology. This issue is assumed to be of significance only in the long-term (20-year) perspective.

5.3.3 Local Perspective

Compared to its neighbours Lao PDR has a low road density per square km. The usage of the roads are still considered as light with average daily traffic (ADT) for

national roads varying between 250 and 500 vehicles and less than 50 on secondary roads.

However, traffic on Route 13 is substantially higher being the main north-south trunk road in the country. A traffic survey carried out by MCTPC in 2000, recorded ADTs from around 700 to 1000 on different sections north and south of Thakhek.

Branching off from Route 13 roads running east-west traverse and encircle the NT2 Project area. These roads will constitute factors that influence and drive social and economical developments in the NT2 Project area and beyond, adding to those created by NT2. Road improvement projects are in the process of being implemented or have been planned for the most important of these roads.

In Savannakhet the ADB supported East-West Corridor Project (Route 9) is nearing completion. The 2000 traffic survey recorded ADT figures around 700 on the section near the border to Vietnam. The improvement will substantially increase the movement of goods and people through the province. However, Route 9 is located some 100-130 km south of the NT2 Project influence area and will as such only have a peripheral effect on developments there.

The East-West Corridor Project also includes the construction of a bridge connection between Mukdahan on the Thai side of the Mekong and Savannakhet on the Lao side. The bridge is planned to be completed in 2006, that is, during the early construction phase of the NT2 Project. In relation to cumulative effects the bridge will probably be more significant than the improvement of Route 9 as it will create a conduit for cross border trade and transport that is likely to influence economic development in the NT2 Project influence area.

In Khammouane, Route 12 from Mahaxai to the Vietnamese border is being upgraded, financed by GoL. It is due to be finished in November 2004. The section between Gnommalath and the Vietnamese border has an ADT of around 300 according to the 2000 MCTPC traffic survey. Between Gnommalath and Thakek the traffic was found to be lighter with an ADT of around 100.

The upgrading of the provincial road from Mahaxai to Boualapha District (46 km) is just finished with support from SIDA. It is expected that SIDA will continue its support for community and district roads in Khammouane.

According to information obtained at the district level a new road from Gnommalath into the Phu Hin Poun NBCA is being constructed as a part of an initiative to develop ecotourism in the area. Information on the exact location of this road was not obtained.

Route 8B starting at the junction with Route 12 and traversing the NT2 Project area and the Nakai Plateau was recorded to have a considerable traffic load with an ADT of more than 300 in 2000. As the ADT figures for Route 12 indicates most of this traffic probably went to Vietnam.


0 10 20 30 Kilometers
N
W
E
S
Route 8A
Route 8B
Route 12
Route 9
Thakek
Legend
Major road projects
Road improvement
Bridge, Thakek
Existing roads
Paved road
Improved unp. road
Unpaved road
Temporary road
Admin. units
Districts
Local urban areas
Mines
Nam Theun 2
Cumulativ Impact Assessment
Map 4: Infrastructure and industry
Date: 20. April 2004

In Bolikhamxai, the most important road in the NT2 context is Route 8 that runs from Vieng Kham on Route 13 through the important district town of Lak Xao and on to the Lao-Vietnamese border. The road will be surfaced for all its length. According to plans the upgrading will be finished towards the end of 2005. Across the Vietnamese border on Route 8 lies the town of Cau Treo that since 1998 has had status as an "economic zone". In 2000 the official figure for import and export in this zone was estimated to 120 million USD, and a total of 180,000 people crossed the border for trade and tourism (Website Vietnam Business Forum, issue No.12, 2002).

Little is known of transport initiatives in the 20-year perspective. It is expected, however, that this area will provide more and more important corridors for transport of goods and people between Thailand, Lao PDR and Vietnam. This will lead to development of infrastructure and service facilities related to transport in the three provinces and in the districts on the Thai and Vietnamese side of the border.

The Integrated Regional Development Plan for the Savannakhet and Khammouane Region (JICA/CPC 2001) proposes to extend the runway and upgrade Savannakhet Airport to international status, as tourism and economic activity in connection with the special economic zone is expected to create a higher demand for air travel. It also proposes that passengers from Mukdahan in the future should utilize the airport and fly to Bangkok from Savannakhet by establishing a special in-migration control arrangement. If this proposal is indeed pursued, it is unlikely that it will be realised until some time after 2010. The annual passenger demand for the Savannaket-Bangkok route is forecasted to be around 39,000 in 2012 and 63,000 in 2017

Thakhek is among the alternative locations for a future Mekong bridge after the construction of the second friendship bridge at Savannakhet is finished in 2006. The Thai authorities have already indicated interest in a Nakhon Phanom-Thakhek bridge, and it is likely that it will be realised within the time period 2010-2020.

5.4 Irrigation

5.4.1 Introduction

Apart from hydropower, irrigation is the sector with the biggest potential to exert impacts on hydrology and flow regimes in a river basin. Depending on the management, as well as the technical standard and technological level of an irrigation scheme, water consumption can vary considerably. In addition to impacts on hydrology, irrigation may also have ramificatons for water quality, biodiversity and soil fertility in terms of salinisation problems.

In a cummulative impact context it is relvant to focus on the Mekong Basin as water abstractions for irrigated agriclture may possibly add to the hydrological effects created by NT2 in the Mekong mainstream, the Great Lake and the Delta. In relation to cumulative impacts, it is the water abstraction for irrigated agriculture during the dry season that is of highest interest and significance as the abundant rainfall during the rainy season makes only partial irrigation necessary. Thus the dry season irrigation will counteract the increased dry season flow caused by storage hydropower. Rice is the most important crop to focus on because irrigated dry season rice requires aroud 3 times more water than other field crops.

5.4.2 Regional Perspective

Irrigated agriculture is responsible for 80-90% of the water abstractions from the Mekong Basin and it is utilized in the form of receding flood water storage, pumping and diversions from rivers and streams including the Mekong, and to a smaller extent, by pumping of ground water resources.

Present areas used for dry season irrigated rice in the Lower Mekong Basin vary considerably between the countries with the largest areas found in Cambodia and in the Mekong Delta. In the Mekong Delta triple rice cropping is common with two harvests in the dry season and one in the wet season. It should also be noted that probably less than half of the area of irrigated dry season rice in Cambodia is fully irrigated. The rest of the area is recession rice receiving supplemental irrigation consuming less than half of the water consumed by fully irrigated rice.

Table 9: Irrigated Dry Season Rice the LMB and Predicted Increase (km^2)

Type of Crop/Land	Thailand	Lao PDR	Vietnam Central Highland	Mekong Delta	Cambodia	Total
Irrigated dry season rice (2000)	1,070	920	370	34,030[1]	2,510	38,900
Predicted situation (2025)	1,200	2,000	400	35,700	5,000	44,300
Increase	10%	100%	0	5%	100%	14%

Source: Lower Mekong Basin, Future Trends in Agricultural Production (MRC, 2003)
[1] Includes double cropping in dry season

The potential for expanding dry season irrigated rice is also unevenly distributed between the countries. In the lowlands of Northern and Northeast Thailand it is assumed that the future dominant production will be low input, low risk, wet season, rainfed and irrigated rice production. Irrigated dry season rice did not increase from 1990 to 2000 and substantial expansions of the area in the future is expected to be limited unless the economic returns from irrigated rice are improved either through technological advances such as higher yields or higher farm gate prices. However, there are still some land areas that may be developed for irrigation, both in northeast and northern Thailand although of varying soil quality. Limited parts of these areas are currently being developed or planned for irrigation. Seen against this background a fair guess of the future expansion is that it would be limited to 10% of today's area over a 20-year perspective. That would mean an additional area of around 100 km^2.

A large percentage of the potential arable land has already been converted to agricultural purposes in the Vietnamese part of the Mekong Delta. Of the total area of flat land and gentle slopes 88% is utilised for agriculture and settlements. Both the lack of suitable land and the limited profitability of growing rice presently discourages further expansion of dry season rice cropping in the Mekong Delta. Instead, the current trend is to devote land to more profitable productions like fruit trees and fish ponds. Thus only small increases in dry season rice cropping can be expected in the future, possibly limited to around 5% in the next 20 years.

The Central Highlands of Vietnam is also in a similar situation as regards land utilization and potential for increased irrigated rice area. Conversion of land for agricultural purposes is likely to continue with a focus on orchards and other pro-

ductions that give higher returns than rice cultivation. The future expansion of irrigated dry season rice in the Central Highands of Vietnam is therefore likely to be limited.

The countries that possess the largest and most significant potential areas for expanded rice cultivation are Lao PDR and Cambodia. Lao PDR has approximately 27,000 km^2 ha of flat and rolling land, which could be utilized for agricultural purposes. A high percentage, possibly as high as 50% of the soils of this land type are infertile and poorly suited for agriculture but there are possibly nearly 10,000 km^2 ha of more fertile land (MRCS, 2003). Most of these high potential areas are located on floodplains of the Mekong tributaries in the central and southern part of the country. The expansion of dry season irrigated rice farming will in the future mostly be on a combination of already existing wet season rice areas and reclamation agricultural land. The pace of the dry season irrigation rice expansion will depend on the availability of water and investment capital for building of new schemes. Given the ample availability of suitable land a doubling of today's area within 20 years may be possible. This would mean an area of around 2,000 km^2 of dry season irrigated rice in 2025.

In eastern and southern Cambodia more than 4,600 km^2 of relatively good agricultural land are located on the Mekong floodplain. However, much of the land in Southern Cambodia is flood prone. In the Great Lake region around 7,500 km^2 of reasonably fertile land can be found but much of the potential land is either isolated or consist of flat areas where water storage is problematic. Still, Cambodia possesses the largest potential for expanded dry season irrigation of all the Lower Mekong Basin countries and it is thus not unrealistic to a considerable expansion in the future. Within a 20-year period one could possibly expect to see a doubling of the irrigated dry season rice also in Cambodia if capital becomes available. That would imply an additional area of around 2,500 km^2 by 2025.

5.4.3 Local Perspective

In the local perspective the Xe Bangfai, the Nam Kading and the Nam Hinboun basins are in the centre of interest as they will be experiencing changes in the flow regimes that may affect the basic conditions for developing irrigation, in particular dry season irrigated rice. As a result of the interbasin transfer of water caused by the NT2 project, Nam Theun, Nam Kading and Nam Hinboun rivers will experience reduced flows while the Xe Bangfai will receive the additional water. Table 10 gives an overview of the existing irrigation schemes and potential for expanding wet and dry season irrigation in the various basins. The information has been compiled from MRC's database on irrigation in the Lower Mekong Basin. This database relies on information received from each member country.

Table 10: Existing Irrigated Land Potential Increase in the NT2 affected Basins

Basin	Existing Irrigated Rice (ha)		Potential Increase - WS		Potential Increase - DS	
	WS	DS	ha	%	ha	%
Xe Bangfai	22,720	16,004	14,140	62	9,375	58
Nam Hinboun[1]	6,040	4,496	5,200	86	3,345	74
Upper Nam Theun[2]	445	445	196	44	196	44
Nam Nyuang[3]	128	90	-		-	
Nam Phao/ Nam Kata[3]	1,475	1,248	1,309	89	1,109	89
Pak Kading – Xe Bangfai, riverine, Lao	4,789	3,706	4,045	84	3,174	86
Pak Kading – Savannakhet, riverine, Thai	15,885	-	-		-	
Total	51,482	25,989	24,890	48	17,199	66

Source: MRC, 2001 (WS = wet season, DS = dry season)
[1] Includes the reach above the confluence Nam Hai–Nam Hinboun
[2] Nam Theun south of Nam Nyuang
[3] Tributaries to Nam Theun

As can be seen from the table there exists considerable potential for expanding the irrigated area both in the wet and dry season in the Xe Bangfai basin. A 62% increase apperars to be possible for the wet season rice while for the dry season rice the potential amounts to a 58% increase.

The Nam Hinboun Basin, which also includes areas upstream of the confluence of Nam Hai and Nam Hinboun, has considerably smaller areas of irrigated and potential irrigated rice areas than the Xe Bangfai Basin. Still the potential for expansion of wet and dry season irrigated rice areas is considerable, amounting to 86 and 74% for wet and dry season rice respectively. However, due to regular flooding, irrigation schemes in the lower reaches of Nam Hai and Nam Hinboun are vulnerable to long periods of high water.

Existing irrigated and potentially irrigable areas are very limited along the Upper Nam Theun. On its tributaries existing and potential areas are larger, especially along the Nam Phao and Nam Kata.

Due to the topographic features of Nam Kading Basin only some limited existing areas with potential for expansion are found along tributaries joining Nam Kading close to its confluence with Mekong. These areas are included in the figures for Pak Kading-Xe Bangfai riverine irrigated and potentially irrigable areas.

The irrigation potential in connection with the Nam Theun 1 Hydropower Project is unlikely to be realised as Nam Theun 1 involves the building of a high dam that makes the project both economically marginal and environmentally doubtful. It is therefore not included in the 20-year plans for hydropower development in Lao PDR.

Because of the high potential for expanded irrigation in the Lower Xe Bangfai, the GoL has designated it a priority area for agricultural development. However, severe and protracted flooding in the wet season presents a serious obstacle to development of irrigation in the area as submergence of rice plants for more than a few days (up to 7 days depending of water velocity and sediments) will kill the crop.

The World Bank Agricultural Development Project (ADP) that started in 2001 and is presently working in 4 southern provinces including Khammouane, will construct 4 irrigation schemes in the province. Details on location and size are given below.

Table 11: ADP Planned Irrigation Schemes in Khammoauane

Scheme Designation	District	Status	Service Area ha
Phandeng	Gnommalath	Bidding	100
Naphoxay	Gnommalath	Design	80
Thathot	Gnommalath	Design	280
Nakosin	Thakhek	Bidding	70
Sangom	Thakhek	Bidding	280
Total Service Area			**810**

The ADP Project will also train water user groups and improve rules and regulations ensuring more gender balance. Other project components are construction of village access tracks, improvement of water supply and sanitation, strengthening of agricultural extension at district level and micro-finance provision. The ADP is due to last until 2007.

5.5 Water Supply and Sanitation

5.5.1 Introduction

Water supply and sanitation has in this study been handled both as a development sector and a sector that might be impacted by the cumulative impacts. As a development sector focus is on water demand and the withdrawal of water from surface and groundwater sources and on the discharge of polluted wastewater back into rivers and lakes. As an impacted sector, which is discussed in Chapter 7, focus will be on the how other water users might have an impact on the availability and quality on water for drinking water supply.

For the analysis of cumulative impacts, water supply and sanitation development are most relevant in the large scale Mekong River Basin and in the local perspectives of the Nakai Plateau and local river basins.

5.5.2 Mekong Perspective

Reported per capita use and demand of water for domestic purposes varies between the countries and between different studies. Demand studies have used assumptions of up to 100 m^3 per capita per year, which sounds very high in countries where a large part of the population lives in rural areas with underdeveloped infrastructure. Also the population growth figures for the individual countries vary, which also results in different scenarios for future water demand.

Table 12 shows estimated population and domestic water demand in the Lower Mekong Basin by 2025. The table is based on figures from documents produced for the MRC Basin Development Plan and Water Utilization Programme.

Population growth rates in the Lower Mekong Basin are expected to decline in the future, mainly because of general economic growth and family planning.

Table 12: Population Increase and Water Consumption

Country	Population 2000	Growth rate %	Population 2025	Demand per capita m^3/year	Total demand 2025 mill m^3
Cambodia	9,800,000	2.3	17,303,000	12	208
Lao PDR	4,905,000	2.6	9,318,000	20	186
Thailand	23,130,000	1.0	29,663,000	24	712
Vietnam	16,920,000	1.4	23,952,000	42	1,006
Total	**54,744,000**		**80,235,000**		**2,112**

Source population figures: MRC-BDP Regional Sector Overview 2002
Source water demand estimates: MRC Water Utilization Programme, 2002

The estimates show that the population may reach 80 million people by 2025 corresponidng to a water demand of around 2,100 million m^3. This translates to an avarage loss of flow of about 70 m^3/s in the Mekong Delta. The need for more water can be counteracted to some extent by improvements in efficiency of supply and leakage reduction in the distribution network. Appropriate pricing of water is also an important countermeasure against excessive use and wastage.

5.5.3 Local Perspective

Under the ADB Water Supply and Sanitation Sector Project there are plans to build two water supply schemes in Bolikhamxai and Khammouane. One scheme will serve Nongbok Town, which is situated in the lower Xe Bangfai Basin and thus within the direct impact zone of the NT2 Project. The other scheme will be built at Lak Xao to the north of the NT2 Project area. At Nongbok, the Xe Bangfai will be used as the source for the planned water supply scheme, and by 2010 an average consumption of 17 litres per second is expected.

For Lak Xao the feasibility study is yet to be done and it has thus not been decided whether river water or ground water will be used. However, given current preferences for technical solutions among the government agencies responsible for water supply, it is most probable that surface water from a nearby river, possibly the Nam Phao, will be chosen.

5.6 Urban Development

5.6.1 Introduction

Economic development generally generates urban development. At the same time urban development can be seen to be a factor that enhances economic growth and in that way reduces poverty. Urbanisation can to some extent be planned and controlled but more often the urbanisation process is determined by general economic development and social preferences in the population. The general standard of living and services will in most cases be better than in rural areas. However, uncontrolled urbanisation often creates destitute and unhealthy slum areas lacking safe water supply and sanitation facilities, social services, etc.

In the context of cumulative impacts assessment, urban development processes in local towns and areas are considered to be the most interesting and relevant

focus as it is here the factors that drive urban development will add to those of NT2.

5.6.2 Local Perspective

Population Growth

The important urban areas to consider in the cumulative impact analysis are Thakhek, Gnommalath and Mahaxai in Khammouane, and Lak Xao in Bolikhamxai. Gnommalath district does, in a strict sense, not have any urban area, only a number of villages along or nearby Route 8B from where it crosses Nam and northwards. These villages include Gnaommalat, the administrative centre, Gnommalath Tay, Ban Hua Khua, Somsanok, Ban Nong Saeng and Keovilay. According to the 1995 census this cluster of villages had a population of around 1700 –2000 people.

Of all the districts surrounding the NT2 project area Mahaxai has had the largest growth in population with an average 3.6% per year. Growth has been more moderate in neighboring Gnommalath with only 2.3 % over the last years. As for the population growth in the district centres it may be assumed that it has grown at a higher rate than districts because if inmigration.

Thakhek, the provincial capital and largest urban area in the Khammouane has experienced an average annual population growth of 3.5 % over the last 8 years. A considerable part of it can be attributed to migration as the natural population growth for in the area can be assumed to have been around or below 3%.

Nakai District on the whole has seen an annual growth of around 3% from 1995 to 2003 while Odoumsouk or Nakai Town has grown at rate of 4.8%. This rapid growth is probably due to the establishment of Nakai as a separate district and the vigorous logging activities that took place on the Plateau throughout this period.

Lak Xao, the administrative centre town in Khamkheut District is the only town in the area north of the NT2 Project area. It is a fairly large district town in the Lao context and its growth over the last years has been estimated to 2.7% annually (Norconsult, 2003)

Table 13: Urban and Rural Population in NT2 Influence Area

Area/Town	Population		Annual Increase - %
	1995	2003	
Thakhek Town (urban area)	25,768[1]	33,017[2]	3.5
Nakai District	15,635[1]	18,812[4]	2.5
Odomsouk (Nakai Town)	1,530[3a]	1,900[3b]	4.8
Mahaxai District	22,982[1]	29,587[4]	3.6
Gnommalath District	21,607[1]	25,612[4]	2.3
LakXao		12,774[2]	2.7

Sources: [1] NSC Census, [2] Lao Urban Data Book, [3a] SDP (figure for 1998), [3b] SDP, estimate based on no. of HH, [4] Data obtained at district level 2004

Projected Growth in Urban Areas

Thakek will continue to be a focal point for urbanization in the province in the future. The economy of Thakhek has to a large extent been fuelled by the timber industry that currently is experiencing a recession. However, because of its size and with the economic momentum of larger growth in other sectors like trade, service and tourism, Thakek will most likely continue to experience a relatively rapid population growth and associated urban expansion. One of the factors that in the short term perspective will contribute to maintain the rapid growth of Thakek and counteract the economic slump caused by the decline of timber industry, is the effect of the NT2 Project. A reasonable assumption will therefore be that Thakek both in the short and long perspective at least maintains a growth of 3.5%.

The economic perspective of Lak Xao is linked to the forestry industry and the cross-border trade with Vietnam. The forestry related activities are declining in Khamkheut but trade and traffic associated with the upgrading of Route 8 will most likely increase. Since there are no other towns in the area it is expected that urbanization in the eastern area of Bolikhamsay will focus on Lak Xao. In addition come the effects created by trade and traffic in connection with the construction of the Nakai Dam. Lak Xao will therefore continue to experience a high growth rate, probably slightly higher than in the past. A reasonable estimate would therefore be that future growth in population will be around 3% on an annual basis.

The future growth of Oudomsouk will be dominated and governed by the NT2 Project activities in the short-term perspective. As long as there are considerable construction activities on the Plateau this will uphold the rapid growth seen in the past. One workers camp with possibly as many as 800 workers will be located near the town. It must be expected that the associated influx of camp followers, employment seekers and small-scale business people will be as least as high. In addition comes the establishment of all the administrative offices with their staff and families. A rough prediction would therefore be that the population of Oudomsouk would be around 4,000 people by 2010 if construction activities still are ongoing. If the workers have left the population will be lower, possibly around to 3,500 people.

Mahaxai District Centre will have its own dynamic in addition to the effect of the NT2 because of the planned cement factory and its location on Route 12. The number of workers that will be employed at the factory will possibly reach 300. Assuming that the population in Mahaxai is presently around 2000 the influx of workers and followers as well as associated service activities will possibly more than double the population by 2010. From there on it may be assumed that the growth will remain high, possibly around 3%.

Gnommalath and the villages along Route 8 up to the regulating dam will experience a considerable population influx and increased urbanization pressure during the implementation of the NT2 Project. Although the 4 planned workers camps with up to 2,200 workers will be located in a forested area at some distance from Gnommalath, one can expect a rise in the population in the villages along the road leading to an amalgamation into a more contiguous urban area. The majority of these will be job seekers, traders and small scale business people trying to capitalize on the increased economic activity in the area. A conservative guess would be that the inhabitants in the area along the road could reach 2,500-3,000 at the end of the construction period, discounting construction workers. After the construction period an operators village for possibly as many as 150 employees service facilities will be established in the area. Assuming that each employee

has a family with 5 household members this will lead to a population increase of 750 after 2010. Afterwards, towards 2025, urbanisation would continue with a growth similar to that of Mahaxai.

Table 14: Estimated Population Increase in NT2 affected Urban Areas

Urban area	Estimated Growth Rate		Basis Population	2010		2025	
	< 2010	2010- 25		Pop.	% incr.	Pop.	% incr.
Thakhek	3.5	3.5	33,017[1]	48,200	46	80,750	145
Odomsouk	-	3.0	1,900[2]	3,500	84	5,400	184
Mahaxai	-	3.0	2000[3]	4,000	100	6,200	210
Gnommalath	-	3.0	2000[3]	4,000	100	6,200	210
LakXao[1]	3.0	3.0	12,774[1]	17,600	37	27,500	115

[1] Lao Urban Data Book (2003), [2] Estmate based on SDP/RAP HH figures 2003, [3] Estimated present population

5.7 Fisheries

5.7.1 Introduction

Fishery is an important but typically not a dynamic development sector locally and in the larger Mekong region. Fisheries are important as a source of protein for a growing population and it seems that the present catch is close to or above the level of sustainability. In this perspective, the options for increased output are few and fisheries are more a sector that is at risk of being affected by other developments than a sector causing impacts to others. Typically fisheries development is not planned, but happens as a result of new opportunities and changed conditions.

5.7.2 Mekong Perspective

When the annual rains begin in late April or May, the flow volume of the Mekong starts to increase. Changes in water chemistry, temperature, turbidity and flow-volume trigger an upstream spawning migration of many fish species, but predominantly catfishes. Many of the species arrive from Cambodian riverine habitats (some species perhaps from the Great Lake) and, after traversing the rapids at the Khone Falls in Southern Lao PDR, they continue their migration further upstream into Thai and Laotian waters. Some species enter tributaries for breeding, whereas others remain and spawn in the mainstream itself.

The Great Lake (Tonle Sap) of Cambodia may be considered as the “heart” of fisheries in the LMB countries. When the annual flood-pulse in the Mekong reaches a certain level in the early wet season the flow in the Great Lake River is temporarily reversed, and water flows into the Great Lake from the Mekong. Many fish species go with it. In most years, this causes the Great Lake to expand from approximately 3,500 km^2 to around 16,000 km^2. Oxidized nutrients under dry-season conditions are released and stimulate primary production. In October-November, the size of the Great Lake begins to rapidly decrease, which causes a massive fish movement migration out of the Great Lake back towards the Mekong via the Tonle Sap River. Here large quantities are intercepted in the bagnet fisheries.

The present fisheries yield in the lower basin is shown in Table 15: Fish Yield in Lower Mekong Basin The total includes about 240,000 tonnes produced in reservoirs and 260,000 tonnes from aquaculture. Of the 500,000 tonnes reported from Cambodia about 235,000 is from the fisheries in the Great Lake.

Table 15: Fish Yield in Lower Mekong Basin (MRCS 2000)

Country	Estimated catch per year tonnes
Cambodia	500,000
Lao PDR	133,000
North east Thailand	795,000
Delta Vietnam	597,000
Total LMB	**2,000,000**

There are clear signs of over-exploitation, such as decrease in the average size of the fish caught. In addition there are a number of threats to the fish production and the fish biodiversity by changes in hydrology, water quality and riverine habitat.

Based on population growth figures and maintenance of the same level of fish consumption as today the demand for fish in LMB will grow from today about 2 million tons per year to about 2.4 million tons per year in 2010 and about 2.9 million tonnes per year in 2025. It not likely that the natural production potential will allow for such an increase in output. The challenge will more realistically be to protect the production potential and to define and control the level of sustainable exploitation.

Aquaculture is an emerging activity in the region. Aquaculture has often been promoted as an alternative to the damage caused by hydropower and irrigation projects. However, only under certain circumstances can small-scale, extensive, village-level aquaculture compensate for losses to “wild” fisheries. This is mainly due to the economics of small-scale systems, lack of technical “know-how”, poor access to credit, marketing problems, flooding and the costs involved in pond or net cage construction.

5.7.3 Local Perspective

Realistic figures for fish production in Xe Bangfai, Nam Kading, Nam Hinboun and their tributaries are near to impossible to obtain. The factors that actually affect the ultimate fisheries production in any particular year are both related to the fishing activities (including destructive fishing methods and over fishing) and natural factors determining production and migrations (flood levels, catchment deforestation, lunar cycles, “flash-floods”, water temperature, turbidity and chemistry, etc.)

The current on-going pre-impoundment study of Xe Bangfai records weekly quantitative data on fish catch from 21 fishers living in seven villages. The estimate for the 2001 to 2002 period, based on reports from 21 “Project” fishers is that a family (household) can obtain on average 255 kg of fish per year. How this figure from “professionals” relates to the average catch of fish for all households in the total area has not been established. It is not known whether the present

catch level is close to the carrying capacity of the fish populations or if there is room for increased catch in the future. No specific plans have been identified during this study for fisheries or larger scale aquaculture development in the Xe Bangfai, Nam Kading or Nam Theun basins.

In the Nakai reservoir area the new "lake" is likely to create opportunities for commercial fishing activities. The social development plans have included requirements for giving the local population the priority in utilising this potential.

5.8 Forestry

5.8.1 Introduction

In this section, forestry as a commercial development sector based on the exploitation of timber resources is described. Sustainable forest management as an activity to conserve forest biodiversity and promote small-scale/traditional forest product utilisation is a sub-sector that might be impacted by commercial logging and other development activities in the area. Such impacts are discussed in Chapter 7.

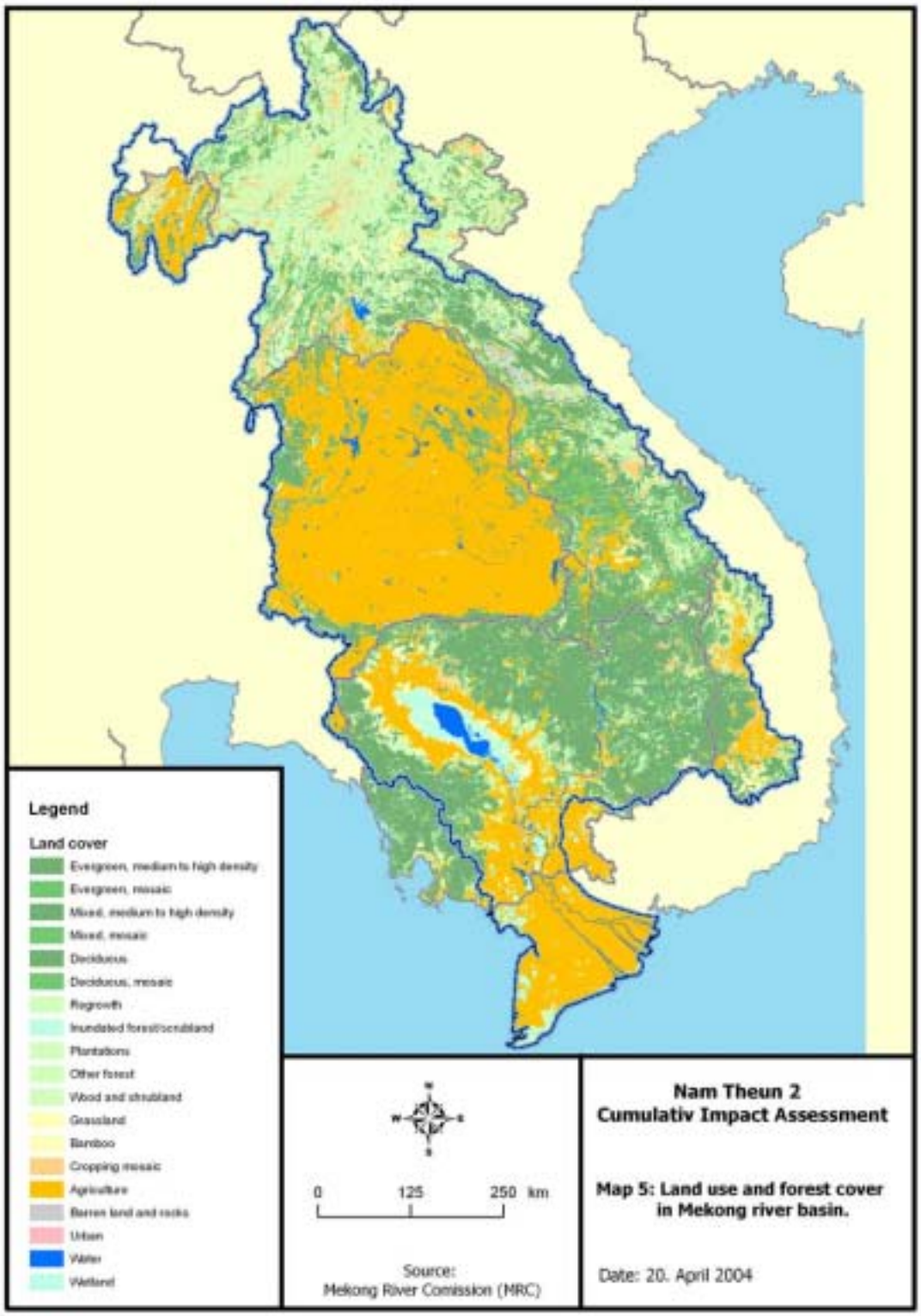
Most of the forestry related impacts would be felt in the local impact areas covered by this CIA. However, the general basin wide trend in forest coverage and forest types might have an impact on the area water runoff pattern and thus the hydrological regime for the whole Mekong Basin.

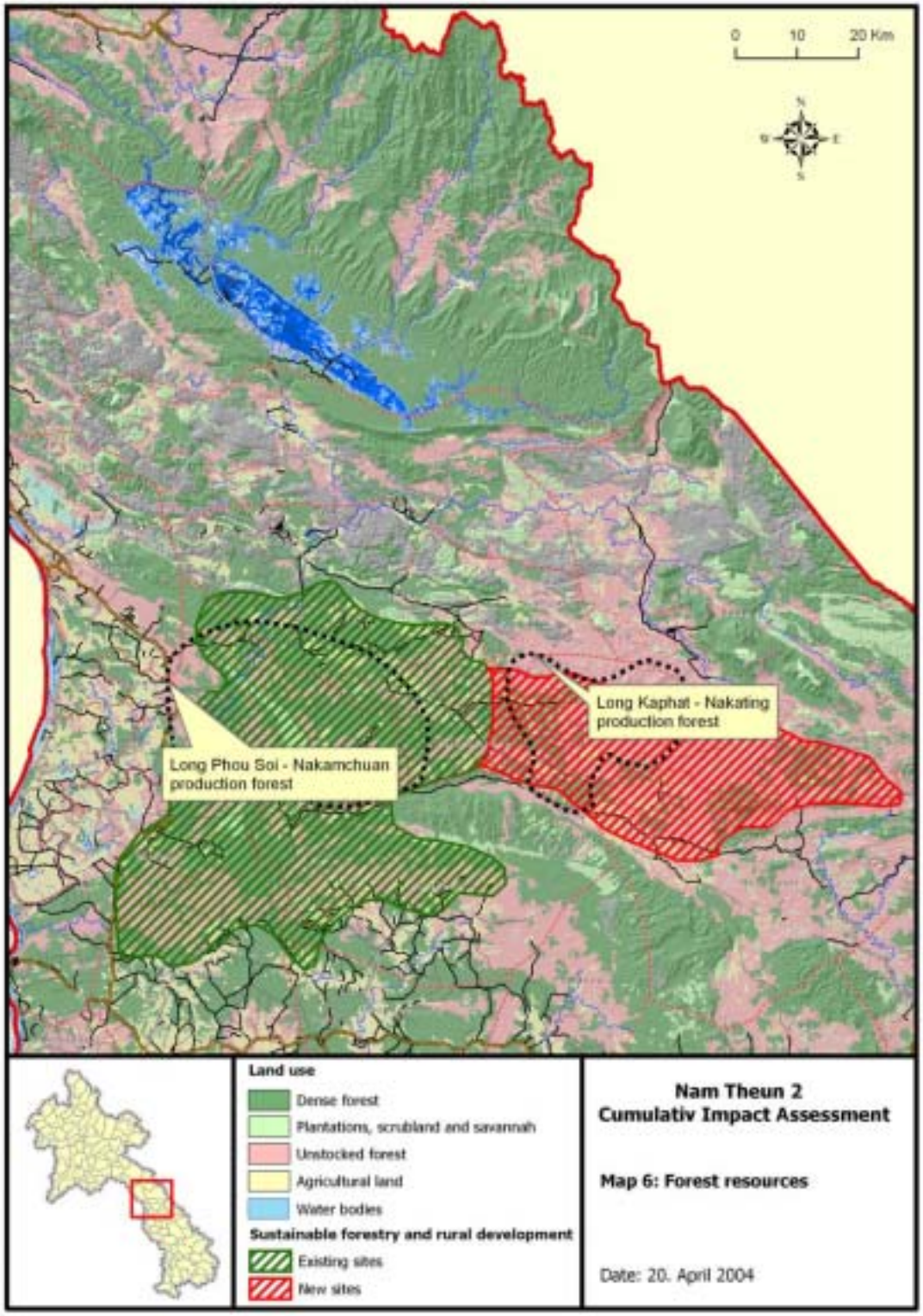
5.8.2 Mekong Perspective

The remaining forested area in the lower Mekong is largely found in Lao PDR and Cambodia. There is however, also some forest left in the Vietnam and Thai parts of the basin. The following figures for forest cover have been calculated on the basis of the Mekong River Commission's GIS database.

Table 16: Forest Cover in the Mekong Basin (MRC 1997)

Country	Total area (km^2)	Forest area (km^2)	Forest cover
Cambodia	181,547	97,748	53.8%
Lao PDR	229,786	88,012	38.3%
Thailand	188,280	29,597	15.7%
Vietnam	67,456	14,127	20.9%
Total	*667,069*	*229,484*	*34.4%*


Legend
Land cover
Evergreen, medium to high density
Evergreen, mosaic
Mixed, medium to high density
Mixed, mosaic
Deciduous
Deciduous, mosaic
Regrowth
Inundated forest/scrubland
Plantations
Other forest
Wood and shrubland
Grassland
Bamboo
Cropping mosaic
Agriculture
Barren land and rocks
Urban
Water
Wetland
0
125
250 km
Source:
Mekong River Comission (MRC)
Nam Theun 2
Cumulativ Impact Assessment
Map 5: Land use and forest cover in Mekong river basin.
Date: 20. April 2004


0 10 20 Km
N
W
E
S
Long Kaphat - Nakating production forest
Long Phou Soi - Nakamchuan production forest
Land use
Dense forest
Plantations, scrubland and savannah
Unstocked forest
Agricultural land
Water bodies
Sustainable forestry and rural development
Existing sites
New sites
Nam Theun 2
Cumulativ Impact Assessment
Map 6: Forest resources
Date: 20. April 2004

The MRC figures diverges somewhat from those in forestry strategy for Lao PDR. (MAF 2003). The discrepancy may be due to different forest definitions. Lao PDR has over the last decades seen a relatively rapid reduction of its forest cover from 64 % in the mid-sixties to 41.5% today measured as forest with more than 20% canopy density. Although the stated goal is to increase the forest cover substantially it is to be feared that the trend of diminishing forest cover will continue also in the years ahead. If the decline continues at the same rate as the last 35-40 years the forest cover will be down to 37-38% in 5 years time and down to around 30% in 20 years time.

Cambodia is the country with the highest forest cover of the Mekong basin. Also here, logging has been conducted on a large scale over the last decades. A reasonable assumption would be that this trend also continues into the future. The forest cover could thus be considerably reduced, perhaps to somewhere between 47 and 50% in 5-years time, reaching below 40% in 20 years time.

Having been reduced to just 15-16%, significant further reductions should not be expected in Thailand. In Vietnam increased agricultural activities could reduce the forest cover down towards 15% in the 20-year perspective

5.8.3 Local Perspective

It is assumed that the significant cumulative effects of developments in the forestry sector and the NT2 Project will primarily occur in the NT2 Project area itself and in adjacent forested areas such as the NBCAs.

The timber harvesting and logging industry has been one of the major sources of employment in Khammouane Province with around 5000 people engaged in it during its peak in the last half of the 1990s. In 1996 there were 9 privately owned sawmills, 5 joint venture sawmills and 1 kiln-drying facility in the Khammouane and Bolikhamsay Provinces relying on logging in Khammouane. These facilities had a combined intake of around 325,000 m^3 per year. In addition there is a plywood mill (near Mahaxai) and a chipboard factory in Khammouane with a combined intake of 100,000 m^3 per year.

There are 2 designated production forest areas in Khammoauane Province, each of around 60,000 ha. These are the Dong Khaphat-Nakating area located in the southeast between the Khammouane-Savannakhet border and the Xe Bangfai, and the Dong Phou Soi-Khamchouan located in the southwest between Route 13, the Savannakhet border and the Mahaxai-Xaibouathong road (see Map 6).

It has been estimated that from 2005 the annual supply from these lowland production areas will be about 100,000 per year (IUCN, 2000b). The timber and wood supply in Khamouan will thus be seriously deficit in relation to the current capacity of the wood processing industry. In fact, diminished wood supply has already led to a contraction in the industry and number of people employed in it.

In Boulikhamsay 8 sawmills and timber processing mills were operating in the province around year 2000 with a combined processing capacity of around 100,000 m^3 per year. In addition, a large integrated wood-processing plant has been constructed at Lak Xao. The production capacity of this plant is assumed to be around 250,000 – 300,000 m^3 per year

Today there is only one production forest area in Bolikhamsay Province with a potential yield that is far less than the current installed production capacity of the processing industry.

An initiative to improve sustainability in the forestry sector is the SUFORD project currently being implemented in Khammouane, Savannakhet, Salavan and Champassak. The project will work in 3 districts in Khammouane. Two of these, Mahaxai and Xe Bangfai, are located in also the NT2 impact zone. The 2 production forest areas form part of the project area.

The project components include capacity building and sustainable forest management with demonstrations of management practices in the field including active participation of villagers. The field implementation will cover 528,000 ha of natural forest whereof 110,000 are in Khammouane Province. The implementation period started in 2003 and will continue until 2007.

Another potentially important factor that will influence the forestry sector in the future is the development of tree plantations with fast growing species suitable for industrial use. The BGA Company is presently developing a total area of 154,000 ha in Bolikhamxai Province. One third will be planted to mainly *Eucalyptus camadulensis*. The plantation area is divided in several sub-plots situated between the Mekong and the mountain range from Pakkading in the north to the mouth of the Hinboun River in the south.

5.9 Industry

5.9.1 Introduction

The industrial development activities that might contribute to cumulative impacts will primarily be activities on the provincial level. Basin-wide development might in the long run have an impact on Mekong River water quality but so far the wastewater discharges are insignificant compared to the recipient capacity of the Mekong.

5.9.2 Local Level Developments

In terms of industrial production, Savannakhet is second only to Vientiane on the national scale. The factories and enterprises are concentrated in Savannakhet town and adjacent areas and comprise the production of electrical appliances, tobacco processing, canning of fruit based products and textiles. The establishment of a special economic zone is likely to attract more enterprises to the province.

Possible future developments include an oil refinery and terminal that will have the capacity to cover 50 percent of the country's consumption. It is not known at this stage how likely it is that the refinery will be constructed. If it becomes a reality it will probably not be built before 2010.

Wood processing (sawmills, etc) is the dominant industrial activity in Khammouane with a total of seven registered enterprises in 2001. The existing sawmills represent a considerable overcapacity. The present output of the plywood factory at Mahaxai is probably much lower than its intended capacity. New establishments are not expected within wood processing. In this sector consolidation is required, and focus is likely to be on value added processing from those enterprises that will be allowed to continue to operate. It is likely that sawmills not able to meet new requirements will be shut down.

A new cement factory is planned to be constructed in Mahaxai District. The construction work is planned to commence in November 2004 and a two year construction period is expected. 300 workers are expected to be employed on a permanent basis by the factory.

In Bolikhamxai the construction material industry dominates. In 2001 there were seven enterprises providing gravel and sand for different types of construction and building activities. Wood processing and production of mirrors also takes place. A notable enterprise is the extraction of chemical compounds from wood (Mai Ketsana) for use in the production of incense sticks and cosmetics.

5.10 Mining

5.10.1 Introduction

Similar to industry, the mining activities that might contribute to cumulative impacts will primarily be activities on the provincial level. Basin wide development might in the long run have an impact on the Mekong River water quality but so far the wastewater discharges are insignificant compared to the recipient capacity of the Mekong.

5.10.2 Local Perspective

Located on the Nam Pathen tributary to the Nam Hinboun there are mines producing heavy metals like tin, lead and zinc. Some of the mines have been in operation for decades, but it is difficult to get any precise information about the level of activity and the processes used. Recent observations, however, indicate that the settling pond systems and pollution control is of a very low standard. There is presently high activity at the mines and it contributes significantly to pollution problems in Nam Pathen and the lower part of Nam Hinboun. High levels of turbidity can be observed. Regular monitoring is not carried out but one sample from July 1995 shows high levels of several heavy metals including lead, zinc, tin and cadmium. The content of iron was extreme (18,700 σg/l compared to the WHO and Lao PDR standard of 300 σg/). In the same period the iron concentration in the lower Nam Hinboun also exceeded the water quality standards (NORPLAN 1997). There is a concern that the mining activity leads to high concentrations of heavy metals in fish and other aquatic organisms.

Alluvial gold is found in Nam Kata a tributary to Nam Phao downstream Lax Xao. Prospects exist for commercial exploitation. At present gold is extracted by artisanal means, which includes the use of mercury. No monitoring of the potential water pollution seems to have taken place.

Gypsum is produced by the State Gypsum Mining Enterprise from the Dong Hene mine in Savannakhet Province. Proven ore reserves at the mine are estimated to be 18 million tons. Gypsum production has increased steadily in the past 4 years because of increased demand by the domestic cement industry and increased exports to Vietnam. Several limestone quarries are presently under operation in Khammouane and Bolikhamxai.

Further developments are foreseen in Savannakhet Province in a long-term perspective. The province has deposits of lead and zinc in the eastern part near the Vietnamese border that might be economically attractive to mine.

The only large-scale mining project within the three provinces that surround the NT2 project area, are the gold and copper mines in Xepon District in Savannakhet. The concession holder and operator of the mines is Oxiana Limited acting through its subsidiary in Lao PDR, Lane Xang Minerals Limited. The gold mine produced 73,247 ounces (2,076 kg) of gold and 35,622 ounces (1,010 kg) of silver the first half of 2004. Gold production is targeted to increase to 200,000

ounces in 2005 and to nearly 400,000 in 2007. Total reserves of gold are estimated at 2.09 million ounces.

Production of copper from their Khanong mine located in Xepon District is expected to start in the first quarter of 2005. A production plant with a capacity of 60,000 tons per year is currently being build at the site. The Khanong mine is estimated to contain 1.21 tons of copper. The Power System Development Plan from 2004 has included the production plant's energy need in their in their demand forecast, amounting to 40 MW from 2005.

The social and environmental impacts of the copper mine and the production plant are expected to be considerable. The Environmental Impact Assessment for this project is presently under review by STEA.

5.11 Social Development

5.11.1 Introduction

Social development comprises a number of sub-sectors and factors, which together affect living conditions, incomes and the general well-being of a population. Health and education services are prominent elements in a social development process while economic growth augments household incomes and employment opportunities. Another important element is the issue of poverty alleviation, which aims to ensure an equitable distribution of resources and economic opportunities. Related to this are the issues of ethnic minorities, vulnerable groups and gender.

In the context of this CIA the social development factors are most relevant for the national and local geographic perspectives.

5.11.2 National Perspective

It is expected that on a national level the NT2 project will create an important precedence for the mitigation of social impacts within the context of future infrastructure development in the country. This relates to the overall participatory approach to planning and implementation, legal issues and specific plans that target ethnic minorities and other vulnerable groups. Countrywide plans for social development in terms of improved health and education services will have a bearing on local level and project area developments, but these impacts do not warrant a cumulative impact analysis on national level.

5.11.3 Local Perspective

Health

The health situation in the NT2 intervention area has been investigated and described in numerous project sponsored studies and reports. Data from these studies, coupled with data and information obtained from national and provincial health statistics, are presented in Table 17. Together with they provide a picture of the health status of the population at national level and in the NT2 influence area.

Table 17: National Level and NT2 Area Health Data

Indicator	National and Provincial Rate	National Ranking

	Nat.	KM	BLX	SVK	KM	BLX	SVK
Natural Growth Rate (%)	2.8	2.6	3.3	3.1	5	14	11
Infant Mortality Rate (infants < 1 year per 1,000 live-births	82.2	91.5	26.0	98.7	5	14	11
Under 5 Mortality Rate (children < 5 per 1,000 live-birts	106.9	116.2	47.7	123.9	15	2	17
Malaria Morbidity[1] (no. per 100,000 patient	48.5	104.7	44.9	61.5	-	-	-
% Households with water supply	50.0	38.0	65.0	66.0	-	-	-
% Households with latrines	29.0	14.0	22.0	11.0	-	-	-
Acute Respiratory Illness (% of children < 5 years, estimated)	5.5	10.7	4.9	11.0	-	-	-
Diarrhea incidence (% of children <5 years, estimated)	2	2.8	2.8	2.5	-	-	-
HIV Infected[1] (no. of persons)	1,102	92	9	487	-	-	-
AIDS cases[1] (no. of persons)	599	17	9	286	-	-	-

KM=Khammouane, BLX=Bolikhamsay, SVK= Savannakhet
[1]Source NCCA, figures for June 2003

As can be read from the table the health situation in the provinces surrounding the NT2 Project are in many respects poorer than the national average. The exception seems to be Bolikhamsay which according to a number of key indicators, e.g. Infant mortality rate and diarrhea incidence, performs better than the national average. However, it should be noted that the statistical basis for calculating indicators sometime is very weak and thus, it should be cautioned against drawing firm conclusions on the available statistical material. It should also be noted that Khammouane appears to have larger problems with malaria than the 2 other provinces. The HIV/AIDS epidemic have so far affected Savannakhet most severely with nearly half of all AIDS cases in the country occurring in the province.

In terms of health staff and facilities in Khammouane province the situation varies from district to district.

As Table 18 shows the central zone along the Mekong and Thakhek are the districts with best coverage.

Table 18: Existing Health Infrastructure in Khammouane Province

District	Health Office Staff	Hospitals		Health Centres	
		Beds	Staff	Number	Staff
Thakhek	18	150[1] / 26	17	12	41
Mahaxai	17	15	17	6	7
Nongbok	21	15	29	10	20
Hinboun	20	15	14	17	36
Gnommalath	22	15	14	5	6
Boualapha	16	15	22	3	11
Nakai	13	15	12	5	11
Xe Bangfai	24	15	13	6	14
Xaybouathong	14	15	16	3	7

[1] Provincial Hospital

A Public Health Action Plan financed by the NT2 Project will be implemented in order to reduce and prevent expected negative health effects in connection with the NT2 Project. It will cover all Project impacted zones from the Nam Theun watershed to the lower Xe Bangfai area. The Plan includes interventions to prevent respiratory diseases, HIV/AIDS, water and vector borne diseases including malaria as well as psychosocial problems like substance abuse, depression and violence. Health infrastructure will be improved by developing the main project medical facilities at the Nakai District Hospital for treatment and stabilization of worker injuries and illnesses within the Oudomsouk Work Camp Zone and the Gnommalath District Hospital for workers at the power station.

Education

Lao PDR allocates 2.4% of its GDP to education. In 2001 the net primary school enrolment rate had reached 80 percent, up from 62 percent in 1990. The Government aims at achieving full enrolment before 2015.

In general the education sector in Lao PDR suffers a lack of funds for salaries and schooling facilities, and a lack of qualified personnel. This situation is most pronounced in the more remote parts of the country in the north and the south. This situation is exacerbated by the fact that the population is young and the majority of school age children live in rural areas. Years of schooling average 2.9 - 3.6 for boys, and 2.1 for girls.

In terms of spending on education Khammouane Provice allocated around 1.8 million Kip per student in 2000 (JICA/CPC 2001). Among all 18 provinces in Lao PDR Khammouane was the third lowest. Vientiane and Sekong spent most per student with around 9 million Kip. Some indicators for the education sector in Khammouane Province are shown below.

Table 19: Education Indicators for Khammouane Province 1998

Indicator	Primary	L. Secondary	U. Secondary
Number of Schools	520	46	9
Enrolment Ratio	76.4	24.8	10.6
Number of Students	47,494	6,741	2.241
Dropout Ratio	20.0	-	-
Repetition Ratio	24.0	-	-
Teacher-Student Ratio	1:31	1:13	1:11
Number of Teachers	1,509	-	-
% of Unqualified Teachers	38.0	-	-

Source: JICA/CPC, 2001

The education component in the Social Development Plan includes construction and staffing of primary schools in every resettlement village. Secondary schooling will be provided according to the needs. An adult literacy programme for the resettlement is also proposed under the plan.

Poverty Alleviation

According to the Lao Expenditure and Consumption Survey (LECS) carried out in 1992/93 and 1997/98 the incidence of poverty has declined slightly in Khammouane and Savannakhet while it in Bolikhamxai has increased substantially. However, the figures for Bolikhamxai is so much lower than the national average and neighboring provinces that some doubt can be raised about their accuracy and validity.

Table 20: Poverty Incidence by Provinces Surrounding NT2

Province	1992/93	1997/98
Bolikhamxai	10.6	25.8
Khammouane	43.7	41.6
Savannakhet	45.7	37.1
National arverage	45.0	38.6

Source: Interim Poverty Reduction Strategy Paper, 2001

In connection with the national poverty reduction strategy work all villages and districts in the country has been classified in relation to the calculated national poverty line. This resulted in 72 districts being cathgegorized as poor and 70 as non-poor. Out of these 72 districts 47 have been earmarked for special priority interventions to reduce poverty.

Table 21 lists the poverty classification of the districts in the 3 provinces in NT2's influence zone.

Table 21: Poor Districts in Provinces Surrounding NT2

Province	Poor Priority Districts	Poor Non-priority Districts	Non-poor Districts
Boulykhamsay	Bolikhan Khamkeuth Viengthong		Pakkading Pakxanh Thaphabat
Khammouane	Boulapha Nakai	Gnommalath Mahaxai Xaybouathong	Thakek Nongbok Xe Bangfai Hinboun
Savannakhet	Nong Xepone Phin Vilabouly	Thaphangthong Xonnabouly Phalanxai	Xaibouly Outhoumphone Khantabouly

Poverty alleviation is now the overarching goal for the Lao Government. In the Interim Poverty Reduction Strategy Paper (I-PRSP) a broad strategy for poverty reduction is outlined. Four sectors are identified as particularly important: agriculture and forestry, education, health and road infrastructure. Improved governance and sound macroeconomic policies are identified important underlying and enabling conditions. The I-PRSP was elaborated in a national Poverty Eradication Plan presented in 2003. The Government is committed to halve poverty by 2015, which is one of the Millennium Goals adopted by Lao PDR.

In terms of poverty reduction efforts in the NT2 influence area the Word Bank is currently preparing a project aiming to improve livelihoods and enhance opportunities for the downstream rural population in the Xe Bangfai Basin. The core districts will be the Gnommalath, Mahaxai, and Xe Bangfai while Boulapha, Nongbok and Xaibouly may receive more specifically targeted assistance. The project is intended to improve the local populations opportunities to benefit from the economic development that is expected to result from the NT2 Project. Interventions will include activities to improve market linkages through building an improved rural access road network and strengthening marketing organisations, improvement of natural resource management, increased agricultural productivity through diversification and extension, and, enhancing women's opportunities to participate in the economic development. The Government has also requested the project formulation team to consider interventions also in the health and education sector. Due to the funds available it has been recommended that the project does not engage in irrigation development.

Ethnic Minorities

Considerable efforts by scholars and government officials have identified a two-tiered system of ethnic classification with 49 main ethnic groups and over 100 sub-groups in Lao PDR. There are four main ethno-linguistic groups in the country: Lao-Tai, Mon-Khmer, Sino-Tibetan and Hmong-mien groups.

Although there are safeguards in the Lao constitution and the PM Degree on Ethnic Minority Policy (1992) regarding the rights of ethnic minorities, the multi-ethnic character of the country and the promotion of development for all groups, the present trend is towards assimilation to and adaptation of the majority Tai-Lao culture by minority groups in terms of livelihood, cultural practices, religion and language in the project area (EMDP, 2003). Many minority groups are consciously changing their ethnic identities in order to improve their socio-economic

situation. Education is only in the official Lao language and Tai-Lao culture stands for modernity (Buddhism as opposed to animist practices, market-oriented economy and wages versus subsistence production, government jobs versus farming, etc.).

This trend is likely to continue regarding small groups that are reliant on traditional practices such as hunting and the gathering of NTFPs, and the pace might be accelerated by development initiated by the NT2 Project. Increased demand for resources due to population influx and more competition for these resources could threaten traditional livelihood systems. However, there are larger ethnic minorities, such as the Brou with a similar livelihood system to the Tai-Lao in lowland areas and such ethnic groups have the potential to develop economically and culturally in parallel with the dominant groups.

Table 22: Ethnic Minorities in the Three Affected Provinces

Province	1995 Census Data	1997 Population Estimates		
		Total	Ethnic Minorities	%
Bolikhamxai	163,589	171,201	34,240	20.0
Khammouane	273,779	288,600	134,500	46.6
Savannekhet	671,581	711,500	302,400	42.5
3 Provinces	**1,108,949**	**1,171,301**	**471,140**	**40.2**

Source: 1995 National Census, Lao PDR

Information on ethnic minorities in the three project provinces is presented in Table 22. Over 40% considered themselves as belonging to an ethnic minority. However, many of these ethnic groups are in the process of assimilation.

The annex on Ethnic Minorities provides a detailed account of the ethnic composition of the project area and surrounding areas and maps. Table 23 illustrates the main groups and characteristics.

Table 23: Main Ethnic Groups in Project Area and Surrounding Areas

Ethnic Group	Location	Main Characteristics
Tai-Lao	Along the Mekong and dominant in urban centres	Majority group
Phou Thay	Along the Xe Bangfai and tributaries and in urban areas in Khammouane and Savannakhet Provinces	Culture similar to Tai-Lao
Tai Moey and other upland Tai groups	Bolikhamxai Province and Khamkeut, Nakai-Nam Theun NBCA and Nakai Plateau	Tai-Lao language, animist with some Buddhist influences and diverse livelihood systems
Tai Bo	Nakai, Hinboun and Khamkeut Districts	Mixed origins, possibly Vietic and other groups now with Lao culture
Lao Kaleung	Throughout the northern parts of Khammouane District	Culture similar to Tai-Lao
Sek	Small numbers of villages and households throughout the area	Ancient Tai culture, animist, knowledge of paddy cultivation
Brou/Makong	Upland areas and central parts of Khammouane Province	Dominant ethnic group in the area – different degrees of integration
Vietic Groups	Scattered small settlements mostly in remote areas and NBCAs	Vulnerable group, dependent on forests and unique culture
Hmong	Recent arrivals in northern parts of Bolikhamxai	Hmong culture is Taoist, patrilineal and reliant on swidden with some exceptions along Route 8

5.12 Conservation

5.12.1 Introduction

In this study, Conservation is presented both as a development sector and a sector that might be impacted by the cumulative impacts by NT2 and other development projects. As a development sector, focus will be on plans and initiatives for extended conservation and improved management of natural resources and biodiversity. As an impacted sector, which is mostly treated in Chapter 7, focus will be on how development projects in other sectors might impact the conservation of biodiversity.

5.12.2 National and International Perspective

Lao PDR ranks as one of the richest countries in South-East Asia when it comes to biological diversity. Unfortunately, the increasingly rapid degradation of the country's forest resources and wetlands, combined with an intense (illegal) hunting pressure and trade in endangered species continues to put undue pressure on its diversity of plants and animals. In order to counteract this negative trend, Lao PDR has initiated several important actions in biodiversity conservation.

Wetlands along the Mekong and on some of the major tributaries are of very high biodiversity value. They are inhabited by a large number of rare and threatened species and play a critical role as stopover sites for migratory birds and are key breeding areas for some of the economically important fish species. The regular flooding of the wetlands is a key factor for the fish production in the basin. The Stung Treng Wetlands, downstream of the Khone falls in Cambodia, has been given a status of Ramsar Site. Few other wetlands have been given formal pro-

tection status. None of the Lao NBCAs have been established for wetland protection per se.

No regional wetlands policy or strategy has yet been prepared. A large-scale Global Environment Facility (GEF) funded project is, however, under development by IUCN in consultation with the four Governments, UNDP, MRC and other key stakeholders in the Region. The project aims to strengthen capacity for conservation and sustainable use of wetlands in the Lower Mekong Basin.

In 1996, Lao PDR ratified the Convention on Biological Diversity (CBD). The obligations of CBD have been followed up with legal and institutional development (see chapter 3.2), as well as by the establishment of 20 protected areas (NBCAs), covering more than 33 100 km^2 (14 % of the land area). In addition, there are also some provincial and district conservation forests.

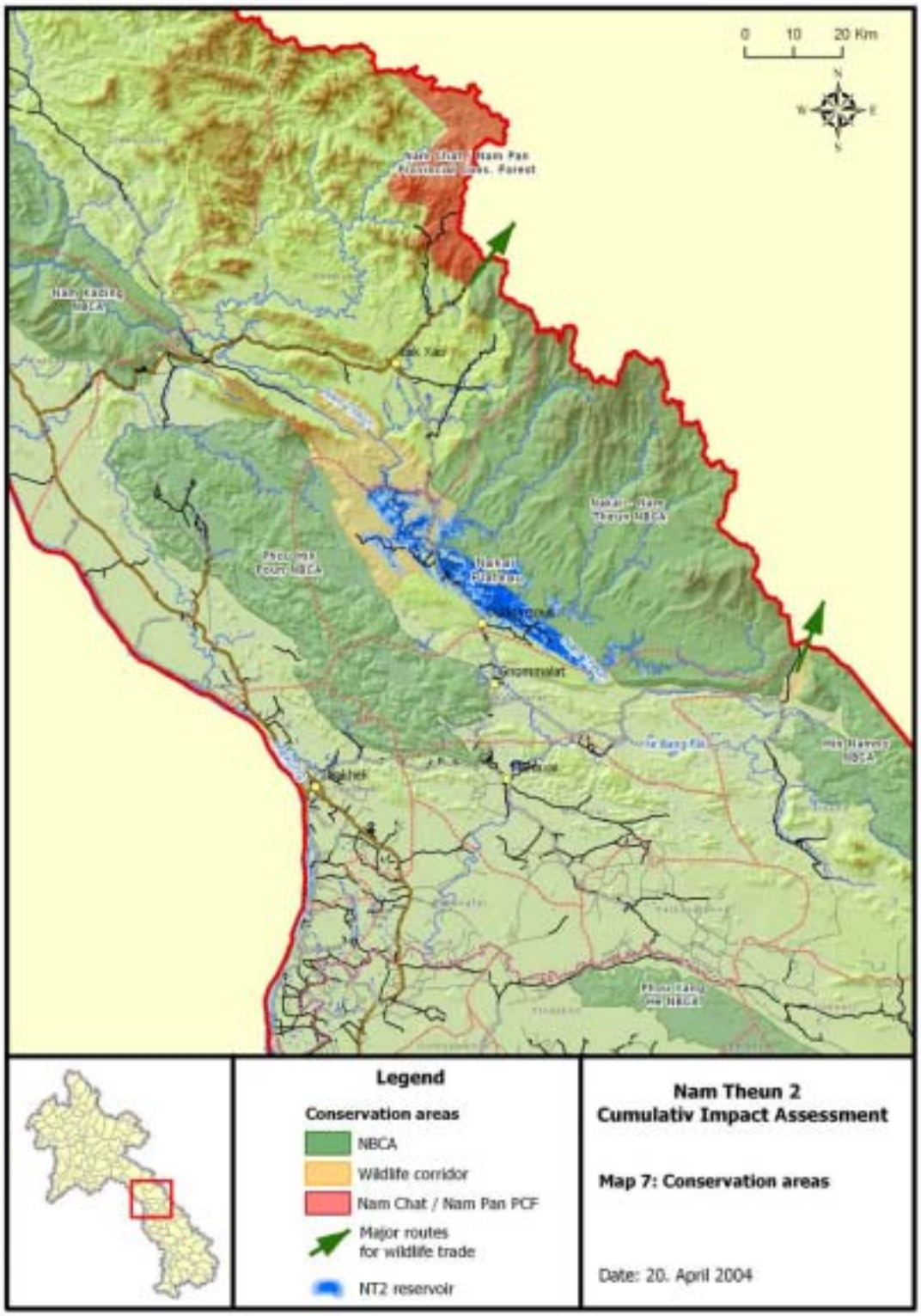
It is not a straightforward task to describe plans and likely development trends in the 5-year and 20-year perspective when it comes to biodiversity conservation in Lao PDR in general and in the affected provinces in particular. However, it seems reasonable to assume that the following national and international plans and trends will play an important role in future efforts to counteract the current trend of biodiversity loss in Lao PDR:

- There has been a decrease in foreign contributions to biodiversity conservation in Lao PDR the last three years (MAF & STEA 2003), and there are indications that bi-lateral co-operation in biodiversity conservation in the future will settle at a lower level than in the late 90s.
- As the extent of pristine nature and biodiversity in Lao PDR and its neighbouring countries dwindles, an increasing focus from international environmental organisations (WWF, WCS, IUCN, CI and others) should be expected.
- In addition to the 20 existing NBCAs, a few other areas are currently considered for future designation as NBCAs or as extensions to existing NBCAs. It is assumed that with the implementation of current plans, a limit is most likely to be reached in terms of further identification of new protected areas.

5.12.3 Local Perspective

Most plans and initiatives in terms of biodiversity conservation come from national authorities. GoL has officially devolved responsibility for national policy implementation to provincial governments and relevant agencies. Even though government agencies like STEA have provincial offices, they are mainly carrying out tasks that have been outlined in national plans and strategies. This means that plans and trends mentioned in the previous section also apply to the provinces influenced by the NT2 Project.

A major problem is the lack of awareness and support for biodiversity conservation among the local population. Without such support it is difficult to enforce the protection and management principles developed by central and provincial authorities.


0 10 20 Km
N
W
E
S
Legend
Conservation areas
NBCA
Wildlife corridor
Nam Chat / Nam Pan PCF
Major routes for wildlife trade
NT2 reservoir
Nam Theun 2
Cumulativ Impact Assessment
Map 7: Conservation areas
Date: 20. April 2004

The unique value of the biodiversity in the Bolikhamxay and Khammouane Provinces are under serious threat. In general for the NBCAs in Lao PDR logging and deforestation for agriculture is seen as the most serious threat to biodiversity. In these two provinces, however, and in particular in the western parts, wildlife trade is seen as an even more acute problem (IUCN, 2000). The centre of this trade is supposed to be Lax Xao and about 60-70 % of the goods is assumed to go to Vietnam and eventually to China.

The lower part of the Xe Bangfai plain is highly developed with little natural habitat and wildlife left. A large tract of previously forested land west of Hin Nam No NBCA has been cleared by logging, and has also lost most of its biodiversity value

Some proposed conservation initiatives, including some already implemented, can be highlighted as follows:

- The proposed extension of Nakai-Nam Theun NBCA to the north, consisting of about 450 km^2 largely undisturbed forest, has been gazetted as the *Nam Chat/Nam Pan Provincial Conservation Forest*.
- Forest corridors linking Nam Kading NBCA with the Phou Hin Poun and Nakai Nam Theun complex to the south have been proposed. The Nam Theun-Phou Hin Poun corridor was gazetted in 2000.
- An extension of Hin Namno NBCA to the south to cover more of the headwaters of Xe Bangfai. A corridor between Hin Namno and Nakai-Nam Theun NBCA has been gazetted.
- An extension (117 km^2) of Phou Xang He to the west and south to incorporate a still largely undisturbed forest area has been proposed.

The NT2 Project will provide the Nakai-Nam Theun NBCA with annual funds of US$ 1 million. This will be an important contribution in order to protect this globally important NBCA against further encroachment from loggers and poachers.

Wildlife Conservation Society (WCS) is planning a 5-year project in Bolikhamxai Province, co-financed by GEF. Provided that the project plans are approved by GEF, this will bring biodiversity conservation in this region an important step forward.

5.13 Development in Neighbour Districts of Vietnam and Thailand

5.13.1 Vietnam

Bolikhamxai and Khammouane provinces, including the Nakai Nam Theun NBCA, share borders with the two Vietnamese provinces, Ha Tinh and Quang Binh. Given the fact that there is already considerable regular and irregular cross-border traffic with relatively free movement of people and goods, developments on the Vietnamese side are likely to have a significant influence on the management and protection of the Nakai Nam Theun NBCA on the Lao side of the border.

Population

Ha Tinh had a population of approximately 1,270,000 out of which only 121,000 (9,5 %) lived in towns and urban areas in 2001. Population growth rates have slowed considerably over the last years and are now around 1,2%, primarily due to out-migration to other areas in Vietnam, such as Hanoi and Ho Chi Min City.

The population is forecasted to be around 1,362,000 in 2005 and 1,431,000 in 2010. Ha Tinh, located in the costal area at the end of Highway 8, is the largest town in the province while nearby Vinh, located north of Ha Tinh across the border in Nghe An Province is the largest urban area in the region with an approximate population of around 210,000. The population of Quang Binh is around 813,000 with urban residents constituting 11%. The population growth rate 1991–2001 was on the average 1.6% and presently assumed to be close to 1.0%.

Economic Development

The economy of both Ha Tinh and Quang Binh is predominantly agriculture and forestry based with 78-79% of the labour force employed in primary productions. Industry and service are the other significant employment sectors. Over the last decade Ha Tinh and Quang Binh have seen a rapid economic growth with present growth rates around 8%. Of special relevance in relation the NT2 project is the Cau Treo economic zone created in 1998 in order to stimulate trade and economic development in the Lao-Vietnam border region and Ha Tinh Province. The zone occupies an area adjacent to the Lao border comprising the Cau Treo border crossing on Route 8, the Tay Son Town and the Son Kim commune of Huong Son District. The economic zone enjoys privileges and preferential treatment to attract investors and trade. In 2000 the official figure for import and export was estimated to 120 million USD, and a total of 180,000 people crossed the border for trade and tourism (Vietnam Business Forum, 2004). The Vietnamese authorities are planning to further develop the zone by improving market infrastructure and reducing bureaucratic procedures in connection with trade.

Transport

Ha Tinh has an extensive road network with a total length of 2,900 km, including 4 national roads passing through the province. Of particular interest with respect to developments on the Lao side of the border is Route 8 running from Ha Tinh Town, over Cau Treo and into Lao PDR.

The construction of the Ho Chi Minh Highway, which started in 2000, is a development that will influence the border region strongly. It will run inland along the border, opening up previously relatively inaccessible areas for settlement and economic exploitation. One particular feature of the Highway is that it will cut through the Vu Quang National Nature Reserve increasing the accessibility to the protected area which is adjacent with the Nakai-Nam Theun NBCA. The Ho Chi Minh highway, which is the biggest transport infrastructure construction project in Viet Nam, is planned to be finished in 2010.

Quang Binh located south of Ha Tinh is connected to Lao PDR through 2 major roads, Route No. 12 crossing into the province south of the Nakai Nam Theun NBCA, and Route No. 9, running through Savannakhet Province and continuing through Quang Binh down to the coast. The Vietnamese extension of Route 9 continues 85 km from the border to Dong Ha, presently being improved as part of the ongoing East-West Corridor GMS Project. Route No. 9 also skirts two NBCAs in Savannakhet Province (Phou Xang He and Dong Phou Vieng) where conservation and illegal wildlife trade are important issues.

Industry

The industry sector in the two provinces mainly consist of building and construction, textile, and processing industries. In the future, Ha Tinh province plans to developing heavy industries to make use of iron ore deposit, inside the province.

Two industrial zones are also planned, one of them located along national Route 8.

Forestry

The forest of Ha Tinh and Quang Binh has been extensively logged in the past and only limited areas of relatively undisturbed forest areas remains in the lower parts of the provinces. Much of the remaining forest is found in the Vu Quang Nature Reserve.

Poverty

Ha Tinh is one of the poorest provinces in Vietnam although poverty has been reduced by development programmes and poverty reduction initiatives over the last years. A Participatory Poverty Assessment (Action Aid, 1999) of 6 communes in Ha Tinh, including Son Ham Commune in the trans-border Huong Son District, found that a majority of people (75% of households) could be classified as either “poor” or “hungry” according to their own assessment. According to official poverty assessments the percentage of people in the province living under the poverty line is 46%. Quang Binh Province also ranks among the poorest provinces in Vietnam with 50% being classified as poor according to the National Human Development Report 2001.

Ethnic Minorities

The ethnic composition of Ha Tinh and Quang Binh provinces is overwhelmingly Kinh, the dominant ethnic group in Vietnamam. Specific or disaggregated information on ethnic minorities and their economic and social situation is difficult to obtain for these two provinces. However, based on national surveys and studies (UNDP 2002) there is a widening poverty gap between the minorities and the majority Vietnamese. This is despite modest gains and efforts to focus on the minorities through government and donor funded development projects. Development challenges include isolation and remoteness, reduced access to good land and natural resources, low access to credit and productive assets, limited quality of social services and limited participation in government structures and public life. In addition, the process of sedentarisation of small groups like the Chut has probably also made social development very challenging.

As with small minority groups in Lao PDR, there is pressure to integrate and assimilate into the mainstream cultural, social, political and economic systems.

Conservation

The Vu Quang Nature Reserve in ha Tinh extends around 30 km along the mountainous Lao Vietnamese border and directly adjoins the north-eastern half of the Nakai Nam Theun NBCA. The Reserve covers an area of around 550 square km spanning from low elevation landscape types dominated by grassland and shrub to high montane habitats of similar quality and biodiversity as in the Nakai Nam Theun NBCA. Vu Quang Nature Reserve was decreed a nature reserve in 1986.and upgraded to national park status in 2002. Much of the reserve area was created on previous logging concession land with only the high mountainous areas consisting of relatively undisturbed forests. Between 1995 and 2000 the WWF Indochina Programme implemented the “Vu Quang Conservation Project” and prepared a management plan for the Reserve.

Vu Quang is credited with the discovery of two previously unknown large mammals, the Vu Quang ox (*Pseudoryx nghetinensis*) or Saola, first described in

1993, and the giant muntjac deer (*Megamuntiacus vuquangensis*), discovered 2 years later. Other new species have also been found, including the world's smallest muntjac deer, the Truong Son muntjac (*Muntiacus truongsonensis*). In addition to the mammal discoveries, 5 previously undescribed fish species have been been discovered since 1992.

In general the largest threat to biodiversity in the Vu Quang nature reserve and the transborder areas is human expansion in terms of establishment of new settlements, conversion of forest land to agricultural land, logging and fragmentation of habitats, hunting and livestock gracing. Hunting and logging occurs throughout the reserve as does grazing of cattle at all times of the year. Another threat to the biodiversity is the planned development of the Ho chi Minh Highway (National Highway NO. 2) that will cut directly through the Vu Quang Nature Reserve. This may lead to fragmentation of habitats and human settlements being established close to the most pristine parts of the reserve.

5.13.2 Thailand

The region in Thailand across from Khammouane and the NT2 influence area comprises the provinces of Mukdahan and Nakhon Phanom. This region is of significance in a cumulative perspective as future economic integration driven by infrastructure developments (the Mekong bridge at Savannakhet and a possible future one at Thakek) will stimulate economic growth on the Lao side of the border and affect developments relating to conservation, migration, human trafficking and social development in the NT2 influence area.

Nakhon Phanom and Mukdahan had a population of around 711,000 and 330,000 respectively in 1998 (JICA/CPC, 2001). The agricultural sector is the largest employer with 67 and 62 % of the population but in terms of share of the total economy it contributes less with only around 20% of the gross provincial product. The service sector is the most important in this respect with a contribution of 60 to 65% employing 22 and 28% of the labour force in Nakhon Phanom and Mukdahan respectively. The industry sector employs 10-12% of the labour force and contributes 15-19% to the provincial economies. The 2 provinces are expected to see a rapid economic growth in the future with a shift towards "higher value added" production and a doubling of the gross provincial production within 2020.

Population growth is moderate ranging from 1.1% in Mukdahan and 0.7 in Nakhon Phanom. In the future it is expected to be around 0.8%. Due to the fact that the agricultural sector has little room for expansion a stronger rural urban movement is expected in the future.

The prevalence of HIV/AID in the population is relatively high indicated by a prevalence infection rate in pregnant women of around 8.6%. Number of AIDS cases per 100,000 people is estimated to be around 17 (UNESCAP, 2004).