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MRC SEA FOR HYDROPOWER ON THE MEKONG MAINSTREAM

ECONOMICS BASELINE ASSESSMENT WORKING PAPER

8 March 2010

The MRC SEA of Hydropower on the Mekong mainstream comprises 4 main phases: (i) scoping, (ii) baseline assessment, (iii) opportunities & risks assessment, and (iv) avoidance, enhancement and mitigation assessment.

The Baseline Assessment Report has two volumes:

VOLUME I: Summary Baseline Assessment Report

VOLUME II: Baseline Assessment Working Papers

This working paper is one of eight in Volume II of the baseline assessment report. The two volumes formally conclude the baseline assessment phase of the SEA and documents the outcomes of the baseline consultations and SEA team analysis.

Disclaimer

This document was prepared for the Mekong River Commission Secretariat (MRCS) by a consultant team engaged to facilitate preparation of a Strategic Environment Assessment (SEA) of proposals for mainstream dams in the Lower Mekong Basin.

While the SEA is undertaken in a collaborative process involving the MRC Secretariat, National Mekong Committees of the four countries as well as civil society, private sector and other stakeholders, this document was prepared by the SEA Consultant team to assist the Secretariat as part of the information gathering activity. The views, conclusions, and recommendations contained in the document are not to be taken to represent the views of the MRC. Any and all of the MRC views, conclusions, and recommendations will be set forth solely in the MRC reports.

This document incorporates a record of stakeholder consultations and subsequent analysis. Whether they attended meetings or not all stakeholders have been invited to submit written contributions to the SEA exercise via the MRC website.

For further information on the MRC initiative on Sustainable Hydropower (ISH) and the implementation of the SEA of proposed mainstream developments can be found on the MRC website: http://www.mrcmekong.org/ish/ish.htm and http://www.mrcmekong.org/ish/SEA.htm

The following position on mainstream dams is provided on the MRC website in 2009.

MRC position on the proposed mainstream hydropower dams in the Lower Mekong Basin

More than eleven hydropower dams are currently being studied by private sector developers for the mainstream of the Mekong. The 1995 Mekong Agreement requires that such projects are discussed extensively among all four countries prior to any decision being taken. That discussion, facilitated by MRC, will consider the full range of social, environmental and cross-sector development impacts within the Lower Mekong Basin. So far, none of the prospective developers have reached the stage of notification and prior consultation required under the Mekong Agreement. MRC has already carried out extensive studies on the consequences for fisheries and peoples livelihoods and this information is widely available, see for example report of an expert group meeting on dams and fisheries. MRC is undertaking a Strategic Environmental Assessment (SEA) of the proposed mainstream dams to provide a broader understanding of the opportunities and risks of such development. Dialogue on these planned projects with governments, civil society and the private sector is being facilitated by MRC and all comments received will be considered.

CONTENT

ECONOMICS BASELINE ASSESSMENT

Key Issues

1. What are the broad national and regional economic implications of large scale natural resource based development in the Lower Mekong Basin (LMB)countries?
2. What are the economic costs and benefits of sectoral development in the LMB countries?
3. What is the distribution of economic benefits between different areas, groups and sectors?

1 BACKGROUND

The Greater Mekong Sub-region (GMS) sustainable energy futures document recently published by the Asian Development Bank(ADB) points to the increasing significance of energy supply and security in the region as a determinant of development (ADB 2008). Trends towards higher as well and more volatile energy prices, issues relating to environmental sustainability (including both local and global environmental concerns), and widespread energy poverty in the region are all emphasized. Access to a reliable power supply is increasingly seen as an important determinant of meeting development targets such as the MDG, indeed there is pressure to include some indicator of access to power supplies in the MDGs (IPCC 2007).

Despite rapid growth in the GMS, average per capita energy consumption is estimated to reach only 2/3 of the average of all developing countries (1993-2005). Furthermore, an estimated 74 million people (approximately 20% of the population) in the region still do not have a connection to electricity supplies. On the other hand, rapid economic growth has been driving growth in energy demand which between 1993 and 2005 averaged about 8% per year. . Moreover, the GMS is heavily reliant on energy imports accounting for about 21% of energy consumption in the region. This appears to be a rising trend. Countries such as Lao PDR and Cambodia also export power to neighboring countries as a primary opportunity to earn revenue in the context of evolving regional power trade and wider economic integration.

1.1 KEY ISSUES

Against this general context, three key strategic economic issues related to the development of hydropower on the Mekong mainstream in the LMB have been identified during the scoping phase of the SEA.

1.1.1 WHAT ARE THE BROAD NATIONAL AND REGIONAL ECONOMIC IMPLICATIONS OF LARGE SCALE NATURAL RESOURCE BASED DEVELOPMENT IN THE LMB COUNTRIES?

Large scale investment in natural resources (and in particular hydropower) in the region is largely funded by the foreign private sector. In some cases this represents an influx of foreign

direct investment from outside the LMB region (e.g. from China) while in other cases it represents a flow of investment from one LMB country to another (e.g. from Thailand or Vietnam to Lao PDR). In either case, a large influx of investment capital will have significant implications for macro-economic performance, especially for the smaller economies of Lao PDR and Cambodia. Moreover, the large revenue streams resulting from these investments (and attendant government revenues) are also likely to have significant macro-economic impacts. These impacts are expected to be a mix of stimulus to some parts of the economy directly associated to the extra consumption implied by this investment, additional government expenditures resulting from the additional revenues, and changes in the relative competitiveness of different sectors due to exchange rate appreciation. This key issue therefore looks at the likely **direct impacts of natural resource investment and resulting value streams** on macro-economic performance in the region.

1.1.2 WHAT ARE THE ECONOMIC COSTS AND BENEFITS OF SECTORAL DEVELOPMENT IN THE LMB COUNTRIES?

The Mekong river plays an extremely important role in determining the productivity and attendant benefit streams from a number of economic sectors. Capture fisheries, agriculture, navigation, tourism, industry and mining (excluding the power sector which is addressed in a separate paper), and construction sectors are all to a greater or lesser extent dependent upon the natural resource base of the basin, to which the Mekong mainstream is central. Any bio-physical changes to the Mekong mainstream are likely to have knock-on implications for the natural resource base and therefore the benefit streams and economic performance of these sectors. This key issue therefore focuses on giving an economic account of the value of these sectors and the impacts of mainstream hydropower development of these values including the economic values of ecological goods and services in the basin.

1.1.3 WHAT IS THE DISTRIBUTION OF ECONOMIC BENEFITS BETWEEN DIFFERENT AREAS, GROUPS AND SECTORS?

It is recognized that development in the LMB is likely to have differential implications for different economic sectors and for different populations in the basin. For example, while urban populations in Vietnam may benefit from hydropower development, riparian communities may lose valuable capture fisheries. This key issue aims to identify the possible distribution of costs and benefits across populations (including poor/non-poor), economic sectors, and bio-physical riparian zones.

1.2 SCOPE OF THIS REPORT

It should be noted that this report represents the first step in the SEA process and involves the construction of baseline trends relating to key development sectors. Generally the analysis

focuses on a discussion of past trends and where feasible future projections to 2030. This baseline report therefore serves as a basis upon which the likely impacts of mainstream hydropower development can be assessed. As such, the reader should not expect to find extensive discussions of hydropower development impacts in this report. In cases where hydropower developments outside the mainstream have already been undertaken, or are expected to be undertaken in the future scenarios used in this report, then there maybe explicit consideration of impacts.

Section 2 of this report looks at the macro-economic baseline and key macro-economic development issues relevant to hydropower in the region. Section 3 looks at trends in key development sectors likely to be affected by hydropower development. Section 4 looks at distributional issues

2 MACRO-ECONOMIC BASELINE

2.1 GENERAL MACRO ECONOMIC CONTEXT

2.1.1 Past trends and current conditions

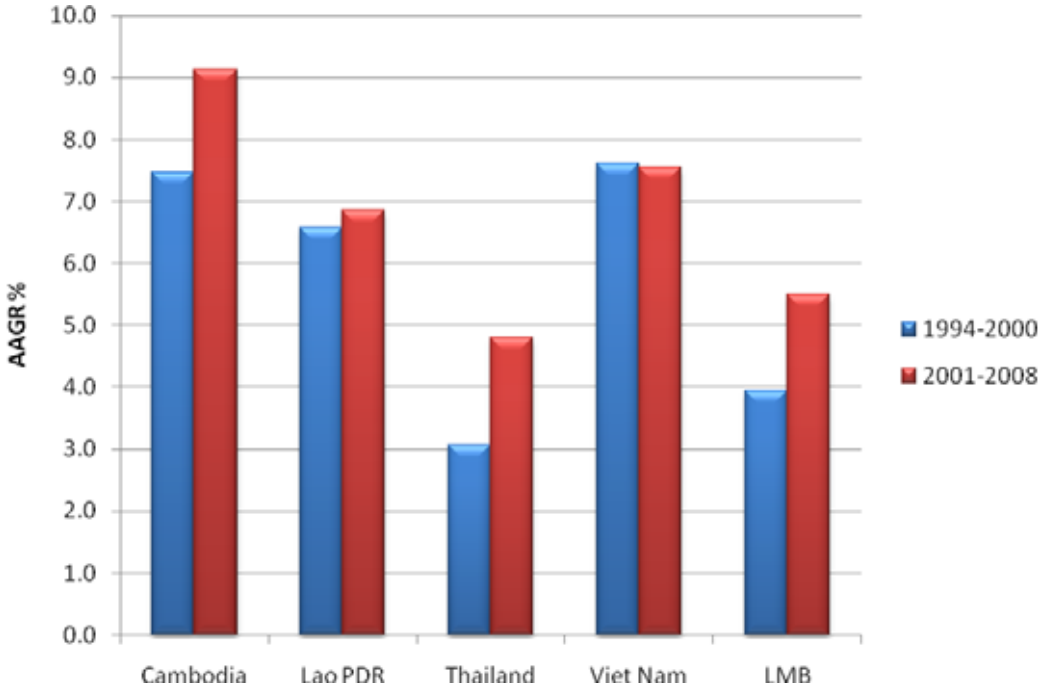
The LMB has experienced important economic developments over the last decade: Rapid economic growth, industrialization and increasing urbanization.

Over the period 1994-2008, all countries in the LMB have experienced rapid GDP growth (Figure 1). For the region, GDP grew at an annual rate of 4% over the period 1994-2000, and approximately 5.2% over the period 2000-2008. Growth has been particularly strong in Cambodia and Vietnam. Thailand's growth rate over the last decade has lagged behind those of other countries in the region, due in part to the Asian financial crisis of the late 1990s, but also in part to its relative economic advancement compared to other countries in the region Thailand's relative economic maturity is also reflected in the size and structure of its economy relative to other countries in the LMB (Figure 2), accounting for about 73% of LMB total GDP in 2008, followed by Viet Nam at 23%, Cambodia at 3% and Lao PDR at 1%.

This rapid economic growth has mostly been driven by industrial development. As shown in Table 1 the share of industry in economic output has increased considerably in all four countries between 1993 and 2007. As a result, this economic growth has brought with it rapid socio-economic changes as employment opportunities in industrial areas clustered in and around cities expand and urbanization rates increase (see table 2). These large structural changes to the economies of the LMB have been driving the expanding energy demands in general and demands for electrical power in particular, with growth in industry and growth in household demand (driven by extension of distribution networks and urbanization) (ADB 2008, ADB/APERC

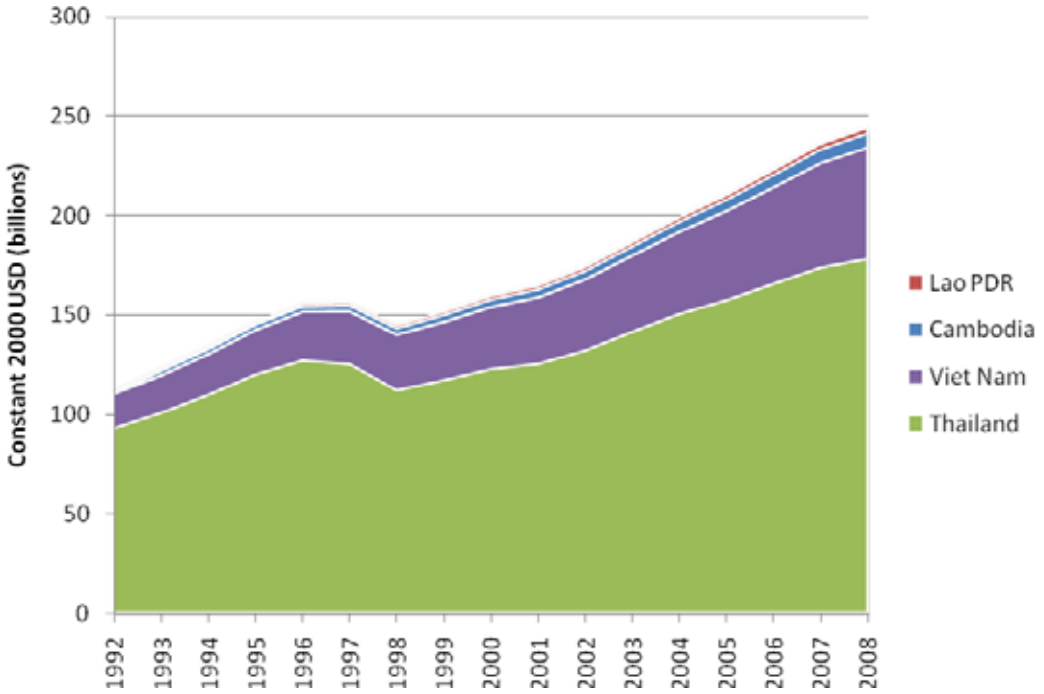
2009). Agriculture has shown a relative decline in importance in all four countries (table 1). This is considered in greater detail in the sector level discussion (section 3 below).

Figure 1: Average annual GDP growth in the LMB 1994-2008



Source: WDI, World Bank 2009

Figure 2: Aggregate GDP in the four LMB countries 1992-2008



Source: World Development Indicators (WDI), World Bank 2009

Table 1: Change in sectoral composition of GDP in LMB countries 1993-2007 (constant 2000 USD)

Country	1993			2007		
	Agriculture	Industry	Services	Agriculture	Industry	Services
Cambodia	47	13	40	29	30	41
Lao PDR	58	18	24	42	33	25
Thailand	9	40	51	8	45	47
Vietnam	30	29	41	19	43	38

Source: WDI, World Bank 2009

All four LMB countries have shown exceptional economic growth over the last decade. This growth in all cases has far outstripped population growth (which is declining across the region) and resulted in significant increases in real GDP per capita, household consumption and significant levels of poverty reduction in the region (table 2).

Table 2: Changes in GDP/capita, household consumption expenditure and urban population in LMB 1998-2008 (constant 2000 USD)

Country	GDP/capita	Household consumption expenditure/capita	Total population	Urban population (%)

							(millions)			
	1998	2008	Change %	1998	2007	Change %	1998	2008	1998	2008
Cambodia	251	512	103.9	243	398	63.3	12.2	14.7***	15.82	21.56
Lao PDR	293	475	62.0	254*	285**	12.1	5.2	6.2	20.16	30.88
Thailand	1,827	2,645	44.8	1,022	1,396	36.7	61.4	67.4	30.78	33.32
Viet Nam	364	647	77.7	256	403	57.4	76.5	86.2	23.46	27.84

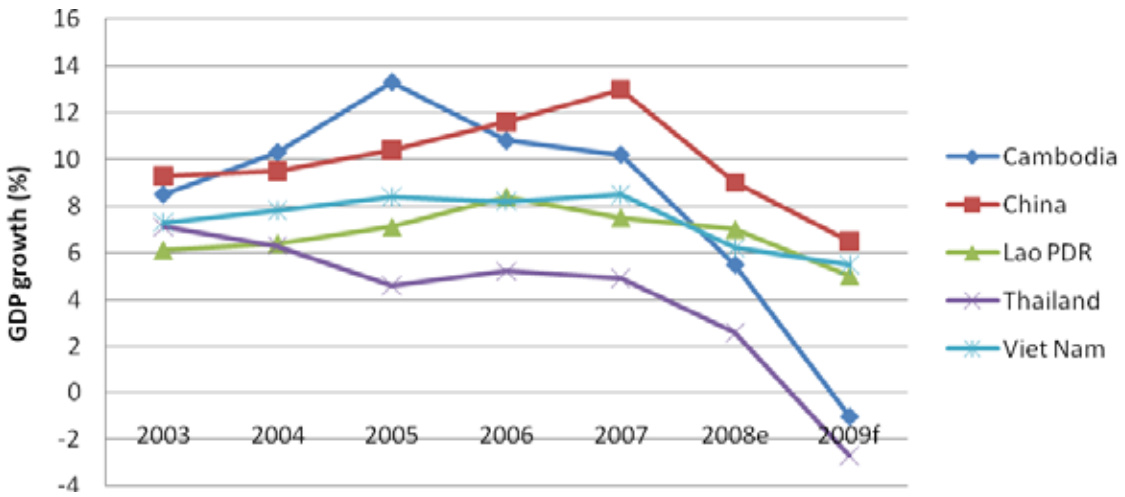
*2000, **2008, ***2007

Source: WDI, World Bank 2009

FUTURE TRENDS

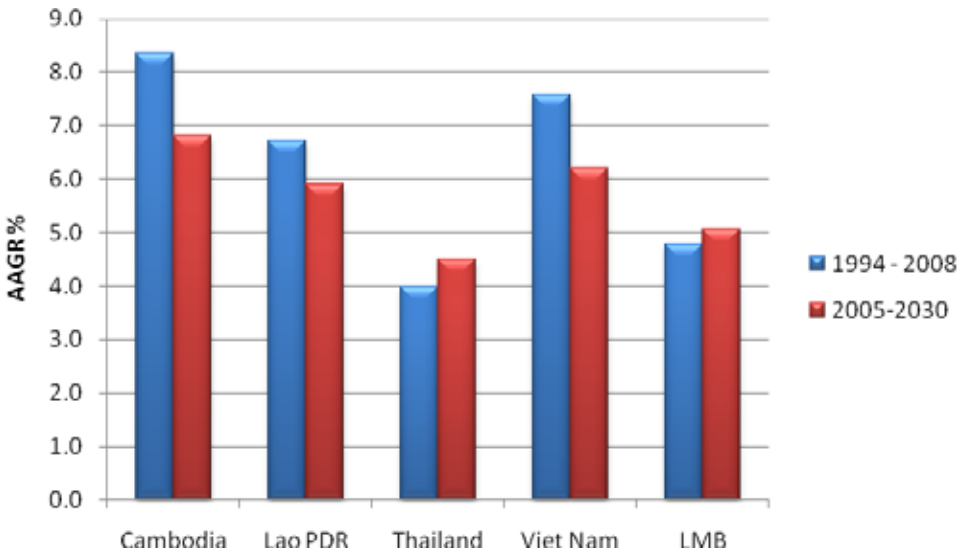
Predicting future economic growth and trends remains an exercise fraught with difficulties and uncertainty. This is especially the case as the region emerges from a severe economic recession which has significantly impacted its development (Figure 3). Nonetheless, planning the development of the energy sector in the region, including the hydro-power sector requires looking into the future, albeit with circumspection.

Figure 3: Rapid decline in economic growth in LMB countries and China 2003-2009



Source: World Bank 2009 note: e – expected, f-forecast

Figure 4: Real economic growth rates in LMB countries 1994-2030

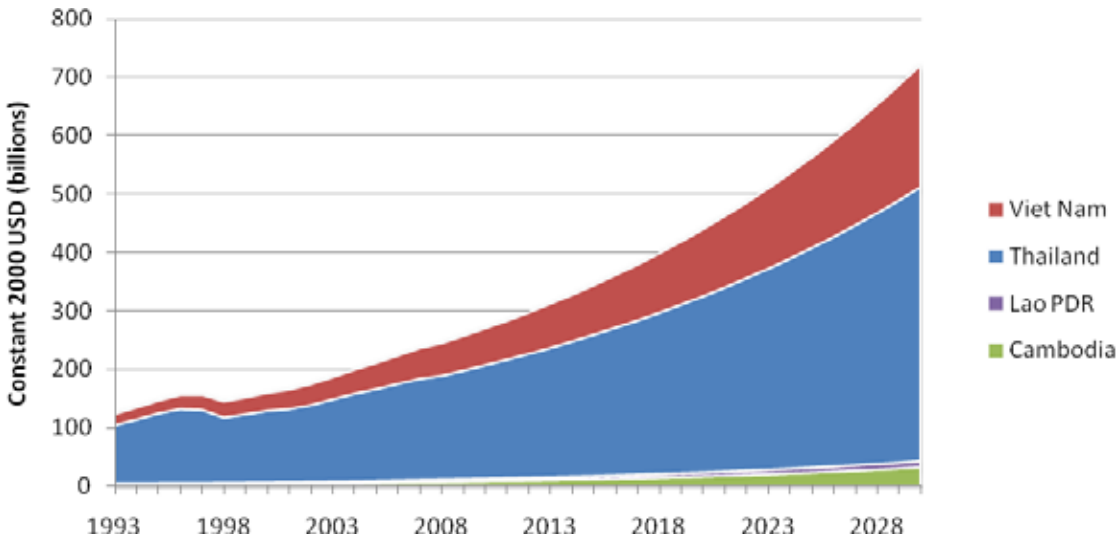


Source: ADB/APERC 2009a

Figures 4 and 5 summarize the expected consequences of the projected growth rates in terms of economic size and relative economic performance of the LMB countries over the next two decades. Firstly, it is surprising that economic growth in Thailand is expected to remain so strong over the period to 2030. The relatively easy gains in productivity and correcting structural inefficiencies which characterize lower income countries are not likely to be available to Thailand. It will face increasingly tough competition both regionally and globally as it attempts to move up the global value chain. Secondly, Thailand will see its economic dominance eroded by more rapid growth in Vietnam, in particular, while it will remain the largest economy in the LMB by a significant margin[1]. Thirdly, the phenomenal expected long term growth of the region ion general stands out, with the region's economy expected to grow by over 240% between 2005 and 2030. Finally, despite expected levels of economic growth above those experienced by Thailand and Vietnam, Cambodia and Lao PDR will continue to be dominated by the two larger economies.

Figure 5: LMB countries economic growth 1993-2030

[1] It should be noted that continuing rapid economic growth in China is likely to be highly significant for the region, whether it will stimulate growth through opening up new markets for LMB goods and manufactures, or depress growth in some sectors through competitive pressure has yet to be seen.



Source: Historical data from WDI, World Bank 2009, projections from ADB/APERC 2009a

While the rapid economic growth experienced in the region is a complex phenomenon, in common with the 'second wave' of Asian industrialization in the nineteen eighties and nineteen nineties, two key strategies stand out as central to economic growth in the LMB. Firstly, large scale inward investment, and in particular foreign direct investment, in a range of sectors, but in manufacturing industry, natural resources development and real estate in particular. Secondly, in the absence of domestic demand for goods, the promotion of exports of manufactures, tourism and natural resources.

Manifestations of both these strategic approaches to socio-economic development are linked very closely to natural resource development in the LMB, and in particular hydropower development in Lao PDR.

2.2 MACRO ECONOMIC IMPACTS

2.2.1 RANGE OF POTENTIAL MACRO ECONOMIC IMAPCTS FROM MAINSTREAM HYDROPOWER DEVELOPMENT

As the World Commission on Dams Thematic Review of Financial, Economic and Distributional Analysis (2001) notes, decision making for dams usually relies on cost-benefit analysis focusing on the supply and demand relationships or input and output markets directly affected by a project. However, the simplifying assumptions upon which CBA is based, such as that those resources are fully employed, frequently do not hold – even where these assumptions do hold macroeconomic impacts can still occur. While the thematic review goes on to note a consensus

amongst economists that secondary impacts should not be used in determining the net economic benefits of a project.[2]

Methods for assessing macro-economic impacts include input-output models, social accounting matrices, and computable general equilibrium models. These approaches are data intensive and beyond the scope of the SEA exercise. The approach adopted for assessing macro-economic impacts will therefore be largely qualitative and draw on other relevant studies performed in the region and worldwide.

In the context of this assessment macro-economic impacts are likely to be significant possibly for Cambodia and almost certainly for Lao PDR, given both the size of the externally funded investment and resulting export earnings relative to the country's economies (e.g. Nam Theun 2 at an estimated investment cost of USD 1.2 billlion, is around half the size of Lao PDR's GDP). In particular, the macro-economic assessment will focus on two areas:

1. Multiplier impacts of FDI in the region; and,
2. Changes in the relative terms of trade between sectors/counties and debt default risk in Lao PDR.

In developing the baseline this section looks at the overall level of FDI in the region, possible future policy and comments on its impacts. It also goes into greater depth looking at foreign exchange in-flows and debt default risk in Lao PDR.

2.2.2 FDI IN THE LMB REGION

PAST TRENDS AND CURRENT CONDITIONS

Over the last decade, the LMB countries have been very successful at attracting inward investment in the form of FDI to a range of sectors including manufacturing industry, natural resource development, real estate, construction and tourism in particular. Overall FDI has been on an upward trend in the region since the effects of the Asian Financial Crisis abated (until the present economic crisis). As with other economic indicators, Thailand continues to attract most of the FDI to the region, although FDI flows to Thailand started to decline in 2007 – possibly in response to worries amongst international investors relating to emerging political risks (see table 3 and, figures 5 and 6). The downturn in Thailand however has been more than compensated for by rapid increases in FDI flows to Vietnam. Cambodia and Lao PDR account for only a small proportion of regional FDI flows however, relative to the size of their respective GDPs, FDI is very significant (as it is in Vietnam). With the exception of Thailand the LMB countries have seen significant increases in FDI in the late 2000s, both in absolute terms and relative to GDP.

[2] This may be as much an assessment based on the theoretical axioms of economics as one based on an assessment of macro-economic realities. The recent economic crisis, for example, has seen the pursuit of various large scale investments – for which macro-economic implications were an important factor in pursing those particular developments.

The profile of FDI Lao PDR in particular differs greatly from the other countries in the region. Expansion of natural resources industries in Lao PDR has been driven on by rising demand for raw materials and power globally and in the immediate region, which in turn has lead to the external funding of plantation, mining and hydropower projects through FDI (ADB 2006). The importance of development in these sectors for Lao PDR comes into relief when considering the balance of payments data. As table 3 shows, Lao PDR, in common with many countries during periods of rapid development is running a significant but stable current account deficit which increased in absolute size to 887 million USD in 2008 (16.5% of GDP). Foreign exchange reserves have increased in absolute terms over the same period, and remained relatively stable in terms of months of prospective imports. Moreover, as Andersson et al (2009) note, ODA has played an important role in Lao PDR accounting for between 10 and 20% of GDP since the 1990s, meaning that it is one of the most aid dependant countries in Asia. In this context the importance of both export markets and FDI in maintaining macro- economic stability and growth is clear.

Table 3: Lao PDR selected national accounts 2003-2008 (million USD)

Item	2003	2004	2005	2006	2007	2008
Exports	472	535	697	1133	1321	1639
Percent change	15.5	13.5	30.1	62.6	16.6	24.1
Imports	786	1056	1270	1589	2156	2816
Percent change	8.8	34.3	20.3	25.1	35.7	30.6
Current account balance	**-266**	**-424**	**-492**	**-367**	**-660**	**-887**
Percent of GDP	-12.4	-16.9	-17.8	-10.3	-15.8	-16.5
Gross official reserves	**216**	**228**	**238**	**336**	**536**	**636**
In months of prospective imports	3.2	3.3	2.8	3.2	3.9	3.4
Capital account	**285**	**442**	**510**	**467**	**862**	**991**
Foreign direct investment	39	315	247	335	779	906

Source: IMF 2009d

As table 4 shows there have been significant changes in the composition of exports. Electricity, timber, and garments remain important, and exports of electricity will expand as more hydropower plants come on-line. The rapid growth of the mining industry is reflected in increased exports of gold and copper. Timber exports have fallen probably due to new restrictions on logging (although informal exports are likely to remain substantial) (Andersson 2009).

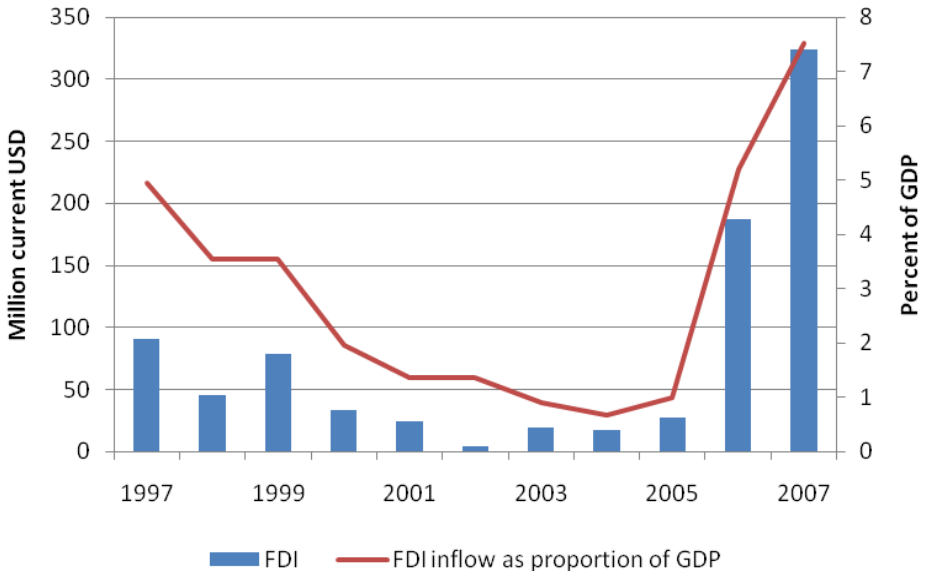
Table 4: Lao PDR composition of exports 1998-2006 (percent)

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Gold	0	0	0	0	0	13	12	14	10
Copper	0	0	0	0	0	0	0	17	36
Electricity	20	25	33	29	28	19	18	17	11
Timber	34	29	20	29	31	28	29	21	17
Garments	21	20	31	31	31	29	31	21	11
Coffee	14	4	4	4	5	2	3	3	1
Other	11	22	12	6	6	8	7	6	13

Source: IMF various years (reported by Andersson et al 2009)

High world market prices for raw materials and energy have resulted in investment in the mining and hydropower sectors which in turn have driven imports of capital goods as reflected in the growth of FDI, recovering rapidly after the decline following the Asian Financial crisis at its beginning (figure 5). In contrast to the 1996-2000 period when the manufacturing sector accounted for most FDI, between 2002 and 2007, the agriculture (plantations), mining and electricity (hydropower) accounted for most FDI. With electricity by far the biggest single sector accounting for 53% of FDI (table 5).

Figure 5: Foreign direct investment to Lao PDR 1997-2007



Source: WDI, World Bank 2009

To summarize, over the last decade Lao PDR has experienced relatively high levels of economic growth and development. The main driver of this growth has been investment in raw materials including agro-forestry plantations, mining and hydropower. These investments have undoubtedly added to growth in GDP, seem to be an important source of foreign exchange and have boosted export earnings from commodities exports.

Table 5: Industry distribution of approved FDI 1996-2007 (percent)

Sector	1988-1994	1995-999	2000-2004	2005	1988-2005	No. of projects 1988-2005	2002-2007*
Agriculture	**2.04**	**4.68**	**6.24**	**38.83**	**4.64**	**152**	**12**
Mining	**0.96**	**2.27**	**22.46**	**45.94**	**8.35**	**86**	**10**
Industry	**74.51**	**76.66**	**52.74**	**6.35**	**67.87**	**489**	**66**
Electricity	59.24	30.44	36.26	0	42.22	24	53
Telecommunications	3.47	31.59	2.48	0	2.2	17	
Construction	2.54	0.87	3.36	0	2.2	580	3
Manufacturing	9.25	13.76	10.64	6.35	11.1	390	7
Handicrafts	*3.56*	*7.55*	*8.61*	*5.04*	*6.38*	*243*	
Wood industries	*3.32*	*5.5*	*1.29*	*1.31*	*3.41*	*62*	
Garment	*2.37*	*0.71*	*0.74*	*0*	*1.31*	*85*	
Services	**22.48**	**16.38**	**18.55**	**8.88**	**19.14**	**541**	
Hotel-restaurant	14.93	12.05	4.37	1.58	10.68	93	3
Trading	2.35	0.85	2.73	7.02	2.03	176	
Banking	2.55	1.17	0.62	0	1.49	10	
Consultancies	0.25	0.13	0.26	0.14	0.21	58	
Other services	2.4	2.19	10.57	0.14	4.72	204	12
Total	**100**	**100**	**100**	**100**	**100**	**1,268**	**100**
USD million	**1,097**	**1,796**	**1,625**	**1,166**	**5,684**	**1,268**	

Source: Committee for the promotion and management of investment, cited ADB 2006, * IMF various years, cited Anderson 2009

This contrasts with the experience of Cambodia which has seen higher levels of FDI (both in absolute terms and relative to GDP) across a more diversified range of sectors. Natural resources sectors remain important, both in their own right an in supplying inputs into manufacturing industry. However, manufacturing industry has seen an increasing proportion of FDI investment in Cambodia. This is a key causal factor resulting in a more diversified export base than in Lao PDR.

Table 6: FDI in Cambodia 1994-2005

Sector	1994-1999	2000-2004	2005	1994-2005	No. of projects
Agriculture	**5.51**	**5.58**	**2.55**	**5.15**	**95**
Mining	**0.36**	**0.57**	**17.01**	**2.65**	**16**
Manufacturing	**35.26**	**28.52**	**59.58**	**37.56**	**814**
Food processing	1.92	3.84	11.25	3.47	47
Garment	6.88	16.26	46.5	30.33	466
Textiles	1.2	1.58	0	1.09	10
Construction	**5.95**	**7.14**	**3.38**	**5.78**	**29**
Electricity and gas	**2.5**	**7.42**	**7.05**	**3.84**	**15**
Services	**43.43**	**50.53**	**10.42**	**40**	**153**
Tourism	35.63	32.49	9.77	31.66	87
Total	**100**	**100**	**100**	**100**	**1,122**
USD Million	**5,559**	**1,142**	**1,050**	**7,751**	

Source: Cambodian investment Board, cited ADB 2006

FUTURE TRENDS

FDI to the LMB is sensitive to regional and global economic conditions. The recent global financial turmoil has lead to rapid declines in flows of FDI to the region (for example FDI flows to Cambodia were reportedly 47% down on 2008 levels in 2009). As with recent declines in regional economic growth, levels of FDI are expected to recover – especially inflows from the broader Asian region. While medium term prospects for FDI flows of FDI into the region are likely to be good, reflecting the overall dynamism and potential for growth in the region, it is difficult to foresee with any accuracy how they will develop as it is highly dependent upon the risk appetite of international investors.

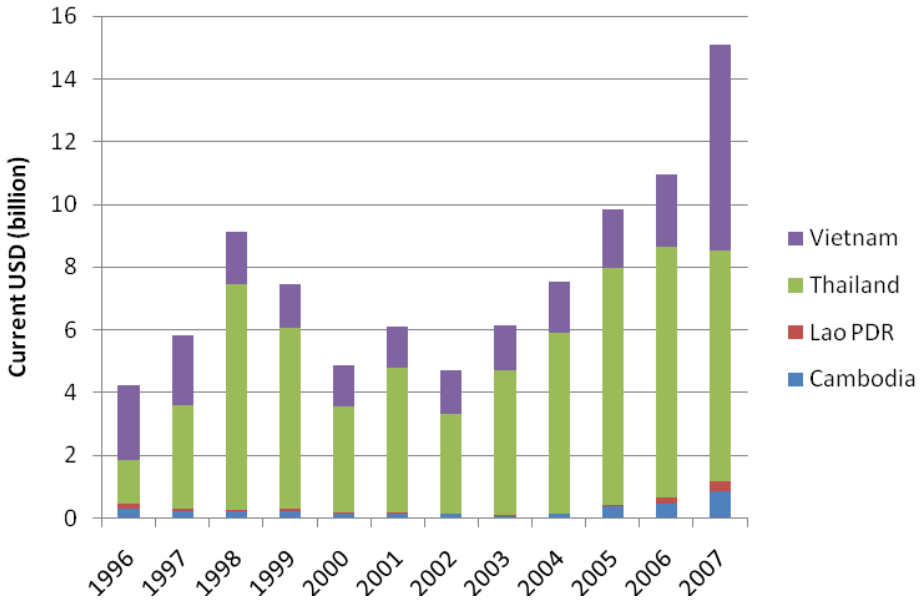
Table 7: Comparing FDI flows in 1996 and 2007 in LMB (billions current USD)

	Cambodia	Lao PDR	Thailand	Vietnam	LMB total
1996	0.29	0.16	1.40	2.40	4.25
2007	0.87	0.32	7.34	6.55	15.08
Growth 1996-2007 (%)	195	102	423	173	255

Source: WDI, World Bank 2009

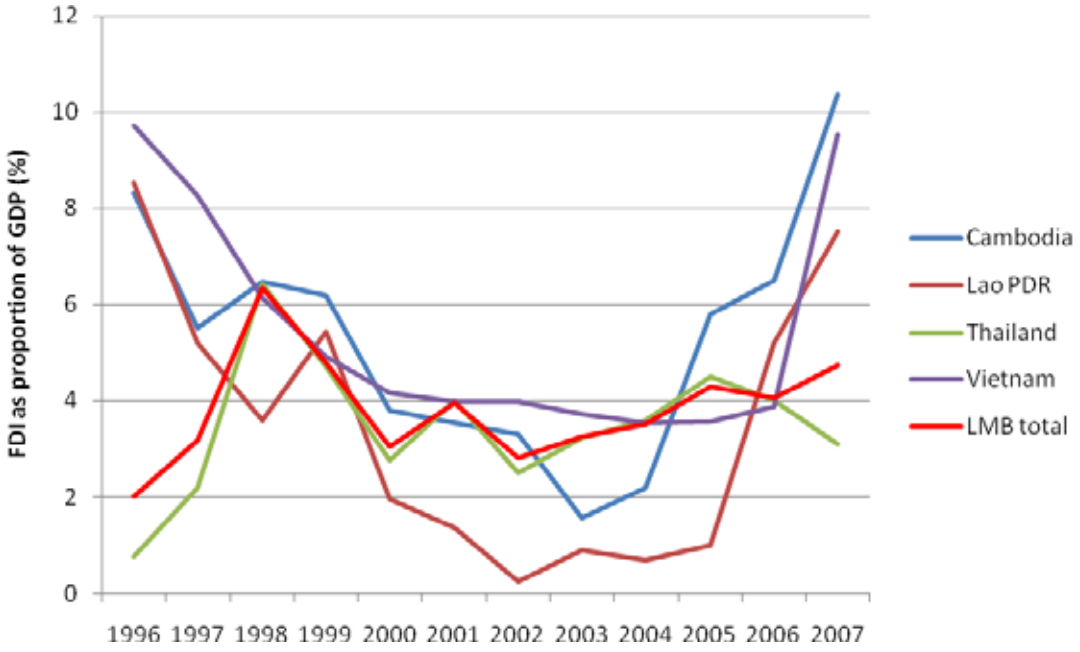
Encouragement of FDI is and has been central to the economic development polices of all four LMB countries. FDI allows the receiving country to increase domestic investment beyond the level permitted by domestic savings. This allows the country to grow without sacrificing current consumption. Additional benefits to FDI depend on the type of investment undertaken but usually include the introduction of better production techniques and practices, opening up of new export markets, and the generation of foreign exchange through increased export earnings.

Figure 6: FDI flows to LMB countries 1996-2007



Source: WDI, World Bank 2009

Figure 7: FDI flows as a proportion of GDP to LMB countries 1996-2007



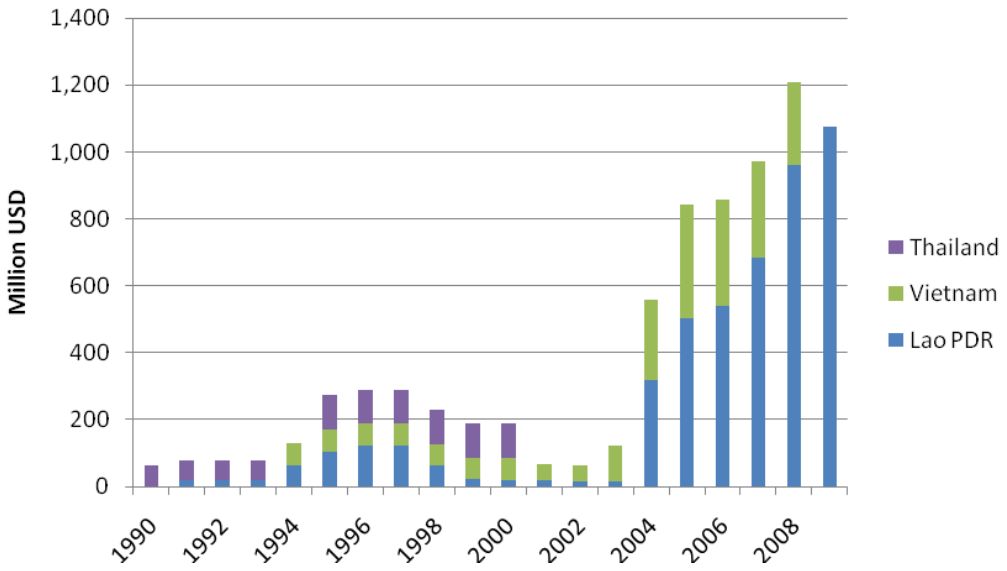
Source: WDI, World Bank 2009

2.2.3 REGIONAL HYDROPOWER INVESTMENT

PAST TRENDS AND CURRENT CONDITIONS

Most of this inflow of FDI funds has been to the manufacturing sector and to a lesser extent the natural resource sector. In particular, while Cambodia, Thailand and Vietnam have all seen substantial FDI inflows to manufacturing industry, real estate and tourism related sectors, most FDI to Lao PDR has been in the natural resource sectors. Figure 8 below gives a breakdown of estimated annual investment in hydropower in the LMB[3]. While not all hydropower investment in the region has been financed through foreign sources, this serves as an indication as to the scale of investment compared to other FDI flows in the region. For example, the peak year for hydropower investment in the LMB in this time series was 2006 with an estimated investment of USD 670 million in hydropower power, this compares to regional FDI in-flows for the region of about USD 11 billion, or about 6% of the total FDI.

Figure 8: Estimated annual investment in LMB hydropower 1990-2009



Source: ICEM based on IKMP hydropower database, MRCS

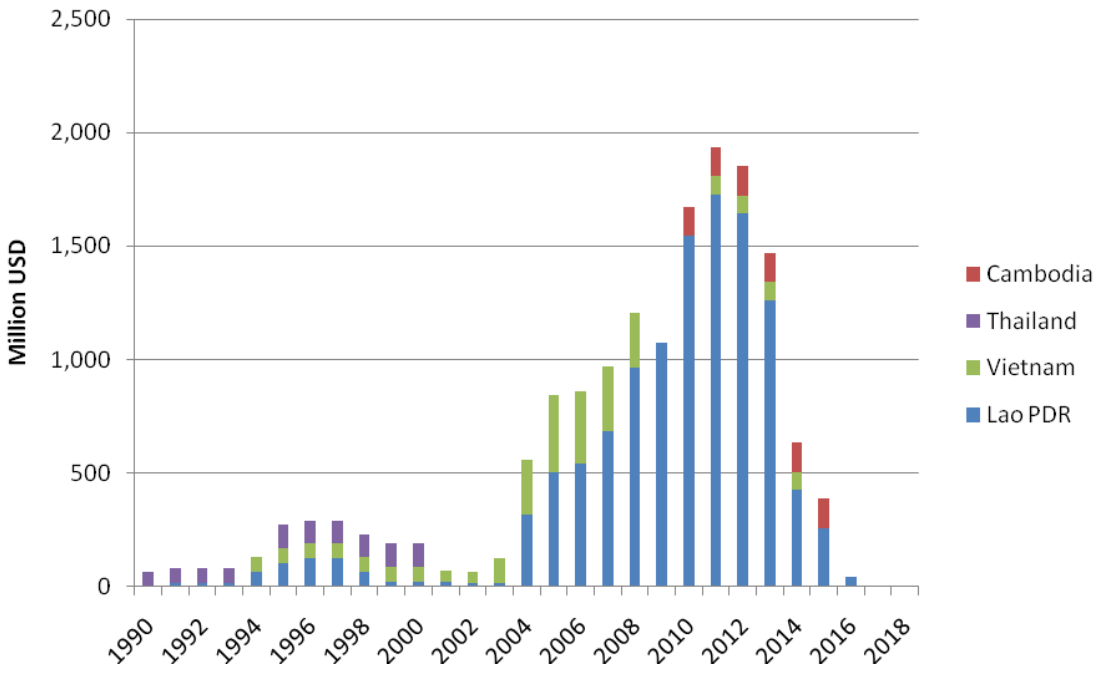
[3] This estimate was developed from the IKMP hydropower database, this gives total investment budgets, commission year and construction period. Investment expenditures for each project were assumed to be evenly distributed over the period of construction ending in the year the project was commissioned. This represents only a rough estimate as investments for these projects will not be evenly spread over the construction period.

While by no-means insignificant in Thailand and Vietnam, the effects of the extra inward investment represented by hydropower is more difficult to establish. It is in the context of the smaller economies of Cambodia and Lao PDR where FDI for hydropower projects is likely to represent a much greater portion of inward investment where the macro-economic impacts of hydropower development will be most obvious. This can be seen most clearly in the case of Lao PDR where FDI investments in hydropower have been central to the government's growth strategy.

FUTURE TRENDS

Future patterns of hydropower investment based on the foreseeable futures scenario developed by the BDP foresees significant growth in investments in hydropower development in the basin. Figure 8 and table 8 report these trends. Expected investment into hydropower development in Lao PDR in particular stands out, based on proposed construction schedules annual investment in hydropower in the basin is expected to peak in 211-2012 at around USD 1.9 billion, with the vast majority of this investment being concentrated in Lao PDR, reaching an annual inflow of USD 1.7 billion in hydropower investment, a figure that would be well over half of the national GDP.

Figure 8: Estimated annual investment in LMB hydropower 1990-2009



Source: ICEM based on IKMP hydropower database, MRCS

Table 8: Planned investment in LMB hydropower – average annual investment 1990-2016 (million USD)

	Lao PDR	Cambodia	Vietnam	Thailand	LMB
Average 1990-2016	400	27	83	30	540
Average 1990-2009	162	0	72	30	264
Average 2010-2016	238	27	11	0	276

Source: ICEM based on IKMP hydropower database, MRCS

Schedules are likely to slip and overrun and the budgets upon which this analysis is based are only indicative, this analysis should therefore be regarded as indicative of development plans and the likely scale of investment. Moreover, there is likely to be an incentive for developers to under-estimate the time it will take them to actually complete a project to allow them to win hydropower concessions (WCD 2000). Given the recent global downturn it is also likely that many of these projects will be delayed indefinitely with the net effect of both flattening the investment schedule - meaning investment flows in any one year are likely to be considerably lower than the current planning indicates – and shifting the years of peak investment further into the future.

Whether or not these investments will go ahead will be dependent upon individual decisions made by hydropower investors as to the financial viability of a particular project. This in turn will depend upon PPAs and MoUs for power exports being signed between governments. World energy prices, economic performance and energy security concerns are likely to influence whether or such agreements are signed (see power baseline paper). Thus which projects or combination of projects actually go ahead is subject to a range of contingencies which are beyond the scope of this assessment. Nevertheless, this analysis is indicative of the significance and magnitude of the proposed developments in terms of economic investment.

2.2.4 IMPACTS OF HYDROPOWER INVESTMENT - MULTIPLIER EFFECTS

PAST TRENDS AND CURRENT CONDITIONS

As already mentioned in the introduction to this section above, the impact of the development of hydropower in the basin in terms of linkages to the broader macro economy are difficult to calculate without use of data intensive models that is not currently available for the LMB. These stimulus effects operate through increased levels of demand for inputs into hydropower development causing demand in other sectors, and increasing demand in these sectors resulting in a stimulus to supplying sectors. For example, increasing investment in hydropower may increase employment in construction which may increase demand for goods from construction

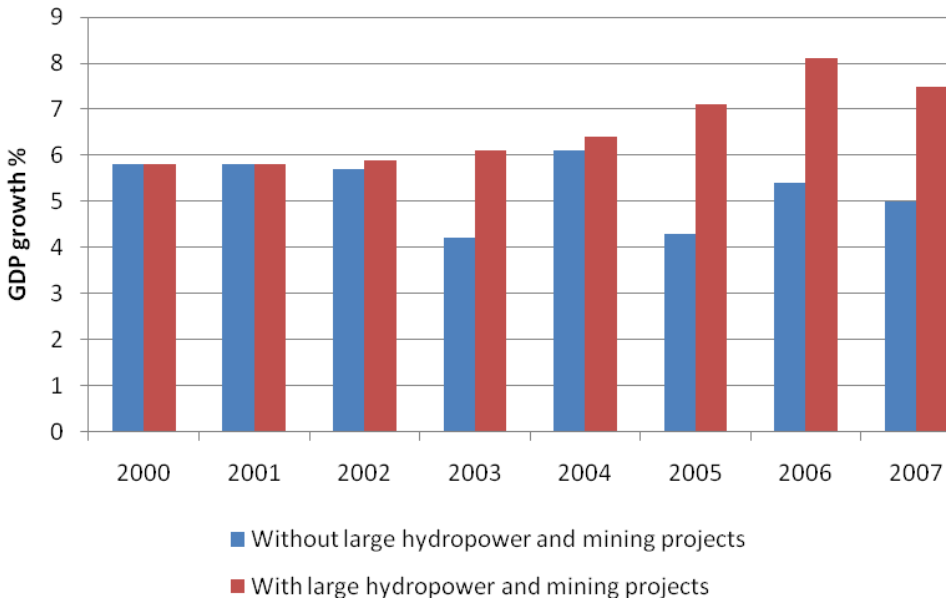
workers and so on. This ripple effect, in principle, can have wide reaching stimulus effects on an economy that go beyond sectors directly affected by increased investment. The net result of this is that one dollar of investment can stimulate greater than one dollars worth of economic activity.

However, in the case of hydropower investment, there are a number of reasons to suspect that the stimulus effects of these investments should not be over emphasized. Firstly, it is not clear that hydropower investment is additional. That is that investment in hydropower is additional to investment that would have taken place without the hydropower projects. It may be the case in Lao PDR that these funds are best regarded as additional, however, it is much less clear that this assumption is valid for the other LMB countries which would need to invest in generation capacity anyway. Secondly, it is not clear that all the investment funds in hydropower are spent within the particular country hoisting the product ort indeed the wider LMB region, for example turbines and labour are often imported from China. Finally, changes in relative price levels between sectors may actually have an adverse economic impact on some sectors in the host country (see section on 'Dutch Disease').

There are a number of studies of the multiplier effect of dams available, but those located so far have been for multi-purpose dams in locations which suffer from water scarcity and include benefits from improved irrigation. Dams in the LMB are generally single use and likely to have more limited multiplier effects. Estimates of actual sectoral impacts are examined in greater detail in section 3.

Lao PDR, however, represents a special case as hydropower investment has been so large relative to the size of the economy (see figure 8 above), for example the investment value of NT2 at USD 1.1 billion was equivalent to 40% of GDP in 2004. The World Bank has estimated the macro-economic impacts of investment in the natural resource sector on growth in Lao PDR. These estimates suggest that the development of extractive industries and large hydropower in Lao PDR is having a significant effect on economic growth, adding around 2.5 percentage points to GDP growth in 2007. At its peak the World Bank estimates imply that large hydropower and mining projects in Lao PDR were responsible for about USD 23 million GDP growth in 2006 and about USD 18 million in 2007. This is a small portion of the estimated investment in hydropower alone (excluding mining) in Lao PDR for those years which was estimated to be around USD 420 million. This is probably due to the high portion of investment funds being spent on purchases of goods and services from outside Lao PDR.

Figure 9: Contribution of mining and hydropower to economic growth in Lao PDR 2000-2007



Source: Lao Economic Monitor, World Bank 2008

FUTURE TRENDS

Continuing rapid development of the hydropower sector is likely in the region over the next 20 years, and especially in Lao PDR is likely to deliver considerable economic stimulus to regional economies. While it is difficult to put a figure on the value of the stimulus, in the case of some of the LMB countries - such as Lao PDR and some economic sectors - such as construction and engineering sectors in countries supplying dam components and construction service and non-tradable sectors in host countries will certainly benefit. The extent of this stimulus effect will vary on a case to case basis but in general is likely to have an overall positive effect, however in the case of Lao PDR in particular, the influx of investment funds may cause second-order macro-economic impacts which may have negative economic consequences for the country depending on how these resources are managed. In the next section these are analyzed in greater detail.

2.2.5 IMPACTS OF HYDROPOWER INVESTMENT – REAL EXCHANGE RATE APPRECIATION AND 'DUTCH DISEASE' (LAO PDR)

There are a number of possible monetary and fiscal impacts of large scale hydropower development. While not a concern for the larger countries in the region they are likely to be concern for Lao PDR and perhaps, to a much lesser degree, in the future for Cambodia. Impacts are related to real exchange rate appreciation and balance of payments situation. In what follows we concentrate on the case of Lao PDR.

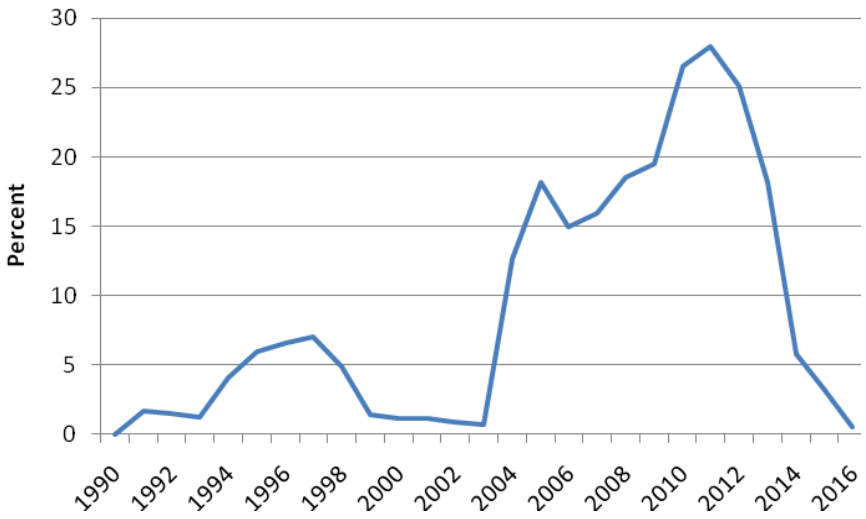
PAST TRENDS AND CURRENT CONDITIONS

Over the last decade Lao PDR has experienced relatively high levels of economic growth and development. The main driver of this growth has been investment in raw materials including agro-forestry plantations, mining and hydropower. These investments have undoubtedly added to growth in GDP, and are an important source of foreign exchange and have boosted export earnings from commodities exports.

For a small economy like Lao PDR inflows of FDI during the construction stage, as well as foreign exchange earnings from hydropower during the operational phase (as well as other natural resource based investment projects) have ambiguous implications for macro-economic stability. On one hand, natural resource development is potentially an important source of investment funds bringing jobs and ancillary infrastructure as a direct result of the development. Moreover, revenues generated from government from the development of these projects are ear marked for socio-economic development purposes as laid out in socio-economic development plans. On the other hand, the implied in-flux of foreign exchange directly from the investment and earnings from these developments may lead to macro-economic imbalances. In particular, inflows into the natural resource sector could lead to rising prices for labor and inputs in that sector, bidding up prices in competing sectors and damaging their competitiveness (in the case of Lao PDR the agricultural sector). The other effect of a booming sector can be to lead to real exchange rate appreciation if the influx of foreign exchange converted to the domestic currency and used to purchase goods and services. In particular, prices of non-tradable goods can rise again leading to real exchange rate appreciation and a decline in prices of tradable relative to that of non-tradable goods in the domestic economy. The changes in the prices of traded goods reduces the competitiveness of sectors producing traded goods, both for export-oriented and import competing sectors. This effect is known as 'Dutch disease' and is well a well established if controversial notion (Mckinley 2005, Corden 1984). It is important to note that whether this effect occurs or not depends upon the extent to which the influx of investment capital and export earnings feeds through into the real economy. For enclave projects (see below) this effect may be limited. Government capacity in effectively managing the large influx of capital is central to avoiding Dutch disease, either through making investments that improve the productivity of adversely affected sectors or through controlling the influx of foreign exchange to the country.

Figure 10: Lao PDR hydropower investments percent GDP[4] 1990-2016

[4] Nominal GDP calculated based upon AARG of 5.9% between 2009-2016.



Source: ICEM based on IKMP hydropower database, MRCS, WRI, World Bank 2009

It is difficult to show Dutch disease effects are taking place, real exchange rate appreciation can take place for a number of reasons including relative increases in productivity, changes in the terms of trade and large capital inflows can also be important in influencing real exchange rates. Moreover, it is difficult to show what may be causing declines in the lagging sector, Estimates relating to NT2 suggested that the real exchange rate appreciation due to FDI inflows and investment during the construction phase could amount to 1.7% per year over the construction period, and during the operating period to 0.75% per year than would otherwise have occurred (Warr 2004). NT2 only accounted for around 1/5th of the investment in hydropower in Lao PDR between 2000 and 2010 not to mention any additional government revenues from the power export earnings. Thus, all other things being equal, we would expect to see real exchange rate appreciation considerably higher than the estimates for NT2 suggested here. Indeed, recent figures on real exchange rate appreciation between 2007 and 2009 show real effective exchange rate appreciation against the US dollar of around 20% (IMF 2009d). However, this may well be due to international pressures on the dollar – rather than real economy effects in the Lao domestic economy.

These figures should be considered an upper bound to probable real exchange rate appreciation for two reasons. Firstly, in the construction phase a relatively high proportion of inputs for the project are likely to be purchased from outside Lao PDR, meaning only some portion of the FDI invested in the project will end up purchasing goods in Lao PDR and influencing their relative price. A recent report by the ADB (2006) reinforces this caveat, finding that NT2 (in common with many planned large hydropower projects in Lao PDR) is essentially an 'enclave project', importing inputs and exporting outputs, meaning that there will be little 'Dutch disease' and deindustrialization effect. Secondly, as regards the appreciation likely to take place during the operational phase, in calculating the exchange rate appreciation between 2000 and 2003, upon which the estimate was based no account was taken of growth during that

period and consequent increases in real incomes - known to result in real exchange rate appreciation. This may mean that the figure for potential real exchange rate appreciation is also an over estimate (Warr 2004).

Notwithstanding these caveats, and despite NT2 being an 'enclave' project, the appreciation due to government revenues from NT2s construction and operation are likely to result in moderate real exchange rate appreciation. According to the figures reported in section 2.2.3 NT2 only accounted for around 1/5th of the investment in hydropower in Lao PDR between 2000 and 2010 and is equivalent to only 1/5th of the estimated value of the developments slated to take place between 2011 and 2016 (in the foreseeable futures scenario), not to mention additional government revenues from the power export earnings. Thus we may expect to see real exchange rate appreciation considerably higher than the estimates for NT2 suggested here. Indeed, recent figures on real exchange rate appreciation between2007-2009 show real effective exchange rate appreciation against the US dollar of around 20% (IMF 2009d)[56].

Although the consequences of 'Dutch disease' are potentially serious, including decreased competitiveness in traded goods sectors such as agriculture and manufacturing (both central to poverty reduction efforts), and downward pressure on real wages in these sectors, with effective state control of these revenues the adverse effects of real exchange rate appreciation could be avoided. In particular, investments to improve the productivity of adversely effected sectors are likely to be important.

FUTURE TRENDS

The above comments only took NT2 into account. It also be noted that NT2 is only one of many large scale foreign invested natural resources development projects in Lao PDR. Similar, effects can be expected to be seen with greater FDI in natural resource projects and increasing government earnings from these – particularly in hydropower and mining. The cumulative impact on the tradable goods sectors may become increasingly significant. Whether or not this translates into increasing inequality and increases in relative poverty will depend on the extent to which the government is willing to off-set these changes through expenditures on effected sectors.

Real exchange rate appreciation maybe an issue which Lao PDR will have to manage very carefully if it is to avoid the negative impacts of Dutch disease. It is unlikely to be an issue elsewhere in the basin as the role of the natural resource sector and foreign exchange earnings

[5] This is also a function of government policy. In the light of extensive investment it may be a choice between real exchange rate appreciation and inflation. Both strategies can have potentially adverse consequences. From the analysis available it is not clear to what extent the relative appreciation of the kip is due to weakness in the US dollar.

[6] Analysis by the IMF suggests that at this level is in line with the kips medium term equilibrium which is suggestive of structural changes to the economy, rather than government policy induced appreciation.

from it are likely to be small relative to the size of the other economies. Although in the case of Cambodia with considerable mineral exploitation and fossil fuel potential, as well as hydropower for export, if these resources are realized for export Cambodia too may see upward pressure on real exchange rates.

As with other macro-economic issues the impact on the tradable sectors of this in-flux of foreign exchange from natural resource related development, and in particular hydropower projects in the basin is under researched and possibly of long term significance for the smaller countries in the LMB and especially Lao PDR. A better assessment of any real exchange rate appreciation which has taken place due to recent expansion in the natural resource sector, in particular an assessment of lagging sector impacts through real exchange rate appreciation would be an ideal place to start. This could form the basis of forward looking projections on the likely development of this trend and the role of hydropower in it.

2.2.6 IMPACTS OF HYDROPOWER INVESTMENT – PUBLIC DEBT SUSTAINABILITY

PAST TRENDS AND CURRENT CONDITIONS

Lao PDR is regarded as a country with a high risk of debt distress both from external and internal indebtedness[7] (IMF 2009d). Therefore, a second consideration relates to the extent to which the GoL will incur contractual obligations of counter guarantee in the case of debt default. While this may not be an issue for the large economies, for Lao PDR (and a lesser extent Cambodia), where proposed investments are large relative to the country's economy this may be an issue. The additional liability this counter guarantee represents may affect Lao PDRs credit standing and debt service burden, and the ability of the GoL to take loans. However, even in the case of NT2 the government equity in the project is only USD 80 million (the remainder being private sector debt), the macro-economic risks are much less than would be the case if the GoL had a larger holding. It has been estimated that government deficits will be only slightly larger with the project – and that slightly higher risks need to weighed against the revenue generated for government by the project – which are expected to off-set these risks. This finding however is controversial and depends upon the extent of revenue generation in these projects relative to the debt burden incurred by government (WCD 2001). Much of this is dependent upon how much equity the GoL will take in the various proposed hydropower developments, as yet no information is available on this.

FUTURE TRENDS

It is not clear to what extent LMB governments (Lao PDR and Cambodia in particular) will take on liabilities and extra debt in supporting development in the hydropower sector in the next 20

[7] While the possible real exchange rate appreciation noted in section 2.2.6 would effectively reduce the debt service burden in the short term,

years. Nor is the extent of government revenues to be generated from such developments clear. Given the appetite of private investors for hydropower investments, and debt constraints on LMB governments it is unlikely that governments will find it necessary – or be willing to invest heavily in these projects.

Nevertheless, there is an absence of independent analysis of this issue and the parameters within which governments can trade-off a greater debt burden for hydropower revenues without incurring a net loss due higher debt service, and the extent of the risks involved for government should be looked at in greater detail.

2.3 CONCLUSION

In summary three key conclusions can be drawn from the macro economic analysis:

- Hydropower development in the LMB represents a massive investment in the region and generation of substantial foreign exchange reserves to some countries;
- This influx of foreign exchange is likely to have profound effects on the key macro economic variables in Lao PDR and will need to be managed effectively to avoid the risk of real exchange rate appreciation; and,
- As a country which is assessed as at a high risk of external debt default, the implications any additional debt obligations the government of Lao PDR incurs as a result of hydropower development need to be considered very carefully.

The expected development of the energy sector in the region, and in particular of the hydro-power sector is likely to have significant consequences for other economic sectors of the region. These include: fisheries, agriculture, industry and mining, construction, navigation, and tourism. In the next section, we provide the baseline for each of these sectors in order to facilitate the identification of the possible impacts of the hydropower sector development.

3 COSTS AND BENEFITS TO SECTORAL DEVELOPMENT

This section seeks to do broadly three things; firstly, to establish the importance of individual economic sectors to the LMB national economies; secondly, to assess the role of the LMB geographical area in that sector; and thirdly, to derive and economic value for goods and services derived from the LMB area. The sectoral focus while not comprehensive focuses on sectors which are likely to be influenced by the development of hydropower in the region. Sectors covered include fisheries, agriculture, industry and mining, construction, navigation and tourism. Environmental goods and services are not addressed separately but are included under the sector for which they are relevant.

3.1 FISHERIES

3.1.1 PAST TRENDS AND CURRENT CONDITIONS

CONTRIBUTION OF SECTOR TO NATIONAL ECONOMIES

Table 9 gives estimates of the contribution of the fisheries sector to GDP. Fisheries sectors in Cambodia and Vietnam are particularly significant. While marine capture and aquaculture are most significant in the latter, freshwater capture fisheries are most important in the former. These estimates are considerably higher than those included in national accounting data. For example, figures for Cambodia are much higher in 2003-2004 11.7-16% compared to 9.3 -8.2% in the national accounts. This is possibly due to an underestimation in the national accounting data as a considerable proportion of capture fisheries and freshwater capture fisheries in particular are likely to be non-commercial.

Table 9: Contribution of the fisheries sector (capture and aquaculture) to GDP in LMB countries

Country	Share of GDP	Sources
Cambodia	11.7%-16%	Starr 2003 - Van Zalinge *et al*. 2004
Laos	6.8%	FAO statistics (http://www.fao.org/fishery/countrysector/FI-CP_LA/en#fn7)
Thailand	2.07%	Sugiyama et al. 2004
Vietnam	7%	Thai Thanh Duong 2003

Fisheries is clearly significant contributor to GDP in all four LMB countries, in general due to rapid growth in the industrial and services sectors this contribution has been in relative decline. For example, in Cambodia value added due to fisheries increased in real terms from about Riel 1.5 trillion in 2000 to about Riel 1.8 trillion in 2008, whereas its contribution to GDP declined from about 10.8% in 2000 to 6.6% in 2007 (IMF 2009a). Similarly, for Lao PDR while value added increased from about Kip 0.9 trillion in 2002 to Kip 1.6 trillion in 2007, the sectoral contribution to GDP declined from 4.2% of GDP to 3.4 % of GDP over the same period (IMF 2009b).

As noted above, these figures are however likely to considerably under-estimate the actual value of capture fisheries to these countries and the LMB. Firstly, a large portion of the capture fisheries will never enter the market as it will be consumed for subsistence purposes within the household. For example, Hortle (2009) shows that official estimates of LMB fisheries is only 45% of estimates based upon fish consumption. Secondly, there are many highly developed up-stream and down-stream linkages between fisheries and other sectors. Up-stream ancillary

services such as manufacture and repair of fishing gear and construction of boats are likely to be important. As are down-stream linkages such as the fish processing, for example in the manufacture of fish sauce.

Fresh water and brackish water aquaculture production in the LMB countries has been estimated to be worth an annual average of 2005-2007, USD 60 million in Cambodia, USD 99 million in Lao PDR, USD 424.5 million in Thailand and USD 1,824 million in Vietnam (FAO, Fishbase)[8]. Aquaculture and marine fisheries production has grown rapidly in recent years in Vietnam in particular with expansion of processing industries and export markets.

VALUE OF THE LMB FISHERIES

The total economic value of the capture fisheries in the LMB is estimated to be between USD 1.4 and 3.9 billion USD annually, these figures are derived from catch estimates multiplied by an average price per kilogram. Price estimations account for variability between species, countries and seasons. The most recent estimate is that of Hortle (2009) who, integrating inflation, has valued Mekong fish resources to USD 2.2 to 3.9 billion on first sale and between USD 4.3 to 7.8 billion on retail markets. Kirby and Mainuddin (2008)[9] recently showed, in a conservative assessment, that the economic value of capture fish in the Lower Mekong is at least as important as that of livestock.

Table 10: Value of fish production in the LMB

	Quantity (tonnes)	Price (USD per kg)	Value (US$ millions)
Riverine capture fisheries	1,533,000	0.68	1,042
Aquaculture	260,000	1.05	273
Reservoirs	240,000	0.68	163
Total	*2,033,000*		*1,478*

Source: Sverdrup-Jensen (2002)

Based on the value range of fisheries and the proportion of the fisheries accounted for by each country, table 10 gives the estimated value of the LMB fishery to each country. Based on these consumption estimates Vietnam and Thailand capture most of the value of these fisheries, however on a per capita basis the portions accounted for by Cambodia and Lao PDR are much smaller. In

[8] Based on the three years from 2005 to 2007.

[9] It should be noted that these figures do not represent value-added and therefore may seem disproportionately large when considered against figures on the contribution of this sector to GDP.

terms of the future discounted[10] income stream that fisheries represents to the LMB between 2010 and 2030 the value is between around USD 12 billion and USD 55 billion depending on the valuation.

Table 11: Value of LMB fisheries by country

	Consumption based estimate (000 tonnes/year)	Proportion of the fishery	Value range (million USD)
Cambodia	587	0.25	348-1,617
Lao PDR	209	0.09	124-576
Thailand	911	0.39	540-2,509
Vietnam	789	0.33	468-2,173
LMB total	2,360	1.00	1,400-6,500

Source: Based on Hortle 2009

However, despite there being a number of valuation projects over the years there is no transparent price per kilo or per ton. The estimation of the value of capture fisheries remains a neglected issue. The large variation in the value of fisheries is a measure of how little is known about the actual contribution of this sector to the socio-economic system of the LMB. In some respects addressing the valuation in aggregate terms misses the other roles played by fisheries as a source of nutrition and livelihoods for some of the poorest sections of the population. This is aspect of fisheries is dealt with in greater detail in the distributional analysis in section 4.

INDIRECT VALUES

As alluded to above, fisheries have a number of indirect values in that they support a number of upstream and down-stream linkages in supporting industries and product processing respectively. Up-stream linkages include gear making, boat-building and salt and ice production which are carried out at a range of differing scales from the household level to the level of large enterprises. Hortle (2009) estimates that there are several million sampans in the LMB, with prices ranging from USD 1000 – 2000 for boats without an engine to USD 3000-5000 for boats with an engine. At a conservative estimate of 2 million boats without engines in the LMB, the output value of this industry alone would be worth USD 2 billion – USD 4 billion[11]. Similarly, Hortle (2009) estimates that salt used in fish processing (for the production of fish sauce etc) consumes around 170,000 tonnes of salt per year, with significant implications for that industry. While there is no available data on ice manufacture, increasing use is made of ice in preserving fish with implications for this industry.

EMPLOYMENT

[10] Using a discount rate of 10%, this is not a net present value as there are no estimates for the current costs of inputs or how these will change over time.

[11] However, this is not necessarily represent additional value added to the value of fisheries, as the boats may well be paid for from value added accruing to people engaged in fishing.

Employment in fisheries and associated industries is also extremely important to the LMB. While national figures are available these bear little relation to the capture fisheries which are so important to the LMB. However, figures on the number of people involved in this segment of the fisheries sector are scarce. This is partly due to the lack of assessment, but also to the elusive nature of involvement in fishing. Although since a minority of people are engaged in full time fishing, a majority of farmers spend time and make gains from fishing. Thus in Cambodia, Keskinen (2003) estimated that around Tonle Sap Lake, fishing was a primary occupation for 17.1% of people only, but a secondary occupation for 28.5%. Some indication of the importance of fisheries in employment is given in tables 12 and 13 below.

Table 12: Number of people involved in the fishery sector (capture fisheries and aquaculture)

	Number of Households/People	**Sources**
Cambodia	1,640,000 people	FAO and WorldFish Center 2008
Laos	N/A	
Thailand	50,198 households 3.13 million fishers	FAO statistics (www.fao.org/fishery/countrysector/naso_thailand/en Lymer et al. 2008
Vietnam	In the Mekong delta , fisheries and aquaculture contributed to 10% of the national labor force. Around 310,000 people are employed in coastal fisheries and around 670,000 people are involved in aquaculture.	FAO statistics www.fao.org/fishery/countrysector/FI-CP_VN/en

Table 13: Number of people involved in the aquaculture sector (inland and marine)

	People involved	**Farms**	**Sources**
Cambodia		53,800 farms in 2008	Minister of Agriculture's speech 01/012009
Laos	5,5200 families or 8.3% of rural households	503,460ha	FAO statistics (www.fao.org/fishery/countrysector/FI-CP_LA/en#fn7 Souvannaphanh *et al*. 2003

Thailand	80,704 households	**Freshwater** aquaculture: 390,853 farms and 131,500 ha in 2002,; more than 440 000 in 2004	FAO statistics (www.fao.org/fishery/countrysector/naso_thailand/en)
Vietnam	670,000 people	327 092 ha of freshwater farms, (36.3%), 575,137 ha of marine and brackish water farms (63.7%)	FAO statistics (www.fao.org/fishery/countrysector/FI-CP_VN/en)

3.1.2 FUTURE TRENDS

Fisheries production in the LMB is likely to constitute an ever smaller portion of the GDP, due to rapid expansion of industry and service sectors in the region. Nevertheless, within the LMB, and especially in rural areas, it is likely to remain an extremely important sector. Aquacultural production is likely to continue increasing particularly in the Mekong delta, but also further up the LMB. The evidence available ton date suggests that freshwater capture fisheries have not declined , but productivity is likely to plateau in the coming years.

Any future stagnation or decline in capture fisheries will only affect the value of that sector to the extent that prices of fish relative to other goods remain the same. However, recent experiences in the region, and globally of rapidly rising food prices -driven by higher input prices (such as energy prices), and increasing demand (driven by population growth and increasing consumption in rapidly developing countries)- suggest that the price of fish relative to other good may increase over time. So even with declining fish catches the overall value of the fisheries could well remain the same – or even increase.

Employment in fisheries, in contrast is likely to decline as other employment opportunities increase and as the catch per unit effort continues to decline. Nevertheless, capture fisheries will remain an important source of employment, income and subsistence in the LMB for the foreseeable future.

3.2 AGRICULTURE AND FORESTRY

3.2.1 PAST TRENDS AND CURRENT CONDITIONS

CONTRIBUTION OF SECTOR TO NATIONAL ECONOMIES

Agriculture has grown less rapidly than the industrial and service sectors in the LMB, as a consequence despite showing steady increases in productivity across the basin the sector has declined as a proportion of GDP (table 14). Despite the relative decline agricultural production is still centrally important to all LMB economies. It remains the largest source of employment,

agricultural exports are an importance source of foreign exchange earnings in some countries, it supplies inputs to the domestic manufacturing sectors and is central to poverty reduction and rural livelihoods *poverty and rural livelihoods is considered in more detail in section3).

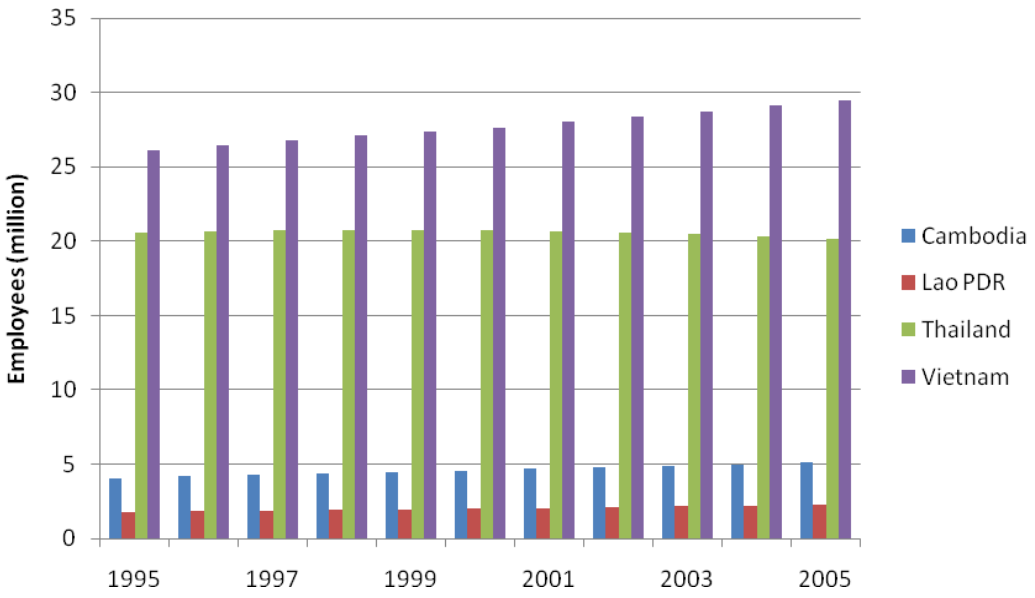
Table 14: LMB countries Agricultural indicators 1997-2007

Country	AAGR 1997-2007 (%)	Proportion of GDP	
		1997	2007
Cambodia	4.49	46.3	31.9
Lao PDR	4.29	52.8	39.9
Thailand	2.50	9.4	11.8
Vietnam	4.00	25.8	20.3

Source WDI, World Bank 2009

Agriculture remains the largest source of employment in all four LMB countries in 2001 accounting for 70.2% of the workforce in Cambodia, and in 2004 42.3% of the workforce in Thailand and 57.9% of the workforce in Vietnam. Recent estimates have not been available for Lao PDR, however in 1995 around 85% of the workforce was employed in agriculture (World Bank 2009). While the proportion of the workforce employed in agriculture has been slowly declining in all LMB countries, due to population growth the absolute number of agricultural employees has been increasing (figure 11) in all countries except Thailand.

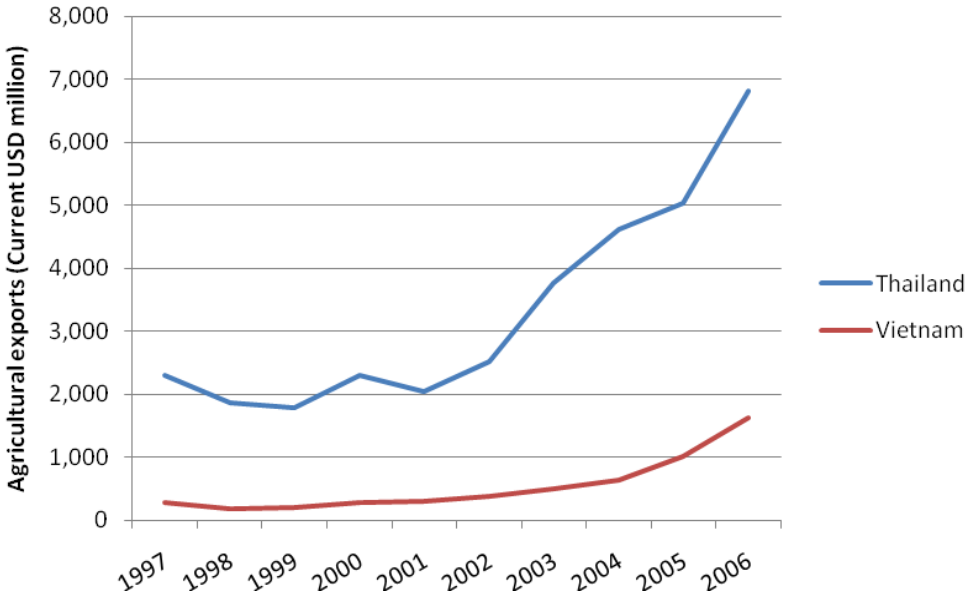
Figure 11: Agricultural employment in LMB countries 1995-2006



Source: WDI, World Bank 2009

Agricultural exports are extremely important to LMB countries, especially to Thailand and Vietnam which are the largest and second largest rice exporters (figure 12). In 2006 accounting for around 4% of merchandise exports in Vietnam and 5% in Thailand, agricultural exports are also for Cambodia comprising around 2% of merchandise exports by value in 2004, figures for Lao PDR were not available at the time of writing (World Bank 2009).

Figure 12: Agricultural exports from Thailand and Vietnam 1997 to 2006



Source: WDI, World Bank 2009

VALUE OF LMB AGRICULTURE

At the LMB level agriculture has even greater dominance, 40% of the land area in the basin is devoted to agriculture. Most production is of rice and vegetables, although in the Mekong delta rice-shrimp cultivation and intensive shrimp mono cultures are also increasingly important (IBFM 2007). Agriculture is also the main source of employment for the LMB population, which along with fisheries and forestry employs 85% of the LMB working population (Kirby and Mainuddin 2006). Irrigated agriculture is extremely important in the region, and extensions of irrigated area have been responsible for much of the productivity gains in agriculture.

Table 15: Value of riparian agricultural production in LMB (based on 100KM corridor centered on the Mekong mainstream)

Zone		1	2	3	4	5	6
	Unit	China to Chiang Saen	Chiang Saen to Vientiane	Vientiane to Pakse	Pakse to Kratie	Kratie to Phnom Penh and Tonle Sap	Phnom Penh to the Sea
Paddy field area	sq.km	500.22	3,655.09	22,916.31	1,625.64	13,910.25	19,810.05
Yield	t/ha/yr	1.00	2.00	3.50	2.60	2.60	5.00
Annual production	t/yr	50,022	731,019	8,020,710	422,666	3,616,666	9,905,024
Value @ 0.2 $US/kg	**US$ million**	**10.00**	**146.20**	**1,604.14**	**84.53**	**723.33**	**1,981.00**
Proportion of value	Percent of total	0.2	3.2	35.3	1.9	15.9	43.5
Orchard		13.88	420.83	94.53	0.00	4.63	0.00
Field crop		123.48	3,418.93	2,467.25	91.59	2,317.79	1,518.06
Swidden cultivation		177.07	1,000.27	37.61	64.94	1,264.64	130.04

Source: ICEM based upon land cover and agricultural productivity data (see terrestrial systems report)

Table 15 gives estimates of production area in a 100km corridor centered on the Mekong mainstream (see terrestrial systems paper). These figures serve to emphasize the importance of irrigated rice production in particular. Riparian irrigated rice in the corridor is estimated to be worth USD 4.6 billion annually, with most of this being produced in zones 3 and 6. The importance of the Mekong delta as a rice producing region comes through strongly in these figures.

RIVER BANK GARDENS

A large portion of households living on the banks of the Mekong river make seasonal use of the nutrient rich alluvial deposits available for half the year (when the river is not in flood) to

cultivate a range of different crops. These river bank gardens are an important source of production for households, requiring relatively few inputs due to the high nutrient content of the river banks. The fertility of these gardens depends upon the annual flooding of the river which brings nutrient rich sediment to fertilize these areas.

There is limited data on the economic value of these river bank gardens, however, work done for the IBFM project cites figures for households along the Se San river in Cambodia which garnered incomes of 65 USD/household (ranging from 32 USD in upland areas to 159 USD in the floodplains). It is estimated that riverbank gardens comprise about 500 ha in Lao PDR (IBFM 7).

Estimates performed in the agriculture baseline paper suggest that river bank gardens account for about 120,000 ha shared between almost 500,000 households. Assuming that households maximize the productive value of their land by cropping vegetables, annual production from these areas could amount to USD 574 million. While assuming households grow a lower value crop such as maize or beans, the value of annual production from these areas is estimated to be around USD 174 million. As these areas are very fertile it is assumed that they do not require additional chemical inputs. Labour costs are estimated to be USD 0.9/hour (World Bank 2009) and 1 hour per day per household for half the year. However, **given that household labour is generally not fully utilized the opportunity cost of this labour time is probably closer to zero**. Given the high estimate over the next 20 years the present value of the future discounted income stream from these gardens is around USD 5.1 billion[12], or around USD 10,000 per household, or USD 1.6 billion –around USD 3,200 per household (table 15).

Table 15: Estimated income from river bank gardens

No.	Ecological Zone	Total area of RBG (Ha)	Annual yield value (Mil.USD)		Labour (Mil. USD)	Net annual income (Mil.USD)	
			Low estimate	High estimate		Low estimate	High estimate
2	Chiang Saen to Vientiane	2,166	3.2	10.4	3	0.4	7.6
3	Vientiane to Pakse	8,395	12.6	40.3	11	1.6	29.3
4	Pakse to Kratie	1,278	1.9	6.1	2	0.2	4.5
5	Kratie to Phnom Penh and Tonle Sap	12,358	18.5	59.3	16	2.3	43.1

[12] Using a discount rate of 10% summing the annual value stream between 2010 and 2030. This is not net present value as no information has been available on the cost of inputs, therefore this represents a maximum value for this asset, if annual costs were deducted the value would be lower.

6	Phnom Penh to the sea	95,291	142.9	457.4	125	17.7	332.2
	Total	119,488	179	574	157	22	417

Source ICEM, based on IBFM and World bank 2009 data (see terrestrial systems paper for more information.

FORESTRY

Forests are an important economic resource in the basin, supplying raw materials for export and for domestic industries, and in supporting rural livelihoods through the utilization of non-timber forest products (NTFPs), their utilization next to the mainstream is limited. Nevertheless, bamboo production upstream of Pak Se (zones 2,3 and 4)in direct vicinity of the mainstream is an important livelihoods activity. Land cover data dating from 2003 suggests that bamboo forest covers over 4,300 sq. km along of a 100km wide corridor centered on the Mekong mainstream. As bamboo is almost certainly present in other land use types this represents a minimum area for this resource.

3.2.2 FUTURE TRENDS

Agricultural productivity growth is likely to continue growing as agricultural techniques are improved and key inputs become available – and in particular as the irrigated area is expanded. However, as the limits of the bio-physical system are reached increasing productivity in the basin will increasingly depend upon increasing labour productivity through land consolidation and mechanization –common in Thailand and Vietnam. Table 16 gives the estimated output growth in a 100km corridor centered on the Mekong mainstream. The assumption of equal growth in yield across the LMB means that different zones do not alter their share of rice output. Overall output value increases from USD 4.6 billion to USD 8.2 billion, or a growth over the period of 81% in output.

Table 16: Estimated agricultural output in 2030 in LMB

Unit	1	2	3	4	5	6
	China to Chiang Saen	**Chiang Saen to Vientiane**	**Vientiane to Pakse**	**Pakse to Kratie**	**Kratie to Phnom Penh and Tonle Sap**	**Phnom Penh to the Sea**
Area (sq.km)	500	3,655	22,916	1,626	13,910	19,810
Yield (t/ha)	1.97	3.95	6.91	5.13	5.13	8.00
Total (t/yr)	98,723	1,442,729	15,829,564	834,168	7,137,802	15,848,038
US$ million	19.7	288.5	3,165.9	166.8	1,427.6	3,169.6

Source: ICEM based on BDP data. Note: Price is assumed to remain at USD 200/tone, paddy area is assumed to stay the same and yield is assumed to grow by 3% per year, with a ceiling of 8/tones/ha being reached in Vietnam in 2023.

Nevertheless, with all LMB countries likely to continue showing rapid industrial and service sector growth, agriculture's share of GDP is likely to continue its decline relative to other sectors. It will continue to provide essential inputs into manufacturing industry, provide an important source of export income and provide secure food supplies for growing urban populations.

As a consequence of rapid growth in other sectors, employment in agriculture is likely to decline relative to other sectors across all LMB countries and within the LMB itself. However, by 2030 it is still likely to remain the main employment sector in each LMB country and in the LMB and as such be centrally important to continuing rural poverty reduction efforts.

3.3 NAVIGATION

Maintaining the navigability of the Mekong mainstream is a central element of the Mekong river agreement. The implications of hydropower development for navigation will not be a determining factor in hydropower investments, nevertheless the navigability of the mainstream will need to be considered in the case that any of the mainstream dams goes ahead. Depending on what developments do go ahead, increases in the minimum depth of the river due to mainstream dams could improve the navigability of the mainstream and provide an opportunity for developing the sector considerably relative to what is currently the case. Therefore, while not a determining factor, navigation is a potentially important value stream which may result from mainstream hydropower development and as such is considered here.

3.3.1 PAST TRENDS AND CURRENT CONDITIONS

Transportation is the largest service sector industry in all the LMB countries (IMF various years). Road transportation accounts for the bulk of this but inland waterways are also important especially in the lower stretches of LMB (with the exception of Thailand which has a well developed road network in the LMB), and the Mekong delta. Present conditions mean that navigability in the Mekong is limited. Nevertheless, there are two relatively dynamic stretches of the river:

- Between Kampong Cham and Phnom Penh, the river can accommodate vessels of 2,000DWT. Between Phnom Penh and the sea, sea-going vessels up to 5,000DWT can navigate; and,
- The region between China and Chiang Saen/Chiang Khong. Navigation improvement was undertaken in this stretch of the river in 2004. New port facilities have been constructed in Chiang Sen (MRC 2009).

Figure 13: Cargo boat on the Mekong between Vientiane and Pak Lai

Source: ICEM 2009

In these stretches of the Mekong the river still plays an important role in transportation. As an illustration of this, estimates suggest that in 2001 Mekong river trade was worth 4 billion USD in Vietnam (including the Mekong delta) - around 20% of Vietnam's foreign trade at the time, around 350 million USD between Lao PDR and Thailand, 235 million USD in Cambodia, and 88 between China and Thailand (MRC 2004). Furthermore, the recent Cambodian Master Plan for Mekong Navigation (2006), shows large and increasing river traffic volumes to Phnom Penh port, where, for example 60% of Cambodia's petroleum requirements are imported. The recent development of container handling facilities at the port have also lead to a large increase in container from 990 TEUs in 2004, to 30,000TEU in 2005. The port also sees bulk commodities and tourist traffic however these are not key market segments.

Despite the growing importance of navigation in the lower reaches of the LMB, this section concentrates on navigation in the upper Mekong river as these are the areas likely to be effected by mainstream hydropower development.

A recent report by Vrenken (2008) for the MRC looks in detail into issues related navigation economics in the Upper Mekong river. It identifies 4 distinct segments in the navigation sector. Firstly, a dynamic freight transport segment between Chiang Saen in Thailand and Guanlei in Yunnan, navigation connects to other modes of transport at either end, and is part of a multi-modal chain connecting Bangkok and Kunming (Vrenken 2008). There are about 60 Chinese owned barges operating this route. Freight transport demand is estimated to be 260,000 tonnes. This is the most economically valuable segment, with its direct contribution to income from employment and investment estimate to be worth USD 2.38 million, and of the whole multi modal chain between Bangkok and Kunming to be USD 9.64 million. Additional indirect benefits relating to industrial and trade development in the region is estimated to be in the region of USD 9.05 million (Vrenken 2008). Part of the success of this transportation link lies with the absence of other alternatives in the area, such as road links, although this may change in the future.

Secondly, freight transport on other section of the upper Mekong in Lao PDR. This is a small and declining sector (carrying less than 30,000 tonnes of cargo a year), which has seen decreasing demand and low productivity. This decline has been driven by improvements in road transport infrastructure. The value of this segment is estimated to be between USD 0.1 and 0.6 million, and USD 0.2-0.3 million in trans-shipment (Vrenken 2008). It should be noted however that this segment is vital for some communities on the river, some of which have limited access to road transport. Moreover, many of these communities are poor suggesting that the welfare value may exceed the economic valuations here (Vrenken 2008).

Figure 14: Small cargo vessels being loaded with fruits and vegetables at a quay in Thailand for transport across the river to Vientiane

Source: ICEM 2009

Thirdly, passenger services connecting villages along the river with the road transport system. This is a low cost transportation mode which plays a mainly social function connecting communities along the river. No reliable cost estimates were available, but it is estimated that this segment is not worth more than 450,000 USD per year (Vrenken 2008).

Finally, the tourist cruise segment, this is largely confined to Lao PDR between Houaisay and Luang Prabang. Tourist cruises are estimated to be worth around 1.5 million USD, 20% of this is accounted for by domestic operators and 80% by international package tour operators. Indirect benefits are estimated to be in the region of 1.9 million USD.

Table 15: summary of current economic values associated with navigation in UMB

Market segment	Direct value (million USD)	Indirect value (million USD)
Freight Chiang Saen to Guanlei	2.38	9.05
Local freight	0.1-0.6	0.2-0.3
Local passenger	0.45	-
Tourism	1.5	1.9
Total	4.43-4.48	11.15-11.25

Source: Vrenken 2008

3.3.2 FUTURE TRENDS

In the future without mainstream dams the navigability of the river is expected to change little outside improvements proposed by the china up stream of Chiang Saen (table 16). There may be growth in certain sectors such as an increase in tourism traffic in the upper reaches of the LMB. Moreover, there is the potential to improve the navigability of some stretches of the mainstream through clearing rocks and other obstructions to boats. But given the controversy associated with previous improvements it is unclear whether any such exercise will be undertaken without the impetus that mainstream hydropower would offer. Improvements in road and rail infrastructure in the region, are also likely to mean that existing river freight traffic will face increasing competition from sectors which are currently more price competitive. Increases in the price of fuel may decrease the relative competitiveness of road freight but this is dependent on contingencies which are highly uncertain. In the delta river traffic can be expected to increase with economic growth and as river transportation infrastructure is developed as an alternative for some transportation markets to road transport.

Table 16: Chinese scenario for improving Upper Mekong (upstream of Chiang Saen)

Phase	Vessel capacity	Vessel type	Yearly transport capacity
1st Phase	100-150 tons	Self-propelled barges	1 million tons

2nd Phase	300 tons	Self-propelled barges	6 million tons
3rd Phase	4x500 tons	Push-tow convoy	Associated with dam development

Source: MRC 2009

In short, the likely picture that emerges for mainstream navigation without mainstream hydropower development is of decline in the upper basin, with the exception of the Chiang Sen – Guanlei stretch of the river, as relatively more costly river transport looses out to cheaper and rapidly developing over-land transportation. In the lower basin and deltaic areas, however, freight transportation is expected to increase for some market segments as better supporting infrastructure is developed. Finally, tourism traffic is expected to increase as the sector grows.

Article 9 of the 1995 Agreement mandates freedom of navigation along the Mekong River. This article requires that dams do not pose an additional obstacle to navigation on the Mekong River. Whilst hydropower developments have the potential to pose a barrier to navigation, it is important to remember that they also offer the possibility of providing more reliable and consistent water depths that facilitate larger vessel capacities operating on a year-round schedule. The cost-effective and appropriate way to realise the benefits of inland waterway navigation in harmony with hydropower development is the construction of navigation locks.

3.4 TOURISM

3.4.1 PAST TRENDS AND CURRENT CONDITIONS

CONTRIBUTION OF SECTOR TO NATIONAL ECONOMIES

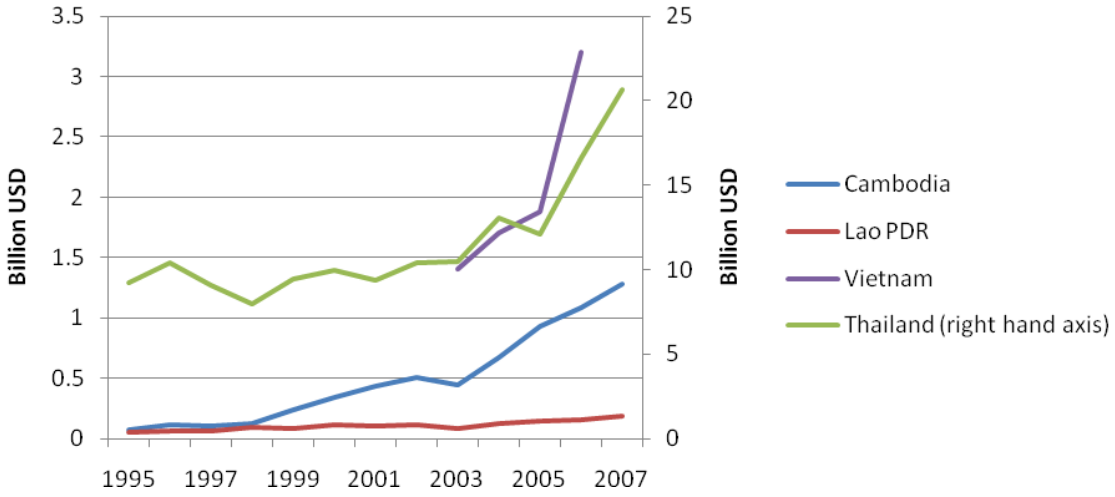
Tourism is an increasingly important sector for all LMB countries. It has seen rapid growth since the middle of the 1990s with international arrival numbers reaching almost 20 million in 2006. While an important sector for all four countries (table 17), it is especially important for Cambodia and Lao PDR. The Thai tourist industry dwarfs that of other the other countries and continues to grow quickly. Tourism is important not just due to the industry's size but also due to the large employment in tourism and the importance of valuable foreign exchange earnings. Literature relating to the ADB's GMS project suggests that the region is one of the most rapidly growing tourism destinations in the world.

Table 17: International tourism growth in LMB countries

	International tourism receipts (% of exports) 2007*	Number of Intl. tourism arrivals		Growth
		1995**	2006	1995**- 2006
Cambodia	22.8	987	1,591	61
Lao PDR	15.7	60	842	1,303
Thailand	11.4	6,952	13,822	99
Vietnam	7.1	1,351	3,583	165

Source WDI, World Bank 2009, *Cambodia 2006, **Cambodia 2004

Figure 15: Increase in international tourism receipts in LMB countries 1995-2007



Source: WDI, World Bank 2009

VALUE OF THE LMB TOURISM

While much of this tourism in Vietnam and Thailand is focused on sites outside the basin with the exception of the Mekong Delta and Chang Rai, tourism in Cambodia and Lao PDR is concentrated along the river. In particular, at sites of historical significance such as Luang Prabang and Siem Reap (IBFM7 2005). As the aquatic ecosystems baseline report also points out the value of river tourism is also potentially large, the ADB's GMs tourism strategy highlighting the potential importance of the Mekong River Tourism Corridor. Revenue streams form river based tourism are particularly vulnerable to bio-physical changes in the as they rely upon a relatively intact natural resource base.

For example, the river dolphins in Kratie attracted 75,000 domestic and 7,612 foreign tourists in 2004 and 82,000 domestic and 10,844 foreigners in 2005. Stung Treng saw 29, 958 domestic and 50, 910 foreign tourists in 2005-2006, mostly visiting the area for ecotourism. The Mekong Delta saw also saw 1.2 million international tourists and 8 million domestic tourists in 2008, and 250,000 people are employed in the tourism sector. Can Tho saw 850,00 tourists in 2008 and 1.1 milllion in 2009 in 2009 with revenues of USD 24.6 million and USD31.6 million respectively. This is expected to increase to 1.1 million domestic and 300,000 international tourists in 2010.

While disaggregated figures for river tourism in the upper reaches of the LMB are not available an estimation performed on Lao PDR provincial tourism figures suggests that river based tourism alone was worth around USD 15 million in 2003 and by 2007 this had increased by 140% to around USD 41.7 million[13].

3.4.2 FUTURE TRENDS

Tourism is expected to grow rapidly in the region. The GMS tourism strategy identifies the region as, globally one of the regions with the largest untapped tourism potentials. This will be driven by both improving transportation across the region and internationally, increased level of regional and international tourism driven by rising incomes, particularly in China. The GMS tourism strategy foresees growth in tourism from USD 29.5 billion in 2010 to USD 52.4 billion in 2015. It is estimated that around a good proportion of this growth will emerge from tourism in the LMB.

For example, in Lao PDR government projections suggest that revenue from tourism will increase from USD 233 million in 2007 to USD 399 million in 2015 (National Tourism Administration). Similarly, tourism plans in Vietnam foresee a 20% growth in arrivals annually, which if translated into revenue growth, would suggest revenue growth of USD 640 million annually.

These rapid growth trends are expected to moderate in the medium term but it is clear that tourism will become an increasingly important sector in Lao PDR and Vietnam. With large tourism sectors already important contributors to the national economies of Cambodia and Thailand, and rapid growth elsewhere in the economy there may be a relative decline in the importance of the tourism sector in these two economies.

3.5 CONSTRUCTION

[13] These estimates are conservative and based on an assumption of one day per visitor per province outside the large cities and based on a calculated average spend per visitor per day.

3.5.1 PAST TRENDS AND CURRENT CONDITIONS

CONTRIBUTION OF SECTOR TO NATIONAL ECONOMIES

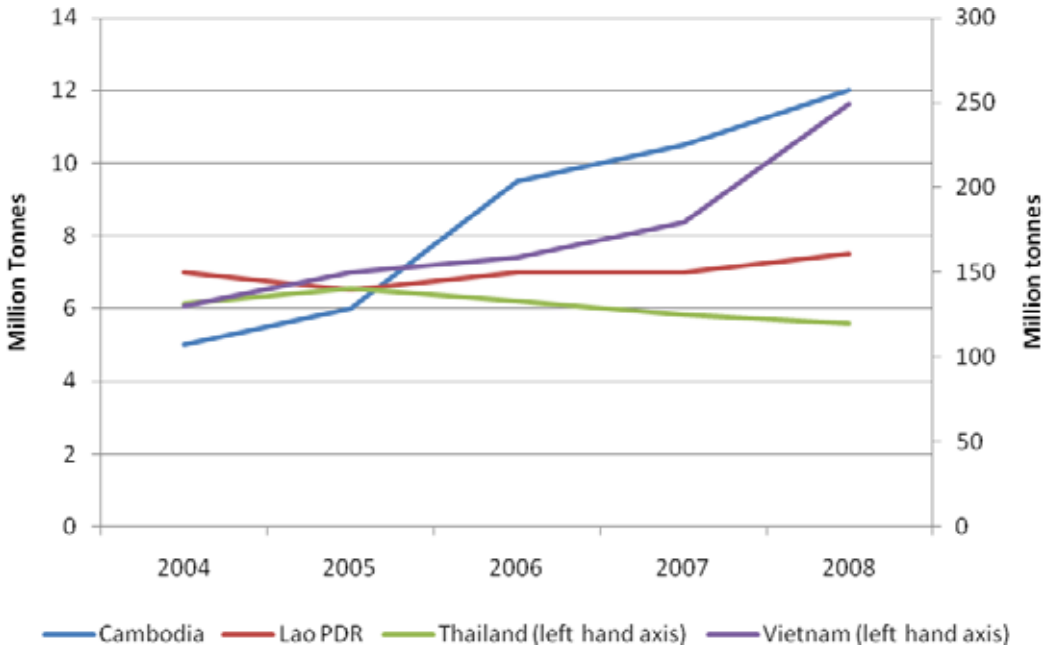
Millions of tonnes of sand and gravel eroded from upper catchment areas and the river bed are deposited and transported down by the river as sediments. These are deposited in sand bars and other features all along the river. This important resource, although currently ubiquitous, is an essential input to the construction industry in and around the basin. Rapid regional economic growth and construction is driving increasing demands for sand and gravel from the region. This increasing demand and extraction of sand and gravel from the basin has lead to export bans in Cambodia and a tightening of controls in Vietnam as resources are preserved for domestic use and to prevent environmental damage. For example, according to recent reports in the Vietnamese press (Tuoi Tre 24 August 2009), the volume of sand that had been exported between January to June 2009 rose to 7 million tones, as much as was exported in the previous 10 years. This surge has been driven by export bans elsewhere such as Cambodia. These national bans have also caused price rises, where previously were around VDN 15,000-17,000/cubic meter, following the Cambodian ban prices rose to VDN 25,000-30,000/cubic meter a 40-50% rise.

Research concentrated in Lao PDR, where about 350,000 m^3 of sand and 180,000 m^3 of gravel are extracted annually. The most recent figures available suggest that in 2002-2003 market price for sand was 2.86USD/m^{-3} and gravel 2.87USD/m^{-3}. In that year production levels for sand and gravel were 277,500m^3 and 322,411m^3 respectively, generating around 122,200 USD and 19,344 USD. The economic value of sand and gravel in Lao PDR was estimated to be around 141,500 million USD annually in 2005 (IBFM7 2005).

Sand and gravel have many different uses including glass manufacture and as aggregates, moreover the export market for sand and gravel for the region has developed in recent years as the narrative above suggests. However, one major consumptive use of these resources is in the production of concrete and mortar for construction purposes. All concrete and mortar production involves the use of cement in a ratio of cement to sand/gravel of between 1:4 and 1:7 depending on construction uses. Moreover, cement is not usually produced for export as it a relatively low weight to value ratio, so practically all production is consumed locally. Given the LMB country cement production figures, and assuming a usual mixing ration of 1:5, this allows an estimate of the amount of sand and gravel used in conjunction with cement, and gives a good idea of a minimum level of sand and gravel consumption in the LMB countries. Figure 16 shows the sand and gravel use trends based upon this calculation. It is worth noting the close correspondence between investment figures (proxied by FDI - see figure 6 above) and cement production figures in the region.

In estimating the value of this production, using the values given above of USD 2.86/cu.meter in Lao PDR and Cambodia, and USD 1/cu.meter in Thailand and Vietnam, the value of sand and gravel used in construction we arrive at a total value of about USD 990 million.

Figure 16: Estimated national consumption of building aggregates (sand and gravel) for LMB countries 2004-2008



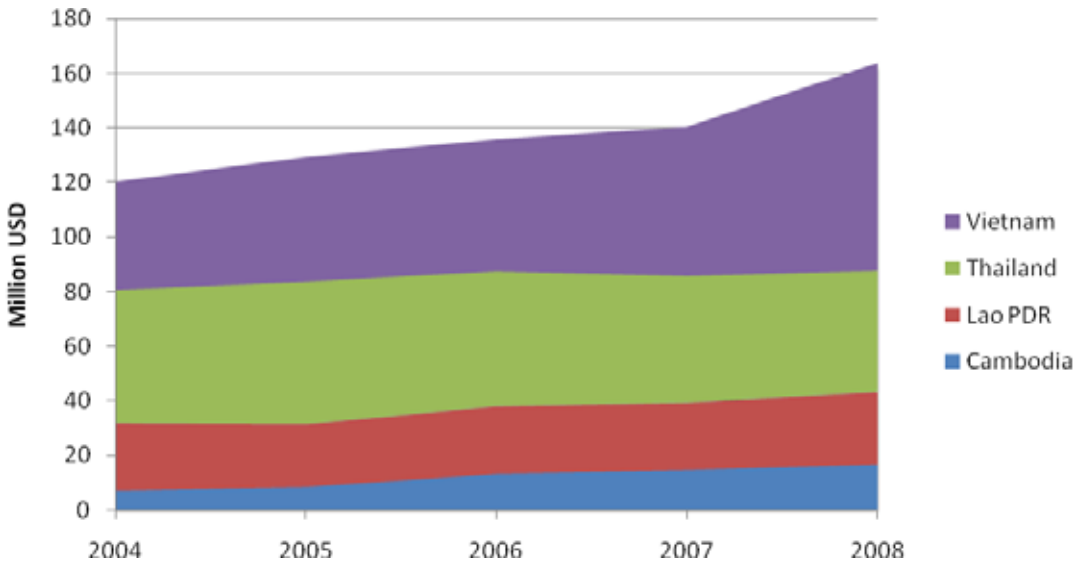
Source: ICEM based on 'Value from Global Cement Report', 7th Edition

VALUE OF SAND AND GRAVEL TO THE LMB

Much of the sand and gravel utilized in the LMB countries comes from sources outside the LMB. To arrive at an estimate of sand and gravel use in the LMB it is assumed that sand and gravel consumption is proportionate to population. Based the proportion of the national population of each LMB country living in the mainstream riparian provinces of the LMB (see table 23) 32% for Cambodia, 82% for Lao PDR, 9% for Thailand and 20% for Vietnam the value of sand and gravel consumed in the construction industry in the LMB is calculated.

These estimates suggest that consumption in the riparian provinces (and by implication extraction) has been increasing at about 12% per year over the 2004-08 period, from around 45 million tonnes in 2004 to around 70 million tonnes in 2008. The estimated value of output hasrisen by around 8% per year over the period from around USD 120 million to USD 164 million. This estimation is relatively conservative as assumed price levels are conservative and a significant portion of extraction for other uses and for export is not included. These estimates are best regarded as a bottom boundary for extraction in and around the Mekong mainstream.

Figure 17: Estimated value of sand and gravel consumed in construction in the LMB 2004-2008



Source: ICEM

3.5.2 FUTURE TRENDS

A reduction in sediment loads will result from sediment capture by the Chinese dams in the Lacang river and the Vietnamese dams in then the 3-S rivers systems of the central highlands. This may well decrease the availability of construction materials in the LMB, increase prices and have knock-on implications for the construction sector. Without more detailed information it is not possible to be more specific at the likely magnitude or timing of these economic impacts.

Increasing regulation of sand and gravel extraction in the basin in order to preserve national supplies (as is now the case in Cambodia and Vietnam) and safeguard the environment is likely to increase the value of these materials in export markets. At the same time moderating price rises on domestic markets, however, the limited capacity to enforce these regulations along with increased incentives to contravene these regulations could mean the impact of the regulation is limited.

These considerations aside, as a measure of minimum demand for sand and gravel in the LMB, and based upon continuing GDP growth driving continuing growth in sand and gravel extraction as described in the baseline, demand in this sector is expected to continue growing. However, recent trends based on the 2004-2008 data are unlikely to represent future growth in this sector as demand will moderate as large infrastructure and other construction needs are met. It is worth stressing demand seems closely related to the absolute size of GDP growth. Demand is therefore likely to grow rapidly in Cambodia, Lao PDR and Vietnam before moderating. In Thailand demand is expected to remain relatively stable.

3.6 MINING AND INDUSTRY

Mining and industry more generally makes extensive use of electrical power and water. Linkages to hydropower development are therefore usually mediated through these two causal connections. However, while power supply to industry is certainly a central concern identifying the incremental economic value to industry of power development in the region is beyond the scope of this study, more general demand is addressed in the power baseline paper. Nor is water supply to industry and mining a critical issue as the Mekong basin is water rich and industry demands are insignificant beside the water available. Key concerns however do relate to water quality and environmental degradation in the basin in general, which is the focus of this brief qualitative section.

3.6.1 PAST TRENDS AND CURRENT CONDITIONS

As noted in section 2, industrial growth is the key diver of economic growth in the LMB countries. In the LMB itself industrial growth has been limited to urban areas and the development of extractive natural resource industries, usually located close to the resource base they rely on. Issues related to urban water pollution and the decline in river quality in and around large urban centers in the basin are documented in the aquatic systems paper. Industrial waste water is undoubtedly a contributory factor in these cases although figures are not available on the quantities of waste water released into the basin it is safe to assume that releases have increased considerably with economic growth.

Dispersed point sources of pollution in the basin from industrial enterprises are a greater issue. Artisanal and large scale mining make significant use of water resources in the refining and processing of ores. For the larger operations mine tailings are generally stored and allowed to settle out before the water is released. In the case of Artisanal mines however, which is quite extensive in some areas of the LMB (e.g. in a recent survey in Luang Prabang province in Lao PDR, depending on the village between 45% and 96% of households were engaged in Artisanal mining (World Bank 2006)), environmental degradation due to uncontrolled mine operations and uncontrolled water pollution from chemicals, and in particular mercury, used in processing are an increasing problem.

Increasing water pollution implies some economic costs however there is no information relating to the costs of pollution in the basin.

3.6.2 FUTURE TRENDS

While improvements in environmental controls at large commercial mine operations are likely as government capacities increase in the basin, the rapidly increasing scale of mining with large new bauxite and gold mines proposed in Lao PDR and Cambodia are likely to off-set any gains from improved environmental controls. Artisanal mining is also likely to grow, but without any

significant environmental controls. Expansion of both these sectors is likely to represent an additional pressure on environmental systems in the region, with deleterious effects on water quality in particular.

Economic costs implied by water pollution will increase with increasing pollution but data is not available on which to base an economic valuation.

3.7 ECOSYSTEM GOODS AND SERVICES

There are a number of important ecosystem goods and services provided by the LMB ecological system (natural products consumed or used directly and functional services that provide benefits indirectly to the basin (IBFM7 2005)) which remain un-monetized, but which are essential to the livelihoods of many people living in the basin and upon which economic sectors depend. While some of these economic values are captured in the sectoral evaluations (e.g. agriculture and fisheries), some are not, yet others provide cross cutting goods and services to different sectors in the basin. This section looks at the goods and services not explicitly covered in the sectoral analysis and where possible attempts to elucidate their economic values.

In what follows we draw on previous work performed in the basin (e.g. IBFM7 2005), however it should be noted that due to the un-monetized nature of these resources and the difficultly of calculating an economic value this analysis is largely qualitative, the following information therefore seeks to identify economic values (and where possible their magnitude), which will allow an identification of possible opportunities and risks in the ecosystem rather than to calculate an economic 'bottom-line'.

3.7.1 AQUATIC PLANTS AND RIPARIAN VEGETATION

the large diversity of plants supported by the LMB contain a significant number that are valuable as foods and medicines. For example, one village in Chiang Rai province was cited as identifying 65 useful species used as herbs, animal feed, fishing bait, fishing gear, household tools and in rituals (IBFM7 2005). Other economically important aquatic plants include Gai which was collected by households for consumption and sale. During season households reportedly were able to earn 300-500 Thb per day in sale of the plant, however it has since declined due to fluctuating water levels. There other plants are also economically important but there is very little data (IBFM7 2005).

3.7.2 WETLANDS

Wetlands are estimated to cover between 6 and 12 million Ha of the LMB. There is considerable variety in the type of wetlands in the LMB with coastal, freshwater and estuarine wetlands. These complex systems provide a range of goods and services, such as fish, clean water supply, plants for food and medicines, fuel wood, nutrient recycling, water purification wildlife habitats groundwater recharge, flood control, carbon sequestration, storm protection etc. Wetland are

highly productive systems, often more production per unit area compared to other land uses (this point is amplified in the aquatic ecosystems paper). Give the range of services they provide valuation is difficult. Some valuations for LMB wetlands have been performed. The That Luang marsh near Vientiane was estimated to have a minimum value of USD 5.1 million per annum. Ream national park in Cambodia with extensive mangroves and mudflats was estimated to have a value of USD 280,000 annually (IBFM 7 2005). Table 18 below gives prices calculated based on other Asian wetlands, while this method is not without its critics, it can serve as a guide to the magnitude of the possible value of LMB wetlands. The overall estimate value is USD 11.2 million annually, or USD 99.8 million in terms of the future discounted income stream to 2030.

Table 18: Area and value of LMB mainstream wetlands (zones 2-5) using transfer prices

Wetland type*	Area (ha)	Value/ha/year (2000 USD)	Total (million 2000 USD)
Unvegetated sediment	25,174	202	5.1
Freshwater marsh	25,174	15	0.4
Freshwater woodland	25,174	228	5.7
Total	75,521	-	11.2

Source: Wetland transfer prices Schyut and Brander 2004; Wetland areas derived from Aquatic ecosystems baseline paper. * Wetland type is assumed to consist equally of all three types of wetland.

3.7.3 ANNUAL FLOODING AND FLOOD CONTROL

The annual flooding of the Mekong implies both costs and benefits. In term so of economic benefits it is important in maintaining the ecology, geomorphology and productivity of fisheries and agriculture in the LMB. Most economic benefits of these floods are captured in the economic assessment of the other sectors and resources covered above. For example, the benefits of nutrient replenishment will be reflected in agricultural outputs. Floods can also generate significant costs (e.g. 2000 to 2001) in terms of loss of crops, livestock, human life and damage to buildings and infrastructure. There is no overall cost-benefit analysis of floods available (IBFM 7 2005).

3.7.4 SALINE INTRUSION CONTROL

Mekong river flows are important in controlling saline intrusion on the Mekong delta. The Mekong delta is increasingly prone to saline intrusion due to increased irrigation decreasing dry season flows. The economic costs of saline intrusion are reflected in the reduction of paddy yield on the delta. Saline intrusion can extend up to 50Km inland of the delta and significant

impacts on crops occur where salinity exceeds 0.4g/litre. However, no estimates for the value of salinity control performed by the river are available.

3.8 CONCLUSION

Sectoral analysis reveals a wide range of goods and services provided by, and dependent upon the bio-physical systems of the Mekong basin and mainstream river in particular. Table 19 below summarizes these.

Table 19: Summary table of sectoral conditions

Description	Goods/services	Value	Future trend
Fisheries	Fish, OAA	USD 1.4-3.9 billion/year (catch value)	Plateau and decline
Agriculture	Irrigation, river bank gardens	(river bank gardens) USD 174-574 million/year (revenue) Paddy USD 4.6 billion annually revenue	Stable 3% growth in yield.
Tourism	Amenity value	N/A	Increase
Navigation	Freight, passenger and tourism transport	USD 4.43-4.48 million/year (direct) USD 11.15-11.25 million/year (indirect)	Stable
Construction	Sand and gravel	USD 164 million	Rapid increase moderating later.
Mining and industry	Sink for waste water (and water supply)	N/A	Increasing costs to other water users in the

			basin
Aquatic plants	Subsistence	N/A	?
Wetlands	Clean water supply, plants for food and medicines, fuel wood, nutrient recycling, water purification wildlife habitats groundwater recharge, flood control, carbon sequestration, storm protection etc	USD 11.2 million (2000 prices)	?
Flooding/flood control	Nutrient replenishment, wildlife habitat, damage to goods and livelihoods	N/A	?
Saline intrusion	Crop productivity	N/A	?

4 DISTRIBUTIUONAL ANALSYSIS

There is a strong perception that the distribution of costs and benefits from hydropower projects is unequal, with riparian communities living in the vicinity and downstream of these projects bearing the brunt of the costs while developers, governments and power consumers reap most of the benefits. Currently, methodological approaches to assessing the distributional impacts of dams are not well defined, nevertheless this section of the paper attempts to map out the distributional context of the LMB from a number of different perspectives.

To do this the paper will look at distributions at two levels one relating to differential impacts on groups by income level (here poor and noon-poor), the second looking at differential impacts by bio-physical zone (as defined in the hydrology and ecosystems papers).

In order to assess these impacts in the following stages of the SEA this section sets out the basic distributional indicators for the LMB and LMB countries in general, looking at population, poverty and livelihood indicators and their distribution throughout the basin.

4.1 DEMPOGRAPHICS

4.1.1 PAST TRENDS AND CURRENT CONDITIONS

NATIONAL TRENDS IN LMB COUNTRIES

All LMB countries are seeing rapid demographic changes as a consequence of their economic and social development. Population growth rates are declining, and population movement – including rural-urban migration and international migration is increasing. Table 20 below gives a breakdown of population growth and urban population growth in all 4 LMB countries. While birth rates are in decline, particularly in Cambodia and Lao PDR which have seen rapid declines in their birth rates since the early 1990s, population continues to grow in all 4 countries.

Caution should be exercised with these figures as in rural areas not all births and deaths are registered especially among ethnic minority populations and populations without citizenship. Rural-urban migrants are notoriously difficult to enumerate often moving back to rural areas during planting season or harvest when their labour is required at home. Many remain unregistered by the authorities and unrecognized in official planning and policy for political reasons. Therefore, urban population statistics are likely to underestimate urban populations by a considerable degree, especially in Thailand and Vietnam which have a longer history of urban growth.

Table 20: Changes in population in LMB 1998-2008

Country	Total population (millions)		Population growth (%)	Urban population (%)		Urban population growth (%)
	1998	2008	1998-2008	1998	2008	1998-2008
Cambodia	12.2	14.7*	1.81	15.82	21.56	4.91
Lao PDR	5.2	6.2	1.81	20.16	30.88	6.08
Thailand	61.4	67.4	0.93	30.78	33.32	1.72
Viet Nam	76.5	86.2	1.19	23.46	27.84	2.90

*2007

Source: WDI, World Bank 2009

Of the 175 million people in the four LMB countries about 8% live in Cambodia, 4% in Lao PDR, 39% in Thailand and 49% in Vietnam, compared to 1998 the relative distribution of population between countries has changed little, (Vietnam has increased its share by 1% and Thailand has decreased its share by 1%). Population dynamics also reflect relative levels of development, Cambodia and Lao PDR have seen relatively high population growth rates of 1.78% and 1.77% respectively between 2000 and 2008, where as that of Vietnam was considerably lower at 1.18% (perhaps as a consequence of the' two-child' policy) and that of Thailand was lower still at 0.96%.

In terms of urbanization, while Cambodia has the lowest proportion of its population living in urban areas, urban population growth rates have been extremely high averaging 4.84% between 2000 and 2008, Lao PDR's urban population growth has been even higher over the same period averaging 6.01%. It is clear that both these countries are going through extremely rapid structural changes. Vietnam's average urban growth rate over the period has been lower at 2.89%, given the size of its population the magnitude of this population movement is much greater, with some estimates suggesting that approximately 1 million people move from rural to urban areas each year (World Bank 2006). Thailand's relative economic maturity is reflected in its higher urbanization rate and lower urban population growth rate relative to the other LMB countries. While Thailand's urbanization rate is low compared to industrialized countries,

Thailand's cities are still growing at a rate that exceeds national population growth suggesting continuing rural-urban migration.

Table 21: Population in largest cities and cities above 1 million 1995 and 2007 (millions and as a percentage of total population unless otherwise stated)

Country	1995				2007			
	Main city	%	>1 million	%	Main city	%	>1 million	%
Cambodia	0.84	51.7	0.84	51.7	1.47	48.5	1.47	10.2
Lao PDR	N/A				N/A			
Thailand	6.12	33.5	6.12	10.2	6.7	30.3	6.7	10.0
Vietnam	4.3	26.5	9.31	12.8	5.18	22.2	11.36	13.3

Source: WDI, World Bank 2009

Rural-urban migration is a well known phenomenon which takes place as part of the structural change accompanying industrialization. As is happening in LMB countries, rapid economic development in the industrial and service sectors located in and around large population centres has expanded employment in these areas and incentivised migration to urban areas. Aside from the employment pull factor, high levels of rural poverty[14] and rural underemployment are a significant push factor in migration decisions.

In addition, improved transportation infrastructure and a decline in transportation costs relative to incomes has meant both rural-urban and international migration are within reach of a greater proportion of the population. Rural-urban migration is often characterised by unskilled labour (utilizing the surplus rural labour force) moving from rural to urban areas, international migration in the wider region is moving towards semi-skilled and skilled labour as productivity, rather than cheap labour becomes more of an issue to employers (ADB 2009)(however as Revenga (2007) suggests the majority of these migrants remain unskilled). Thailand in particular has seen increasing levels of low skilled international migration estimates suggest that there are around 2 million migrants from surrounding countries in Thailand. 80% of these are from Myanmar, most of the remainder coming from Cambodia and Lao PDR. Migrants are drawn by increasing income differentials between Thailand and the surrounding countries, Thailand's aging population also means that labour supply in some sectors is more difficult to source domestically (Revenga 2007). Table 22 give the number of registered migrants, as much migration is temporary and unofficial actual figures are likely to be much higher especially for Thailand.

Table 22: International migrants in LMB countries 1995 and 2005 (percent of population)

Country	1995	2005
Cambodia	1.02	2.18

[14] Reasons for this are complex and discussed at greater length in latter sections of this report and in the social issues paper.

Lao PDR	0.49	0.35
Thailand	0.96	1.49
Vietnam	0.05	0.07

Source: WDI, World Bank 2009

DEMOGRAPHIC TRENDS IN MAINSTREAM RIPARIAN AND LMB POPULATIONS

Riparian populations, defined as those living in provinces along the course of the Mekong mainstream (excluding the Tonle river), are concentrated in the Vietnamese provinces of the Mekong delta, accounting for 53% of the total riparian population. The rest to the riparian population is fairly evenly divided between the other three countries. The importance of riparian areas to the country as a whole is indicated by the proportion of the national population living in the riparian area, riparian provinces accounting for over 4/5ths of the total population in Lao PDR, about 1/3rd of the population in Cambodia, 1/5th in Vietnam and less than 1/10th in Thailand. The riparian areas in Lao PDR also stand out as regions which have been seeing greater population growth than the national average over the last 10 years. In contrast, other countries have been seeing lower growth rates meaning that while populations in absolute terms are growing, these areas account for increasingly small proportions of the national populations. This difference is explained by rapid urbanization in the LMB countries, whereas the urban population centers which have been attracting increasing numbers of rural-urban migrants in Lao PDR are situated along the mainstream, in the other countries these population centres (Phnom Pheng, Bangkok and Ho Chi Minh city) are away from the mainstream.

Table 23: Population change in mainstream riparian provinces

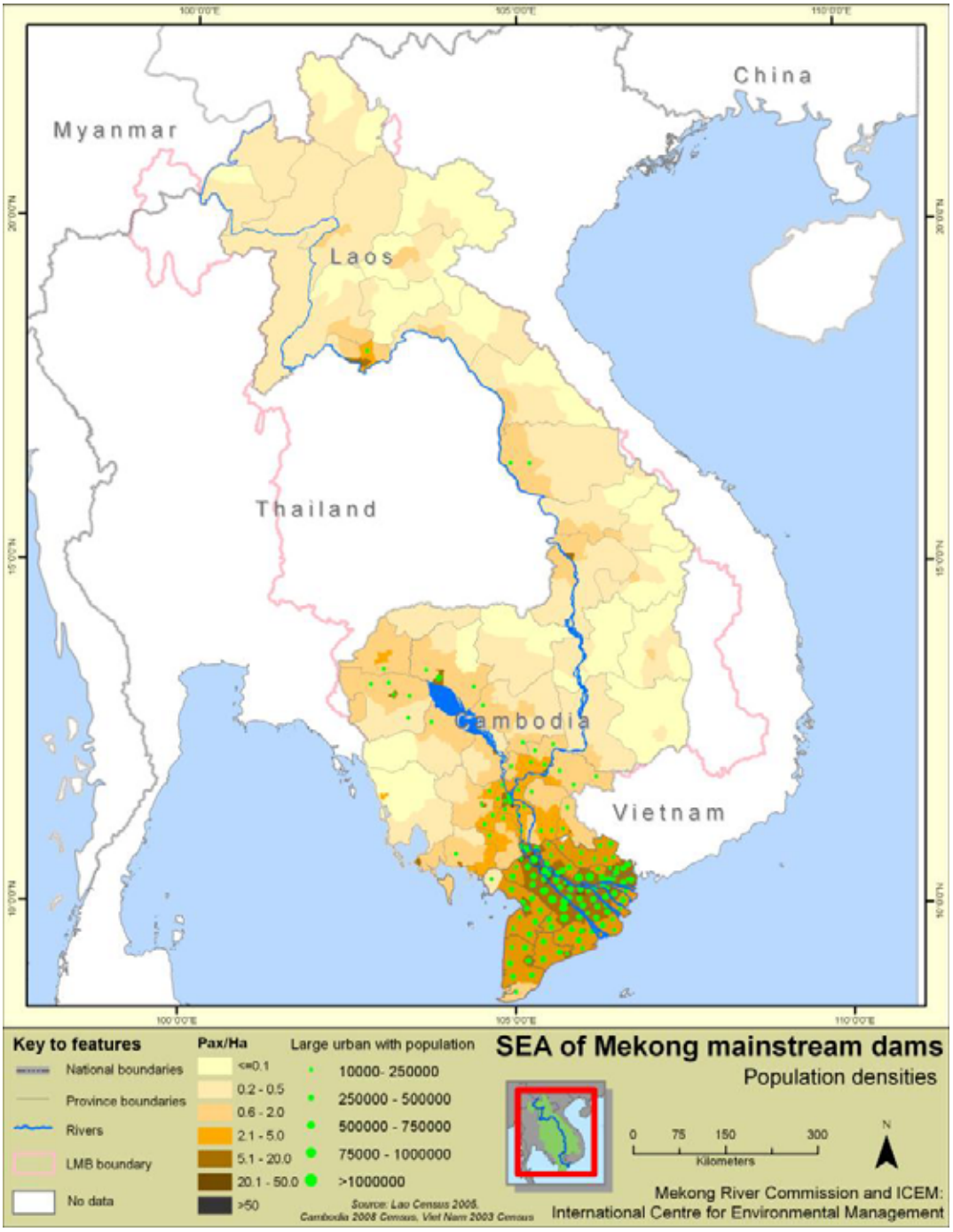
	Population		Population 2009 est		Proportion 2009 est		Growth	
Country	Riparian	National	Riparian	National	Of riparian	Of national	Riparian	National
Cambodia	4,323	13,389	4,358	13,605	14	32	0.8	1.6
Lao PDR	4,564	5,622	4,983	6,115	15	82	2.2	2.1
Thailand	5,666	66,148	5,701	66,679	18	9	0.6	0.8
Vietnam	17,179	85,790	17,179	85,790	53	20	0.6	1.2
Total	31,732	170,948	32,221	172,188	100	19		

Source: ICEM own calculations based on national statistics. Note: Cambodian and Thai statistics based on censuses conducted in 1998 and 2008, Lao PDR censuses conducted in 1995 and 2005 and Vietnam on censuses conducted in 1999 and 2009. Estimates are based on growth rates derived from this data.

The population of the basin and riparian region is and has been historically predominantly agrarian, as such population distributions in the region are closely related to bio-physical conditions and environmental carrying capacity (figure 17). While the relationship between population distribution and the environment is weakening with urban and industrial development, urban development actually serves to reinforce existing patterns of settlement as urban areas which have developed in alluvial lowland plains which provide fertile soils and ample water resources for agricultural production reach a 'critical mass' and becomes important attractors of would-be rural-urban migrants. So whereas forested upland areas in Lao PDR and north east Cambodia have the lowest population density, for example as low as 2 persons/sq.Km in Mondal Kiri. Urban areas have very high and increasing population densities

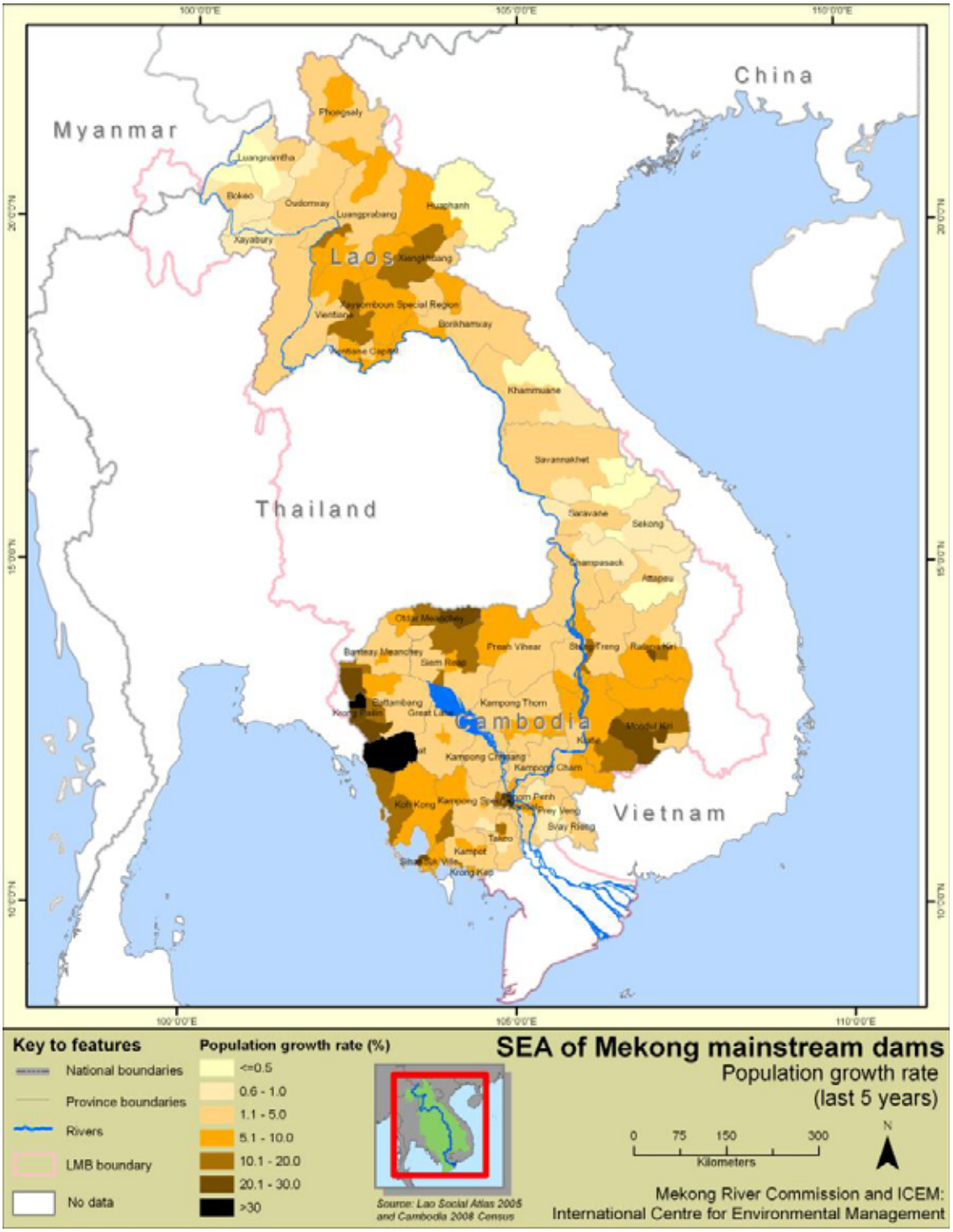
from 3,500 persons/sq.km in Phnom Penh in 1998 reaching an estimated 4,969 persons/sq.km in 2004 (MRC 2003, Save Cambodia's Wildlife 2006). With the exception of urban areas, lowland areas towards the mouths of the Mekong river show increasing population densities with relatively high population densities in the central Mekong delta provinces. Generally the larger countries of Vietnam and Thailand show higher populations densities than Cambodia and Lao PDR.

Figure 16: Population distribution within the LMB



Shifts in the population distribution in the basin are due to differential natural population growth rates (birth rate minus death rate)and net migration (in migration minus out migration), which together determine population growth rates. As already discussed at the national and provincial level population growth rates differ. At the national level this is mainly due to higher natural growth rates in Lao PDR and Cambodia. However, this pattern is also likely to be

Figure 18: Population growth in the LMB



repeated within national borders across the basin, as relatively wealthy urban populations see lower birth rates and therefore lower natural growth rates than rural areas. Despite the higher natural growth rates, urban areas are showing higher overall population growth rates due to net migration from rural to urban areas. Therefore urban centres across the basin are seeing increasing population densities.

Focusing more closely on the mainstream population, available estimates echo the overall basin wide picture of higher population concentrations and therefore river dependant populations in the lower reaches of the basin. The most ecologically productive areas coincide with higher river dependant populations. Zones 3, 5 and 6 consisting of large wetland areas and alluvial plains subject to annual flooding, offer much more fertile agricultural land and productive riparian ecosystems which support larger populations. These areas contrast to the relatively narrow, fast flowing stretches of the river with little available agricultural, limited flooding and smaller wetland areas.

Table 24: Riparian populations by ecological zone 2005

No.	Ecological zone	<15Km from river	River dependant	Proportion of river dependant population (%)
1	China to Chiang Saen			
2	Chiang Saen to Vientiane	523,232	313,939	2.63
3	Vientiane to Pakse	2,238,637	1,343,182	11.24
4	Pakse to Kratie	387,328	232,397	1.94
5	Kratie to Phnom Penh and Tonle Sap	5,969,920	3,581,952	29.96
6	Phnom Penh to the sea	10,803,947	6,482,368	54.23
Total		19,923,064	11,953,838	100

Source: ICEM based on IBFM studies

4.1.2 FUTURE TRENDS

NATIONAL TRENDS IN LMB COUNTRIES

According to the UN's World Population prospects database population growth in all LMB countries is expected to decline between 2005 and 2030. However, population growth rates will remain high in Cambodia and Lao PDR. Overall the population of the LMB is expected to increase by about 40 million over the period.

Table 25: Population growth in LMB countries 2005-2030 (1,000's population)

	2005	2010	2020	2030	Natural pop. GR 2005-2030
Cambodia	13,866	15,053	1,707	20,100	1.49
Lao PDR	5,880	6,436	7,651	8,854	1.64
Thailand	65,946	68,139	71,443	73,462	0.43
Vietnam	84,074	89,029	98,011	105,447	0.91
Total LMB	169,766	178,657	178,812	207,863	0.81

Source: UN World Population Prospects Database 2008

Urbanization trends are also forecast to continue, with very high urban population but gradually declining urban population growth rates in all four countries. In all countries urban population growth exceeding that natural population growth suggests a continuing rapid rural-urban migration and urbanization. Over the 25 year period urban populations in the region are expected to grow by about 48% or over 42 million. Much of this growth is likely to be concentrated in large metropolitan centres such as Bangkok, Phnom Penh, Ho Chi Minh city, Hanoi and Chiang Mai. Furthermore, migration across national borders within the region is likely to become increasingly common as transportation infrastructure improves, travel becomes more affordable and restrictions on labour markets within the region decline.

Table 26: Urbanization projections for the LMB 2005-2030

Country	2005	2010	2020	2030	AAGR 2005-2030 (%)	Urbanisation rate (%)	
Cambodia	2,753	3,470	5,355	7,678	4.10	20	38
Lao PDR	1,551	2,048	3,192	4,322	4.10	26	49
Thailand	20,352	22,118	26,456	31,682	1.77	31	43
Viet Nam	22,454	26,191	35,230	46,123	2.88	27	44
Total LMB	47,110	53,827	70,233	89,805	2.58	28	43

Source: UN World Urbanization Prospects Database 2007

Table 27 looks at the implications of expected rapid urbanization on the rural populations in the LMB. Across all countries rural population growth rates are expected to decline from historical values, and rural populations are expected to decline from 123 million to 118 million. However, this overall decline is influenced by trends in the two large countries of Thailand and Vietnam where rural populations are expected to fall, in Cambodia and Lao PDR rural populations are expected to continue growing although at a relatively slow pace.

Table 27: Change in rural populations 2005-2030 (1,000)

Country	2005	2010	2020	2030	AARG %
Cambodia	11,113	11,583	12,352	12,422	0.45
Lao PDR	4,329	4,388	4,459	4,532	0.18
Thailand	45,594	46,021	44,987	41,780	-0.35
Viet Nam	61,620	62,838	62,781	59,324	-0.15
Total LMB	122,656	124,830	124,579	118,058	-0.15

Source: ICEM based upon UN World Population Prospects Database 2008

TRENDS IN THE LMB

The implications of these broader population changes for the LMB are difficult to judge without more detailed information on population growth rates and migration rates for smaller areas within the basin. While rural areas in the basin are likely to see low population growth, urban areas within the basin are likely to see very high growth. Thus determining likely growth rates

for the mainstream riparian provinces is not possible. As calculations of the river dependant population exclude urban populations their growth rates are assumed to be the same as national rural growth rates, allowing the projection of riparian population levels to 2030 (table 28). Over the period these estimates suggest that the riparian population will be at a relatively stable level of about 12 million, with only the stretch from Phnom Penh to the sea seeing falling riparian populations.

Table 28: Riparian populations by ecological zone 2005-2030

No.	Ecological zone	River dependant population 2005	Growth rate (%)**	River dependant population 2030
1	China to Chiang Saen			
2	Chiang Saen to Vientiane	313,939	0.18	314,505
3	Vientiane to Pakse	1,343,182	0.18	1,345,602
4	Pakse to Kratie	232,397	0.18*	232,816
5	Kratie to Phnom Penh and Tonle Sap	3,581,952	0.45	3,598,107
6	Phnom Penh to the sea	6,482,368	-0.15	6,472,652
Total		11,953,838	0.003	11,963,681

Source: ICEM based on IBFM studies Note: * assumed to be the same as for Lao PDR as similar riparian environment and population densities.** assumed to be the same as the rural growth rate.

4.2 POVERTY

The social theme paper goes into considerable detail characterizing the causes of poverty in the LMB and poverty reduction in the region over the last decades. This section looks at the spatial distribution of poverty throughout the basin and poverty trends in general as a means to establish the distributional implications for the different groups in the impact assessment phase of the SEA.

4.2.1 PAST TRENDS AND CURRENT CONDITIONS

NATIONAL LEVEL POVERTY AND INEQUALITY IN THE LMB

The rapid economic growth in the region has brought with it significant decreases in poverty rates across all four LMB countries (figure 19). Thailand saw its phase of rapid poverty reduction in the 1980s and early 1990s, with its current poverty rate relatively low (at 2%) and stable – suggesting that there are some portions of the population remaining in poverty untouched by economic growth. Vietnam has seen very rapid declines in poverty especially in the latter half of the 2000s, rates have declined from over 60% (the highest in the region), to a little over 20%. Lao PDR has also seen a relatively rapid decline in poverty from about 55% in 1992 to around 45% in 2004. Cambodia has also seen a decline in poverty but at a slower rate than either Vietnam or Lao PDR.

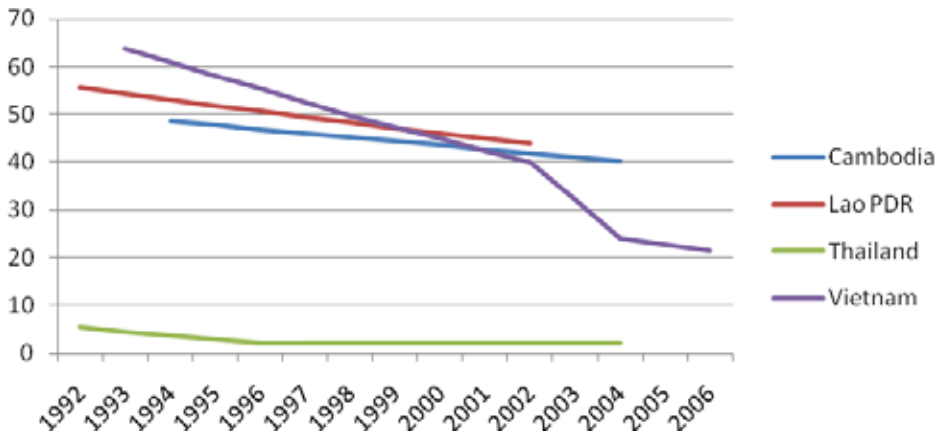
Nationwide figures for inequality measured by the Gini index[15], add to this picture (table xx). These figures suggest that the rapid economic growth in Cambodia and Vietnam, despite the poverty reduction which has taken place, is also leading to a more uneven distribution of income. Only Thailand shows a decline in the Gini coefficient.

Table 29: Inequality in LMB countries 1990s-2000s

	Average 1990s Gini index	Average 2000s Gini index
Cambodia	38.28	41.27
Lao PDR	32.67	32.63
Thailand	44.38	42.205
Vietnam	35.6	38.16

Source: ICEM based on WDI, World Bank 2009

Figure 19: Poverty head count ratio (international poverty line) in LMB countries 1992-2006



Source: WDI, World Bank 2009 Note: missing values for intervening years have been interpolated.

[15] A figure between 0 and 100, where 0 represents complete equality, and 100 complete inequality.

POVERTY IN THE LMB

As reported in the social baseline, Mekong river riparian provinces generally have higher living standards than those at more distance from the Mekong with the exception of provinces in the northern upper reaches of the Mekong where land in proximity to the river is steeper and less productive. In Lao PDR in particular there is an association between poverty and relative altitude of population, with a poverty headcount of 28.2% of the lowland population (57.5% of the population) in contrast with a poverty headcount of 43.9% of the upland population (25% of national population). In contrast, the northeastern provinces of Thailand which boarder on the Mekong river also show higher poverty rates than the rest of the country (see social baseline).

4.2.2 FUTURE TRENDS

There are no poverty projections available for this study. It is safe to assume, however, that although levels of absolute poverty are likely to decline over the next 20 years, relative poverty and geographical locations where poverty tends to persist will remain. Within this overall picture a few probable trends stand out. Firstly, urban poverty is likely to grow with urban populations[16], while poverty rates may be lower than in deprived rural areas the absolute number of urban poor is likely to grow substantially. Secondly, rural populations which rely on the natural resource base to support their livelihoods are likely see incomes and living standards decline as this resource base passes its carrying capacity and starts to become depleted. In the longer term this may be an additional push factor for would be rural-urban migrants and may result in larger population movements- and consequently higher poverty levels in urban areas. However, population estimates above suggest that rural populations in riparian areas are likely to remain stable, which should mean, all other things being equal, that the carrying capacity of the bio-physical systems on which these communities depend should not be exceeded.

4.3 LIVELIHOODS

4.3.1 PAST TRENDS AND CURRENT CONDITIONS

Rural livelihoods in the LMB are dependent on a range of different activities including agriculture (irrigated rice, rain-fed rice and other crops, river bank gardens and swidden agricultural production to name a few), fisheries (including capture fisheries and aquaculture), raising livestock (including cattle, buffalo, pigs, ducks, chickens etc) use of non-timber forest

[16] In fact, as most poverty measures are based on a basket of goods designed around rural consumption patterns key aspects of urban expenditure – such as urban shelter – are not taken account of in poverty lines and therefore urban poverty is often under estimated.

products, trading, artisanal mining, small and household industries to name but a few (see social baseline paper).

As the analysis for the social paper shows there is a high dependence of populations on natural resources and associated income opportunities (such as trading) for livelihoods, as well as the considerable household diversification of employment sources. The paper also emphasizes the predominantly rural nature of the riparian populations emphasized by the high dependence on agriculture as the main livelihood. Although in urban areas in Thailand and Cambodia wage labour in factories is an important source of income. Nevertheless, livelihood resources directly related to the Mekong river were found to be important in most areas. These include fishing, fish farming, floating gardens, riverbank gardens, sand and gravel extraction, gold panning, and gathering of aquatic plants. However, apart from sand and gravel extraction and to a small extent fisheries, all these livelihood sources form a component of household livelihoods rather than the main source.

In establishing a baseline which can allow the identification of hydropower development impacts, therefore the indicators of agricultural employment and fisheries employment stand out as useful indicators in determining the likely impacts of dam development. The figures included below analyze this in greater detail.

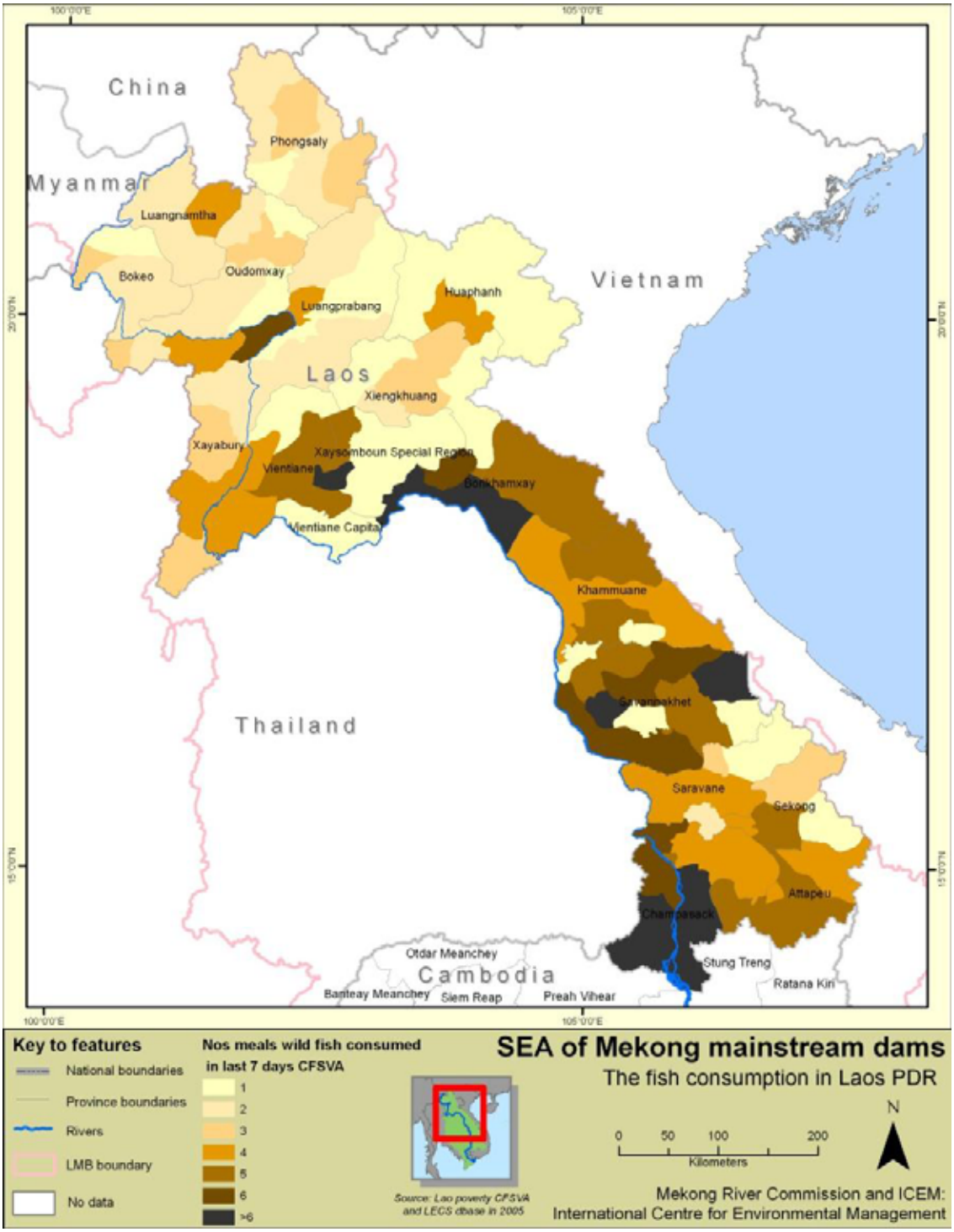
Table 30 gives available figures on employment in agriculture and fisheries and is illustrative of their importance in the riparian districts of Lao and Cambodia. These figures probably underestimate the importance of fisheries in particular as this is rarely a primary source of employment. It, however, often constitutes an important subsidiary source of employment. A better indication of this can be found in the importance of fish consumption in Lao PDR shown in map 1 below.

Table 30: Population density, and employment in agriculture and fisheries for riparian districts

Mainstream districts in	Population density (pax/ha)	Population employed in agriculture		Population employed in fisheries	
		No.	%	No.	%
Cambodia	1.14	1,486,789	29	58,937	1
Lao PDR	0.37	917,395	39	787	0
Thailand	N/A	N/A	N/A	N/A	N/A
Vietnam	12	N/A	N/A	N/A	N/A

Source: Consultants own calculations based up Lao PDR census 2005, Cambodia census 2008 and Inter-ministerial poverty mapping taskforce for Vietnam 2003.

Figure 20: Weekly household fish consumption by district Lao PDR



4.3.2 FUTURE TRENDS

As with poverty trends, projection of livelihoods trends into the future is difficult. Nevertheless, a few important trends are likely to emerge over the course of the next 20 years. Firstly, the number of people involved in the cash economy will increase both as rural-urban migration increases the amount of wage labour and as marketing agricultural goods becomes more common with improved access to markets through improved infrastructure, and expanding opportunities for wage employment in rural areas. Secondly, commercial agriculture is likely to increase, especially in Thailand and Vietnam, which will see declining rural populations and gradually increasing farm incomes. Thirdly, conversely, unless the urbanization trend in Lao PDR and Cambodia increases rural livelihoods dependant on under-pressure natural resources may also come under pressure.

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