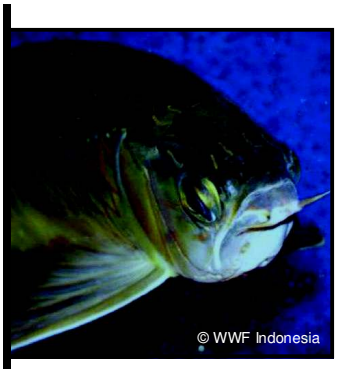
Witteveen + Bos Indonesia

WWF Heart of Borneo Initiative

Quick scan watershed services

Heart of Borneo



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EXECUTIVE SUMMARY

In 2007 the three governments of Indonesia, Malaysia and Brunei Darussalam committed themselves to the Heart of Borneo Initiative: a conservation and sustainable development program aimed at conserving and sustainably managing the contiguous tropical forest in the island of Borneo.

To outline this process, a 'Roadmap' for a Green Economy in the Heart of Borneo is currently being developed. It aims to highlight benefits of investing in Heart of Borneo's ecosystems and natural capital, linked to spatially explicit and measurable targets, forest solutions and key success factors which governments, key decision makers and the private sector can implement together. The work includes providing the value proposition as to why the Heart of Borneo's natural capital is economically valuable.

In general, the ecological conservation case is not strong enough against short term economic profits made by land use changes. This means, the central question to transition to a green economy is "what economic case is powerful enough to withstand the temptation of cutting the forest?" In other words "who is willing and also able to pay for forest conservation and who should drive this?"

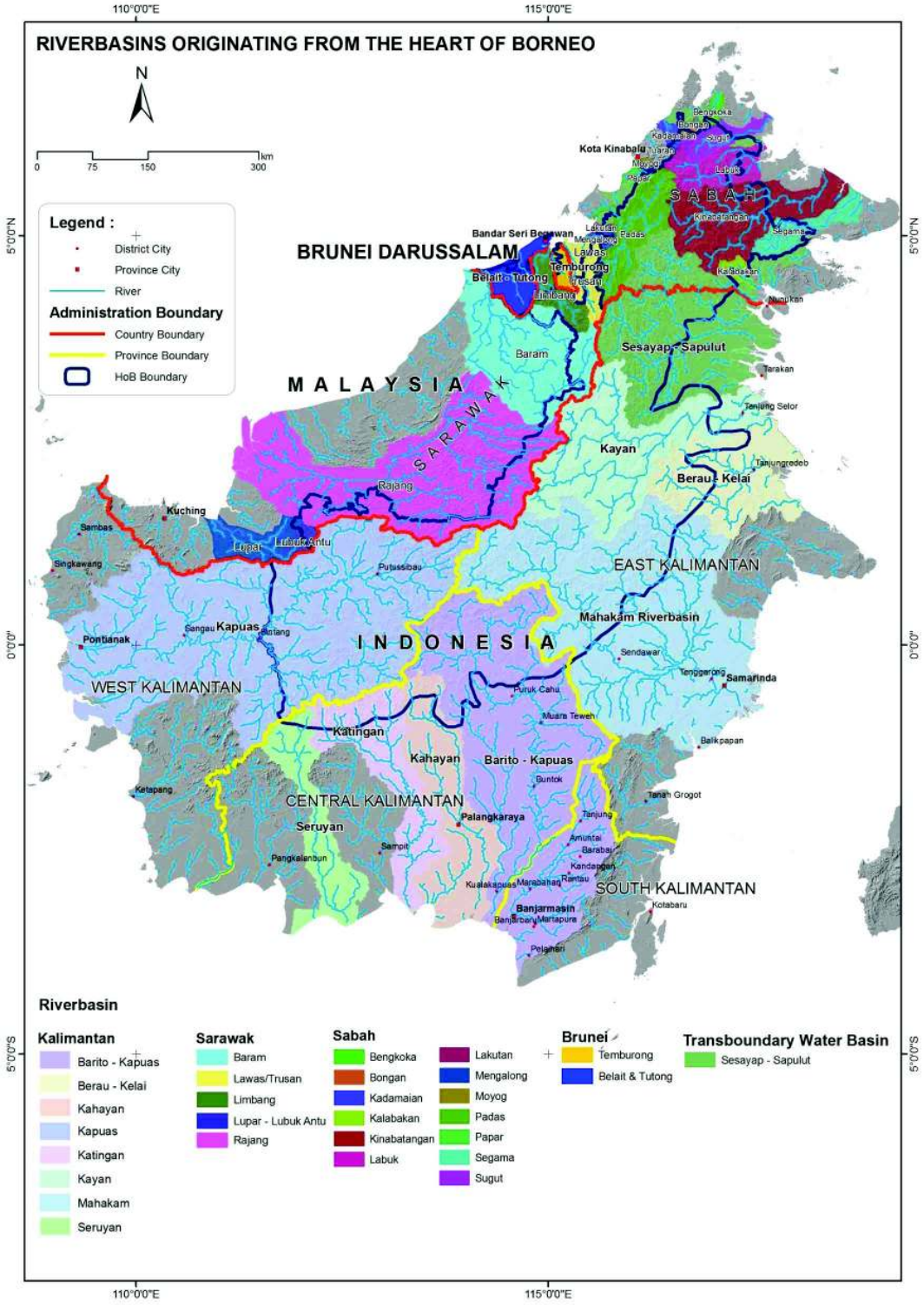
The key to answering this question lies within the concept of payment for ecosystem services (PES). Payment for ecosystem services (PES) can be part of the solutions to making forests worth more standing than cut down. Alongside payments for services, the transformation of government subsidies and incentive structures to favour conservation and best practices is crucial to bridge the inevitable financial gap.

With 14 of the 20 major rivers in the island of Borneo originating in the tropical rainforests of the Heart of Borneo, watershed services are an important component of ecosystem services. What we focus on in this study is the possibilities for payment for watershed services. We provide an overview of the various watershed services from the Heart of Borneo as well as a quick scan on their users and beneficiaries.

In total there are 29 river basins which originate in the Heart of Borneo. The total area of these river basins is approximately 54 million hectares, while the Heart of Borneo itself is 22 million hectares. Loss of forest in upstream ecosystems of the Heart of Borneo will cause problems in towns and cities as well as industrial activities downstream. This shows that the area influenced by the HoB forest and river systems is much larger than the Heart of Borneo itself.

River basins which presumably have good opportunity to build the economic case for payments for watershed services should still have existing pristine forest upstream in the Heart of Borneo and important economic activities downstream. Presence of political will and a favorable institutional setting is furthermore preferred.

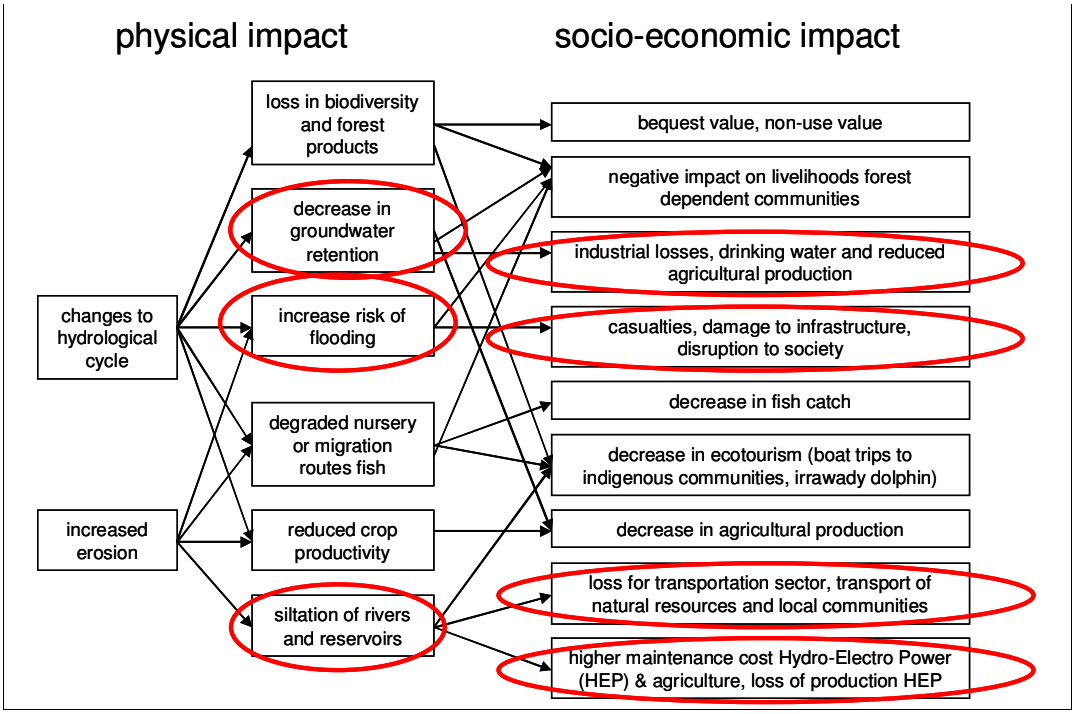
Picture 0.1 Selected river basins with good potential for payment for watershed services



Picture 0.2 shows an overview of physical and socio-economic impacts due to loss of forest on the island of Borneo and highlights the largest financial impacts. We focus on the "big consumers", the ones that can significantly contribute to a payment or funding mechanism. The "big" consumers of watershed services include:

1. large water intensive industries like LNG or methanol plants that require a large amount of water for processing;
2. mining, logging and palm oil companies that use the river for transportation;
3. downstream cities with their economic activity which could be damaged by flooding;
4. water companies which use surface and/or groundwater to provide water supply to consumers / population;
5. the fishing industry which depends on clean and reliable water supply as well as good breeding grounds/habitats.

Picture 0.2. Largest financial impacts related to watershed services due to loss of forests on the island of Borneo



Based on existing reports, interviews with WWF- field-based staff and expert judgment from the authors on the physical and economic impact, seven river basins have been selected as potential pilots to test the business case for implementation of payments of watershed services (see picture 0.1):

Brunei, Belait & Tutong river basin

The Belait & Tutong river basin is the sole supplier of water for industrial, agricultural, domestic and inland transport uses throughout the district. With Kuala Belait being the main production base of oil and gas, hosting LNG-operations and the Brunei Methanol Plant, its reliability is as much a security and social issue as one of economics. A failure in supply would shut down a very significant percentage of Brunei's industry, impacting the national GDP significantly.

Malaysia (Sarawak), Rajang river basin
With the presence of various Hydro Electric Powerplant (HEP), the Rajang river basin is potentially the most suitable river basin in Sarawak to provide for a robust business case to encourage payment for watershed services. Sediment retention of forests is a valuable watershed service for HEP with sediment loads causing large maintenance cost to the HEP facilities.

Malaysia (Sabah), Labuk river basin
Labuk river basin is especially interesting as a pilot site because of the demonstrated link between logging and large scale palm oil and sediment and nutrient discharges in Labuk Bay. The impact on aquaculture in Labuk Bay and the tourism industry on Turtle Island Marine Park could provide a basis for payment for watershed services. In addition, the relatively large population, the plans for HEP and the scarcity of water are other reasons why payments for watershed services of the Labuk river basin might be economically attractive.

Malaysia (Sabah), Kinabatangan river basin
Kinabatangan river basin provides an interesting economic case due to its large scale palm oil plantations. Palm oil plantations pose a threat to forest and at the same time experience the impact from deforestation by means of flood damage. Other beneficiaries in this watershed include the tourism industry, aquaculture and Kinabatangan's population in terms of prevention from flooding, assured transportation and improved livelihoods.

Indonesia (Kalimantan), Barito-Kapuas river basin
Main watershed services in the Barito-Kapuas river basin are expected from the protection against flooding and transportation of coal and other natural resources along the river. Although sedimentation of the river is already occurring, it is likely to become worse when also the area within the HoB is logged and converted, due to its high vulnerability to erosion. When dredging rivers is a feasible alternative to investments in railways, the provision of watershed services from conserving the remaining forest in the HoB could be substantial.

Indonesia (Kalimantan), Mahakam river basin
Main watershed services from Mahakam are expected to be protection against flooding and sediment retention (transportation of coal and other natural resources along the river). Mining and palm oil pose big threats to the remaining forests in this watershed so there is a sense of urgency. The tourism industry is also a potential beneficiary of watershed services through the conservation of habitat for various flagship species e.g. irrawady dolphin.

Indonesia (Kalimantan), Kapuas river basin
With 21% of the HoB in this river basin and a relatively high population, the Kapuas river basin could provide an interesting economic case for payments for watershed services. Although there are no big industries in this river basin, there are many smaller beneficiaries. WWF is active in this river basin together with other NGO's. Political will is present to conserve the ecosystems and even small scale PES-systems are in development. Payment mechanisms for watershed services will likely not be sufficient on their own. Other sources of financing should also be considered to pay for the conservation of HoB forests and the careful management of its natural capital. Nevertheless this river basin could be an interesting pilot to study since watershed services benefit many small beneficiaries.

Based on this rapid assessment, these river basins described above, provide sufficient economic arguments to start building a case for payments for watershed services at the scale of the entire river basin. The next step is to carry out a socio-cost benefit assessment in close consultation with stakeholders for one or a few of these river basins. Such an economic assessment should provide insight to the range of costs/investments and benefits/revenues associated with maintaining or foregoing watershed services. This information and knowledge then builds a strong foundation to develop a river basin wide payment for watershed services mechanism, as well as to attract donors to finance a HoB- or river-basin specific "Water Fund". Political will, development of related policies and legislation as well as broad stakeholders support will be needed to test such a payment mechanism.

Payments for watershed services, alongside other payment mechanisms such as forest carbon (REDD+) and government-driven financial incentives, provide part of the solutions to bridge the financial gap to make forests worth more standing than cut down and transit to a green economy.

INDEX **P.**

1. INTRODUCTION

1.1. Context

The island of Borneo contains some of the most biologically diverse habitats on earth with many endemic species. While a large part of the lowland areas has been converted to other land use types, most of the Heart of Borneo is still pristine. However, growing population, demand for land conversions for agriculture (oil palms) and the potential impacts of climate change pose a big threat to primary forests. Deforestation causes loss of a variety of ecosystem services including carbon sequestration, watershed protection, biodiversity and nature based tourism. The Heart of Borneo is also a home for several ethnic groups of indigenous people that depend on the forest for food, medicinal plants, wild game, fish and water.

In 2007 the three governments of Indonesia, Malaysia and Brunei Darussalam committed themselves to the Heart of Borneo Initiative. This initiative is a conservation and sustainable development program aimed at conserving and managing the contiguous tropical forest in the island of Borneo.

To outline this process, a 'Roadmap' for a Green Economy in the Heart of Borneo is currently being developed. It aims to highlight benefits of investing in Heart of Borneo's ecosystems and natural capital, linked to spatially explicit and measurable targets, forest solutions and key success factors which governments, key decision makers and the private sector can implement together. The work includes providing the value proposition as to why the Heart of Borneo's natural capital is economically valuable. Understanding the economics of ecosystem services and climate change will help find appropriate solutions while recognizing that maintaining natural capital is fundamental to increasing economic well-being.

With 14 of the 20 major rivers in the island of Borneo originating in the tropical rainforests of the Heart of Borneo, protection and careful management of Heart of Borneo's natural forests is key to a green economy in Brunei, Kalimantan, Sabah and Sarawak. A first step in this ecosystem valuation process is to better understand the users and beneficiaries of the watershed services which the Heart of Borneo provides to the island. This will provide insight on which watershed services need to be protected and who benefits from them.

In this report we give an overview of the various watershed services from the Heart of Borneo as well as provide a quick scan on their users and beneficiaries. River basins with most downstream economic activity are elaborated in more detail as these are likely to provide most watershed services to society and will present a stronger business case for establishing payment for watershed services (PWS) schemes.

1.2. Who will pay to conserve the forest?

In nature conservation focus has always been on the protection of vulnerable ecosystems against human economic development. Protection of biodiversity has usually been the ecological rationale for conservation. In this approach human society and nature are separated from each other, as if no important relationships exist between them. On the other hand economists thought for long that ecosystems have no economic value and that nature can be endlessly exploited.

Text Box: Living Rivers

The ”Living rivers” campaign WWF launched back in 1992 in the Netherland is a good example of how long it takes to achieve transformational changes in mindset and be fully supported by the public. .

´Living Rivers´ aimed at gaining 200,000 hectares of new green areas in the Netherlands in ten years to show the economic importance of nature to human wellbeing and biodiversity. The choice fell on restoring nature along rivers. "Along Dutch rivers, it will be possible to restore the natural river biotope in secondary channels stretching almost 400 kilometres long", concluded Living Rivers. Living Rivers clearly showed that nature was not only vulnerable, but also had to be protected from further degradation. The dynamic floodplains along the rivers proved to be extremely resilient. Living Rivers focused on the restoration of secondary channels in the floodplains. Shallow and caving riverbanks and dead wood in and along running water had disappeared from sight everywhere. The same held for living organisms that filter water in secondary channels by foraging for food in river water and keeping it clear and rich in water plants. The new secondary channels provide a new habitat for those organisms. Giving more room to the river by extracting clay, restructuring agriculture in the river forelands and supplying drinking water are just a few functions that can be combined with the restoration of nature.

A successful nature restoration project in the Ooijpolder along the river Rhine in the Netherlands shows the economic importance of nature to human wellbeing and biodiversity

Even though it took twenty years to come to this change of mindset, this WWF initiative had a significant impact on how the Dutch implement water management practices today. Several secondary channels and river restoration projects have been successfully completed. Beavers have successfully returned to the Dutch rivers and otters will hopefully follow soon.

At this moment (2010) the Dutch Ministry of Public Works is still working on the implementation of many nature restoration projects along the rivers Rhine and Meuse within the frame of the European Water Framework Directive and the national programme ´Room for the River´, which aims at making the Netherlands a climate proof delta.

Nowadays it is widely accepted that ecosystems do have economic value to human society and that unlimited ecosystem exploitation can be very harmful to mankind, but it has taken governments many years to come to this realization. An example of such a transformational change in mindset is the way rivers are managed in the Netherlands. It took twenty years for the Dutch government to shift to this new paradigm. Instead of heightening the dykes, schemes to restore secondary channels together with nature restoration were developed and are still under construction. WWF played an important role in making this shift happen (see the text box on Living Rivers). Other examples of economic value forests provide to mankind are the provision of food and income security to local forest dependent communities (when the forests are cut down they can no longer derive their food from these forests) as well as preventing severe river floods in downstream areas and cities.

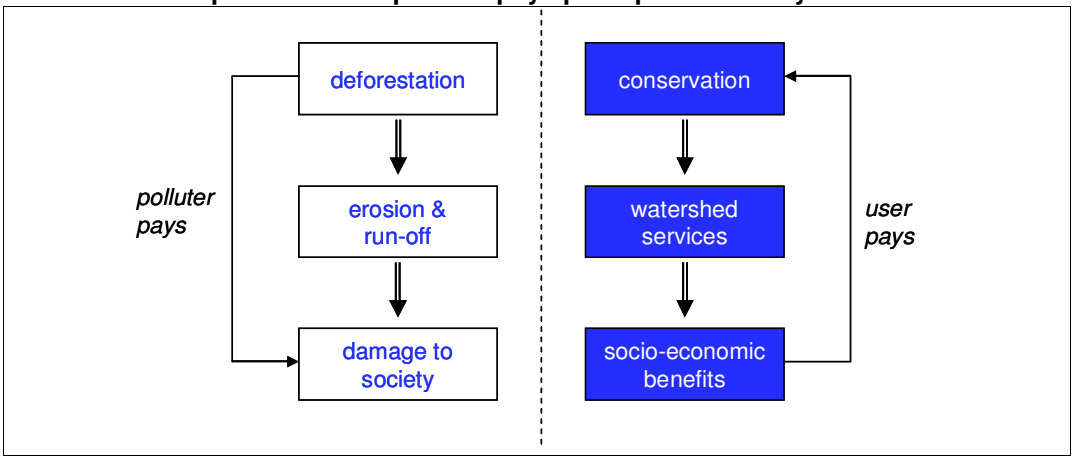
The difficulty with deforestation and other forms of ecosystem degradation is that the costs and benefits are not equally distributed. The logging companies and oil palm plantations make huge profits, whereas local people and those living downstream pay the costs. A common way to deal with the uneven distribution of costs and benefits is to let the polluter pay for his actions. The logging company compensates or mitigates the negative impacts by paying a high price for its concession to the local government. The local government can use the concession fee for compensation measures. While this is an important form of payment, the main disadvantage of this polluter pays principle is that the harm is already done. The forest is gone and the negative impacts can merely be mitigated.

Therefore the most important question now is how forest conservation can be financed. Clearly, the ecological conservation case is not strong enough against short term economic profits made by land use changes. In other words: which kind of economic case is powerful enough to withstand the temptation of cutting the forest? Can we transform our mindsets to make standing forests worth more than palm oil or mining?

Who is willing and also able to pay for forest conservation?

The key to answering this question lies within the concept of payment for ecosystem services (PES). The ecosystem provides services to society. Many of these services do not yet have a price tag. However, ecosystem services are not free! Therefore, part of the solution lies within the society paying for these services.

Picture 1.1. Comparison of the polluter pays principle and ecosystem services



Text Box: Water board

Dutch water boards are regional government bodies in the Netherlands. Water Boards have a rich history dating back to the middle ages, and their charter is unchanged:

- maintenance of dikes and dunes,
- maintenance of the waterways (and roads in several communities),
- controlling the water quantity (level),
- and controlling the quality of all surface waters.

By 1 January 2009 there were 27 Water Boards in the Netherlands. All Water Boards operate independently from national, provincial or local government and levy their own taxes. The water boards are chosen democratically. Each Water Board has a board of governors consisting of the chairman (Dyke reeve or "dijkgraaf"), and several members who traditionally represent 4 types of water users; the inhabitants (homes), the industries (factories or industrial buildings), the communities (urban areas), and the farmers (agricultural land or open parks).

From a river basin management approach, the administrative boundary of the water board ideally coincides with the hydrological boundary (water divide) of the river basin.

heraldic shields of the Delft Water Board members in 1645, the year that the Water Board bought this house for board meetings, on the facade of the water board office in Delft.

source: http://en.wikipedia.org/wiki/Water_board_(Netherlands)

Payment for ecosystem services (PES) is the opposite of the polluter pays principle (figure 1.1). Within one river basin it is possible that both PES and polluter pays are applied. It could even happen that an oil palm plantation contributes to PES to conserve forest upstream, preventing the plantation from flood damage, and at the same time having to pay for discharging its effluent on the river (polluter pays).

Payment for ecosystem services (PES) can be part of the solutions to making forests worth more standing than cut down. Alongside payments for services, the transformation of government subsidies and incentive structures to favour conservation and best practices is crucial to bridge the inevitable economic gap. What we focus on in this study is the possibilities for PES.

1.3. River basin approach

Downstream water users depend on the availability and quality of river water coming from upstream areas. Since water ignores political boundaries many large rivers cross a number of borders and pass through multiple nations with different laws, languages, religions, and cultures. However, because the river flows from upstream to downstream areas, the river basin should be considered and managed as one entity. This is called the river basin approach.

Sustainable management and equitable use of water strain both institutional and legal capabilities. Sometimes, nations which share transboundary rivers agree to create a joint commission to manage waters cooperatively and resolve disputes. The Rhine, Mekong and the Nile are the best known examples of this. In the Netherlands, the user pays principle also applies and is commissioned through waterboards (see text box on water boards).

1.4. Objective of this quick scan

The objective of this quick scan is a rapid assessment on the various watershed services from the Heart of Borneo and identify and locate the users and beneficiaries of these watershed services. Several river basins will be elaborated in more detail where a full watershed services valuation study can be carried out successfully as the first step towards building the economic case to value forests in the economy and more practically for the implementation of a system to help finance forest conservation and management. The full watershed services valuation study (socio-economic cost benefit analysis) will need to be carried out as follow up to this watershed quick scan study.

1.5. Contents of this report

In this report we summarize the general theory of the valuation of nature in chapter 2. In chapter 3 we present an overview of the watershed services which originate from the Heart of Borneo. In chapter 4 we elaborate on the selected river basins which could provide a good economic case for payment for watershed services.

2. THEORY OF ECOSYSTEM VALUATION AND DECISION MAKING

2.1. Why ecosystem valuation?

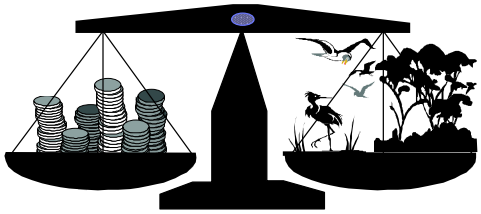
Ecosystems provide many goods and services to society. Some of these goods and services are market goods, such as timber, fish, vegetables, fruits and game. Hence, these products have a commercial price. But ecosystems also provide goods and services such as clean water, clean air, biodiversity, and amenity. These public goods, although they are very important for human society, do not have a price-tag associated to them. Without paying markets, we don't look after these goods and services and tend to over-exploit them.

The tragedy of the commons:

"when the price is low, we tend to use too much"

Environmentally sound decision making

In order to prevent mismanagement of natural resources such as rain forests, we should put a price-tag on the public goods and services they provide. In this way we can compare the value of the public goods to the value of the marketable goods and services. This is important for making environmentally sound and sustainable decisions.



How do we recognize a sustainable decision?

To answer this question we go back to the definition of sustainability by the World Commission on Environment and Development (Brundtlandt, 1987).

Brundtlandt, 1987:

"a development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs."

For an economist, sustainable development is about maintaining the welfare-generating capacity of a nation's capital stock. A minimum requirement for sustainable development is that the welfare per capita of future generations may not decrease (Pearce *et al.*,1990). This means that welfare growth is necessary in the case of a growing population.

Capital stock theory

A nation's capital stock can be divided into four categories (Serageldin, 1994; figure 2.4):

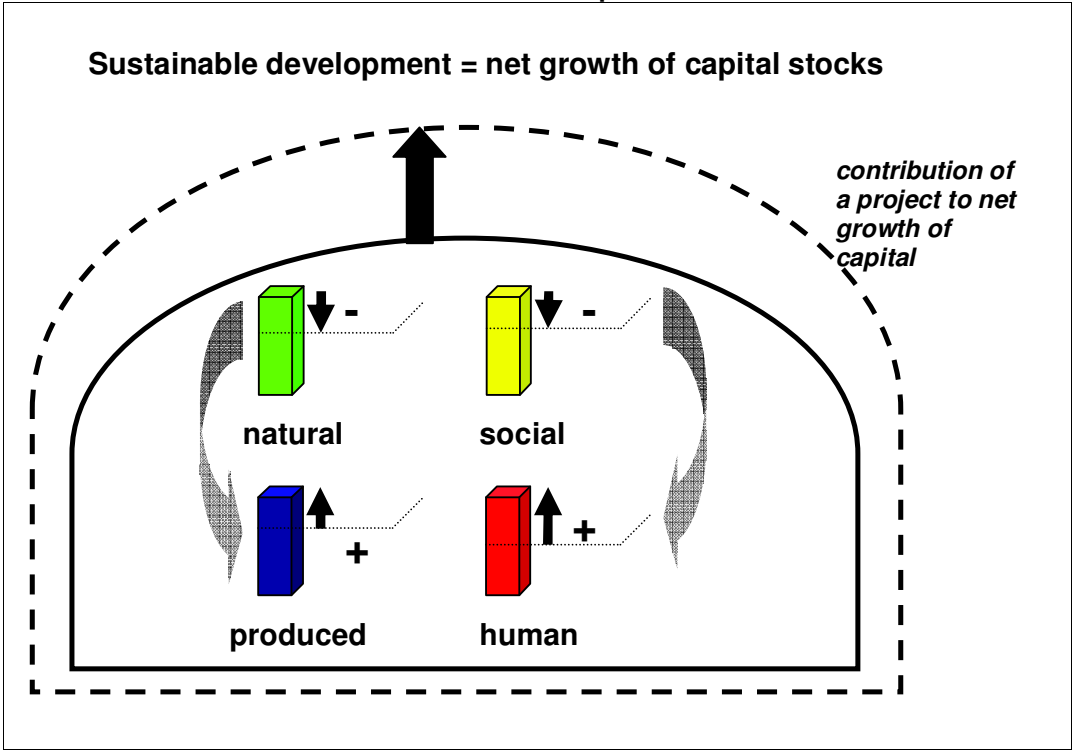
(1) natural capital: all natural resources humans use, e.g. oil and forests;
(2) produced capital: man-made things, e.g. machinery;
(3) human capital: e.g. skilled labour, and,
(4) social capital: society's institutional arrangements: laws and organizations.

The concept of sustainability[1] implies that the welfare-generating capacity of all four capital stocks together may not decrease, but it leaves room for substitution. The reduction of one capital stock may be compensated by growth of another capital stock, as long as the total welfare-generating capacity is not reduced. Also substitution between natural capital and produced capital is allowed.

Economists measure the value of the four capital stocks in monetary terms (dollars, euro's, rupiah, etc.). The goods and services provided by the ecosystem can be regarded as a constant flow of dividend from the natural capital stock to society (TEEB, 2010).

How to prevent unsustainable use in practice?
Projects should be judged by the contribution they have on a country's capital stock. Only projects which help to increase a country's total capital stock, contribute to sustainable development. The method used for assessing whether or not a project contributes to growth of a nation's capital stock is the so-called socio-economic cost benefit analysis (SCBA). Socio-economic cost-benefit analysis is a method to assess all positive and negative impacts of an investment (project) to society as a whole.

Picture 2.1. How to measure sustainable development



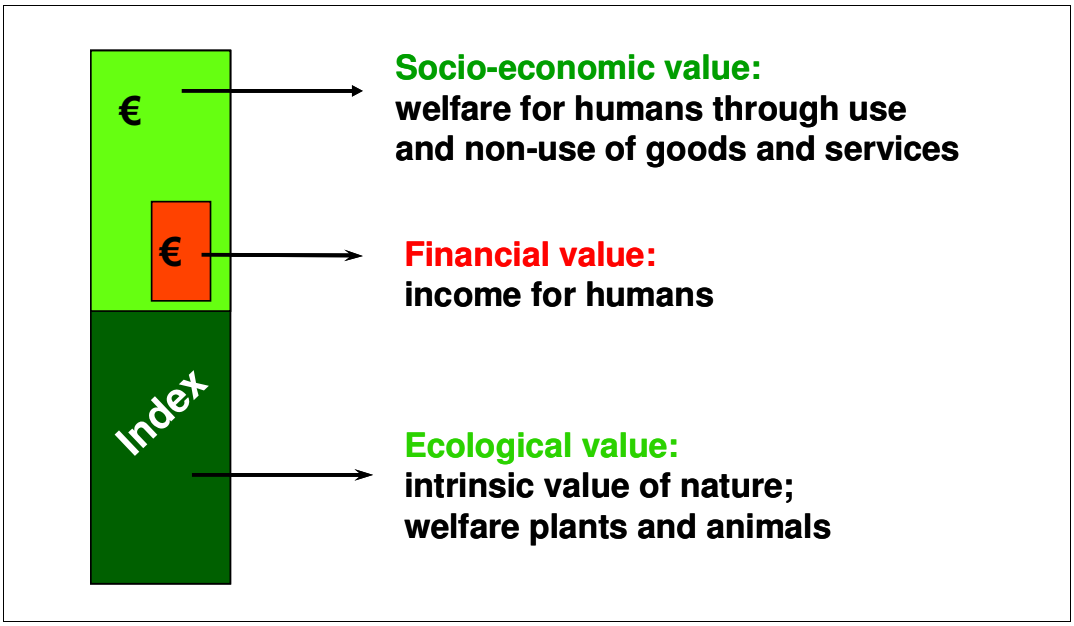
[1] In theory, one can distinguish several concepts of sustainability (Serageldin, 1994; Turner *et al.*, 1994; Hueting, 1996), among which ´strong sustainability´ and ´weak sustainability´. These two forms of sustainability are identified on the basis of the allowed substitutions between and within the natural capital stock and the produced capital stock. S*trong sustainability* means that the welfare-generating capacity of a nation's total capital stock may not decrease and that the welfare potential of each of the natural capital stocks may not be diminished. In this report we use the concept of weak sustainability, which implies that the welfare-generating capacity of all four capital stocks together may not decrease, but it leaves room for substitution.

One of the strengths of SCBA is that it includes welfare impacts due to changes in the natural environment. At the same time, one of the most difficult components of a SCBA is the pricing of the non-market impacts: in other words the valuation of the impacts on the natural environment is a specific feature of SCBA that requires specific attention.

2.2. The value of 'nature'

The socio-economic value of ecosystems is defined as the amount of material and immaterial forms of welfare that nature generates for society. This means that the socio-economic value is larger than the cash flows derived from nature.

Picture 2.2. The three values of the natural environment

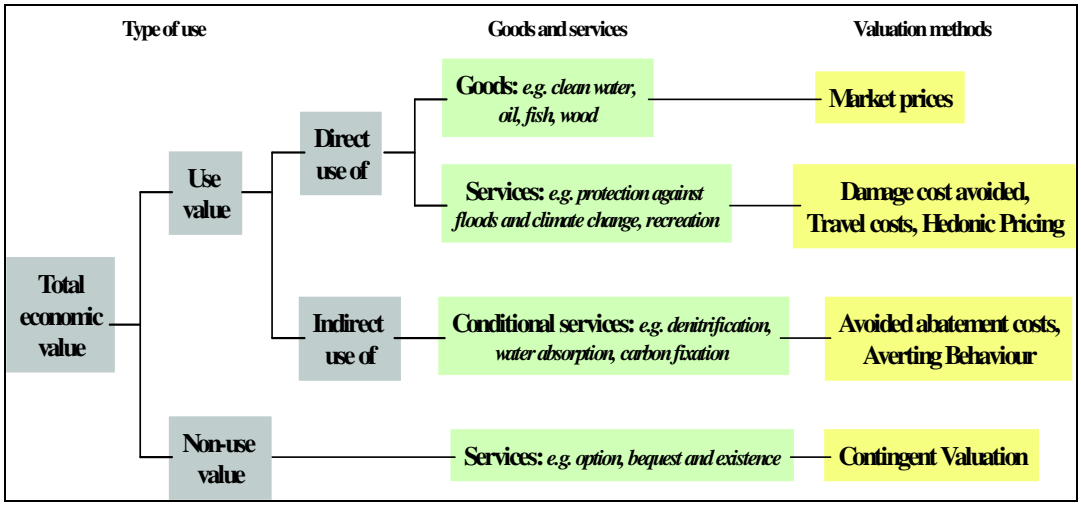


Source: Ruijgrok et.al. (2004).

The cash flows, which can be rather limited for not exploited pristine nature areas, form the financial value. The broad welfare definition means that the socio-economic value is a purely anthropocentric measurement. Socio-economic value pertains strictly to human welfare, as welfare for other organisms, plants and animals (biodiversity), the intrinsic value, is not included.

Unlike the intrinsic value, the socio-economic value of ecosystems can be expressed in monetary terms by means of several economic valuation techniques. Figure 2.3 shows an overview of goods and services and their valuation techniques. Once expressed in monetary terms, this value can be included in socio-economic cost benefit analyses, which are also in monetary terms.

Picture 2.3. Goods and services and valuation methods



Source: Ruijgrok et.al. (2004).

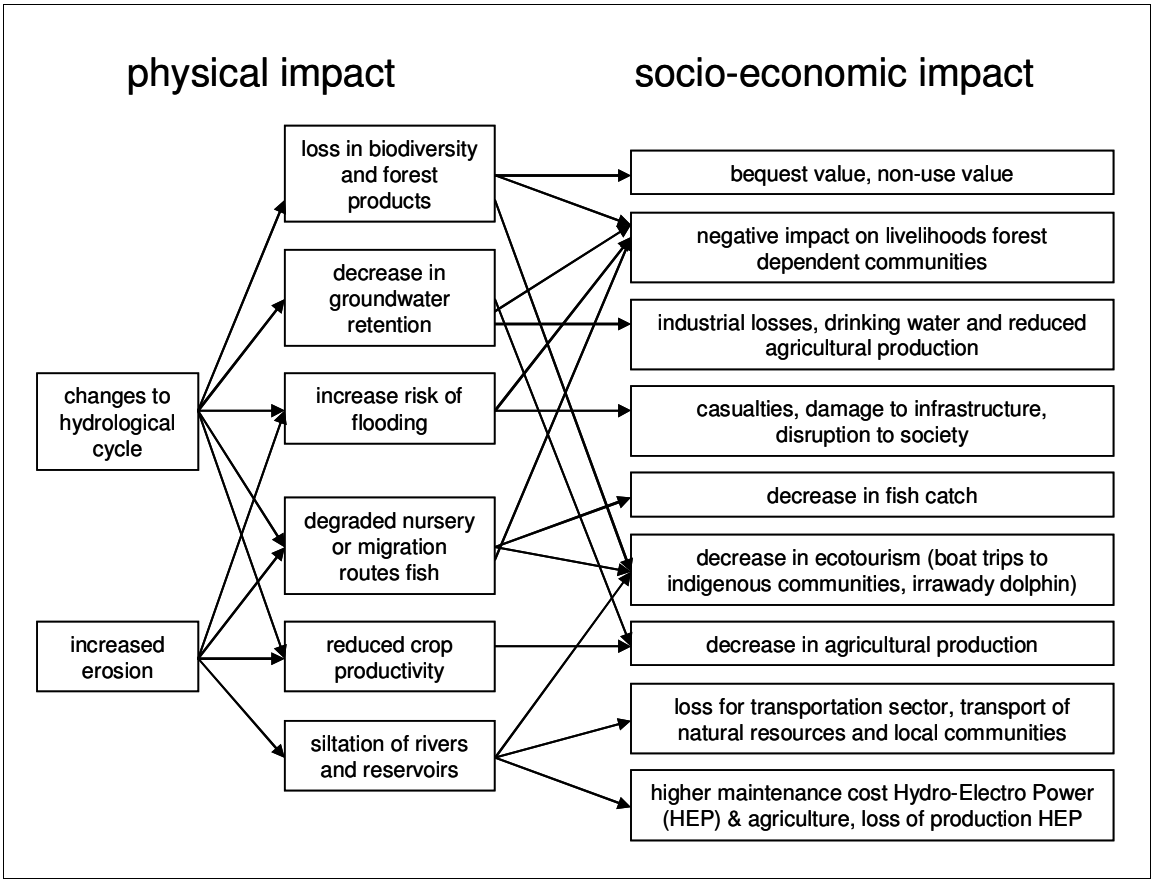
2.3. Watershed services

To capture the full value of an ecosystem it is important not to omit any goods and services that the ecosystem produces. A complete list of ecosystem benefits should be made using:
- existing checklists from previous SCBA´s;
- consulting experts;
- brainstorm sessions with stakeholders.

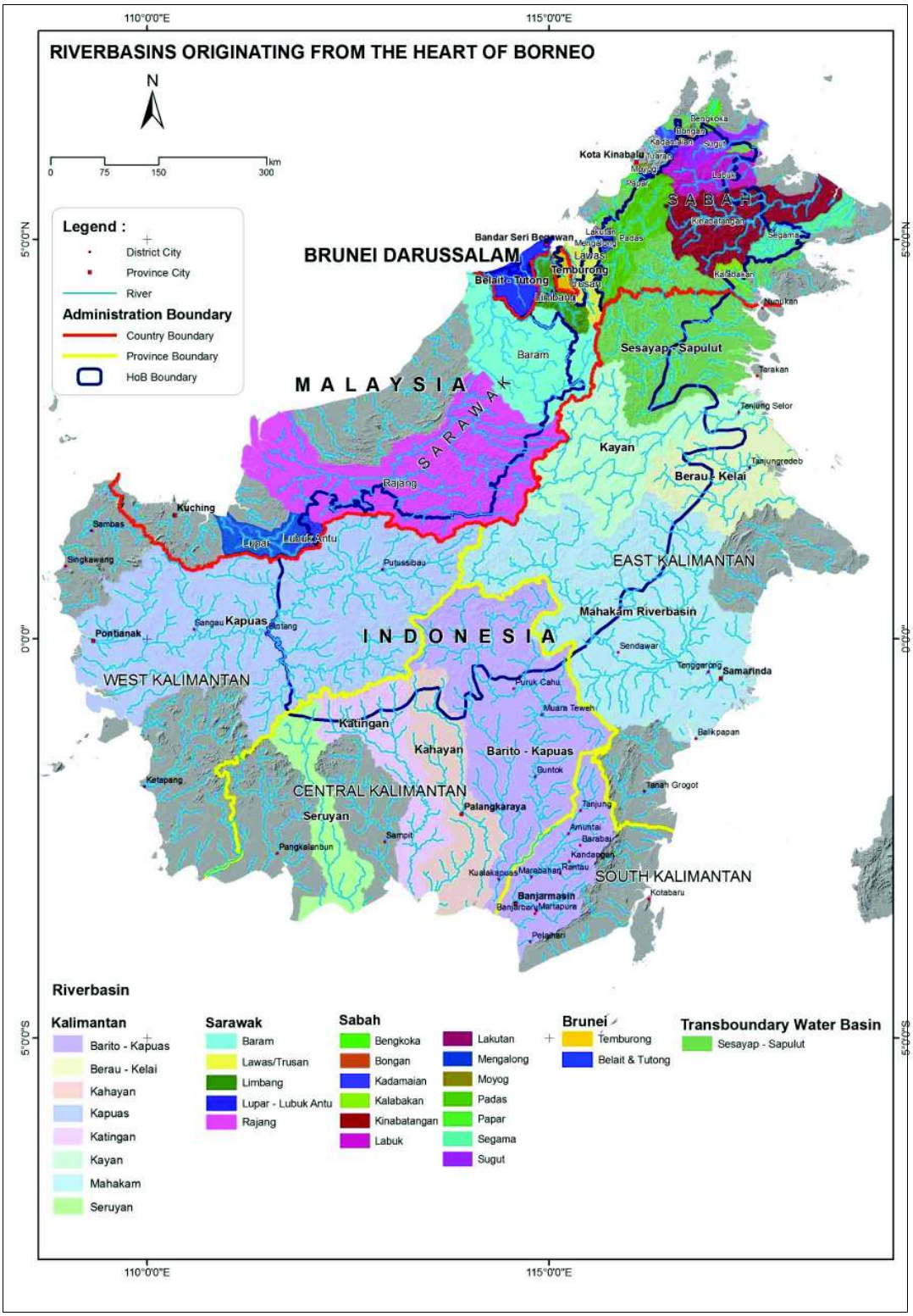
Usually a large number of potential benefits can be identified. In figure 2.4 an overview is given of the physical impacts and socio-economic impact related to watershed services due to loss of forest on the island of Borneo.

Another benefit nature provides that is not reflected in figure 2.4, is the resilience of ecosystems in times of climate change. The link with watershed services consists of the negative impact climate change can have on the ecosystem leading to degradation of the forest and resulting in enlarged changes in the hydrographical cycle and erosion. A resilient ecosystem will be able to cope with climate change and limit this exponential impact. By comparing the impact of deforestation in various climate scenarios the benefits from resilience can be determined.

Picture 2.4. Overview of physical impacts and socio-economic impact related to watershed services due to loss of forests on the island of Borneo



Picture 3.1. River basins from the Heart of Borneo to the coast



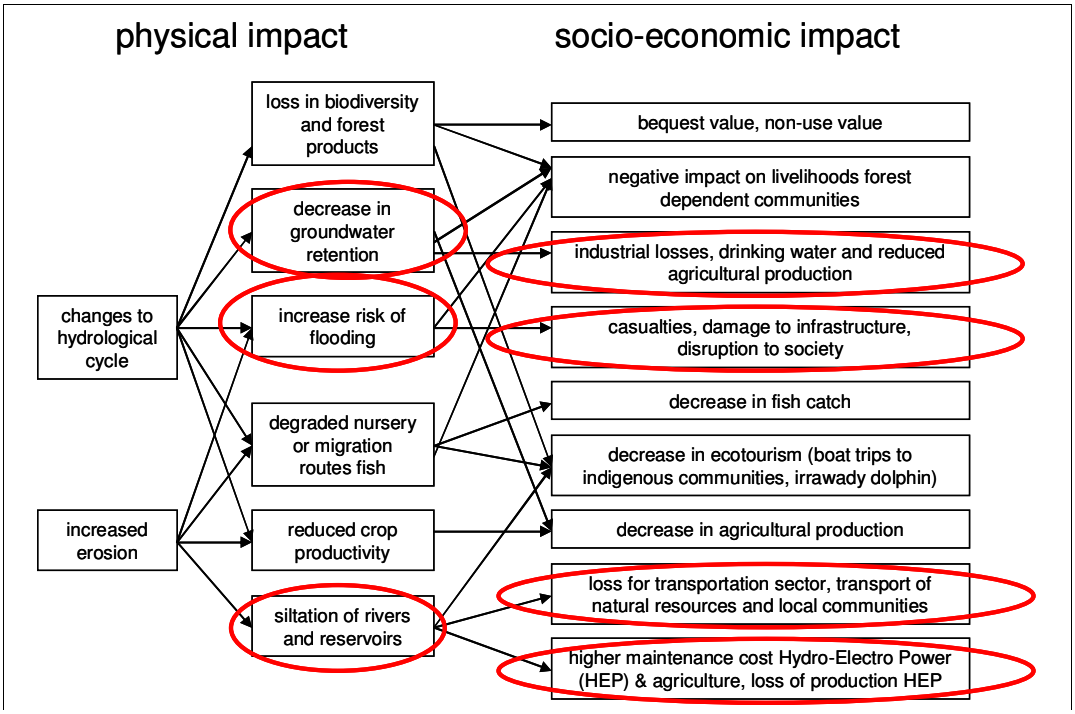
3. OVERVIEW OF RIVER BASINS AND WATERSHED SERVICES FROM THE HEART OF BORNEO

3.1. Introduction

Figure 3.1 shows all river basins which flow from the Heart of Borneo to the coast. In total there are 29 river basins that originate in the HoB. The total area of these river basins originating from the HoB is approximately 54 million hectares, while the HoB itself is 22 million hectares. This shows that the area influenced by the HoB rivers is much larger than the Heart of Borneo itself. In the quickscan we study the watershed services that the HoB delivers to the entire river basins, so not limited to the HoB boundaries.

Loss of forest upstream will cause problems in cities and industrial activities downstream. Focus in this quick scan is on the financers, the ones that can significantly contribute to a payment or funding mechanism. Picture 3.2 highlights the largest financial impacts due to loss of forest on the island of Borneo.

Picture 3.2. Largest financial impacts related to watershed services due to loss of forests on the island of Borneo

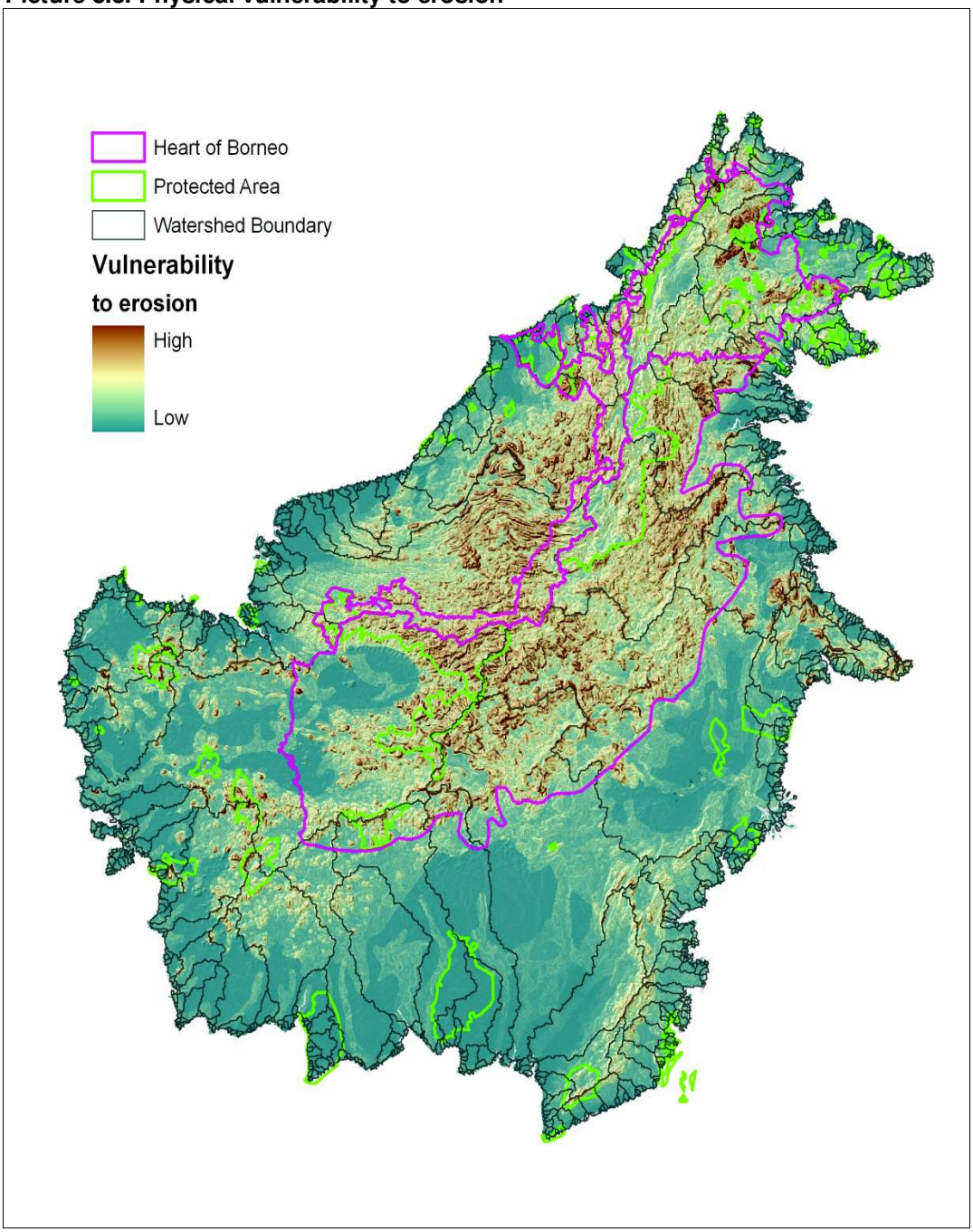


River basins which presumably have good opportunity to build the economic case for watershed services should still have existing pristine forest upstream in the Heart of Borneo and important economic activities downstream. Presence of political will and a favorable institutional setting is furthermore preferred. For each river basin we looked therefore at:

- total area and land use in HoB → indicator for potential impact
- economic activities downstream → indicator for potential payers

Each item is described in more detail in the next sections.

Picture 3.3. Physical vulnerability to erosion



source: A. Shapiro, 2010

3.2. Potential impact

The bigger the catchment area within the Heart of Borneo the more water is flowing down the river and the bigger the change in flow when the forest is disturbed (for example, due to logging and mining) and converted (for example, for the purpose of agriculture). Herein the relative size within the Heart of Borneo compared to the total size of the river basin is used as a parameter. See table 3.1 for the overview per river basin. The table shows that there are five river basins with less than 15% of their catchment area within the HoB: Kahayan, Seruyan in Kalimantan, Lupar/ Lubuk Antu in Sarawak and Bengkoka and Moyog in Sabah. These river basins will not be elaborated further.

Table 3.1. Area river basin and part within HoB

Brunei

riverbasin	area river basin (ha)	area in HoB (ha)	% in HoB	% total HoB size
Belait & Tutong	454,026	317,780	70%	1%
Temburong	127,231	98,880	78%	0%

Kalimantan, Indonesia

riverbasin	area river basin (ha)	area in HoB (ha)	% in HoB	% total HoB size
Barito-Kapuas	7,857,880	2,198,403	28%	10%
Berau-Kelai	2,030,031	678,707	33%	3%
Kahayan	2,351,783	218,976	9%	1%
Kapuas	10,040,614	4,819,564	48%	21%
Katingan	1,936,846	481,715	25%	2%
Kayan	3,137,180	2,815,035	90%	12%
Mahakam	8,231,732	3,598,346	44%	16%
Seruyan	1,396,078	95,561	7%	0%

Transboundary, Malaysia-Indonesia

riverbasin	area river basin (ha)	area in HoB (ha)	% in HoB	% total HoB size
Sesayap/Sapulut	3,551,536	2,308,368	65%	10%

Malaysia

riverbasin	area river basin (ha)	area in HoB (ha)	% in HoB	% total HoB size
Sarawak				
Baram	2,273,994	451,459	20%	2%
Limbang	384,271	230,295	60%	1%
Lupar / Lubuk-Ant	635,798	69,406	11%	0%
Rajang	5,022,629	1,159,108	23%	5%
Trusan / Lawas	371,920	208,224	56%	1%
Sabah				
Bengkoka	93,736	13,855	15%	0%
Bongan	45,531	14,714	32%	0%
Kadamaian	90,952	21,030	23%	0%
Kalabakan	123,401	67,350	55%	0%
Kinabatangan	1,669,170	1,162,827	70%	5%
Labuk	580,165	445,512	77%	2%
Lakutan	30,034	14,719	49%	0%
Megalong	56,405	34,587	61%	0%
Moyog	29,953	4,047	14%	0%
Padas	892,640	839,095	94%	4%
Papar	90,527	34,430	38%	0%
Segama	470,538	239,395	51%	1%
Sugut	310,484	215,368	69%	1%

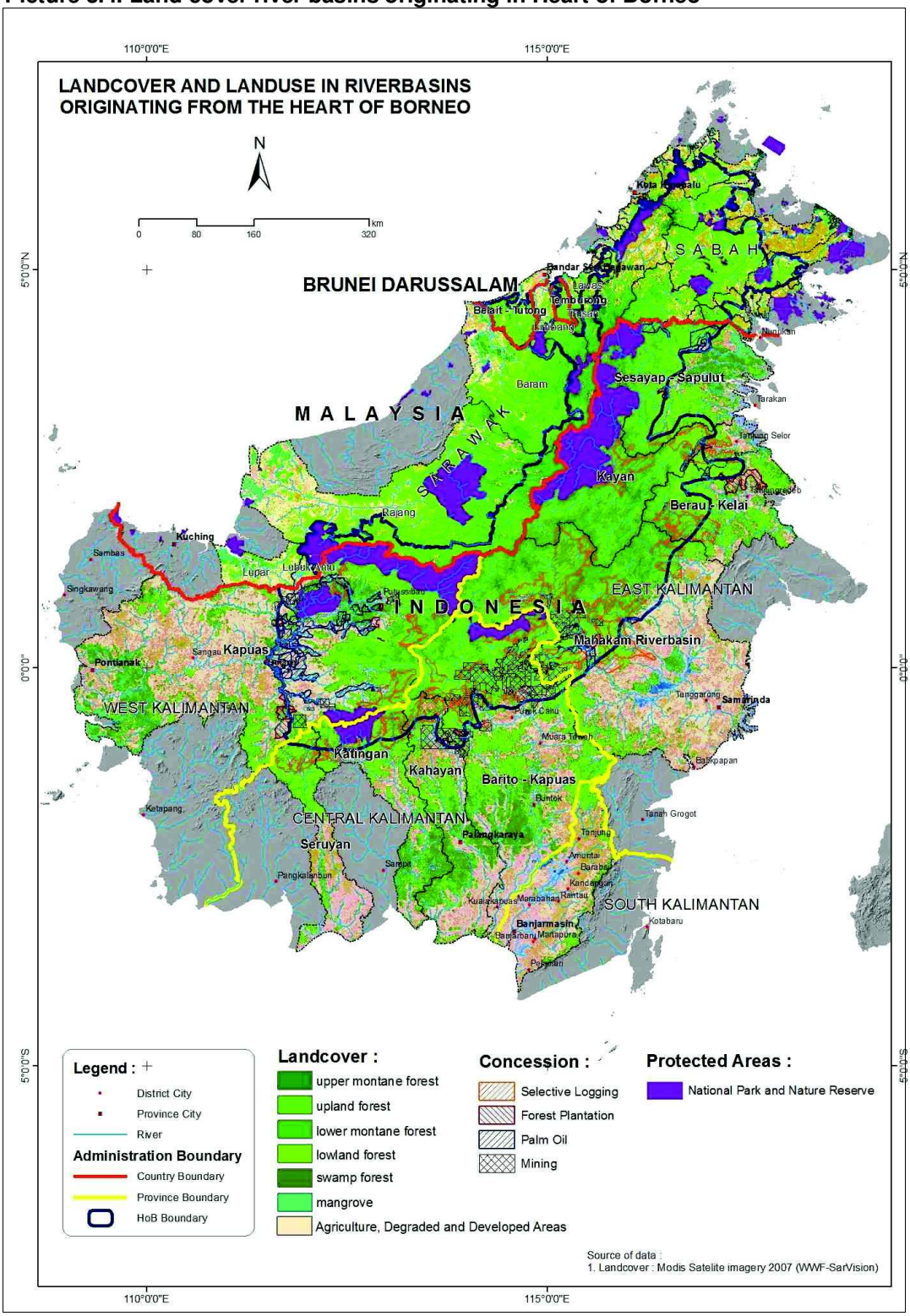
source: GIS data WWF Indonesia, data 2007

For the impact of sedimentation load the vulnerability to erosion is an important factor[1]. Figure 3.3 shows the physical vulnerability to erosion on the island of Borneo. The map shows that the highly erodible areas are located primarily in the Heart of Borneo. This is an indication that deforestation in these areas can result in large impacts across the river basin. Belait & Tutong in Brunei and Katingan in Kalimantan have relatively low vulnerability to erosion. Also Kapuas river basin has large areas with low vulnerability in the HoB. At the same time areas with high vulnerability are protected in National Parks. In the river basins Rajang and Baram in Sarawak a large area outside the HoB also has a high vulnerability to erosion. Based on this parameter alone it is not possible to exclude certain river basins.

A third parameter to determine the potential impact is the current land use in the Heart of Borneo. How much of Heart of Borneo's forested ecosystems have already been degraded or converted to other landuses? And how big is the impact of logging, agriculture and/or mining already? Figure 3.4 shows the land cover in the river basins that originate in the HoB.

[1] The vulnerability is based on physical characteristics of rainfall, soil and topography and mapped for the island of Borneo using remote sensing data (A. Shapiro, 2010).

Picture 3.4. Land cover river basins originating in Heart of Borneo



source: WWF Indonesia, data 2008

3.3. Potential payers

The "big" consumers of watershed services are:

6. large water intensive industries like LNG or methanol plants that require a large amount of water for processing;
7. mining, logging and palm oil companies that use the river for transportation;
8. cities with their economic activity downstream that have risk of flooding;
9. water companies that use surface and/or groundwater to provide water supply to consumers / population[1];
10. fishing industry.

In Brunei, the Belait & Tutong river basin is the economic heart with several oil refineries in Belait. In Kalimantan most economic activity can be found in the river basins of Barito-Kapuas, Mahakam and Kapuas. Mining and palm oil are the main sources of income. In Sarawak, Liquid Natural Gas (LNG) and petroleum are the primary revenue sources, followed by timber and palm oil. LNG plants are located in the river basin of Baram. Due to the hilly landscape, many hydro-electro power (HEP) dams exist or are in development in Sarawak.

Sabah's economy traditionally depends on lumber based industries. Other key sectors nowadays are palm oil and tourism. West Sabah is the industrial zone and tourist gateway with Kota Kinabalu as the main regional centre with all administrative services. The central region is the food production belt and East Sabah is known for its biodiversity and oil palm plantations with low density population. The link with river basins is however not really there. The development of a Palm Oil Industrial Cluster in Lahad Datu on the East Coast is connected by road to the hinterland and not by river and the palm oil plantations are situated in another river basin. Cities are located at sea arms or in bays and not so much at the river mouth of HoB rivers. Along the coast, especially on the north side there is a lot of aquaculture. Here a clear link can be found with the river systems.

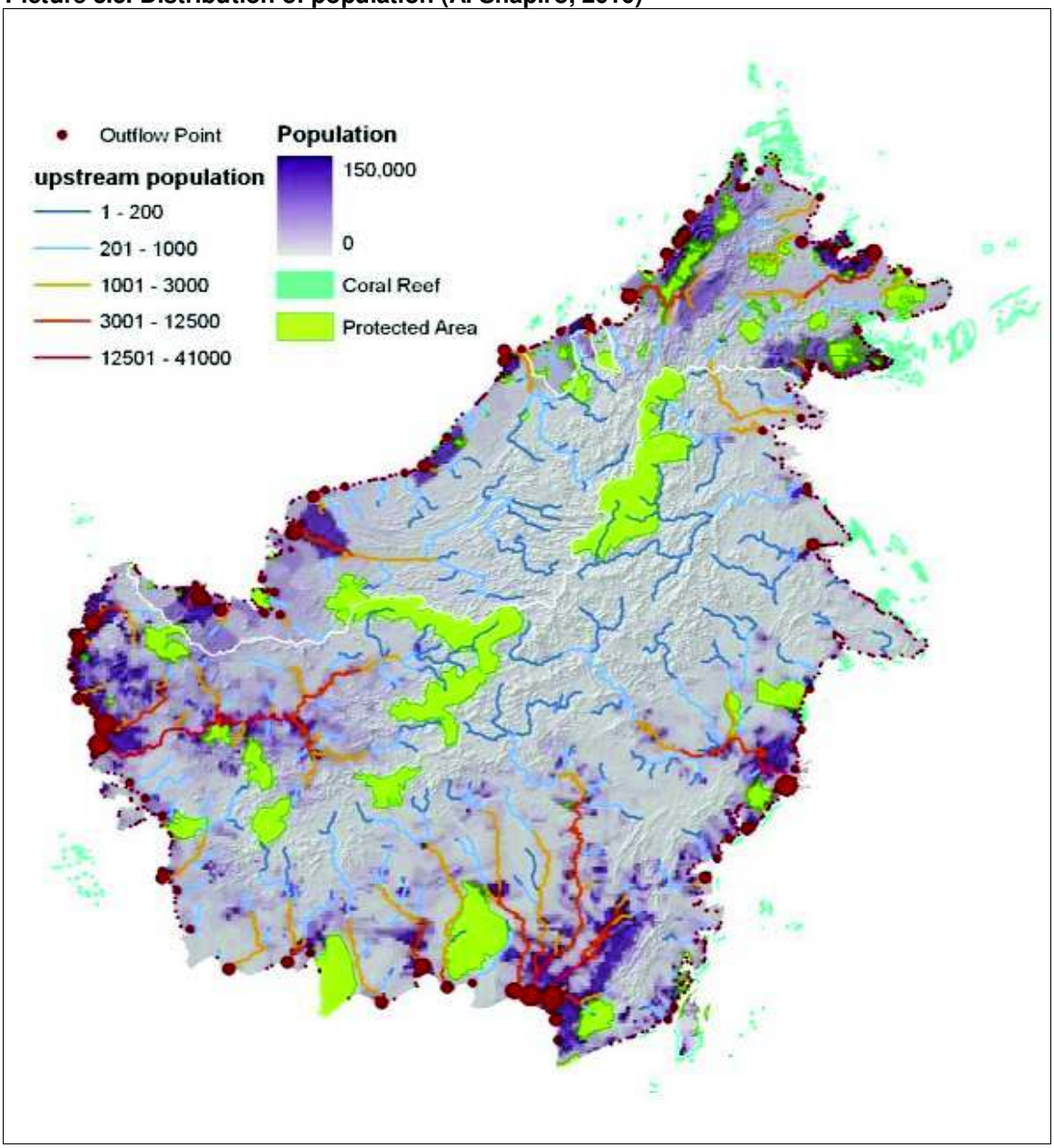
In each river basin there is a basis for payment for watershed services: the river water is used for drinking everywhere. A scheme involving small contribution from households such as the one being done in Lombok, Indonesia, is feasible to apply anywhere (see textbox).

Textbox: Payments for Watershed Services, Lombok, Indonesia

In 2004 a scheme with payment for environmental services (PES) (water) was initiated in Rinjani Protected Area, Lombok, Indonesia. In July 2007, the PES scheme was adopted as part of the local government's policy, and became effective for Lombok island. The initiative involves the Municipality of Mataram the Water Utility Company and individual water consumers in Mataram as the buyer of water system services from communities up stream who maintain the water supply and forest. Through the local regulations (Perda No. 4/2007), 75 % of the cost paid by the people who use the water services from the Water Utility Company Lombok, are allocated to the people in the hills of Mount Rinjani as a payback mechanism to help look after the forest that sustains the living systems of this small island. The scheme is expected to be fully implemented by 2010 upon the issuance of a District Regulation regarding Environmental Services.
(Source: WWF Indonesia,
http://www.wwf.or.id/en/about_wwf/wherewework/rinjani/wwf_achievements_in_rinjani.cfm)

[1] Water companies provide for potable/drinking water. In most settlements along the river and large areas within the cities, people also use water directly from the river for washing, bathing etc.Although these consumers will not pay for the money they will experience negative impact from degraded water quality or scarcity of water during the dry season.

Picture 3.5. Distribution of population (A. Shapiro, 2010)



Considering the river basin approach, funds are distributed within one river basin. River basins with a large population will generate more funds than river basins with a sparse population. Figure 3.5 shows a map with the distribution of the population on the island of Borneo.

We can roughly estimate per river basin what the income is that can be generated from households. Table 3.2 shows how much USD can be collected in each river basin and how much that would be per hectare in the HoB. Calculation is based on a contribution of 1 USD per household per year and the assumption that on average a household consists of 5 persons.

table 3.2. Rough estimation of the potential income from payment for watershed services by households per river basin

Brunei

riverbasin	population river basin*	area in HoB (ha)	USD/ yr**	USD/ha HoB/yr
Belait & Tutong	350,000	317,780	70,000	0.22
Temburong	50,000	98,880	10,000	0.10

Kalimantan, Indonesia

riverbasin	population river basin*	area in HoB (ha)	USD/ yr**	USD/ha HoB/yr
Barito-Kapuas	3,413,706	2,198,403	682,741	0.31
Berau-Kelai	128,948	678,707	25,790	0.04
Kahayan	366,711	218,976	73,342	0.33
Kapuas	2,583,228	4,819,564	516,646	0.11
Katingan	130,271	481,715	26,054	0.05
Kayan	80,700	2,815,035	16,140	0.01
Mahakam	1,221,225	3,598,346	244,245	0.07
Seruyan	94,524	95,561	18,905	0.20

Transboundary, Malaysia-Indonesia

riverbasin	population river basin*	area in HoB (ha)	USD/ yr**	USD/ha HoB/yr
Sesayap/Sapulut	341,136	2,308,368	68,227	0.03

Malaysia

riverbasin	population river basin*	area in HoB (ha)	USD/ yr**	USD/ha HoB/yr
Sarawak				
Baram	358,020	451,459	71,604	0.16
Limbang	46,947	230,295	9,389	0.04
Lupar / Lubuk-Antu	93,379	69,406	18,676	0.27
Rajang	548,775	1,159,108	109,755	0.09
Trusan / Lawas	57,860	208,224	11,572	0.06
Sabah				
Bengkoka	37,586	13,855	7,517	0.54
Bongan	65,807	14,714	13,161	0.89
Kadamaian	90,121	21,030	18,024	0.86
Kalabakan	15,000	67,350	3,000	0.04
Kinabatangan	176,955	1,162,827	35,391	0.03
Labuk	504,138	445,512	100,828	0.23
Lakutan	20,000	14,719	4,000	0.27
Megalong	34,680	34,587	6,936	0.20
Moyog	507,555	4,047	101,511	25.08
Padas	364,012	839,095	72,802	0.09
Papar	245,883	34,430	49,177	1.43
Segama	199,934	239,395	39,987	0.17
Sugut	95,632	215,368	19,126	0.09

* the population per river basin is roughly estimated based on population data per district/state: Jeffreys e.a., 2009 for Brunei; SUPAS, 2005 for Indonesia; Banci Census, 2010 for Malaysia;

** the calculation is based on a contribution of 1 USD per year per household and the assumption that an average household consists of 5 persons

For river basins which do not have 'big' consumers, the payment for watershed services from households is a start, but it will not contribute significantly to the business case for funding conservation of upstream forest. In those river basins focus for the potential of PES should be on other ecosystem services (CO_2, biodiversity). Examples of such river basins are Temburong in Brunei, Kayan and Berau-Kelai in Kalimantan, most river basins in Sabah, Limbang and Lupar / Lubuk-Antu in Sarawak and the transboundary river basin of Sesayap/Sapulut. These river basins are therefore not considered as useful pilots to test the business case for payment of watershed services.

4. RIVER BASINS WITH A POTENTIAL GOOD ECONOMIC CASE FOR WATERSHED SERVICES

4.1. Introduction

In this chapter we will describe the river basins which seem to have a good business case for payment for watershed services. The data used in this quick scan is collected from existing reports and interviews with WWF-staff. It is a first quick assessment of beneficiaries based on field experience from WWF-staff and expert judgment from the authors on the physical and economic impact. In a next phase the identified beneficiaries should be analyzed in more detail.

An important note before reading this chapter is, that although the local communities living in the Heart of Borneo will benefit from conserving the forest, they are not elaborated on in this quick scan. The reason for this is that the focus in this quick scan is on the financers, the ones that can significantly contribute to a payment or funding mechanism.

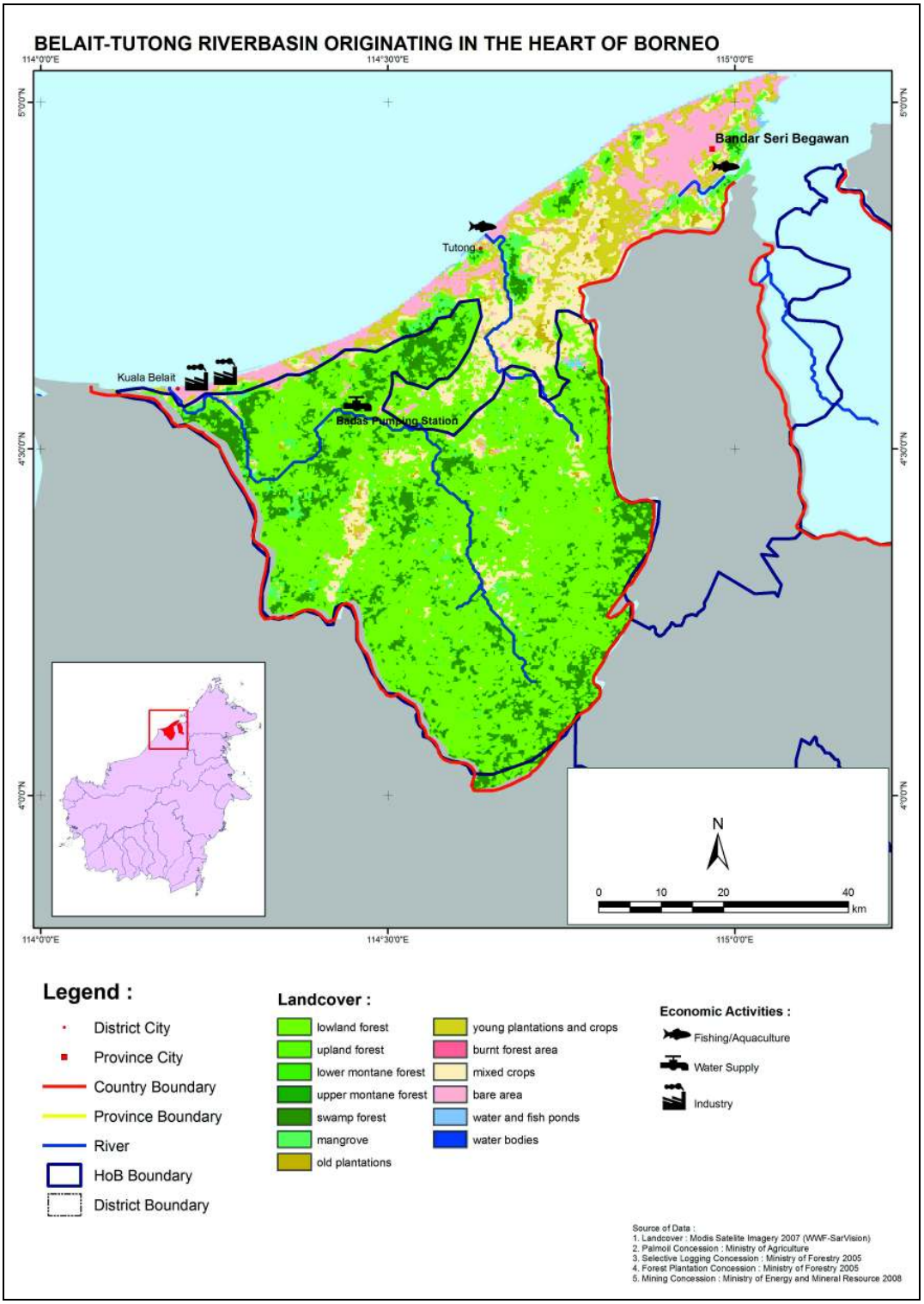
4.2. Selection of river basins

Based on the assessment using the criteria mentioned in chapter 3, we have selected the following river basins which could become useful pilots to test the business case for implementation of payments of watershed services:

- Brunei, Belait & Tutong river basin;
- Malaysia (Sarawak), Rajang river basin;
- Malaysia (Sabah), Labuk river basin;
- Malaysia (Sabah), Kinabatangan river basin;
- Indonesia (Kalimantan), Barito-Kapuas river basin;
- Indonesia (Kalimantan), Mahakam river basin;
- Indonesia (Kalimantan), Kapuas river basin.

In the next sections the characteristics of these selected river basins are described in more detail.

Picture 4.1 Brunei, Belait & Tutong river basin



4.3. Brunei, Belait & Tutong river basin

The Belait & Tutong river basin is located in Negara Brunei Darussalam and consists of three major rivers: Belait, Tutong and Brunei river. 70% of the river basin is located within the HoB. The 320,000 hectares cover only 2% of the entire HoB. Almost 25% of the area within the HoB is proposed as protected area, almost 70% exists or proposed as sustainable forestry area.

Economic activity downstream
Brunei is a sparsely populated country with approximately 400,000 inhabitants, of which almost 70% live in the capital Bandar Seri Begawan. Kuala Belait is the main production base of oil and gas, hosting LNG-operations and the Brunei Methanol Plant. Process water for cooling is taken from the Belait river. From the same intake, water is lead to residential and commercial areas. Many coastal fisheries are found in the deltas of Tutong and Brunei river.

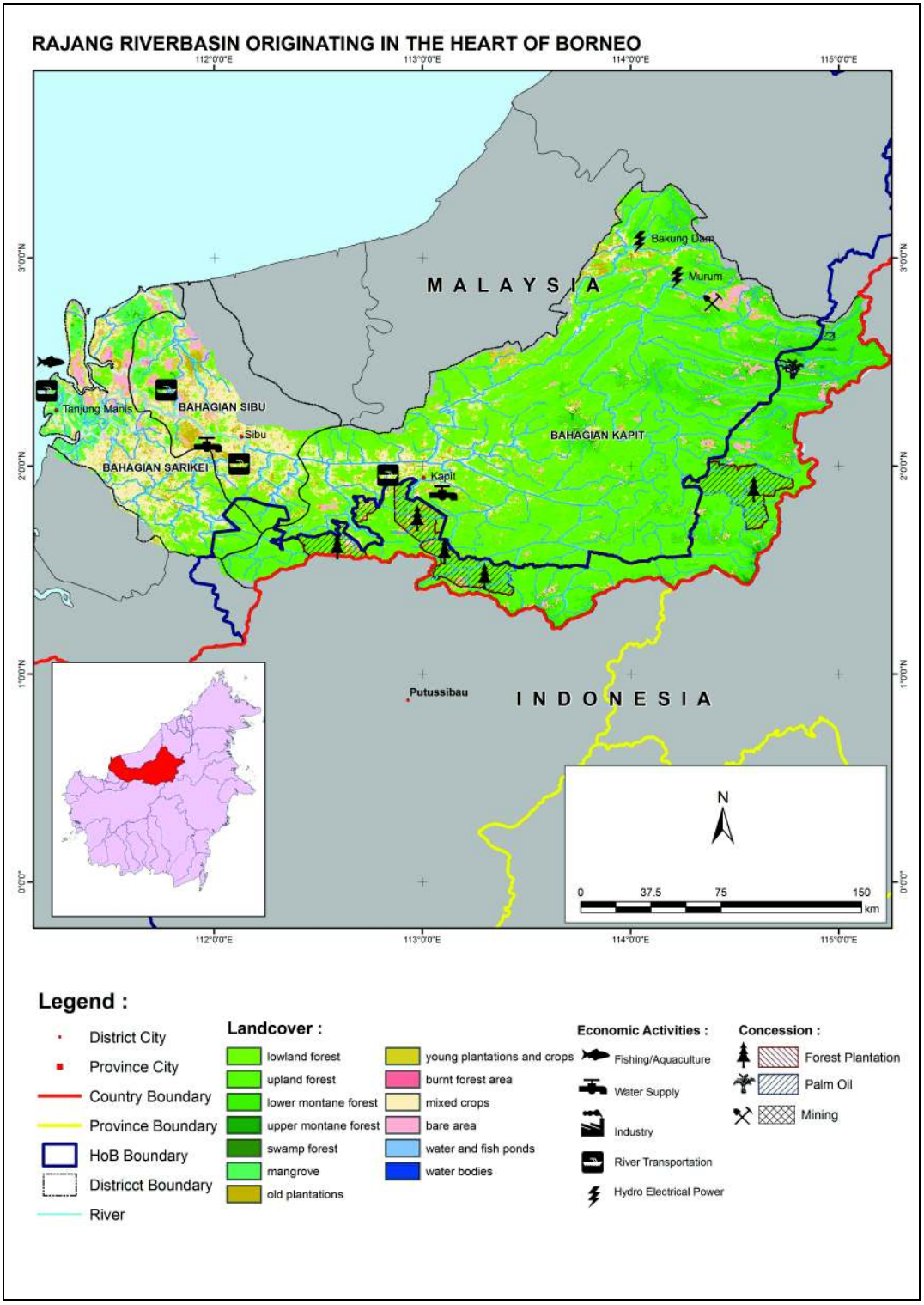
Existing watershed related problems
With the increased demand from water intake at Badas pumping station in Belait River small changes in the upper river could lead to shortages of water in the dry season. To reduce the impact of salt intrusion in the dry season, a dam has been constructed downstream from the water intake. To buffer the Belait water supply in the dry season the Brunei government has commissioned another dam, the Kargu dam, which will form a buffer basin upstream of the Belait river. In the dry season this basin should be able to release water back into the Belait river.

Recommendation
The Belait & Tutong river basin is the sole supplier of water for industrial, agricultural, domestic and inland transport uses throughout the district. Its reliability is therefore as much a security and social issue as one of economics. Furthermore, a failure in supply would shut down a very significant percentage of Brunei's industry, impacting the national GDP significantly.

Thus the dependence on Belait river water for LNG-compression operations and other spinoff industries like the Brunei Methanol plant provides a solid argument to pay for watershed services. Since a shutdown of the LNG plant will cost millions of dollars a day, the willingness to pay should be there, especially if the big picture of multi-sectoral dependence on the Belait's river water is taken into account.

The question remains whether the changes in water availability are being influenced by other water users or by changes in the upstream conditions or by both of these. In other words: will investments in maintenance and management of the catchment be enough to guarantee a consistent and secure water source that justifies payments for watershed services? A cost-benefit analysis should study what is the most efficient and effective option for the district to manage its long-term water supplies. A system of fair and equitable payments should be derived from that analysis to generate sustainable funding for the river basin management.

Picture 4.2 Malaysia (Sarawak), Rajang river basin



4.4. Malaysia (Sarawak), Rajang river basin

Rajang river, with a length of 760 km, is the longest as well as the largest river basin in Malaysia with a total catchment area of more than 5 million ha. Almost 25% of the Rajang river basin is part of the HoB, it covers 5% of the entire HoB. There are two proposed national parks in the HoB: Danum Linau (30,000 ha) and Balleh NP (22,300 ha)

Economic activities downstream
The Rajang river basin is home to a number of settlements. Interestingly, the upstream population in this river basin is bigger than downstream. The total population is approximately 500.000 inhabitants. Dominant land use is small-scale agriculture, besides this, timber harvesting, acacia and oil palm plantation development take place. On Merit mountain coal is mined.

The Rajang river is an important waterway for transport into the hinterland. It is navigable for sea-going ships and barges carrying goods and logs. The principle port for the central region of Sarawak is located in Sibu, 113 km upstream from the rivermouth. The port provides a feeder route to major ports in Malaysia.

The river is also a popular tourist route. At the delta of Rajang, Tanjung Manis is situated, a sea port that is proposed to be become an important fishing port.

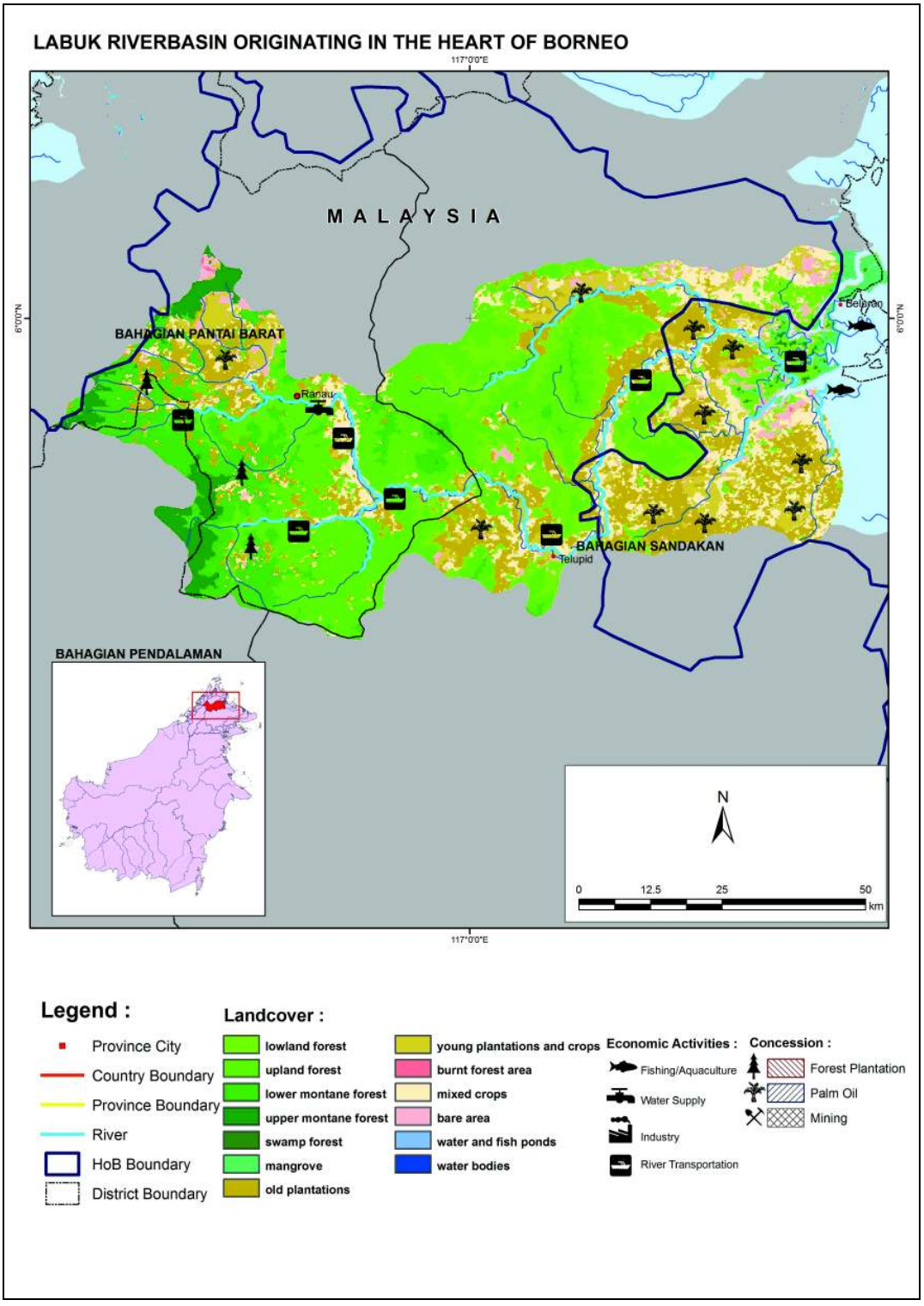
There are two hydro-electrical power (HEP) dams in construction: Bakun Dam with 2,400 MW and Murum Dam with 900 MW. Another HEP in Baleh river is being studied. Two aluminium smelters are planned.

The city of Kapit takes its water from the Rajang river.

Existing watershed related problems
Sibu area suffers from yearly flooding in the rainy season as a result of an increase in silt in the river. With the newly constructed dams all kinds of other impacts are notable in the river basin. These impacts are not related to changes in the HoB.

Recommendation
With the presence of various HEP, the Rajang river basin could be the most suitable river basin in Sarawak to provide for a robust business case to encourage payment for watershed services. Sediment retention of forests is a valuable watershed service for HEP with sediment loads causing large maintenance cost to the HEP facilities.

Picture 4.3 Malaysia (Sabah), Labuk river basin



4.5. Malaysia (Sabah), Labuk river basin

Labuk river basin is a relatively small river basin with 580,000 ha. Almost 80% of this river basin covers the HoB landscape. Labuk river has its offspring in Liwagu river, off the southern slope of Mount Kinabalu. Labuk river discharges in Labuk Bay.

Economic activities downstream
Labuk river basin has 126,000 inhabitants, the largest population in Sabah. Kundasang, Ranau, Telupid and Beluran are the main (small) cities in this river basin. Furthermore the population is scattered in settlements along the river and coastal areas.

Land use along the river basin changes from intensive vegetable production and tourism in the upper catchment, followed by areas with more extensive mixed agriculture and ending in the low lands with increasing areas of large scale oil palm plantations. There are several palm oil mills along the rivers in the hinterland. The swamp forest and mangroves in the delta, at the fringe of Labuk Bay, provide a valuable source of timber and other forest products and the mangrove swamps and oxbow lakes support major commercial fishery. Labuk Bay is an important fishing ground, particularly for prawns, the source of livelihood of the local community in this area.

Labuk River is used to transport timber. There is some tourism along the river to see the long-nosed monkey called Proboscis monkey. Some 56,912 ha of mangrove forest are included in the Kuala Bonggaya and Kuala Labuk Forest Reserves.

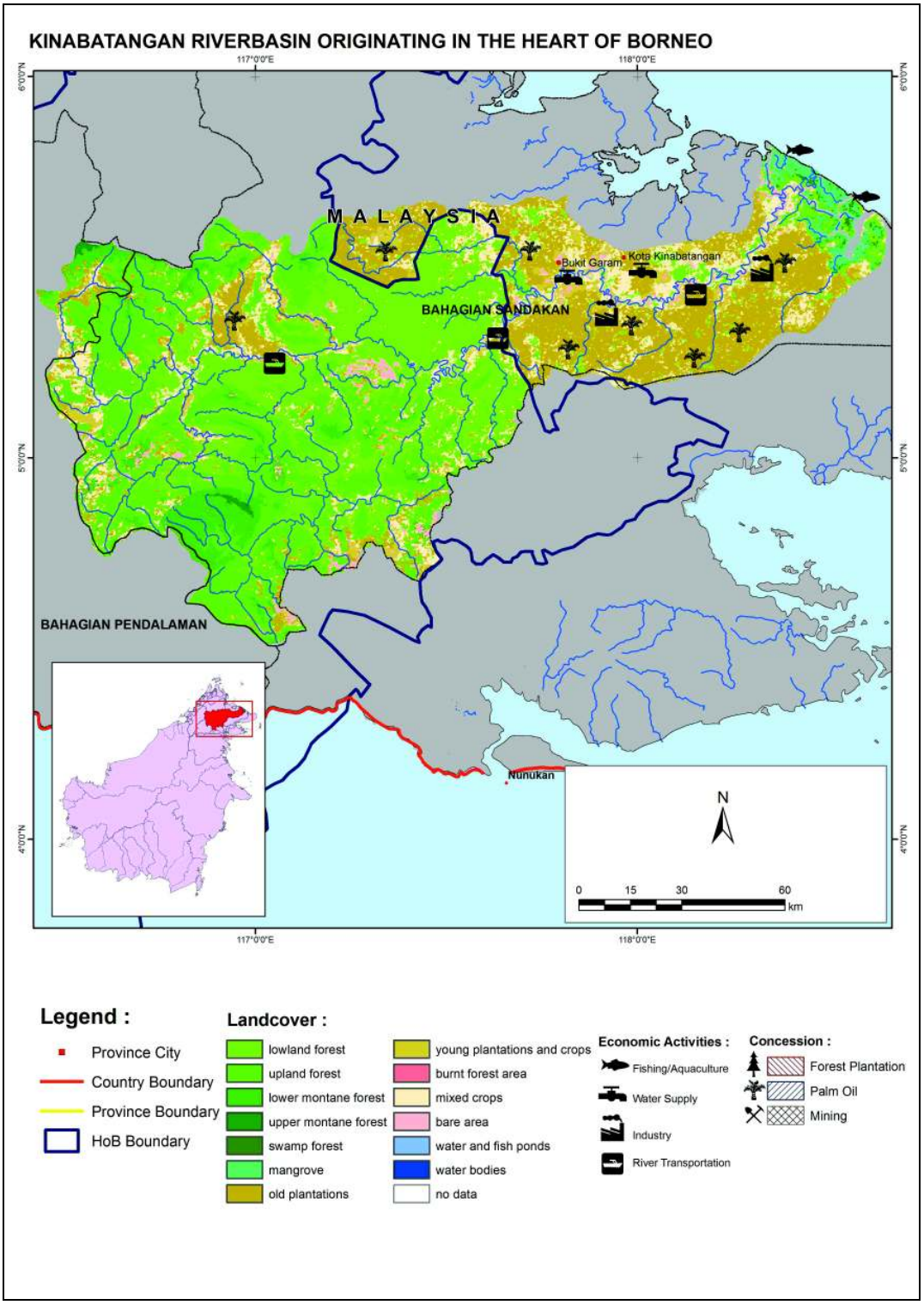
A hydro-electric power dam (190 MW) has been proposed in Liwagu river, the upper reaches of the Labuk River.

Existing watershed related problems
The extensive logging and rapid change of landuse upstream from forests and wetlands to oil palm plantations have led to a large increase in sediment runoff as well as nutrient loading. Labuk Bay, is severely affected by these sediment and nutrient discharges. In addition numerical modelling has shown that these plumes affect the Turtle Island Marine Park, which is a major tourism attraction in the Sandakan area (DHI Water and Environment, 2005).

In the upper part of the river basin, there are conflicts of land, largely due to competition for water by agriculture, tourism and municipal supplies.

Recommendation
Labuk river basin is especially interesting as a pilot site because of the demonstrated link between logging and large scale palm oil and sediment and nutrient discharges in Labuk Bay. The impact on aquaculture in Labuk Bay and the tourism industry on Turtle Island Marine Park could provide a basis for payment for watershed services. In addition, the relatively large population, the plans for HEP and the scarcity of water provide other potential for benefits.

Picture 4.4 Malaysia (Sabah), Kinabatangan river basin



4.6. Malaysia (Sabah), Kinabatangan river basin

The Kinabatangan River is the largest and longest river in the Malaysian state of Sabah. It has a length of about 560km, and a catchment area of about 1.7 million hectares. and includes 5% of the total HoB landscape. The Kinabatangan floodplain is the largest remaining forested floodplain in Sabah and the lower stretches of the Kinabatangan River contain some of the few surviving freshwater swamp rainforests and oxbow lakes in South-East Asia. The lower Kinabatangan wetlands are nominated as Ramsar sites.

Economic activities downstream
Kinabatangan has a relatively sparse population with around 175,000 inhabitants. Main settlements include Kota Kinabatangan and Bukit Garam. Kinabatangan river basin is mostly populated with Bangsa Sungei, one of the indigenous groups in Sabah. They depend on the river ecosystem for fish, prawns, and forest products including rattan, beeswax, camphor, and edible-nest swiftlet *Aerodramus fuciphagus* nests. Together with its tributaries, the Kuamut and Lokan, the Kinabatangan river is the only transportation link between the coastal towns and the forested interior.

Economic activities are centred around oil palm plantations, forestry and wood-based industries. Nowadays 85% of the floodplain is converted in palm oil plantation and there are about 20 palm oil mills in the Kinabatangan basin.

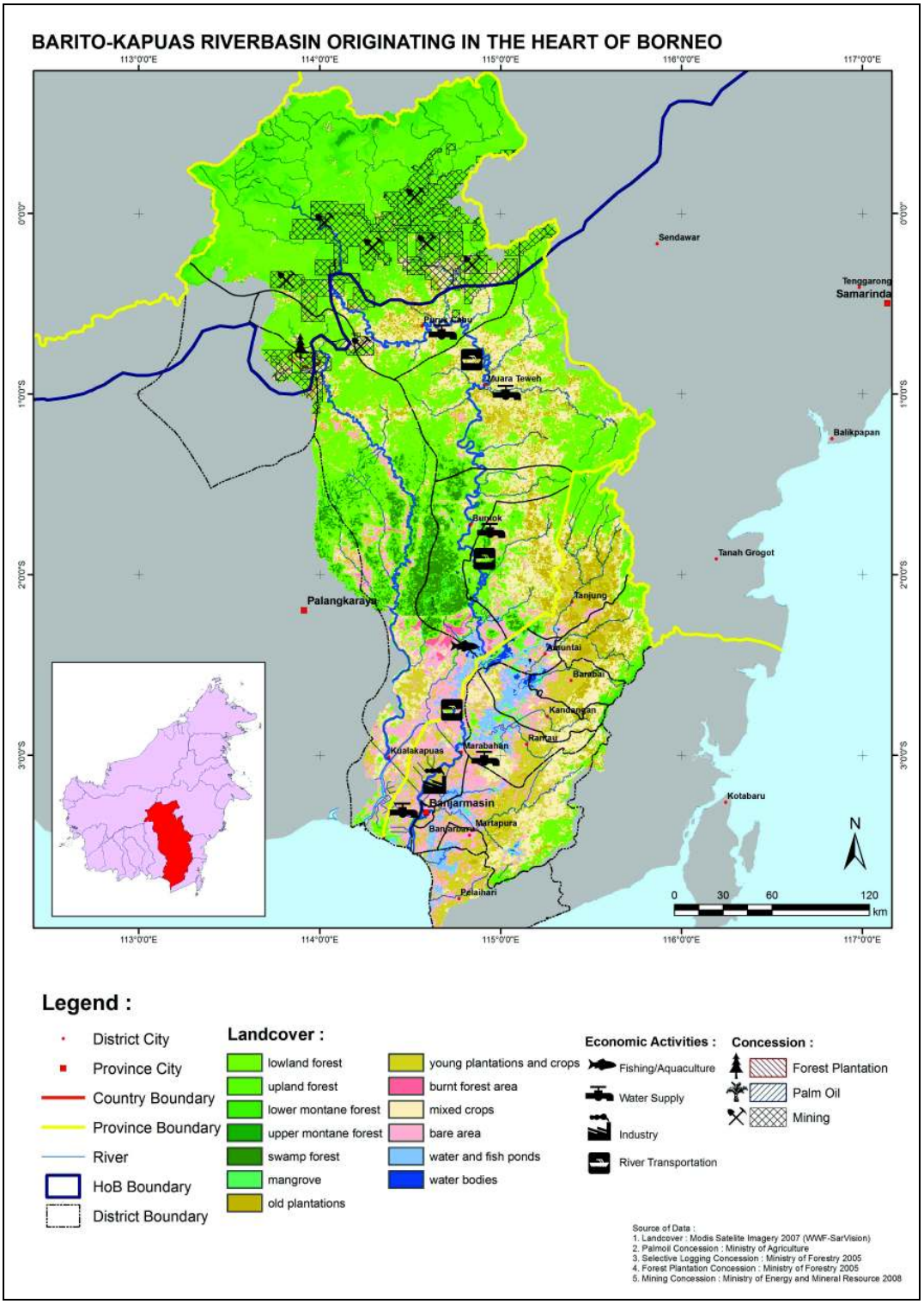
There are several ecotourism lodges along the river, providing accommodation and wildlife cruises on the river.

Existing watershed related problems
Hundreds of square kilometres have been logged and cleared for oil palm plantations in the catchments over the last decades. This has resulted in more frequent and longer flood events in the floodplains of Kinabatangan. Major flood events cause serious damage to livelihoods and property. Also oil palm plantations are suffering from the impacts of higher and more frequent floods, with economic losses as a result.

The rivers discharge large loads of sediments to the coast, but much of the sediment is very fine and transported far away from the coastline and deposited in deeper water.

Recommendation
Kinabatangan river basin provides an interesting business case due to its large scale palm oil plantations. Palm oil plantations pose a threat to forest and at the same time experience the impact from deforestation by means of flood damage. Other beneficiaries in this river basin include the tourism industry, aquaculture and Kinabatangan's population in terms of prevention from flooding, assured transportation and improved livelihoods.

Picture 4.5. Indonesia (Kalimantan), Barito-Kapuas river basin



4.7. Indonesia (Kalimantan), Barito-Kapuas river basin

Barito-Kapuas, located in Central and South Kalimantan, Indonesia, is the third largest river basin on the island of Borneo with almost 8 million hectares. With more than 2 million hectares within the HoB (districts Murung Raya and Barito Utara), Barito-Kapuas covers 10% of the entire HoB. Within the HoB the dominant land cover is forest. The biggest threat is coal mining with 650,000 ha in concessions.

Economic activities downstream
Barito Kapuas is the most populated river basin with almost 3.5 million inhabitants. Banjarmasin is the biggest city with 590,000 inhabitants (SUPAS, 2005). Other small cities in this river basin are Puruk Cahu, Buntong, Marabahan and Muara Teweh with each between 50,000-100,000 inhabitants.

Coal mining is the main economic activity in this river basin. Also wood, gold, palm oil, rubber and rattan are extracted. Most of the resources are transported as raw materials to Java. Only in Banjarmasin a few factories produce plywood (4 or 5), half process of rubber and rattan can be found.

There are three hydropower plants in this river basin. The biggest one, Riamkanan dam, is however not fed from the Barito river and will therefore not receive negative impact from changes in the HoB. The two smaller ones, do depend on the HoB.

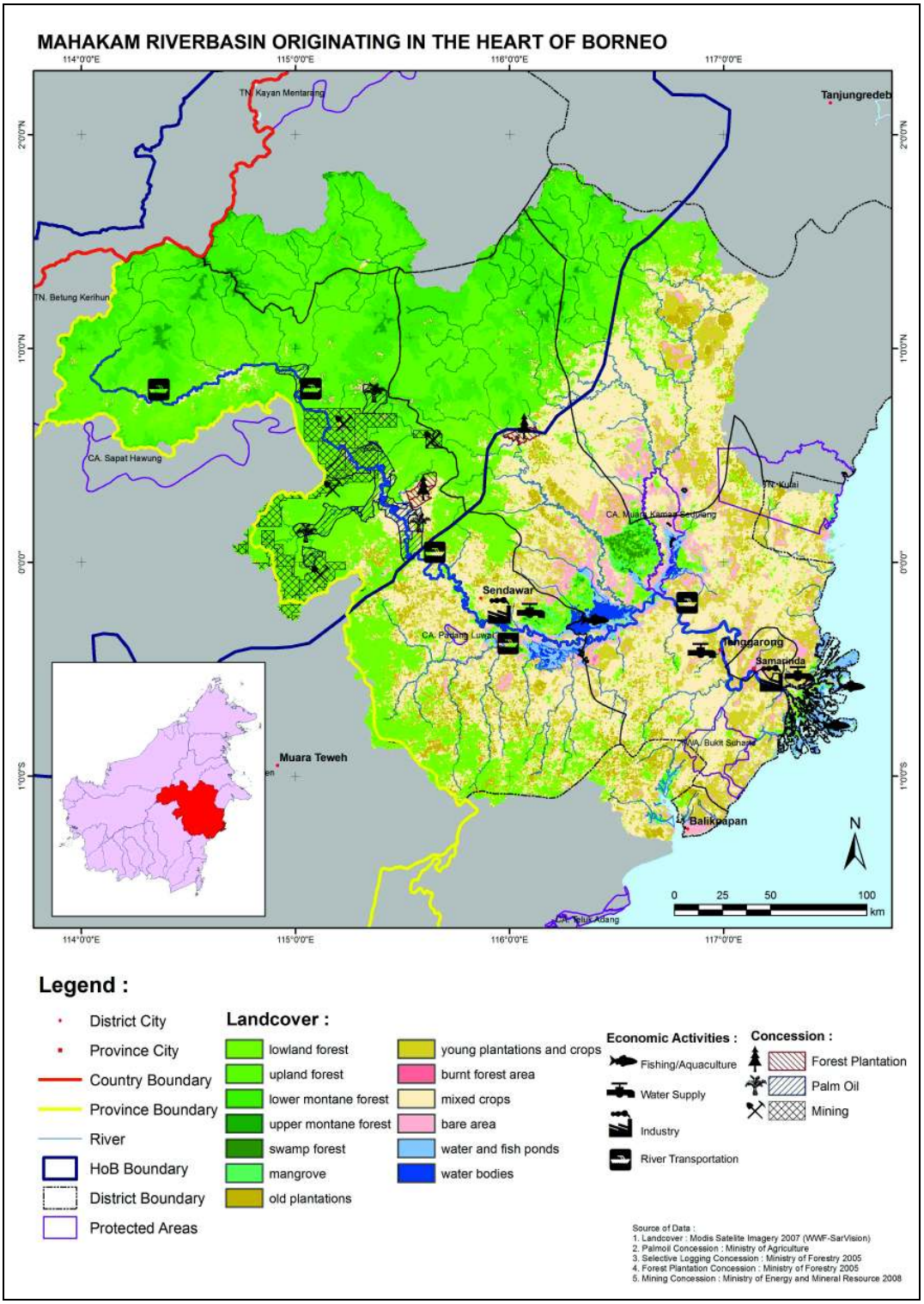

Tabat barito @WWF Indonesia

Along the riperians of the Barito river rice is cultivated for own consumption. Along Barito river, in the riparian zone, grows the medicinal plant ‘tabat barito” (ficus deltoidea). This plant is collected by the dayak people all over Kalimantan but especially the one along Barito rivers is famous and being transported to Surabaya to a pharmaceutical company. Tabat Barito is vulnerable to changes in water quality and quantity. A change in the hydrological cycle can significantly impact its habitat. In the lowland areas, leis fish is caught and exported to China.

Existing watershed related problems
Especially the city of Banjarmasin experiences flooding in the rainy season. In the dry season transport on the Barito river is problematic due to sedimentation and transport is shifted to the road. Although this river basin has a relatively extensive road network the road capacity is limited and there are plans to construct an extensive railway network in Central Kalimantan to overcome this problem.

Recommendation
Main watershed services are expected from the protection against flooding and transportation of coal and other natural resources along the river. Although sedimentation of the river is already occurring, it is likely to become worse when also the area within the HoB is logged and converted, due to its high vulnerability to erosion. When dredging rivers is a feasible alternative to investments in railways, the provision of watershed services from conserving the remaining forest in the HoB could be substantial.

Picture 4.6 Indonesia (Kalimantan), Mahakam river basin



4.8. Indonesia (Kalimantan), Mahakam river basin

Mahakan is located in East Kalimantan, Indonesia. With 3.6 million hectares within the HoB (Kutai Barat, Kutai, Kutai Timur and Malinau district), it covers 16% of the entire HoB. After Barito-Kapuas, the Mahakan is the river basin with most concessions within the HoB based on 2008 data; mining (250,000 hectares), palm oil (150,000 hectares) and selective logging (1 million hectares). In the HoB, upstream of Kutai Barat illegal gold mining takes place.

Economic activity downstream
1.2 million people live in the Mahakan river basin, of which 575,000 in the city of Samarinda. Samarinda is located in the delta of the Mahakan river where also a sea port is located. All coal from upstream Kutai Barat is transported directly by boat to Java, China and Japan. Also palm oil, after being processed in Kutai Barat or Kutai Kartanegara, is exported directly to Sumatra and Java. Other products which are transported by river include rubber and edible swiflets swallow birdnests. Consumables and electronics are transported by road.

In Samarinda there are many industries for plywood and rattan along the river. The products are being exported to Japan and Java. Cold storage for shrimp from the Mahakam delta is also located along the Mahakam river, downstream from Samarinda.


Irrawadv dolphin © WWF Indonesia

The river is a favorite transportation mode for tourists wanting to see its biodiversity (e.g. a variety of orchids, the endangered irrawady dolphin) and dayak communities around Kutai Barat. Rafting is another attraction.

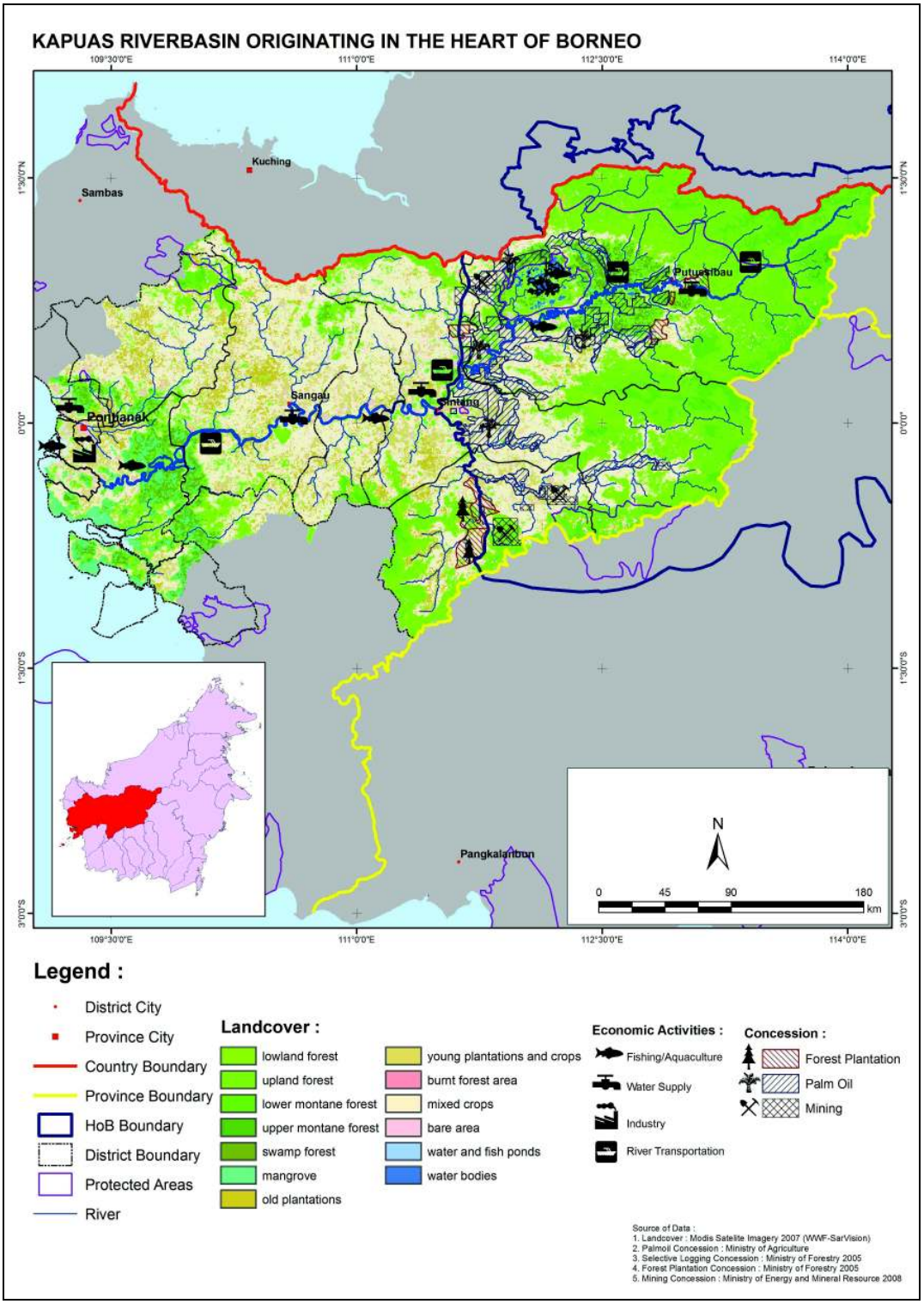
Existing watershed related problems
In the rainy season the Mahakam river becomes too strong to go upstream, in the dry season the flow is too low for river transport. Transport is therefore diverted to the road. In the last decade the types of boats used have become smaller to be able to continue use the river.

The cities in Kutai Barat and Tengarong experience floods in the rainy season. The city of Samarinda is also regularly flooded. It is however not known whether these floods are due to increased flow in the Mahakam river.

Saltwater intrusion is a problem during the dry season. Alteration in sediment load causes a seaward progression of the brackish/marine water boundary, threatening the mangrove forests in Mahakam delta.

Recommendation
Main watershed services from Mahakam are expected to be protection against flooding and transportation of coal and other natural resources along the river. Mining and palm oil pose big threats to the remaining forests in this river basin so there is a sense of urgency. Tourism is another potential interesting source for PES.

Picture 4.7 Indonesia (Kalimantan), Kapuas river basin



4.9. Indonesia (Kalimantan), Kapuas river basin

The Kapuas river lays in West Kalimantan, Indonesia. The Kapuas river basin is with more than 10 million hectares the biggest river basin that originates in the HoB. Almost half of this river basin lays within the Heart of Borneo in the districts Kapuas Hulu, Sintang and Melawi, covering 21% of the entire HoB.

In the Kapuas river basin a lot of HoB forest has been cleared for development of palm oil plantations. Only 60% of the area in the HoB remains forest (ca. 3 million ha). There are four National parks: Betung Kerihun National Park (800,000 ha), Danau Sentarum (132,000 ha), which is also a Ramsar site, Gunung Kelam Nature Tourism Park (520 ha) and part of Bukit Baka Bukit Raya. There are also active mining and palm oil concessions within the HoB.

Economic activities downstream
The total population of this river basin is around 3 million (SUPAS, 2005). Pontianak is with approximately 500,000 inhabitants, the most important city. Most of the economic activity can also be found in this town. Water using industries are rubber, plywood[1] and cold storage of shrimp. Oil palm mills can be found in Pontianak and upstream on the shores of the river. The Water Utility Company (PDAM) uses water from the Kapuas river.

Pontianak is the distribution centre for gasoline. The Kapuas river is an important means of transportation. Gasoline, as well as food & beverages are transported from Pontianak to Putussibau, which is more than 1,000 km upstream. In the other direction, palm oil, rubber and coal are transported downstream. The river is also a popular track for tourists, to visit the indigenous villages and wildlife around Putussibau.

The waterways in and around Sentarum Lake in the Heart of Borneo is a breeding area of the red arowana. The arowana fish are listed as endangered species. Red arowana are caught in this region, sold for around USD 340 (IDR 3 million) and further grown in captive breeding farms/ponds in Pontianak. The third generation of these fish, once inserted with a microchip, can be legally exported throughout Asia with pricetags of thousands to tens of thousands of dollars. The arowana fish are considered as “lucky” fish and popular as aquarium fish.


Red arowana © WWF Indonesia

The toman fish is also an export product. In Malaysia market price reaches 17 USD/kilo. The toman fish breeds and grows in Sentarum lake. The mangroves in the delta of Kapuas are a nursery for prawn.

The waterplants in Sentarum lake provide a habitat for bees. Honey collection is a source of income for the local communities (injecting around USD 50,000 into the local economy in the season 2008/2009) (WWF HoB newsletter, December 2010).

[1] There are many plywood factories in Pontianak but most of them are located along the river Landak. Landak does not originate from HoB. Along Kapuas river only one or two factories are located.

Existing watershed related problems
Existing problems in this river basin are flooding in the rainy season and salt intrusion in the dry season in Pontianak. Both impacts are expected to increase when more forest is being logged. In addition reduced waterflow for transport and reduced quantity and quality of water intake might become a problem for the industries and the PDAM. The water quality will especially become a problem when forest are logged for oil palm or mining.

Recommendation
With 21% of the HoB in this river basin and a relatively high population, the Kapuas river basin could provide an interesting business case for payments for watershed services. Although there are no big industries in this river basin, there are many smaller beneficiaries. WWF is active in this river basin together with other NGO's. Political will is present to conserve the ecosystems and even small scale PES-systems are in development. Payment mechanisms for watershed services will likely not be sufficient on their own. Other sources of financing should also be considered to pay for the conservation of HoB forests and the careful management of its natural capita. Nevertheless this river basin could be an interesting pilot to study since watershed services benefit many small beneficiaries.

APPENDIX I SOURCES OF INFORMATION

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