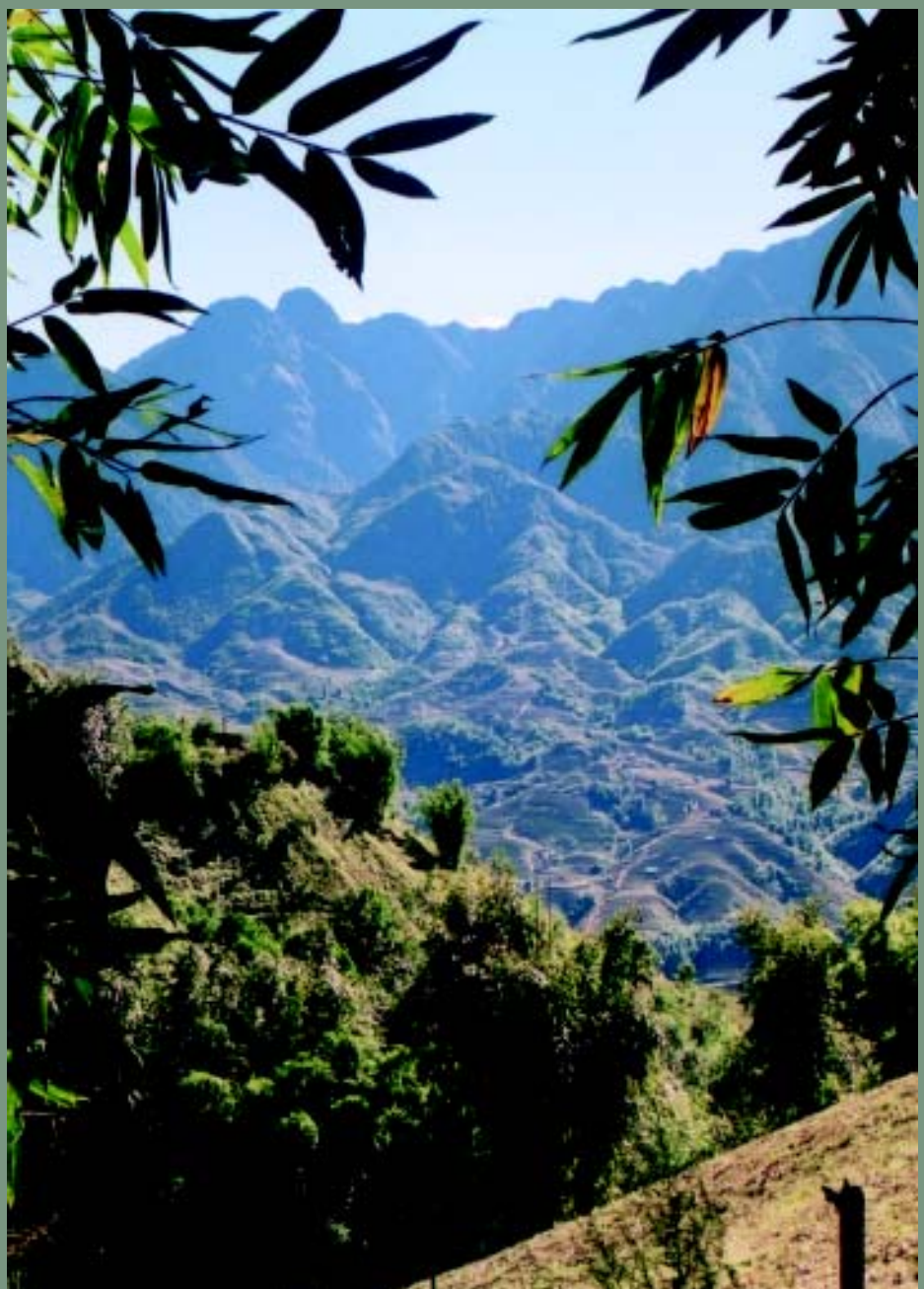
Field Study: Vietnam

Thua Thien Hue Province



Section 1

Introduction

1.1 Field study objectives

This field study was undertaken in Thua Thien Hue Province in Central Vietnam in late 2001 and early 2002. It had two objectives, the first being to examine the actual and potential economic contribution of protected areas to different economic sectors in the province. This analysis was consistent with methodologies and experiences derived from international assessments of the benefits of protected areas. An overview of the goods and services provided by protected areas in Thua Thien Hue province is provided in Section 2.

The second objective was to define important policy and planning issues related to maintaining and enhancing the development benefits from protected areas. This information will help policy-makers and planners understand how their actions can influence protected area management and associated economic development in the sectors and local livelihoods. A number of case studies investigated specific connections between protected areas and economic sectors in greater depth.

1.2 Economic values of protected areas and incentives

Protected areas (PAs) are important in sustaining livelihoods, supporting natural functions that underpin economic development and providing opportunities for recreation and enjoyment of nature. They provide a broad range of goods and services to society. These goods and services are categorised according to the type of value they provide:

- direct use values are those from goods and services consumed directly (e.g. timber or tourism) or part of household production (i.e. non-timber forest products);
- indirect use values measure those environmental functions that are non-marketed (and often unrecognised) components of production (e.g. water supply or flood control);
- option values reflect the future use of protected areas and the value of protecting them (e.g. the conservation of genetic and biochemical material for future use in producing new drugs); and
- existence values refer to the satisfaction derived by people from merely knowing that the resources and biodiversity in protected areas continue to exist, even if they have no immediate plans to visit protected areas or use them in any way (e.g. conservation of rare or endemic species).

Benefits of protected areas may also be categorised by the way they are distributed. Economic benefits derived from protected areas can be realised at the commune, provincial, national or global level. This report emphasises the level at which benefits are appropriated and the way they are perceived by economic planners. Benefits can help augment production or reduce costs in specific economic sectors. Protected areas must be fully appreciated for all of their values and integrated into development planning.

Traditionally, decisions regarding natural areas have been made on the basis of major direct uses that generate tangible, marketable local and national benefits. Typically, this has resulted in timber extraction or the conversion of forest to agricultural or other uses. In an effort to understand why some goods and services are

allocated in a (more or less) optimal manner by markets while others are not, economists have examined their characteristics. In the process, the concepts of "exclusion" and "rivalry" were identified as the salient distinctions between private and public goods (Box 1). In general, markets achieve an appropriate allocation of private goods but fail to do so for public goods, including many of the environmental goods and services provided by protected areas. In such cases of market failure some form of intervention or institutional arrangement is required to realise the benefits that these areas can provide.

Box 1. Exclusion and rivalry of goods and services

The term "exclusion" refers to limiting consumption by potential users or beneficiaries of goods provided by nature or through the activity of other individuals. Exclusion can be achieved by physical barriers; for example, preventing entry into a park. This is likely to be effective only if property rights are established which can be defended (economically and legally) within the existing legal framework. The ease or difficulty of exclusion varies; ease of exclusion depends on the physical attributes of goods and on the local institutions.

The term "rivalry" refers to the degree to which the use of goods by an individual or community reduces the potential for use of the same goods by others. For instance, consumption of an NTFP or food item by one community may prevent it from being consumed by others. On the other hand, it is possible for many people to simultaneously consume information without that information losing the potential of being consumed by others.

Goods with low degrees of exclusion and rivalry are considered to be public goods. Goods with high degrees of exclusion and rivalry tend to be private goods.

1.3 The field study process

The field study was conducted in four phases: a scoping exercise; preliminary assessment; data collection and map preparation; and analysis and write-up of results. The team included national counterparts and consultants, as well as international team members.

The team travelled to Thua Thien Hue Province for the first field mission, which consisted of interviews with representatives of different sectors and a number of visits to the different protected areas and development activities in the province. Interviews were conducted with a series of organisations, including the following:

- Provincial Peoples Committee;
- Provincial Forest Protection Department;
- Bach Ma National Park Management Board;
- Department of Planning and Investment;
- Thua Thien Hue Integrated Rural Development Project;
- Department of Agriculture and Rural Development;
- Department of Fisheries;
- Department of Science, Technology and the Environment;
- SNV project: Capacity Building for the Forestry Department;
- Department of Tourism; and
- Management Board of Huong River Projects.

On the basis of the mission and further discussion the case studies were agreed upon and the terms of reference for the data collection and mapping were prepared.

1.4 Case studies

Based on this rapid appraisal of the links between protected areas and the economy, and of related protected area management issues, a number of topics were selected for further evaluation in detailed case studies. The preliminary criteria employed in selecting the cases were as follows:

- they involved issues perceived to be of critical importance by planners;
- management responses would likely have the largest net economic benefits (as perceived by the review team); and
- the issues had potential significance, both economically and socially, to local communities.

From the list of contributions by the protected areas in Thua Thien Hue Province (Table 1, page 113) the following were selected as case studies:

1. The contribution to fishery production if the Tam Giang and Cau Hai lagoon protected areas were established, including protection of the nursery function of mangroves, seagrass beds and other nursery habitat for shrimp and fish species;
2. The contribution of Ha Truoi reservoir to irrigation production (by protecting the watershed of the intact primary forest in the core protected zone of the Bach Ma NP) and the potential contribution of improved management of the ecological rehabilitation zone within the park;
3. The contribution of Special Use Forests and Protection Forests to the major rivers of the province (O Lau, Bo, Huong), ameliorating normal flooding regimes and with possible important implications for infrastructure and production in the low-lying areas of the province;
4. The sustained contribution to local livelihoods from wildlife and other non-timber forest products (NTFPs) under a managed system of use and zoning in the Phong Dien Nature Reserve; and
5. The contribution to tourism and local livelihoods that Bach Ma NP will make as tourism services are expanded and the parks tourism assets are further enhanced.

During the second field visit a sixth case study was discussed as a potential. This was the support to water-supply plants offered by the Watershed Protection Forest in the Huong River catchment (Huu Trach and Ta Trach Rivers).

This rapid appraisal provided a first approximation in valuing the existing or potential contribution of protected areas to the provincial economy. Where difficulties were encountered they are summarised briefly so as to inform future efforts in this field. As well as providing a substantial indication of the importance of protected areas to local economic development, the study also provides suggestions on how this potential could be increased and better incorporated into conservation and development planning.

Section 2

Overview and rapid assessment

Thua Thien Hue Province is located in Central Vietnam (Figure 1), bordered on the east by the South China Sea and on the west by Lao PDR. (Unless otherwise indicated, provincial statistics are derived from TTHSO 1996 and 2001.) The province has a area of 5,053 sq. km and is divided into nine administrative districts (Figure 2). The population is over one million; 300,000 people reside in or around the capital city, Hue.

Much of the province's infrastructure and industry lies in the coastal plain (Figure 4). The North-South Highway and the railway linking Hanoi to Ho Chi Minh City pass through Hue and effectively bisect the province. Roads extend to the district centres, including A Luoi, the relatively isolated westernmost district. Rivers in A Luoi District drain to the Mekong River, instead of directly to the sea, as in the rest of the province.

Figure 1. Location of Thua Thien Hue Province

Most of the population lives on the coastal plain, within 25 km of the coast (Figure 3). Much of the interior of the province has a population density of less than 50 people per sq. km. The province's gross domestic product (GDP) was approximately US$240 million (at current prices in 2000), a per capita GDP of approximately US$230 at market prices (IMF 2002; TTHSO 2001). The exchange rate provided by the IMF was used to recalculate the TTHSO's figures (TTHSO 2001) for GDP for current prices and population. This is significantly below the Vietnam average, which was US$370 in 1999 (The World Bank 2001).

Figure 2. District boundaries, Thua Thien Hue Province

The province is served by Phu Bai airport (Figure 4), which has daily flights to Hanoi and Ho Chi Minh City as well as other domestic destinations. The airport serves the provincial tourism industry, which has grown rapidly in recent years due to the attraction of Hue as a cultural destination. In 2000 transportation, communication, and hotels and restaurants contributed eight per cent to the local economic output, with tourism overall contributing three per cent.

Figure 3. Population density, Thua Thien Hue Province

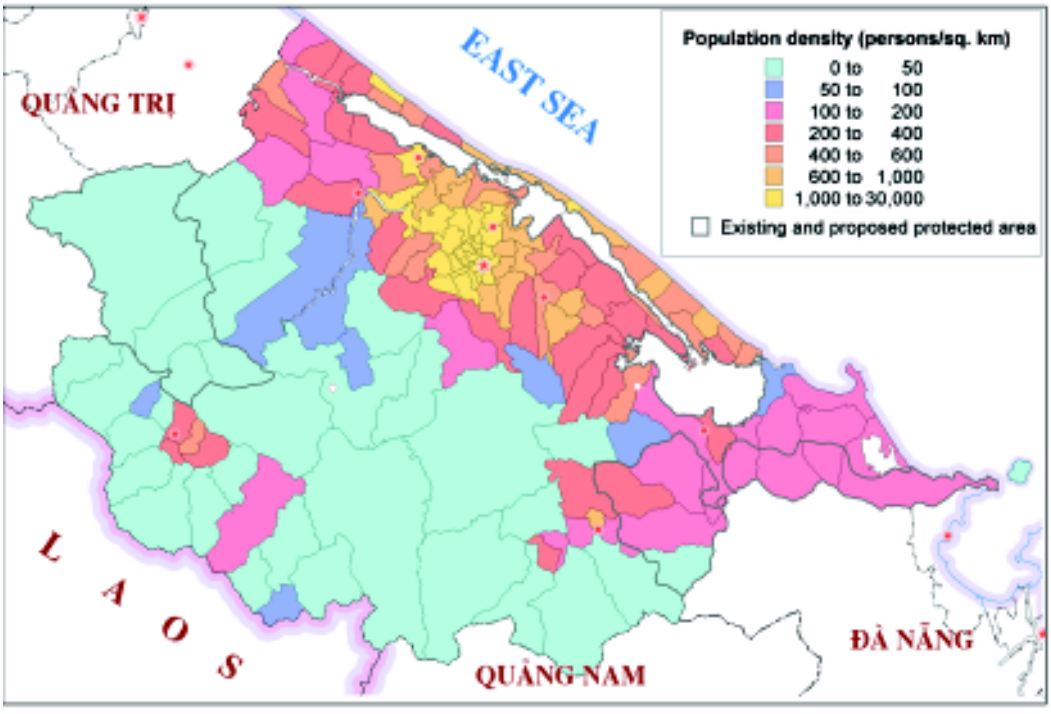
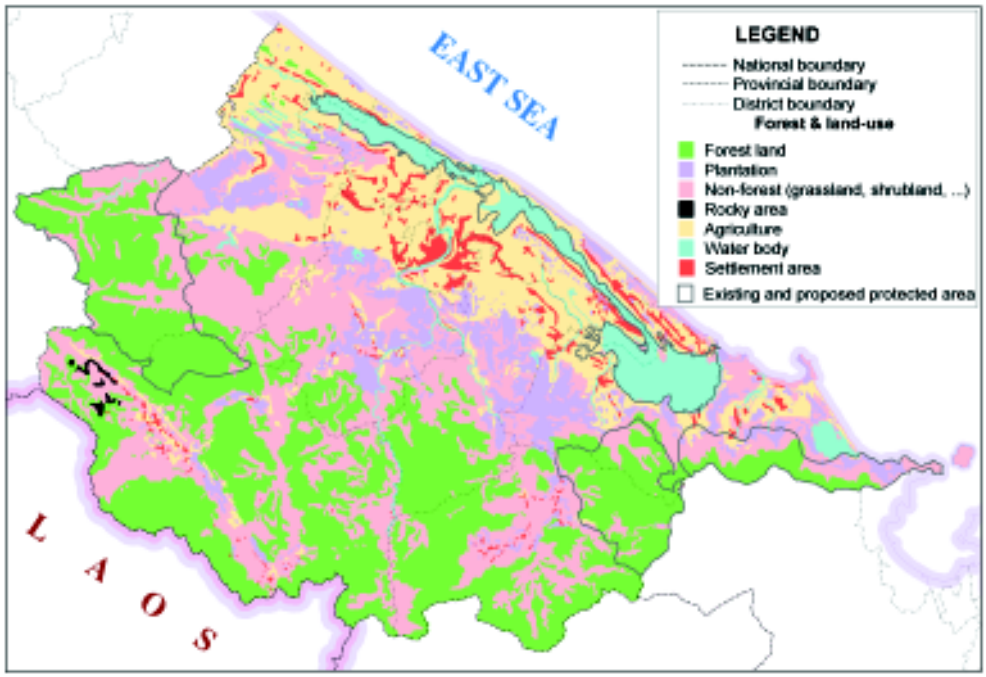


Figure 4. Principal infrastructure

The dominant geographical feature of the coastal area is the large group of lagoons that lie behind the coastal sand dunes. A seaport is located where the Huong River meets the Tam Giang Lagoon (Figure 4). The lagoon and coastal fisheries are an important part of the coastal area's subsistence and commercial economies. In 2000 commercial fisheries yielded three per cent of gross output. In the coastal plain, the dominant land use is agriculture, primarily paddy rice (Figure 5). Forestry and livestock predominate in the

Figure 5. Land use, Thua Thien Hue Province



remaining lowland areas. In 2000, agriculture and forestry made up 17 per cent of gross provincial output. In the highland areas the main land uses are forestry, subsistence agriculture and NTFP collection.

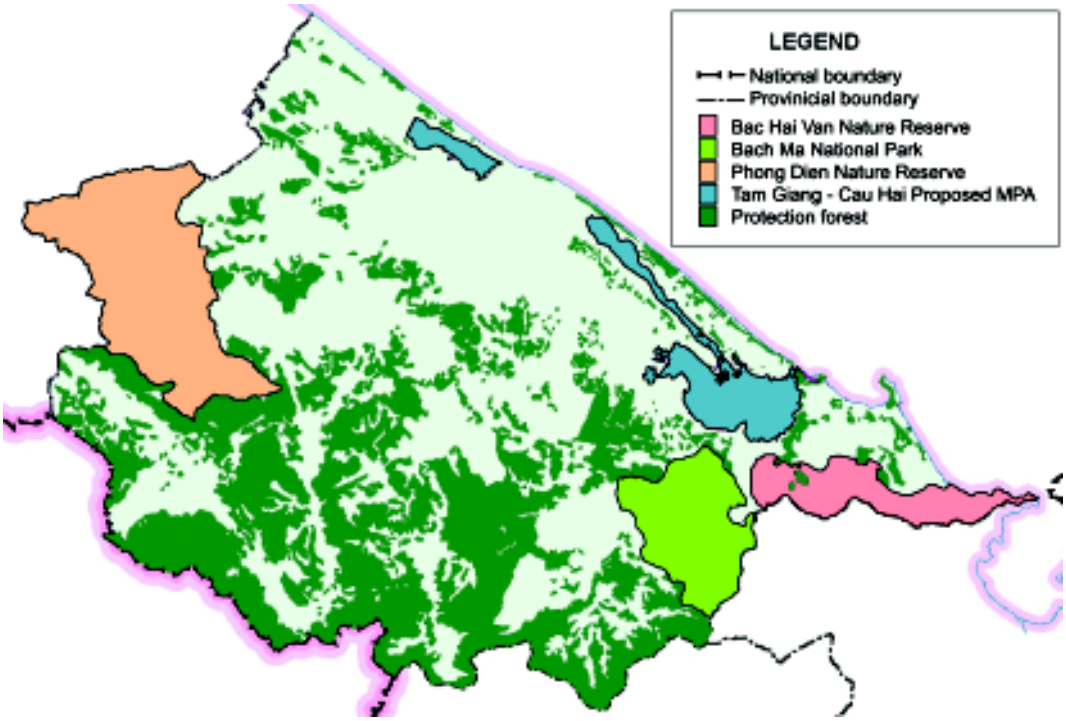
2.1 Protected areas

The current and proposed protected areas in Thua Thien Hue province include both special use forests (SUFs) and proposed marine protected areas (MPAs):

- Bach Ma National Park, a long-standing park of 22,300 hectares (ha);
- Phong Dien Nature Reserve, 41,548 ha, approved in 2001;
- Bac Hai Van NP, a proposed cultural and historical park of 14,500 ha;
- Tam Giang and Cau Hai Lagoon, a proposed protected area of almost 25,000 ha; and
- Hai Van-Hon Son Tra, a proposed marine protected area of 6,000–7,000 ha.

In addition, there are a number of extensive areas and smaller patches of forest designated as watershed protection forests, or WPFs (including watershed, coastal and wind protection forests). These total 143,162 ha, or some 28 per cent of the province. All told, 44 per cent of the province's area is terrestrial protected areas. Half of the province's surface area is protected if the proposed MPAs are included (Figure 6). The parks and reserves cover the northern and southern portions of the mountainous area that drains to the sea. The corridor between these two areas is made up mostly of WPF, with interspersed areas for forestry and agricultural production. Much of the A Luoi district to the west is also WPF.

Figure 6. Protected areas, Thua Thien Hue Province



2.2 Goods and services provided by PAs

A rapid appraisal of the goods and services provided by protected areas in Thua Thien Hue and their associated institutional, policy and incentive issues (Table 1) identified the following: goods and services provided by protected areas; links between protected areas and infrastructure or productive activities; sectors that benefit from goods and services provided by protected areas; the level at which each benefit is appropriated (i.e. local, provincial, national, global); and classification of each of the goods and services in terms of its public good characteristics.

Table 1. Goods and services provided by PAs in Thua Thien Hue

	Examples	Sectors	Level	Classification
Direct Use Values				
Timber	• Limited to production forests	Forestry	Local and district	private good
NTFPs	• Phong Dien and WPFs are being exploited	Community issues	Local	common pool resource
Tourism	• all PAs have potential • only Bach Ma likely to begin	Tourism	All levels	toll good
Provision of land for:				
electricity trans.	• Bach Ma	Energy	National	public good to toll good
irrigation reservoirs	• Bach Ma	Agriculture	District	public good to toll good
roads	• Bach Ma	Transport	National	public good to toll good
Transport	• Tam Giang Lagoon • Cau Hai Lagoon	Transport	Local	public good
Education, science	• all have potential, but Bach Ma the only one with a facility	Education, Science	Provincial	toll good
Indirect Use Values				
Nursery function	• Tam Giang/Cau Hai lagoons and coastal inshore fishery	Fisheries	Local	common pool resource
	• Tam Giang/Cau Hai lagoons mobile fishery	Fisheries	Local	common pool resource
	• Tam Giang/Cau Hai lagoons and aquaculture	Fisheries	Local	common pool resource
Hydrological Services				
• Prevention of sedimentation	• Bach Ma and Ha Truoi Reservoir	Agriculture	District	upstream public good downstream private good
• landslides	• Cau Hai, nr Hwy 1 and railway	Transport	Provincial and national	public good
• water quality	• Huong River: water supply, brewery, fish processing, etc.	Industry	Provincial	upstream public good downstream common pool
	• Phong Dien and Bo River: water bottling	Industry	Provincial	upstream public good downstream common pool
	• To Cau Lai and other towns: water supply	Industry/ Water	District	upstream public good downstream common pool
• flood protection	• Protection forests/Huong R.	Public works	Provincial	upstream public good
	• Phong Dien, Bo and O Lau Rs	Public works	Provincial	downstream public good
• dry season flow	• Bach Ma and Truoi Reservoir	Agriculture	District	upstream public good
	• Bo, O Lau and Huong Rivers and Tam Giang Lagoon saline levels	Energy, Public works and Fishery		downstream public good
• ground water	• Bach Ma and wells	Public works,		upstream public good
	• Protection forests and wells	Water and	Local to district	downstream common pool
	• Phong Dien and wells	communities		
Coastal protection	Tam Giang Lagoon	Public Works	District	public good
Carbon sequestration	Bach Ma, Phong Dien, WPF	Environment	Global	public good
Option value and existence values				
Protection of tigers and other species of int'l importance	Phong Dien and Bach Ma	Environment (international)	Global	public good
Agrobiodiversity and option values	Bach Ma and Phong Dien	Rural livelihoods	Local to global	public good

Section 3

Economic contribution of protected areas

3.1 PAs and forest management

The use of the forest estate for production is limited and declining. From 1995 to 2000 the harvest of wood products fell by 25 per cent; firewood harvest dropped by more than 55 per cent (TTHSO 2001). The bamboo harvest doubled during this period, although interviews with local officials suggest that little if any of this harvest came from SUFs or WPFs. In 2000 expenditure on reforestation activities, although only a small portion of the total forestry sector budget, was US$1.2 million; this investment contributed to the afforestation of 4,000 ha, tree planting on 3,000 ha and care and treatment of 7,700 ha.

The forest provides a range of other non-wood products to local communities and businesses, including plants and animals for nutritional, ceremonial, medicinal, ornamental and commercial purposes. Although statistics on many of these uses are not kept, case study 1 provides a detailed look at their contribution to local subsistence.

Case Study 1: Wildlife and NTFPs in Phong Dien Nature Reserve

Methodology

Non-timber forest products (NTFPs) are used both for subsistence and for trade or sale; consequently, they can be valued using either non-market or market calculations (IIED 1995).

Where valuation is based on market prices the costs of harvesting, extraction and transport can be deducted from the market price to obtain a net price (or stumpage value) for the NTFP. The total market value for a product is calculated by multiplying the unit price by estimated extraction volumes. Where NTFPs are used for subsistence, their value can be estimated using several non-market approaches, including the following (this analysis used market valuations where possible, along with the indirect substitute approach):

- Direct substitute approach. This uses the market value for the closest substitute available; for example, fuelwood can be valued by determining the cost of substitute fuels sold in the market. There are two limitations to this approach. One, it will overvalue NTFPs when consumers would not consume the resource if it were not publicly available. Two, it can be difficult to identify market substitutes for some products.
- Indirect substitute approach. The closest substitute for many non-market products may be other non-market items. Where this is the case, the opportunity cost of the substitute product can be used to determine its value. This approach requires detailed data and estimates.
- Barter exchange. Where NTFPs are exchanged in off-market transactions for products that have a market value, the market value of the barter item may be used for the NTFP.
- The opportunity cost of labour. Value estimates for NTFPs must be net of harvesting costs.

In the case of Phong Dien, analysis suggests there are few other value generating activities that could be pursued at the time NTFPs

are collected. In many cases, the collection of NTFPs is opportunistic; therefore, the opportunity cost of labour is taken to be zero for the purposes of this analysis.

The study consisted of two steps. The first was an assessment of the relative importance of NTFPs to the local livelihoods of villages around the Phong Dien Nature Reserve. Quantitative and qualitative data on the total annual harvest of wildlife and other NTFPs was gathered at the household level from Ha Long and Khe Tran, two villages bordering Phong Dien Nature Reserve (Trai et al. 2001, 2002). Team members also obtained information about the wildlife trade from traders within the region. Information from the field was used to calculate actual rattan extraction levels between 1990 and 2001 and to estimate wildlife extraction rates for hunting and trapping activities for the same period. These calculations were based on a combination of actual data and historical NTFP reliance patterns reported by villagers.

To determine the overall contribution of NTFPs to local livelihoods, three extraction value scenarios were calculated (low, average and high) based on current minimum and maximum market prices paid by local traders in Phong Dien district (historical market values were unavailable). Changes in NTFP use were also analysed.

The economic contribution of NTFPs to livelihoods was calculated by extrapolating the Ha Long and Khe Tran extraction levels and value scenarios on a per capita basis using the population estimates in Table 2.

Table 2. Population estimates, Phong Dien District

District/Commune	Area (ha)	Households	Population
Phong My border region	39,400	897	4,431
Phong Xuan border region	15,740	964	4,900
Phong Son border region	11,530	1,852	10,441
Phong Dien district border region	66,670	3,713	19,772
Ha Long	55	284	
Khe Tran	18	91	
Per annum population growth rate		1.52 per cent	

Source: Trai and Richardson (1999); Trai et al. (2001)

Extrapolation was limited to the populations in the region bordering the reserve; these people extract the majority of NTFP resources from the reserve and are its immediate economic beneficiaries. The results were compared to per capita agricultural output estimates for the district (Table 3).

Table 3. Estimated value of per capita agricultural output, Phong Dien District

	Unit	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gross agriculture output converted to paddy	ha	23,268	24,931	20,976	20,388	30,294	30,880	32,776	29,239	35,090	32,059
of which paddy	ha	19,111	21,174	17,834	16,822	26,428	27,602	29,806	26,893	33,283	30,001
Sown area of food crop	ha	10,513	10,660	10,100	10,345	10,280	10,050	10,084	9,844	9,916	9,582
Population		87,630	89,994	92,172	93,980	96,073	97,052	98,031	99,011	99,990	100,969
of which rural		87,630	89,994	92,172	93,980	96,073	94,907	94,907	94,907	94,907	94,907
Per capita agric. output in paddy rice equivalent	kg	266	277	228	217	315	325	345	308	370	338
Farm gate price of paddy	d/kg										1,550
Exchange rate	d/US$										14,749
Vietnam CPI for food staples	%	*10.6	*10.6	*10.6	*10.6	*10.6	10.6	35.2	6.1	–3.4	19.1

*Source: Phong Dien Department of Statistics, IMF (2002); *estimated figure*

Due to the limited data, the economic contribution of NTFPs relative to other income sources may be substantially understated in this case study, which is based only on the contribution of rattan and hunting and trapping. Trai et al. (2002) suggest that other NTFPs are traded and consumed by local inhabitants; they include scented wood and resins, tannins for pigments, bamboo and honey as well as ornamental, edible and medicinal plants. Quantity and market value information was not available and was therefore excluded from this analysis.

In the second step, management responses were identified that would maintain the reserve's biodiversity.

Results

Reliance on NTFPs in the border region of the Phong Dien Nature Reserve is low, with a total value between 490 and 507 million dong in 2001 (Table 4). This value compares to an estimated total agricultural output for the region of 10.7 billion dong. The importance of NTFPs relative to other income sources has decreased substantially during the past decade, due to a drop in NTFP availability outside of the reserve's core zone and increased reliance on agricultural production (particularly wet rice cultivation). The Phong Dien Nature Reserve region has been heavily exploited since the 1970s, so NTFP use has been declining for more than 30 years (Trai et al. 2001).

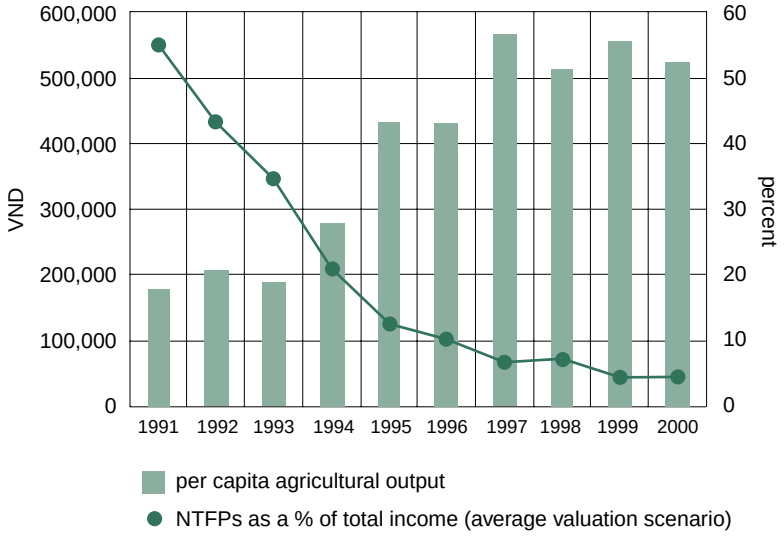
On a per capita basis, NTFP contribution to local livelihoods in the Phong Dien border region decreased from between 97,000–115,000 dong per annum in 1990 to approximately 24,500 dong per annum in 2001 (Table 4). Over the same period, per capita agricultural output increased from 177,000 dong to 525,000 dong per annum. The result is a decrease in the relative importance of NTFPs to local incomes, from a level between 50–60 per cent of total per capita income in 1991 to 4–5 per cent in 2000 (Figure 7).

Table 4. Estimated value of NTFPs by Phong Dien border region residents, 1990–2001

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Vietnam dong (millions)												
Rattan												
Low	906.93	817.27	727.61	637.96	548.30	502.50	337.50	225.00	252.00	45.00	45.00	45.00
Average	1,058.08	953.48	848.88	744.28	639.68	586.25	393.75	262.50	294.00	52.50	52.50	52.50
High	1,209.24	1,089.70	970.15	850.61	731.07	670.00	450.00	300.00	336.00	60.00	60.00	60.00
Wildlife												
Low	761.47	759.84	758.20	453.93	452.94	451.94	450.94	449.93	448.92	447.90	446.92	445.93
Average	761.70	760.06	758.43	454.07	453.07	452.08	451.07	450.06	449.05	448.03	447.05	446.06
High	761.92	760.29	758.65	454.20	453.21	452.21	451.21	450.20	449.18	448.17	447.18	446.19
Total												
Low	1,668.40	1,577.11	1,485.82	1,091.89	1,001.24	954.44	788.44	674.93	700.92	492.90	491.92	490.93
Average	1,819.78	1,713.55	1,607.31	1,198.35	1,092.76	1,038.33	844.82	712.56	743.05	500.53	499.55	498.56
High	1,971.16	1,849.98	1,728.80	1,304.81	1,184.27	1,122.21	901.21	750.20	785.18	508.17	507.18	506.19
US$												
Rattan												
Low	61,491	55,412	49,333	43,254	37,175	34,070	22,883	15,255	17,086	3,051	3,051	3,051
Average	71,739	64,647	57,555	50,463	43,371	39,748	26,697	17,798	19,934	3,560	3,560	3,560
High	81,988	73,883	65,778	57,672	49,567	45,427	30,511	20,340	22,781	4,068	4,068	4,068
Wildlife												
Low	51,629	51,518	51,407	30,777	30,710	30,642	30,574	30,506	30,437	30,368	30,302	30,235
Average	51,644	51,533	51,422	30,786	30,719	30,651	30,583	30,515	30,446	30,377	30,311	30,244
High	51,659	51,548	51,437	30,795	30,728	30,660	30,592	30,524	30,455	30,386	30,319	30,252
Total												
Low	113,120	106,930	100,740	74,032	67,885	64,712	53,457	45,761	47,523	33,419	33,353	33,286
Average	123,383	116,181	108,978	81,250	74,090	70,400	57,280	48,313	50,380	33,937	33,870	33,803
High	133,647	125,431	117,215	88,468	80,295	76,087	61,103	50,864	53,236	34,454	34,388	34,321

Between 1995 and 2001, rattan extraction from the reserve fell by 90 per cent, as a result of stocks being overexploited between 1991 and 1997 in response to high foreign demand. Income and subsistence from hunting and trapping of wildlife also declined, due to decreased availability in the reserve (Figure 8). Generally, hunting (primarily in the form of trapping) is now conducted only in conjunction with rattan collection in the reserve's core zone. Species that continue to be hunted and trapped include bear, civets, crested argus, pangolin, pheasants, porcupine, various turtle species, water monitor and wild pig. Recent research (Trai et al. 2002) suggests that villagers have little remaining economic incentive to hunt, and are motivated more by cultural and recreational reasons.

Figure 7. Estimated NTFP market value as a percentage of agricultural output, 1991-2000



Total agricultural output, expressed in paddy rice equivalent, increased between 1994 and 2000 by approximately 70 per cent; this amounted to 4 to 6.8 million tonnes in the reserve's border region of Phong Dien district (Figure 8). The increase was due to several factors. During the past decade, settled agriculture increased significantly, encouraged by higher economic returns and government policies (particularly a 1995 agriculture-forestry resettlement program). The introduction of irrigation technology into the region allowed many villages to expand wet rice production, making it the area's primary source of income. In the Phong Dien border region, villages that had little land suitable for wet rice cultivation increased cultivation of crops such as maize and peanuts and diversified into government-supported plantation establishment.

Figure 8. NTFP extraction and agricultural output, Phong Dien border region, 1990-2001

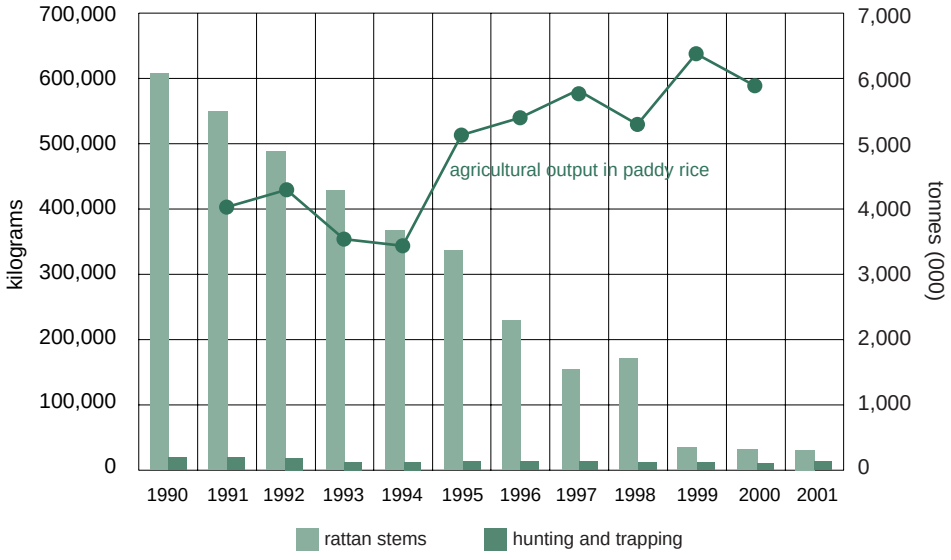


Table 5 lists the major crops grown in the region bordering the reserve; however, it must be stressed that each village is different and the diversity of cropping practices is greater then the figures would indicate (Trai et al. 2001). Evidence suggests that NTFP extraction practices are closely linked to villages' seasonal

planting calendar (Trai et al. 2002). This means that increased agricultural activity during the past decade will have decreased labour availability for NTFP collection.

Table 5. Agricultural production (in ha) in the Phong Dien Buffer Zone, 1997

	paddy rice	hill rice	cassava	maize	peanuts	potatoes	sugarcane	beans	total
Phong My	150	30	—	1	74	72	450	30	807
Phong Xuan	470	—	110	2	150	110	293	—	1,135
Phong Son	447	—	121	2	246	121	52	3	992
Total	1,067	30	231	5	470	303	795	33	2,934

Source: Phong Dien Department of Statistics

Management response

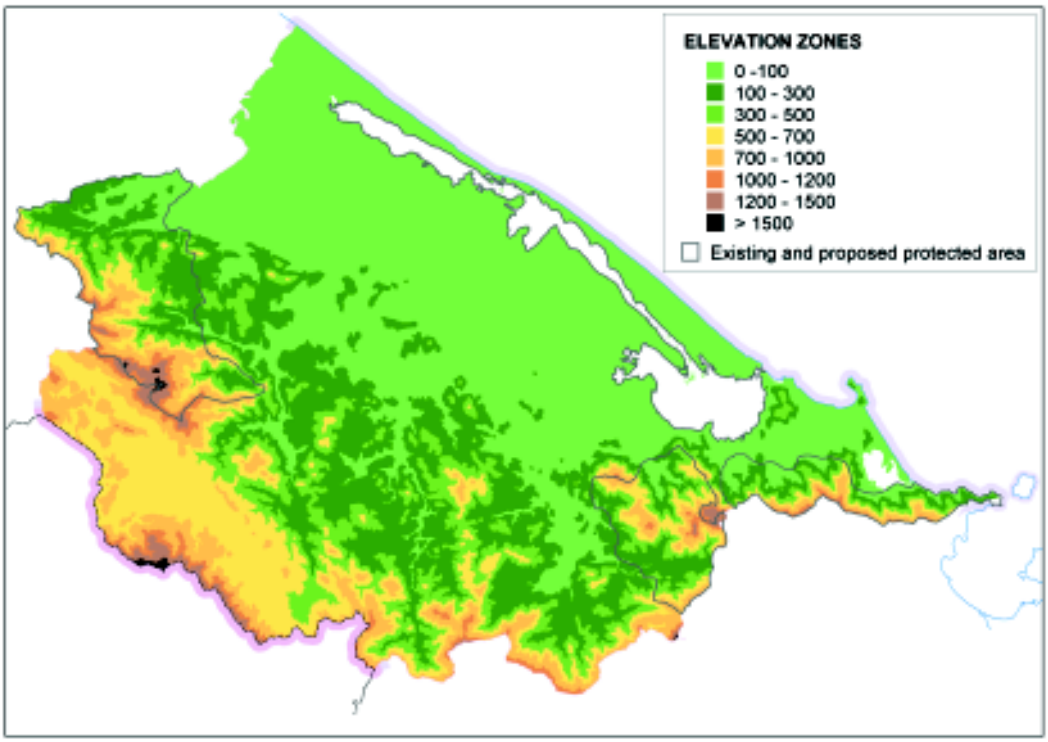
In terms of management of the Phong Dien Nature Reserve, even the remaining low levels of rattan extraction and hunting and trapping pose a substantial threat to the remaining resources. In the case of wildlife, this will result in direct pressure on valuable species from hunters and indirect pressure through the reduction in levels of prey species. Because NTFP collection and hunting currently contribute relatively little to household economies in the Phong Dien buffer zone, alternative income generating activities — to dissuade locals from collection and hunting in the reserve — will likely not be needed. The focus should be on the development of community and environmental awareness strategies to discourage local rattan collection and hunting and trapping for cultural or recreational reasons. Park management will need to take action against specialist hunters who travel from other provinces in search of species of high value for trade. Preventative actions may include reducing or eliminating overnight NTFP collection visits, engaging local ex-hunters on a part-time basis or developing incentives to report hunting by those from outside the area.

The difficulty is that regulatory and financing arrangements for protected areas in Vietnam would not enable management boards to implement such initiatives. An alternative approach could be to allow local villagers to continue hunting more plentiful species for recreational purposes and to allow collection of NTFPs other than rattan as incentives for monitoring and reporting hunting activities by professional hunters from outside the area. Properly managed, this could allow for continuation of traditional cultural and recreational activities while helping threatened species to recover. Yet, currently all extraction from protected areas is illegal.

3.2 Protected areas and flood management

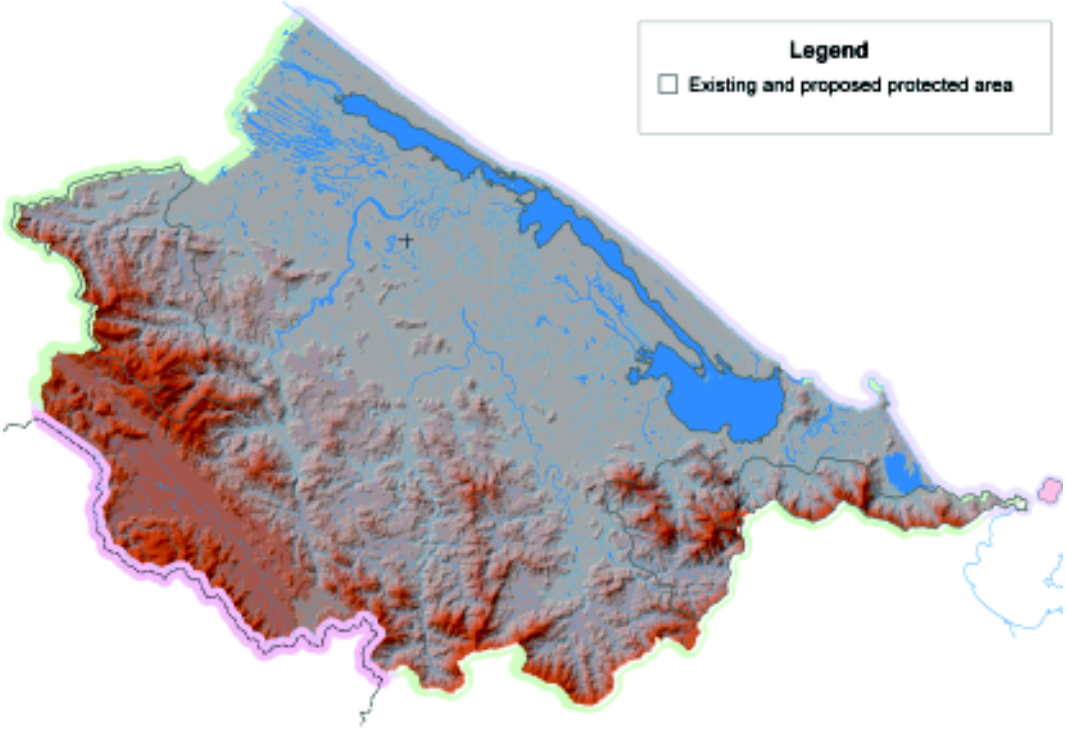
The steep hills that ring the coastal plain, rising to an altitude of 700 to 1500 metres, and the short distance to the sea (Figures 9 and 10) heighten the risk of flood in the province. The catchments draining to the sea have a length of only some 50 km, so in the monsoon season in October and November, when there is heavy precipitation in the mountains, the water drains quickly into the plain.

Figure 9. Elevation of Thua Thien Hue Province



The railway and north-south highway function as two-metre dams across the entire valley. While there are numerous culverts, bridges and other openings, the road and railway are likely to restrain the flow of water towards the coast. This may have a positive impact on lands upstream during dry periods by retaining moisture for agriculture.

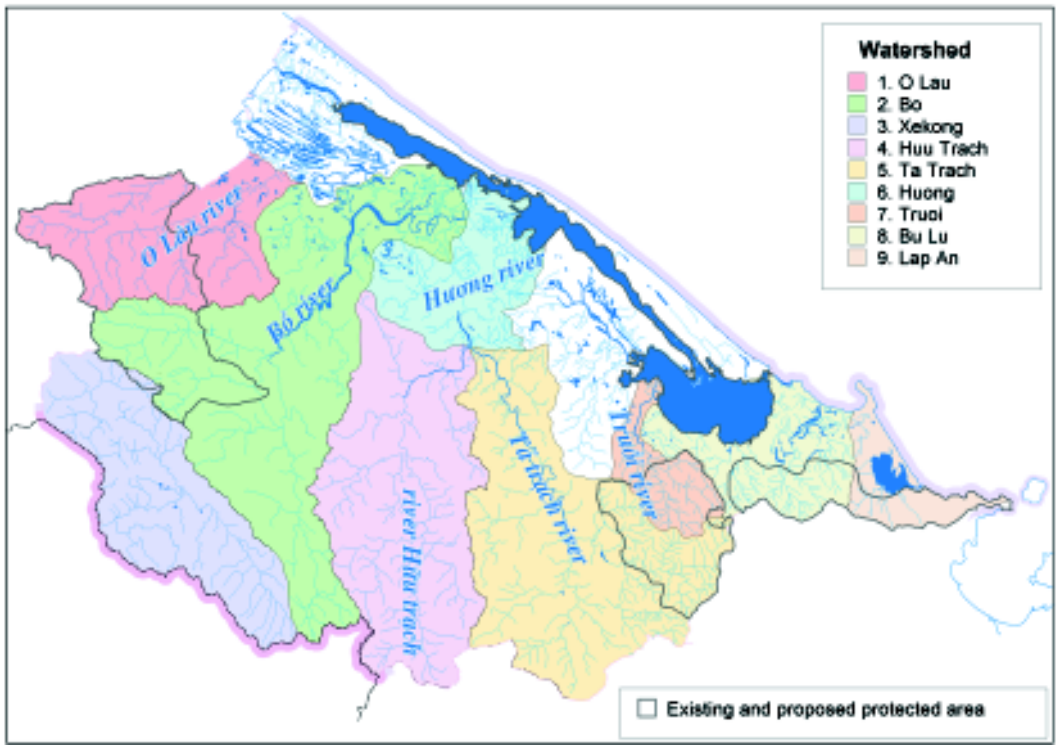
Figure 10. Drainage, Thua Thien Hue Province



During normal rainfall periods, these structures may have a limited positive effect downstream by acting as dams. During periods of intense rainfall and consequent peak flows, however, these structures probably increase the pressure and flood volumes at the few openings through to the lagoon area. It is this area that is most heavily populated and industrialised and most vulnerable to flood damage.

Given the terrain, the rainfall and the location of urban and industrial areas, the natural flood risk in the province is quite high. When forests are cleared, flood flows will increase. This effect decreases in importance as the distance from the site increases. The extent of soil compaction and reduced water infiltration associated with alternative land uses will also determine the extent to which flood discharge will increase during storms. There are also questions as to how fast and to what extent reforestation will lead to restoration of infiltration capacity (Bruijnzeel 2002).

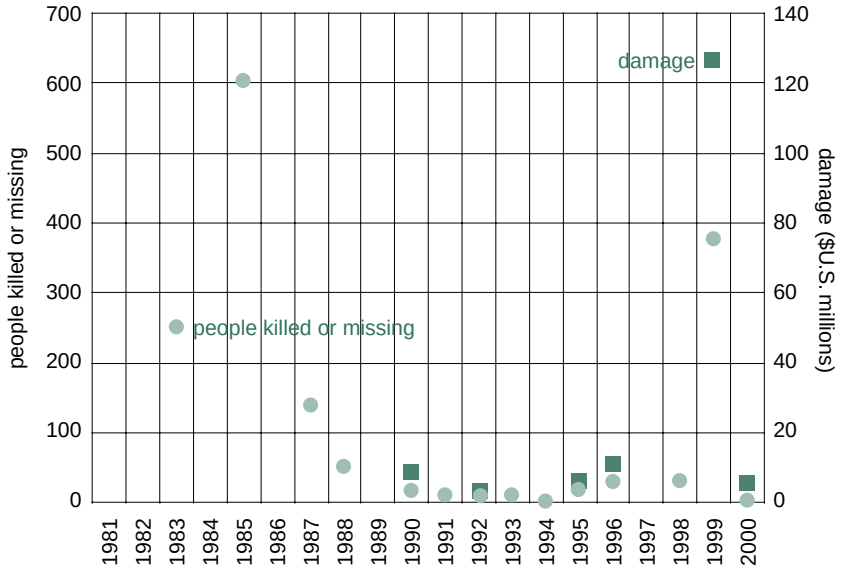
Figure 11. Catchment areas, Thua Thien Hue Province



Thua Thien Hue Province is an extreme case in terms of the potential effect of forest clearance. With the short, steep nature of the upland areas, deforestation and subsequent use of the land for different purposes — even for plantation forestry — are likely to increase flood severity. Maintaining existing forest cover through protection activities will contribute to mitigating flood damage. Whether reforestation will provide a similar contribution where land is already cleared will depend very much on the technology and species employed. Land preparation and planting using heavy machinery would reduce infiltration.

It was not possible to undertake a detailed analysis of the situation for this study, although data on investments in flood control engineering and past floods was collected. The data provides an indication of the economic importance of flood mitigation functions provided by special use forest and watershed protection forest areas. While loss of life and economic damage have fluctuated considerably over the years (Figure 12), the flood of November 1999 demonstrates the costs that can arise in the absence of effective flood mitigation: 373 people were killed or missing and economic damage exceeded US$100 million. While catastrophic events of this nature are not likely to be mitigated by changes in land use, protected areas in Thua Thien Hue Province can significantly ameliorate the damage caused by storms of lesser intensity.

Figure 12. Death and economic loss as a result of by floods, 1991–2000



Source: People's Committee of Thua Thien Hue Province, Steering Committee of Flood and Storm Resistance

3.3 Protected areas and water supply

The contribution of forests and other natural vegetation in limiting soil erosion and maintaining water quality is a well-recognised service provided by protected areas. The watershed protection forest and intact areas of the Special Use Forests in Thua Thien Hue Province can have an important impact on municipal and industrial water supply. Changes in water quality, particularly increases in sediment, can raise water treatment costs and necessitate the installation of ever more sophisticated and costly equipment in new treatment plants. This will increase as service is extended to new customers and consumption from existing connections increases.

The Thua Thien Hue Water Supply and Drainage Company operates five water treatment plants in the province. Three of them (Quang Te I, Quang Te II and Gia Vien) are located on the Huong River (Table 6). They have a potential capacity of 70,000 cubic m in a 24-hour period, and supply water to 375,000 people in and around Hue (Table 6 and Figure 13).

Figure 13. Annual water supply from water treatment plants on the Huong River, 1996-2000

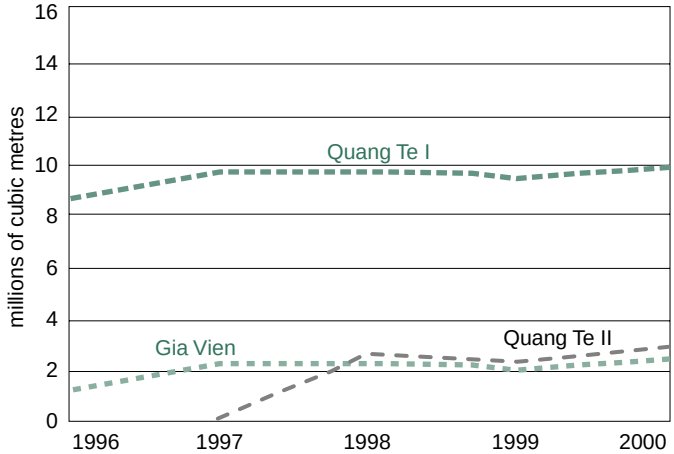


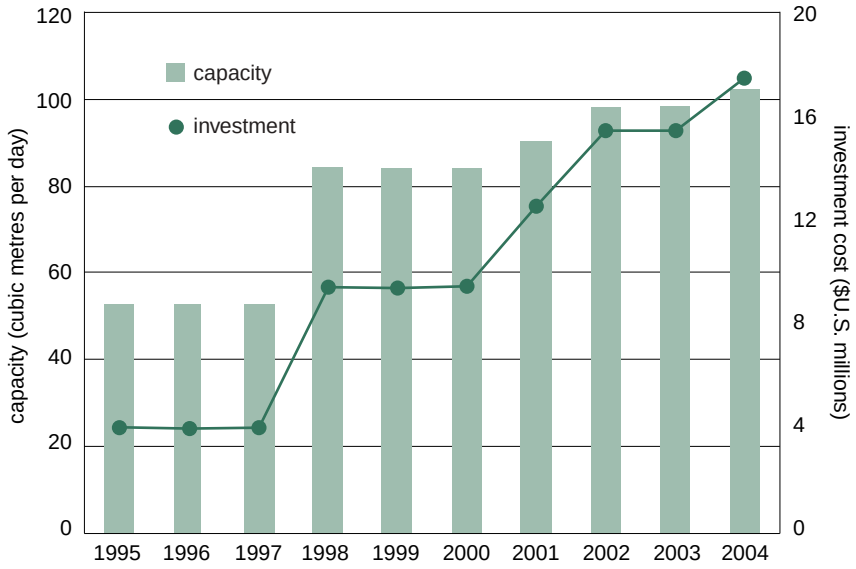
Table 6. Water treatment plants on the Huong River

Name	Quang Te I	Gia Vien	Quang Te II
Year commissioned	1909	1956	1998
Year renovated	1993–1995	1993–1995	—
Investment amount (US$)	2,500,000	1,500,000	3,000,000
Investment per m^3 of capacity (US$)	63	125	109
Average annual O&M cost (US$)	957,312	182,345	643,906
O&M as percentage of capital costs (%)	38	12	21
O&M cost per unit capacity (US$)	23.93	15.20	23.41
O&M per through-put (US$)	0.11	0.11	0.70
Estimated population served	168,000	32,000	113,000
People per m^3	4.2	2.7	4.1
Potential capacity (m^3/day-night)	40,000	12,000	27,500
Capacity used in 2000 (%)	59	36	9
Type of treatment	Horizontal settlement pressure filter	Vertical settlement pressure filter	Combined settlement pressure filter

O&M: Operations and maintenance

In the province 35 per cent of residents receive their water from Thua Thien Hue Water Supply and Drainage Company treatment plants. In Hue the percentage jumps to 95 per cent and for outlying districts the figures is about 10.5 per cent. Those who rely on surface or ground water are likely to be even more subject to the effects of land-use change on water quality than those who get their water from large centralised treatment plants.

Figure 14. Water treatment capacity and investment, 1995–2004



Source: Planning Bureau, Thua Thien Hue Water Supply and Drainage and Industry Bureau, Department of Planning and Investment

Changes in forest cover and land use over time also are likely to lead to the need for more treatment systems. By 2004 a total of nine such plants will be in operation. They will have a total capacity of 102,000 cubic m/day, service the needs of 370,000 people and reflect an investment over nine years of US$17.5 million (Figure 14).

Changes in water quality due to land use will also affect the costs of treatment. For the three existing plants in the province that operate at a reasonable capacity (36–59 per cent in 2000) annual treatment costs per cubic m are between US$0.11 and US$0.14. Costs for the other two plants, which operate well below capacity, are much higher. Initial analysis of data obtained from the Thua Thien Hue Water Supply and Drainage Company indicates that an improvement in downstream water quality due to better management of upstream watershed protection forests would significantly reduce the material costs of chemicals used in treating water. A full valuation of water quality benefits of improved forest management in the Huong River catchment is needed to confirm this conclusion.

3.4 Protected areas and industrial development

The connection between protected areas and industrial development might, at first glance, appear to be a tenuous one. Most industrial development depends on materials, labour, technology and financial capital. Yet, where water or biodiversity are directly employed as source materials — whether primary or secondary — protected areas can make a contribution. Water, for example, is used in bottling and the food industry. There are at least three other environmental services that protected areas (including those in Thua Thien Hue Province) provide to industry:

- primary production of raw materials, i.e. the protection of fish nurseries, which in turn support the commercial fishery;
- leads for technological development (so-called bio-prospecting), i.e. natural structures and properties that can be used or mimicked to develop new products such as pharmaceuticals, crops, bio-control, etc; and
- providing a “sink” for waste by-products of industry, i.e. a forest storing carbon can help reduce greenhouse gases.

Documenting such relationships requires primary research, since many of these support functions are unrecognised in traditional accounting and statistical methods. The importance of a few of these benefits in the province was investigated. Raw material processing industries — such as the US$10 million Huong River Marine Product Export-Import and the US$1.2 million Thua Thien Hue Fishery Product processing plants in Hue — are inextricably linked to the production of the raw material and, therefore to the ecosystems that support that production. Water is a primary input for the bottling industry, which includes the following investments:

- US$21.6 million in the Hue Beer Company, a joint venture between the Hue Beer Company and Denmark’s Tuborg Beer Corporation, established in Hue in 1993. It produces 50 million litres per year; and
- US$1.1 million in the Thanh Tan Mineral Water, a joint-stock company with the Peoples’ Committee of Thua Thien Hue. This plant was established in Phong Son Commune in 1998 and has a capacity of 2000 bottles per hour.

Since the Hue Beer Company, like many industries in and around Hue, receives its water from the Thua Thien Hue Water Supply and Drainage Company, its dependence on the potential watershed protection function of protected areas is one step removed. Thanh Tan Mineral Water obtains its water from hotsprings at the foot of the Phong Dien Nature Reserve. Further research is required to assess the reliance of this supply on the reserve's management. The Thanh company is also developing a spa and ecotourism resort at the springs. In the future, as the management of the reserve is put into place, there will be an opportunity to benefit from visitor access to the reserve's forest areas. The prohibition against visitors in nature reserves would need to be overturned for such economic activity to be fully developed.

Extractive industries also depend on a supply of fresh water. The Thua Thien Hue Mineral Exploitation Company, with an investment of US$1.1 million by the Industry Department, has been employed since 1998 in titan exploitation (approximately 20,000 tonnes/year). The company relies on water obtained directly from the Bo River. Other mineral extraction takes place at different sites throughout the province.

The ability of natural systems to process waste is important to industry. In many countries, environmental legislation strictly regulates the prevention or mitigation measures that industry must take. Ecosystem management can provide clean water, air and soil and high-quality materials to industries, or provide sinks where waste products can be reprocessed, diluted or stored. The Ngu Binh electric power generation company, in Hue, operates a 6.3-MVa diesel plant. It was built in 1989 and generates US$250,000 a year in power sales. The subsidised consumer price of electricity is US$0.05/kWh (665 dong/kWh) and the plant's annual operations and maintenance (O&M) cost is just under US$500,000. The plant uses 12,000 cubic m of water per year (from Hue Water Supply) for cooling purposes. Many other industries depend on water in this way, which demonstrates the need to accurately recognise the role of protected areas in waste processing. If environmental function is degraded the alternative is either to suffer the consequences to human health and quality of life or divert scarce financial resources to technological fixes. These options may well have higher costs than effective ecosystem management of protected areas.

3.5 Protected areas and agriculture

Agriculture, particularly paddy rice, is the predominant economic activity in the province's flat coastal plain. Cultivation makes up 64 per cent of the gross output of the agricultural sector. Paddy makes up 63 per cent of the cultivated area, 91 per cent of food output, and 44 per cent of gross agricultural output value. Only 6 to 7 per cent of paddy area is irrigated (Table 7). Some irrigation water is derived directly from rivers and lakes; some comes from dams. Six dams are in operation and supply irrigation water (Table 8); only one is large (over 15 metres high) and their total useable volume is 23 million cubic m. A number of large irrigation or multipurpose dams are either in construction (Ha Truoi) or in the planning stage (Ta Trach and Khe Ngang). The Ta Trach dam's useable volume, 500 million cubic m, will dwarf the capacity of other dams. It will supply water to 25,900 ha of paddy, half the total paddy in the province.

Table 7. Irrigation projects in Thua Thien Hue

	Projected		Actual (2001)			
	Spring paddy	Autumn paddy	Spring paddy	Autumn paddy	No. of producers served	Projected crop value US$ per yr
Su Lo (Phu Vang)	250	150	100	150	150	170,333
Phu Ho (Phu Vang)	n/a	30	n/a	30	30	20,440
Phu Mau 1 (Phu Vang)	100	n/a	94	n/a	94	64,113
Vong Tri (Phu Vang)	100	100	100	90	100	129,453
An Luu (Phu Vang)	95	85	95	77	95	117,189
Phu My 1 (Phó Vang)	160	151	149	145	149	200,312
Thuy Phu 2 and La Nga (Huong Thuy)	n/a	20	20	n/a	20	13,627
Thuy Luong (Huong Thuy)	20	50	n/a	50	50	34,066
Huong Xuan (Huong Tra)	600	600	148	148	148	201,674
Phu Thanh (Tu Ha)	250	250	84	90	90	118,552
Phong Hien (Phong Dien)	250	250	80	100	100	122,640
Pho Ninh (Phong Dien)	280	280	65	70	70	91,980
Phong Son (Phong Dien)	650	650	44	46	46	61,320
Vinh Phu (Quang Dien)	600	600	246	248	248	336,579
An Gia 1 (Quang Dien)	300	300	79	102	102	123,321
Quang Tho (Quang Dien)	400	400	198	190	198	264,357
Chuong Binh (Phong Dien)	800	800	85	150	150	160,113
Total irrigated area	4,855	4,716	1,587	1,686	1,840	2,230,069
Total area in paddy			26,504	24,837		
Irrigation as a percent of total paddy area (%)			6	7		

n/a: not available

The benefits that protected areas provide to irrigation systems — including dams, pump stations and canals — include prevention of erosion and transport of sediment in the rivers that feed these systems. Sedimentation of dams and canals can affect the productivity of irrigation systems, both by reducing the live storage capacity (the volume above the out-take) or by raising O&M expenditures by necessitating dredging and accelerating equipment maintenance and replacement costs. Sedimentation can also shorten the lifespan of dams by reducing their storage capacity. No studies of the economic benefit of protected areas have been conducted in the province, but lessons can be drawn from international experience (Aylward, in press). Table 8 is a preliminary assessment of the potential benefits that Bach Ma NP might provide to the Ha Truoi dam and reservoir.

Table 8. Irrigation dams in Thua Thien Hue Province

Name	Operated by	River	Location	Year complete	Invest. (US$)	Average annual O&M	Height (m)	Usable vol. (m^3)
Mi Xuyen	Huong River's North Irrigation Mgmnt Co.	Mi Xuyen lake (sandy region)	Phong Hoa Commune Phong Dien District	Before 1975	—	1,000	7	1,050,000
Chau Son	Huong River's South Irrigation Mgmnt Co.	Cau Vuc	Thuy Phuong Commune Huong Thuy District	1977	—	1,000	8	2,500,000
Tho Son	Huong River's North Irrigation Mgmnt Co.	Soc Chang	Huong Thuy District	1978	—	6,000	14	3,500,000
Phu Bai 2	Huong River's South Irrigation Mgmnt Co.	Phu Bai	Thuy Phu Commune Huong Thuy District	1982	3.5 million	1,000	12	5,600,000
Nam Gian	Huong River's North Irrigation Mgmnt Co.	Niu	Quang Thai Commune Quang Dien District	1995	80,000	2,800	5.2	660,000
Hoa Mi	Huong River's North Irrigation Mgmnt Co.	Rao Cao (O Lau branch)	Phong Mi Commune Phong Dien District	1995	5 million	5,000	29.6	9,670,000
Ha Truoi	TBD	Truoi	Bach Ma NP	2002	11 million	TBD	60	73,000,000
Ta Trach	MARD	Ta Trach	Duong Hoa Commune Huong Thuy District	2008	80-140 million	TBD	55	509,800,000
Khe Ngang	TBD	Tu Ca (Huong branch)	TBD	2005	3 million	TBD	10	12,000,000

TBD = to be determined; n/a = not available

Case Study 2: Ha Truoi Reservoir and watershed protection

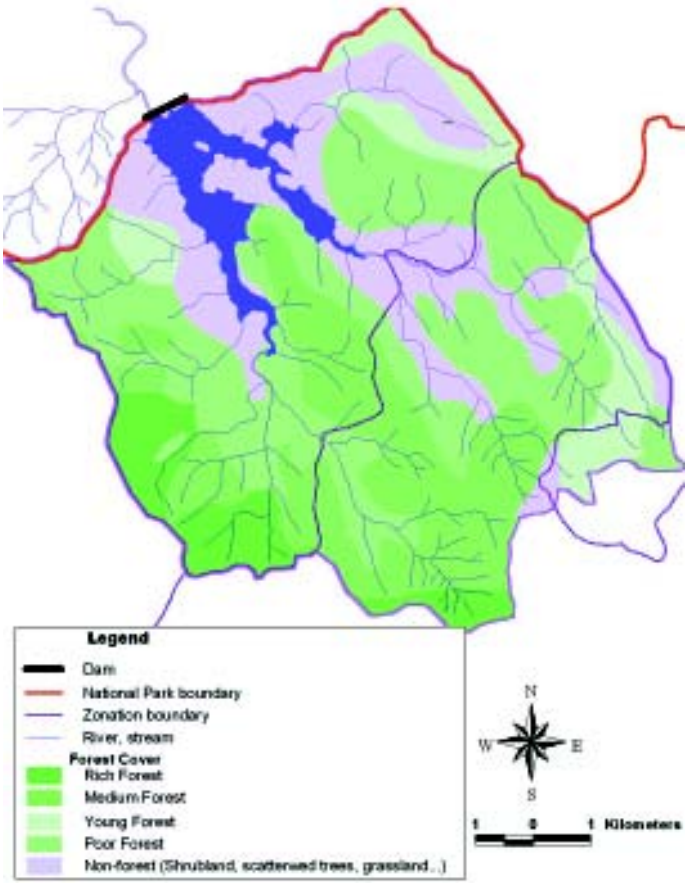
The Ha Truoi dam and reservoir are scheduled for completion in 2003 at a total cost of some US$11 million (164 billion dong). The dam is on the Ha Truoi River, on the border of the Bach Ma NP with the reservoirs inside the park (Figure 15). It is 60 metres high and has a useful storage of 73 million cubic m at high-water level (47.86 m). The dead storage of the reservoir (the volume below the out-take) is 4.18 million cubic m. The dam is expected to provide irrigated water supply to 8,697 ha and have a life of 40–50 years. With irrigation, annual crop production values are expected to rise from US$4.9 million to US$8.1 million.

The reservoir drains an area of 7,330 ha. At high-water level the reservoir will flood approximately 415 ha of the ecological restoration zone of the park, leaving a land area of 6,915 ha. That area is divided as follows:

- an ecological restoration zone of 4,030 ha, 66 per cent of which is forested, with an average slope of 22 degrees;
- a core zone of 2,697 ha, 83 per cent of which is forested, with an average slope of 30 degrees; and
- an administrative zone of 188 ha, 91 per cent of which is forested, with an average slope of 34 degrees.

This case study assesses the potential contribution to irrigation of the watershed protection function of the intact primary forest in Bach Ma NP's core protected zone. It also evaluates the potential contribution of improved management of the ecological rehabilitation zone of the park. The emphasis is on the effect of primary forest and reforestation on soil erosion. Estimates of soil erosion with and without forest cover are not available for the site, nor are the parameters for using established models to calculate them. Instead, representative values — drawing on international experience — are analysed, including ways in which changes in these parameters might influence outcomes. The key factor in estimating erosion rates is the natural erosion risk (slope, rainfall intensity and other biophysical characteristics) and the area's land-use.

Figure 15. Bach Ma National Park and Ha Truoi Reservoir watershed



Methods and parameters

Based on a general knowledge of the Bach Ma area and data for tropical forest systems (Table 9) it can be concluded that the natural erosion hazard is quite high. The driving factors are likely to be slope and high rainfall levels. From local knowledge it is assumed that deforestation of the core area is for the purpose of harvesting timber, followed by forest plantation or tree crops (with little to no ground cover). Erosion rates for the core zone are estimated to be six tonnes/ha/yr under forest and 50 tonnes/ha/yr following deforestation, with a second, high-erosion scenario in which erosion rates reach 100 tonnes/ha/yr. In the ecological zone, with lower slopes and natural ground cover in the non-forested areas the erosion rate under forest is estimated to be three tonnes/ha/yr and the rate for current areas under natural regeneration is set to six tonnes/ha/yr. Following reforestation, the rate is assumed to fall to three tonnes/ha/yr. In the high-erosion scenario the rate for regenerating areas is set to 25/tonnes/ha/yr. The same figures are used for the administrative zone as for the core zone.

Calculating the economic costs of deforestation in the core zone and the benefits of reforestation in the ecological zone uses a series of parameters and variables, the initial values of which are presented in Table 10.

Table 9. Surface erosion in tropical forest and tree crop systems

(tonnes/ha/yr)	No.locations	No.treatments	Minimum	Median	Maximum
Natural forest	18	27	0.03	0.3	6.2
Shifting cultivation, fallow period	6	14	0.05	0.2	7.4
Plantations	14	20	0.02	0.6	6.2
Tree crops with cover crop/mulch	9	17	0.10	0.8	5.6
Shifting cultivation, cropping period	7	22	0.4	2.8	70
Tree crops, clean-weeded	10	17	1.2	48	183
Forest plantations, litter removed or burned	7	7	5.9	53	105

Source: Wiersum (1984) in Bruijnzeel (1990)

The valuation exercise seeks to determine for a given scenario (a) the dead storage available at the end of the 50 years (i.e. whether the project's life has been shortened), and (b) the loss of live storage capacity and whether it causes a shortfall in production. The effects are then assessed based on the expected net annual profits of the project per cubic m of water. The values from a scenario without land-use change are then compared to different scenarios that include land-use change.

Table 10. Parameters and variables for estimating watershed protection benefits

Erosion rates			
Ecological zone	Unit	Base	High
Forest	tonnes/ha/yr	3	3
Non-forest	tonnes/ha/yr	6	25
Core zone			
Forest	tonnes/ha/yr	6	6
Non-forest	tonnes/ha/yr	50	100
Administrative zone			
Forest	tonnes/ha/yr	6	6
Non-forest	tonnes/ha/yr	50	100
Sediment delivery rate (%)		50	
Density of soil	m^3/tonne	1.00	
Deposition of suspended sediment (%)			
Dead storage		75	
Live storage		25	
Time to full establishment of Ha Truoi command area	years	10	
Annual water requirement at full command area	million m^3	55.2	
Average productivity of irrigated water	US$/$m^3$	0.06	
Time horizon for the analysis	years	50	
Discount rate (%)		10	

The calculations in Table 10 project land use for each of the three zones over a 50-year period and estimate the following for each year:

- the erosion and sedimentation produced by each area using the erosion rates, sediment delivery ratio, and density of eroded material;
- the resulting sedimentation to the live and dead storage volumes;
- impacts on dead and live storage volumes over time;
- if dead storage volume is exceeded prior to year 50;
- the loss of live storage and available storage each year;
- the yearly demand for water;
- any water shortfall; and
- the net value of production according to the water available in the live storage.

The final step is to discount the production values generated over the duration of the project.

These calculations were carried out for a range of scenarios. The change in net production between no land-use change and the current scenario was then measured to assess the extent to which the other scenarios improved or worsened the project's economics. It was expected that with deforestation the economics would worsen (i.e. suffer a fall in production) and that with reforestation the economics would improve (i.e. experience an increase in production). The land-use change scenarios for deforestation of the core zone and reforestation of the ecological zone were evaluated according to base and high erosion, and according to slow and rapid land-use change. For the core zone, a slow clearance was assumed to last 20 years (100+ ha/yr) and a fast clearance five years (450 ha/yr). For the ecological zone a slow reforestation was assumed to take ten years (140 ha/yr) and a rapid reforestation five years (275 ha/yr).

Results

The analysis produced two scenarios of no land-use change (with base and high erosion rates) and eight sets of results that include land-use change. A summary of the results for the deforestation scenarios is presented in Table 11; the reforestation scenarios are found in Table 12. The objective was to assess whether protection of the core zone and/or reforestation of the ecological zone contribute to the irrigation sector by preventing erosion and sedimentation of the reservoir, thereby increasing production in the long run. Erosion and sedimentation rates are altered in all scenarios — with consequent impacts on live and dead storage volumes — yet the impacts are not catastrophic even with the greatest degree of change.

In the deforestation calculation, the high erosion rate does lead to the reservoir's filling, but only after 40 years. The scenario of total sedimentation of the reservoir is not valued explicitly in the model as it is unlikely that the project would shut down. More likely, a watershed management program would be undertaken once the problem became obvious or dredging would be carried out. The dam does not have full sluice gates so flushing the sediment is not an option. An alternative would be to raise the out-take, though this would cut into production.

In terms of live storage volume and impact on irrigation, all scenarios demonstrate a negative impact on production. The high erosion rate scenarios have the most significant impact. The loss of production is valued at US$83,000–198,000 in present value terms. In conclusion, the irrigation project is receiving a modest level of watershed protection benefits from Bach Ma NP. Across the forest areas in the core zone these benefits are between US$56 and US$116 per ha.

Table 11. Scenarios for deforestation of the core zone

		Base/high erosion		Base erosion		High erosion
Totals over 50 years	Units	No land-use change	Slow defor.	Rapid defor.	Slow defor.	Rapid defor.
Erosion	million tonnes	2.7/5.2	6.7	7.4	13.7	15.3
Sediment delivered	million m^3	1.4/2.6	3.4	3.7	6.9	7.7
Dead storage remaining at 50 yrs	million m^3	3.2/2.2	1.7	1.4	(1.0)	(1.6)
Dead storage fills	year	—	—	—	42	37
Cumulative loss of live storage million	m^3	0.3/0.7	0.8	0.9	1.7	1.9
Live storage at 50 yrs	million m^3	64.7/56.7	54.1	50.2	34.2	25.8
Shortfall in supply	million m^3	0	1.4	16.7	152.9	70.1
Production	US$million	22.1	22.1	22.1	22.0	21.8
Change in production	US$		– 1,000	– 10,000	– 125,000	– 261,000

The reforestation scenario does indicate lower erosion and sedimentation rates, only marginally in the low erosion case but more significantly in the high erosion scenario. Despite these decreases there is no effect on production. This is a consequence of the results obtained in the no land-use change scenario. Apparently the project is built with a tolerance even for the higher erosion rates: even at these rates water demand can be met each year. Thus, there is no benefit gained from the reduction in sediment under reforestation.

The model has a shortcoming. It does not account for annual variation in reservoir inflow. Another issue to consider is the change in dry season flow or ground water seepage into the reservoir from the ecological zone under regeneration and reforestation. Apart from its control of erosion, would reforestation increase or decrease water availability?

Table 12. Scenarios for reforestation of the ecological zone

		Base/high erosion		Low erosion		High erosion
Totals over 50 years	Units	No land-use change	Slow refor.	Rapid refor.	Slow refor.	Rapid refor.
Erosion	million tonnes	2.7/5.2	2.5	2.5	3.8	3.8
Sediment delivered	million m^3	1.4/2.6	1.3	1.3	1.9	1.9
Dead storage remaining	million m^3	3.2/2.2	3.2	3.2	2.7	2.8
Cumulative loss of live storage	million m^3	0.3/0.7	0.3	0.3	0.5	0.5
Live storage at 50 yrs	million m^3	64.7/56.7	65.2	65.3	60.7	61.2
Shortfall in supply	million m^3	0	0	0	0	0
Production	US$million	22.1	22.1	22.1	22.1	22.1
Change in production	US$		0	0	0	0

3.6 Protected areas and energy development

Protected areas can provide benefits to the energy sector, both subsistence and commercial energy. The sustainable harvest of firewood from protected areas helps meet the energy needs of rural and urban communities. In 1995, 14 per cent of gross output came from firewood, although it is not possible to determine how much of this amount came from protected areas or protected watersheds. The amount of firewood collected is on the decline in the province, falling by more than half from 1996 to 2000.

Protected areas also contribute to the energy sector by protecting watersheds above hydro-electric schemes, providing benefits along the lines of those described in Case Study 1. At present there are no hydro-electric dams in the province. There are plans to build the Ta Trach Dam on the Ta Trach River, including a possible 12–18 MW hydro-electric facility. The dam's primary purpose is irrigation and flood control. It is planned to be 55 metres high and will flood a large area (71,700 ha) of the upstream catchment. Most multipurpose dams rely on the sale of hydro-electric power to generate cash flow (Ljung 2000). In the case of Ta Trach, cost estimates range from US$50–140 million. Much of the Ta Trach catchment is forested and classified for watershed protection, and could provide important support for this scheme. In terms of energy production, though, the benefits would be minimal given the dam's small power capacity and its primary use for irrigation and flood control.

3.7 Protected areas and fisheries

Commercial and subsistence fisheries in Thua Thien Hue Province consist of lagoon and coastal fisheries. The lagoon fishery (including Tam Giang and Cau Hai, contiguous water bodies) includes both aquaculture and capture fisheries (Table 13). The fisheries' gross annual output is US$20 million, three-quarters of which is produced by capture fisheries. Aquaculture production is four times more valuable than the capture fishery. Much of this value derives from shrimp culture (fish and shrimp are farmed in equal proportions but the shrimp are much higher in value). In constant 1994 dong terms the value of shrimp output was nine times that of fish. In the case of the capture fishery, the coastal fishery produces five times the catch of the lagoon fishery but accounts for only three times the value. According to the data in Table 13, the lagoon capture fishery may be worth in the order of US$4 million per year.

Table 13. Capture fishery and aquaculture production and value in 2000

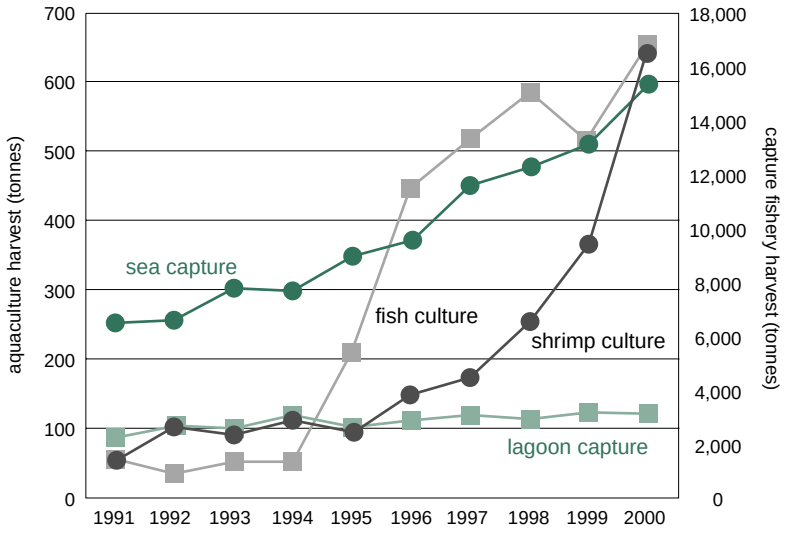
	Area (ha)	Harvest tonnes	Value m/dongs	US$million	Unit value US$/kg
Capture					
Lagoon		3,099			
Coastal		15,430			
Subtotal		18,529	222,003	15.7	0.85
Aquaculture					
Shrimp	1,770	649			
Fish	630	657			
Other	218	161			
Subtotal	2,618	1,467	73,987	5.2	3.56
Total		19,996	295,990	20.9	1.04

Note: Value figures in 2000 prices; Source: Thua Thien Hue Statistical Yearbook 2001

Aquaculture areas encroach on the surface area of the lagoon. Large areas of the lagoon have been encircled by earth bunds or staked netting and are used for shrimp and fish production. In 2000 the area in production totalled 2,618 ha, somewhat less than ten per cent of the lagoon area. It is unclear whether these figures include moribund ponds close to shore. The pond fishery suffers from an open access problem; since the ponds are built outwards into the lagoon, the ponds closest to shore have problems in access to water and water quality. There is a continual leapfrogging effect as pond owners compete to have access to the waters of the lagoon.

Nonetheless, shrimp and fish production in the lagoon has shown an almost exponential growth in the 1990s (Figure 16). Catch from the coastal (sea) fishery have also grown over this period, effectively doubling since 1991. In fact the only fishery to remain stable in terms of catch (in tonnes) has been the lagoon capture fishery. A discussion of why this might be the case is found in Case Study 3.

Figure 16. Trends in harvests from the capture fishery and aquaculture, 1991-2000



Source: Thua Thien Hue 1996 and 2001

Many of the same issues regarding watershed protection provided by protected areas in Thua Thien Hue Province come into play. The lagoon, coastal and culture fisheries rely on two main natural ecosystem functions provided by protected areas. First, water quality in the lagoon depends very much on the timing and quantities of discharge from the O Lau, Bo, Huong and Truoi Rivers. Water from these rivers helps regulate salinity levels in the lagoon. In large part salinity levels (and their timing) determine the productivity and species composition of the lagoon fishery. The lagoon serves as a breeding and nursery ground for species that spend their adult lives in the sea, and there is a direct connection between ecosystem well-being and the productivity of the coastal fishery.

Fresh inflows during the dry season have an important effect on salinity levels in spawning and rearing areas. There is an assumption that forests act as a sponge, absorbing water in the wet season and releasing it gradually during the dry season, although this relationship between forest cover and dry season base flow is not well understood.

Changes in transpiration will occur with a change in vegetative cover and infiltration capacity as new land uses and management practices affect soil compaction (Bruijnzeel 1990). The majority of experimental evidence suggests that lower dry season flows may result from reforestation activities (Lamb and Gilmour

2000). Further, there are important questions as to the speed and degree to which the infiltration capacity of degraded lands will be restored following reforestation (Bruijnzeel 2002). For these reasons, and in the absence of substantial evidence regarding the hydrological role of restored forests in Thua Thien Hue Province, it is best to be cautious about the degree of support they would provide to the lagoon fishery. In any event, the combination of engineering works designed to channel water quickly through to the lagoon and other flood works, as well as irrigation infrastructure development, may well have a more profound impact on inflow patterns over time.

The issue of mangrove forest rehabilitation and restoration of other wetland habitats within the lagoon is another matter. Providing breeding and rearing sites for native fish populations will support the lagoon and coastal fisheries. The impact of this nursery function on aquaculture will depend on the extent to which farmers rely on the natural supply of fry and fingerlings from the lagoon (instead of hatchery-reared fish and shrimp). The impact on capture fisheries is more certain; the impact on coastal fisheries will depend on the proportion of catch derived from species that depend on the lagoon areas.

Case Study 3: Nursery protection in the Tam Giang and Cau Hai lagoons

A proposal has been made to protect a large portion of the Tam Giang and Cau Hai Lagoons, and so protect a series of important breeding and rearing sites. These include some of the few remaining intact stands of mangroves in the lagoon. These sites are dispersed throughout the lagoon area (Figure 17). The objective of this case study was to examine if establishing the protected area in Tam Giang Lagoon would help protect the nursery function of mangrove, seagrass and other nursery habitat for shrimp and fish species. The hypothesis of the case study was that protected area interventions would increase productivity (with an assumption that productivity had fallen due to destruction of habitat).

Figure 17. Important nursery sites in Tam Giang and Cau Hai lagoons

Methods

The case study consisted of two steps. In the first phase trends in productivity were assessed. While this would normally be done using a bioeconomic model relating area/quality of nursery areas to fish stock/catch it was recognised early in the study that it would be best to use data on catch, value and effort to assess if mobile lagoon and coastal fisheries have seen declining catch and/or catch per unit effort over time.

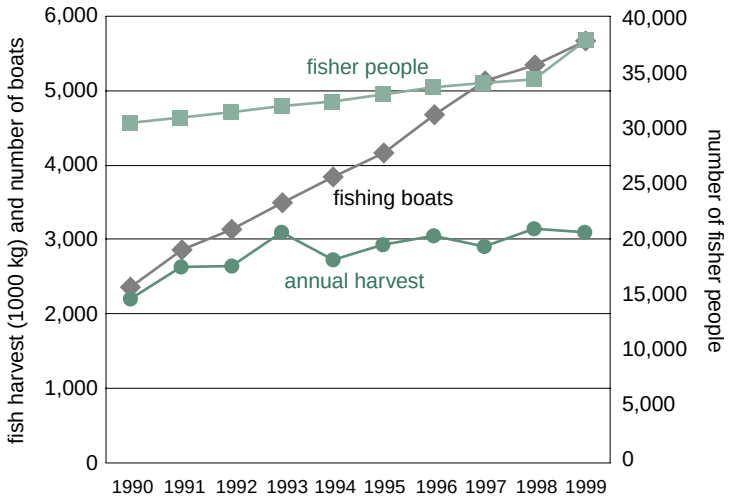
The second step in the study was to identify the management response to this problem. The existing plan to create a protected area in the lagoon is taken as the alternative to the status quo, given that it would be difficult to identify other measures that might be effective, such as removing blockages to flushing, nutrients and sediment.

The third step assessed the potential costs and benefits of the management response. It was envisioned that an indicator could be provided by gathering information on three indicator species over last ten years, with an estimate of what would happen in the future with and without the creation of the protected area.

Results

There is reason to be concerned about the status of the lagoon fishery. As discussed earlier and shown in Figure 18, the productivity of the lagoon fishery (in tonnes) has been more or less constant over the last decade, particularly in the last five years. This is in spite of the fact that the number of fishing boats and fisher people working in the lagoon fishery has continued to rise. This suggests that productivity per unit effort in the lagoon fishery is declining: more people in more boats are catching fewer and fewer fish.

Figure 18. Declining productivity in the lagoon fishery



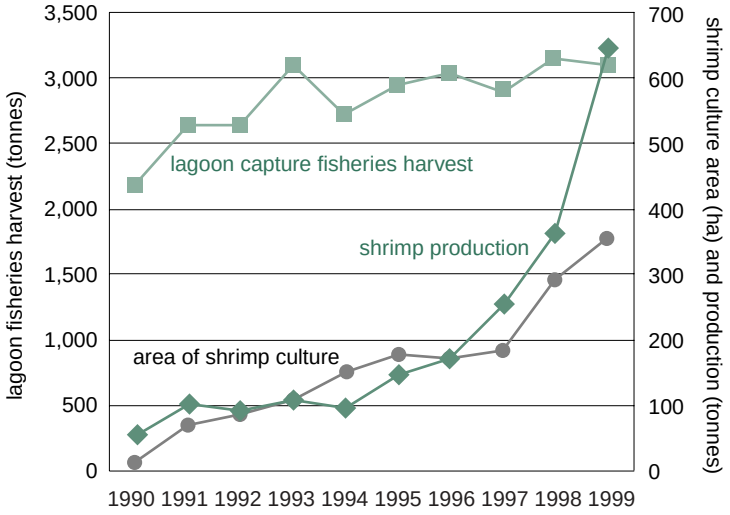
Source: Thua Thien Hue 1996 and 2001

While it would seem that the fishery has reached the limits of its productivity, a number of caveats must be kept in mind. First, the analysis depends very much on the data employed. Interviews with the Department of Fisheries in Hue reveal that the data on effort may not be accurate. The count of boats and fishers may only include those that enter the fishery and not those that exit. In other words new boats are counted, but boats that are retired from use or diverted to other uses or locations may not be. While inaccurate data would certainly compromise any conclusions, it is worth noting that the number of boats has multiplied threefold. There would need to be many omissions from the data to render the conclusion invalid.

There are other reasons that suggest the conclusion is correct. During the period in question the area and production under aquaculture has increased. Most — if not all — of this increase has come from shrimp culture. Figure 19 shows that as the productivity of the lagoon capture fishery has levelled off and the productivity per unit appears to have dropped, the area under fish culture has expanded rapidly.

If the annual increase in area under shrimp culture is adjusted by pi (to account for the area-to-radius relationship of a circle as the ring of shrimp ponds encircles and encroaches on the lagoon area) the resulting measure can be used to explain 92 per cent of the change in lagoon productivity. The measure is a highly significant predictor of fish production, indicating that the expansion of shrimp ponds is a good predictor of the slowdown in production from the lagoon capture fishery in the 1990s.

Figure 19. Lagoon capture fisheries and shrimp culture, 1990 to 1999



Source: Thua Thien Hue 1996 and 2001

The case study demonstrates that a) the fishery is in decline and b) the expansion of shrimp ponds is an important factor in this decline. This stands to reason, ecologically speaking, as the expansion of the ponds has meant the destruction or isolation of mangrove areas (left high and dry behind a wall of ponds) and other nearshore areas that support the nursery function. Such a result is consistent with findings elsewhere in Southeast Asia. There is a need to protect or restore nursery sites in the two lagoons. Further study of the effectiveness of the proposed sites in serving such a purpose — as well as analysis of the costs and benefits of establishing such protection — would be the next steps in justifying any investment in restoration.

3.8 Protected areas and tourism

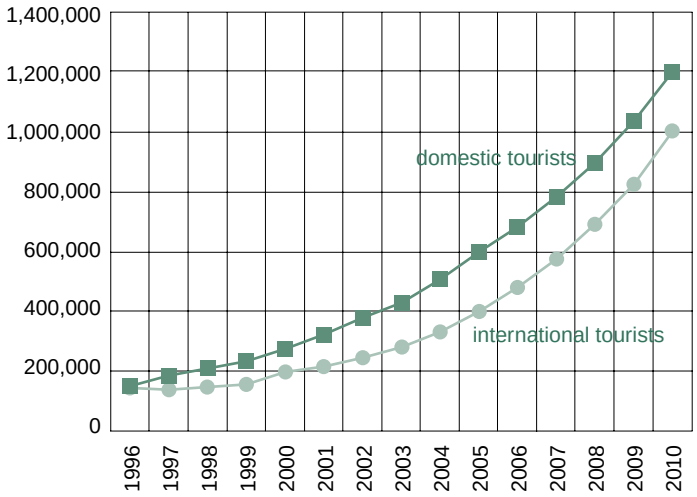
Thua Thien Hue Province has a variety of attractions for domestic and international visitors. Hue was the capital city of Vietnam during the Tay Son and Nguyen dynasties; in recognition of its cultural value the partially-restored citadel in the heart of Hue has been declared a UNESCO World Heritage Site. Tourists are also drawn to the ancient tombs located upriver from Hue on the Huong (Perfume) River. The province also boasts considerable natural attractions, including beaches, scenery and forested mountains.

Significant numbers of Vietnamese from other provinces visit Thua Thien Hue (some 275,000 in 2000). International tourism is also growing, with 195,000 international tourists visiting the province in the same period. In the future, international air service to Hue is likely to service this trade. The Five-Year Plan and

Ten-Year Strategy both call for continued and rapid growth in visits by both domestic and international tourists. The total number of visitors is expected to top two million per year by 2010 (Figure 20). To realise such growth, visits will need to increase by 15–20 per cent per year for the next ten years. Such growth rates are not unheard of in tourism, particularly when a site with strong cultural and ecological attractions becomes popular in the international market. The domestic market has, in fact, grown at these rates from 1996 to 2000. International visits grew less rapidly during this period although they did jump 15 per cent in 2000.

The economic impact of such rapid growth is likely to be positive. Hotels and restaurants already make up four per cent of the province's gross output, as does transportation and communications (not all of this output relates to tourism). According to the Thua Thien Hue Statistical Office the gross tourism turnover in 2000 came to US$13.4 million or three per cent of provincial output. Clearly, few sectors are likely to grow at a sustained rate of 15 per cent per year and the projections in the Five-Year Plan and Ten-Year Strategy indicate that the province expects tourism to grow in its share of provincial output and income.

Figure 20. Number of tourists, Thua Thien Hue Province, 1996–2010



Source: Thua Thien Hue 2001 and Five-Year Plan and Ten-Year Strategy for Thua Thien Hue Province

Hue's cultural history is a significant attraction for both domestic and international tourists. The Citadel in Hue, as a World Heritage Site, is also a protected area. It is safe to say that protected areas generate the lion's share of tourism sector earnings, and likely all the earnings from foreign visitors.

Case study 4 explores the synergy that can be realised between the complementary cultural and biological assets in the case of Bach Ma NP. While tourism can provide important economic benefits, rapid growth in tourism and the accompanying influx of people can also have significant negative impacts. In the case of parks, one way to mitigate potential impacts and problems is to ensure that local communities share in the economic benefits of tourism.

Case Study 4: Entrance fees at Bach Ma National Park

This case study seeks to demonstrate the contribution to tourism and local livelihoods that Bach Ma NP can make as visitor numbers increase, tourism services expand and the park's tourism assets are further enhanced. The study aims to show that this contribution can be increased through progressive and differentiated pricing policies for entrance fees, and how the returns could be shared with impoverished local communities.

Ecotourism in Bach Ma National Park

Bach Ma NP is situated on the southern edge of Thua Thien Hue province, some 30 miles from Hue. The park comprises 22,300 ha, which is divided into a core protection zone, a regeneration zone and an administrative zone. The park offers a steep, winding and very scenic climb up to the top of the mountain range. At the top of the mountain there are a variety of attractions, including hikes, visit to the ruins of the old French chalets and viewing of a crashed helicopter. The misty mountain peak is an idyllic setting and there are a number of lodges and restaurants, a number of which have recently been renovated. Medium-term plans include enlarging the attractions and services offered in the park.

Visits to the park have increased fivefold in four years, from 3,000 in 1998 to 15,000 in 2001 (Table 14). International visitors make up only about seven per cent of total visitors but their numbers are increasing rapidly. Twice in the past four years the number of international visitors has doubled and total international visits in 2001 exceeded 1,000.

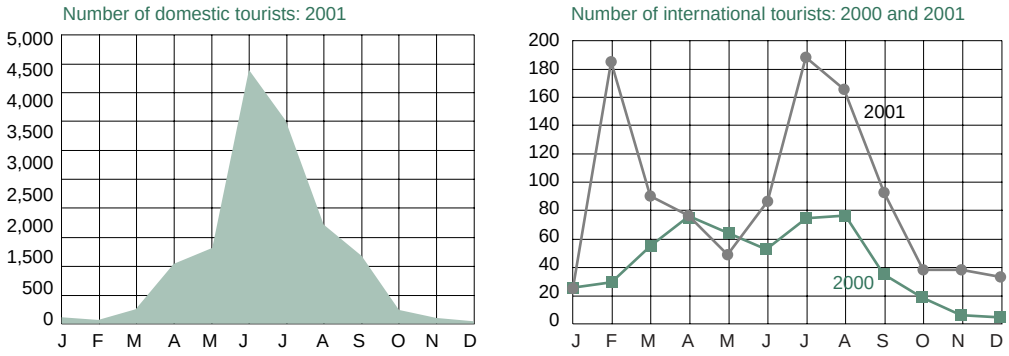
Table 14. Number of visitors, Bach Ma National Park, 1998–2001

	1998	1999	2000	2001
Number of international tourists	164	433	513	1,064
Number of national tourists	2,742	5,178	6,249	13,990
Total	2,906	5,611	6,762	15,054

Source: Bach Ma National Park Centre of Ecotourism and Environmental Education

The number of visitors to Bach Ma fluctuates quite strongly through the year (Figure 21a). Most visits take place during the summer months, with a pronounced peak in June and July. During the rainy and cold period, from October to February, there are few visitors. The intensity of the rains from October to December make visits difficult except for the most hardy travellers. In 2001, the number of international visits for the first time showed two peaks, the first in February and the second in July and August (Figure 21b). This pattern is often observed in the case of European and North American tourists. Increasing the number of visits during the off-season is an important objective to make better use of the park's existing capacity at the park, and this development is a positive sign.

Figures 21a and b. Seasonal nature of visits to Bach Ma NP, 2000 and 2001



Source: Bach Ma National Park Centre of Ecotourism and Environmental Education

All visitors must pay a park entrance fee, which is currently 10,000 dong (US$0.70). The entrance fee is the same for international and domestic tourists alike. Visitors also pay vehicle fees and a small sum for insurance. Park staff estimate that total revenue from entrance fees (and insurance) in 2001 came to 112 million dong (almost US$8,000). In 2001 additional revenues from vehicle fees and accommodation totalled another 80,000 dong (US$5,500). Since the park is within a one-hour drive of Hue few visitors spend the night and revenue from accommodation is quite low. Because of this, efforts to generate additional revenue from the tourist trade are likely to rely on entrance fees. Of the revenues generated, 90 per cent is kept by the park and 10 per cent is returned to the provincial government.

Management response

There are several possible ways to share benefits with local communities. A number of alternatives exist for generating additional revenue for biodiversity conservation in the park:

- raising entrance fees;
- differentiating fees; and
- raising and differentiating fees.

To explore the consequences of these alternatives the following scenarios are assessed in quantitative terms (the values used are described in Table 15). The simulation is conducted over the period of the current ten-year strategy (2001–2010); growth rates for the province's international and domestic tourists are used to project baseline increases (from 2001 levels) in the number of visits over this period.

The term "elasticity of demand" refers to the percentage change in the number of visits for a given percentage change in price. Based on available data from other countries (Lindberg and Aylward 1999), the elasticity of demand for Bach Ma NP is set at –0.05 for international tourists and at –0.10 for domestic tourists. In other words, for international tourists it is assumed that a 100 per cent increase in the price will lead to a five per cent drop in demand. In the case of domestic tourists, demand is expected to be more responsive to fee increases, due to lower income levels and the increased likelihood (compared to international tourists) that they would visit alternative attractions. As shown in Table 16, however, an increase in fees can raise total revenues even as the total number of visitors decreases.

Table 15. Scenarios for entrance fees and benefit-sharing

	Existing	Raising	Differentiating	Raising and differentiating
Entrance fee scenarios (US$)				
International tourists	US$0.70	US$2.00	US$5.00	US$10.00
Domestic tourists	US$0.70	US$2.00	US$0.70	US$2.00
Benefit-sharing scenario (%)	Existing	All scenarios		
% of fee returned to government	10	10		
% of fee retained by Bach Ma	90	50		
% of fee to communities	0	40		
total	100	100		

An additional factor in the calculation is determining the percentage of tourists who actually pay entrance fees. Based on the data for 2001 a figure of 70 per cent is used for domestic tourists and a figure of 95 per cent is used for international tourists. To analyse the potential for benefit-sharing it is assumed that a significant portion of the revenues would be shared with communities. In order to set the park's share at 50 per cent of revenues the communities' share would be 40 per cent.

Results

The initial low number of international tourists suggests that differentiating fees would have a marginal impact compared to raising fees — even slightly — for domestic tourists. The results suggest that to counterbalance the impacts of reducing quantity and raising price the optimal price is in the US$5 range. Even given the low participation by international tourists, the rise in fee levels could garner an additional US$20,000–50,000 in revenues (Table 16). These revenues could be increased substantially if the park were marketed directly to foreigners, many of whom travel through the province unaware of its existence.

Table 16. Entrance fee and benefit-sharing scenarios

Entrance fee scenarios (US$)	Existing	Raising	Differentiating	Raising and differentiating
Fees from international tourists	13,128	34,025	64,969	62,960
Fees from domestic tourists	137,249	319,315	137,249	319,315
Total fees	150,377	353,340	202,219	382,275
Distribution of fees				
to government	15,037	35,334	20,222	38,228
to the park	135,340	176,670	101,109	191,137
to communities	—	141,336	80,887	152,910

For domestic tourists a rise in fee (from US$0.70 to US$2.00) would more than double the income from entrance fees, resulting in an increase in revenue of US$180,000 even while reducing the number of domestic tourists who visit the park (for the sake of simplicity revenues are not discounted). Over the ten-year period 280,000 people visit the park under the existing entrance fee scenario, while only 228,000 visit it with the US$2.00 fee. Those people who decide not to visit the park are likely to be only marginally

interested in nature or have income that does not provide for the higher fees. Many of the Vietnamese who visit the park are students, a majority of whom presumably would not be able to afford a higher fee. Prior to raising fees it will be important to conduct a survey to better assess the current clientele and their willingness and ability to pay for the experience offered by Bach Ma. If necessary, certain groups could pay a lower fee.

A significant sum of money is generated by all three entrance fee scenarios, particularly those that involve raising domestic tourist fees. The prospective revenue that could be shared with local communities comes to between US$80,000 and US$150,000. This is a significant amount when compared to local per capita income (which is in the low hundreds) and it demonstrates ecotourism's potential to provide significant local economic benefits. Sharing revenues with the communities represents a payment by visitors for the future conservation of the park; this is important in terms of park-community relations and the need to involve communities in the benefits generated by the park.

Section 4

Conclusions

The paper has identified and illustrated many of the types of benefits that protected areas deliver to the larger economy of Thua Thien Hue Province. A remarkable number of different connections exist. Across a wide range of sectors, protected areas can make an important contribution by supporting economic development and lowering the cost of achieving sustainable growth.

The case studies examined connections between protected areas and the economy. In each case the benefits of protecting natural habitat are worth undertaking. While the studies are preliminary, they provide the potential to more fully analyse these benefits using economic valuation techniques. Further, the two studies in Bach Ma show how services provided by protected areas yield specific goods and services to consumers and producers, who in turn can often be charged for them. For example, raising and differentiating entrance fees in Bach Ma or instituting a system of charges from irrigation producers for watershed protection are all ways of recognising the contribution made by protected areas and at the same time providing valuable cash flows for conservation.

In Thua Thien Hue Province — as in Vietnam as a whole — the important and complementary relationship between natural capital in protected areas and sustainable human development has often been undervalued. Half of the province's surface area is now protected or proposed for inclusion in a protected area. As the economy advances, the work force becomes more technologically advanced and the population grows the requirements and demands of its citizens will change. Clean water, more water for irrigation, healthy air, secure property, beautiful scenery, wild animals and diverse bird life are things that tend to be in greater demand as peoples' income grows. By improving the management of its protected areas, Thua Thien Hue Province can take the steps that will enhance its economic efficiency and income generation potential. This will bring Vietnamese and international tourists to visit in the province, and support employers who want a healthy environment for their employees.

Section 5

References

Aylward, B. In press. Land Use, Hydrological Function and Economic Valuation. In M. Bonnell and L. A. Bruijnzeel (eds.). *Forest-Water-People in the Humid Tropics.* Cambridge: Cambridge University Press.

Bruijnzeel, L.A. 2002. Tropical forests and environmental services: Not seeing the soil for the trees? *Agriculture, Ecology and Environment.*

Bruijnzeel, L.A. 1990. *Hydrology of Moist Tropical Forests and Effects of Conversion: A State of Knowledge Review.* Paris: International Hydrological Program of the United Nations Educational, Scientific and Cultural Organization.

Calder, I.R., and Aylward, B. In press. *Integrated Watershed and Flood Mitigation Management.* Rome: FAO.

IIED. 1995. *Economic Evaluation of Tropical Forest Land Use Options: A Review of Methodology and Applications.* London: International Institute for Environment and Development.

International Monetary Fund (IMF). 2002. *Vietnam: Selected Issues and Statistical Appendix.* IMF Country Report No. 02/5. Washington, D.C: International Monetary Fund.

Lamb, D., and Gilmour, D. 2000. A Succinct Overview of the Issues from the Scientific Sessions as a Basis for Interfacing with Policy. Paper presented at UNESCO Symposium on Forest-Water-People in the Humid Tropics, Bangi, Malaysia, 30 July–4 August.

Lindberg, K., and Aylward, B. 1999. "Price Responsiveness in the Developing Country Nature Tourism Context: Review and Costa Rican Case Study." *Journal of Leisure Research 31* (3): 281-299.

Ljung, P. 2000. *Trends in the Financing of Water and Energy Resources Projects.* Thematic Review No. III. 2. Cape Town: World Commission on Dams.

Trai, L.T. and W. Richardson. 1999. *A Feasibility Study for the Establishment of Phong Dien (Thua Thien Hue Province) and Dakrong (Quang Tri Province) Nature Reserves, Vietnam.* Hanoi, Vietnam. Birdlife International Vietnam Program.

Trai, L.T., Long, D.T., Ha, P.T., Tuan, L.N. 2002. *Economic Study of Hunting Practices of Local Communities Living Adjacent to Phong Dien Nature Reserve.* A report prepared for the WWF Indochina Program Central Truong Son Conservation Initiative and the Review of Protected Areas and Development of the Lower Mekong River Region.

Trai, L. T., Minh, T. H., Ngoc, T. Q., Dung, T. Q. and Hughes, R. 2001. An Investment Plan for the Establishment of Phong Dien Nature Reserve, Thua Thien Hue Province, Vietnam. Hanoi, Vietnam. Birdlife International Vietnam Program and Forest Inventory and Planning Institute.

TTHSO (Thua Thien Hue Statistical Office). 2001. *Thua Thien Hue Statistical Yearbook 2000.* Hue, Vietnam: Thua Thien Hue Statistical Office.

TTHSO (Thua Thien Hue Statistical Office). 1996. *Thua Thien Hue Statistical Yearbook 1995.* Hue, Vietnam: Thua Thien Hue Statistical Office.

Wiersum, K.F. 1984. Surface Erosion Under Various Tropical Agroforestry Systems. In *Symposium on the Effects of Forest Land Use on Erosion and Slope Stability.* Hawaii.

World Bank. 2001. *The Little Green Data Book 2001.* Washington, D.C: The World Bank.