

1 **Tropical forest services and mechanisms to finance their conservation and**
2 **sustainable use: a case study of Tapantí National Park, Costa Rica**

3 **Florence Bernard¹, Rudolf S. de Groot^{1*} and José Joaquín Campos²**

4 Paper submitted to Forest Policy and Economics -- FORPOL264 (August 2006)
5
6

7
8 ¹Environmental Systems Analysis group, Wageningen UR

9 PO Box 47, 6700 AA Wageningen, The Netherlands

10 * Corresponding Author: Dr. Rudolf de Groot, Email: dolf.degroot@wur.nl

11 Tel: +31-317-482247, Fax: - 484839

12
13 ²CATIE (Centro Agronomico Tropical de Investigacion y Ensenanza/Tropical Agricultural

14 Research and Higher Education Center)

15 7170 Turrialba, Costa Rica
16
17

18 **Abstract**

19 This paper presents a study on economic valuation of services provided by Tapanti National park, a
20 tropical rain forest area in Costa Rica, and mechanisms to finance their conservation and sustainable use.

21 Based on interviews with over 300 stakeholders, the study identified the main beneficiaries of three
22 selected ecosystem services provided by the park: water supply (for drinking and electricity generation),
23 maintenance of biodiversity and opportunities for recreation and tourism. The monetary benefits of the
24 three services combined were estimated at US\$ 2,594,743 per year, equivalent to an average of US\$
25 44 per hectare per year for the total park area. Compared with other, similar areas, the recreation values
26 are relatively low (662,900 US\$/year) while the water-supply service is very high (199,570 US\$/year
27 drink water and 1,675,373 US\$/year hydro-electricity), both can be correlated with the high rainfall (over
28 6.500 mm/year).

29 To develop payment-mechanisms for the conservation and sustainable use of Tapantí National Park, the
30 stakeholders were asked about their willingness to pay for the maintenance of the service they benefited

1 from. Different financing mechanisms have been explored, such as taxes, user fees, individual and
2 corporate donations, friends schemes, and voluntary contractual arrangements. On average, most of the
3 stakeholders were willing to pay for the ecosystem services they received. The total potential payments
4 amounted to approximately 388,500 US\$ per year (excluding hydro-electricity, the main beneficiary),
5 which would be sufficient to cover the current (245,000 US\$) and additionally needed budget (100,000
6 US\$) for the National Park management.

7 _____
8 **Keywords:** Ecosystem Services, Water Supply, Recreation, Biodiversity, Economic Valuation, Financing
9 Mechanisms, Protected Areas, Tropical Forests, Tapanti NP, Costa Rica

10 **1. Introduction**

11 National Parks and other protected areas are mainly designated and managed for conservation purposes
12 but they also deliver a continued flow of many ecosystem services (such as watershed protection and
13 opportunities for recreation), which often represent considerable economic benefits. Unfortunately, these
14 benefits are often neglected, or at best their value is under-estimated and setting aside protected areas is
15 usually still seen as being un-economical. However, scientific evidence is increasing that sustainable,
16 multifunctional use of natural ecosystems is economically more beneficial than conversion into single-
17 purpose uses (Balmford et al, 2002). Yet, few original studies are available on the “full” economic value
18 of protected areas (IUCN, 1998; Hadker et al., 1996) and even less on how to link these values to
19 financing mechanism (IUCN, 2000).

20 This paper describes the results of a study by Bernard (2005) who investigated the economic value of a
21 selected number of ecosystem services (water supply, recreation and biodiversity conservation) provided
22 by Tapanti NP (Costa Rica), and the willingness to pay for their maintenance by the main beneficiaries of
23 these services

24 Tapantí NP was established in 1982 and is located in the central part of Costa Rica and covers an area of
25 58,323 ha (see Figure 1) and is part of La Amistad Pacifico Conservation Area (ACLAP). Tapantí NP
26 contains five different life zones: premontane wet forest; premontane rain forest; low montane rain forest;

1 montane rain forest; and sub-alpine rain paramo (Holdridge, 2000). Altitude ranges from 700-3.491 m
2 and precipitation ranges from 2.500 to almost 8.000 mm per year

3 **> Insert Figure 1. (Location of Tapantí National Park) about here**

4

5 **2. Methodology**

6 Four research tools have been used, representing different steps of an integrated assessment framework
7 used by this study: (1) Function Analysis, (2) Stakeholder Analysis, (3) Function Valuation, and (4)
8 Market Analysis (Figure 2).

9

10 **> Insert Figure 2 (Integrated Assessment Framework for ecosystem services analysis and valuation)**
11 **about here**

12

13 **(1) Function Analysis:** This step deals with the translation of ecosystem characteristics into a
14 comprehensive list of goods and services (De Groot et al, 2002). It was used to describe and determine the
15 magnitude of the actual and potential availability of the main ecosystem services in ecological and bio-
16 physical terms.

17 **(2) Stakeholder analysis:** A systematic approach was used to identify stakeholders from the local to the
18 national level (Reitbergen-McCracken et al., 1997, Ramirez, 1999). Information was collected through
19 semi-structured interviews, questionnaires, and conversations with people or key informants and
20 participant observation to identify the main beneficiary groups or “users” of the ecosystem services
21 provided and to understand the relationship they had with specific ecosystem services. In total, 50
22 representatives from authorities, NGO’s, associations, chambers of tourism, companies and research
23 centres were consulted. In addition, representatives from 19 industrial companies were questioned and 30
24 families from small local communities were interviewed. Finally, surveys were performed with 174
25 tourists in Tapantí NP and 48 tourism businesses (e.g. hotels, restaurants).

26 **(3) Function Valuation:** This step deals with the assessment of the ecological, socio-cultural and
27 economic benefits (or values) of the goods and services identified in the function analysis (de Groot et

1 al., 2002; Farber et al., 2002). This value can be expressed in monetary terms or other terms of
2 appreciation using various valuation methods (Lette et al., 2002).

3 **(4) Market analysis:** This step was used to design financing mechanisms to capture the financial benefits
4 delivered to user groups and create revenues for Tapantí NP. It addressed different aspects of the
5 implementation of these mechanisms regarding the legal context (regulatory and policy framework) and
6 some equity concerns (IUCN, 2000; Perrot-Maître et al., 2001; Powell and al., 2002; Verweij, 2002;
7 Campos *et al.* 2005).

8 The main results of the study are presented in the following sections.

9 **3. The current and potential availability of the selected ecosystem services of Tapantí NP**

10 **3.1 Maintenance of biodiversity**

11 Tapantí NP provides an important habitat to many wild animals and plants. To measure the current and
12 potential importance of this service, the ecological value was determined based on diversity, uniqueness
13 and integrity.

14 (a) Diversity: Tapantí NP has a high diversity of ecosystems and more than 20 % of the animal species
15 existing in Costa Rica can be found in Tapantí NP along with about 27 % percent of fern species and 46
16 % of moss species. (personal communication, Mora F., Tapanti NP Director, 2005)

17 (b) Uniqueness: There is a significant amount of endemic species in Tapantí NP with 13 % of endemic
18 orchids species, almost 28 % of endemic bromeliads species and 19 % of endemic bird species. Tapantí
19 NP also provides habitat to endangered species such as the tapir or the jaguarondi. The sub-alpine rain
20 paramo is a very uncommon ecosystem with high endemism that is still little investigated. (personal
21 communication, Mora F., Tapanti NP Director, 2005)

22 (c) Integrity: Most of the Tapantí NP is under native vegetation cover (mainly forest). However, a study
23 carried out in 2004 by the National Institute of Biodiversity in Costa Rica (INBio) found some disturbed
24 areas under cultivation of blackberries and coffee, mostly located near the borders of Tapantí NP
25 (personal communication, Luis Paniagua, INbio, 2005). In total, it represents only 0,4% of the Tapantí
26 NP area. Furthermore, some species are threatened due to the illegal extraction of orchids, mosses, palm
27 hearts and some hunting of birds.

1 **3.2 Water supply (quantity and quality)**

2 More than 150 rivers originate in Tapantí NP and flow into the Caribbean Sea. The abundance of rivers in
3 this park is due to the very high precipitation; Tapantí NP is known as being one of the rainiest places in
4 Costa Rica and in the world (mean annual rainfall in the Tapantí sector is 6550 mm). Furthermore, the
5 local climatic conditions (moisture and temperature) cause permanent clouds and mist which are regularly
6 in contact with the forest vegetation, leading to condensation corresponding to about 15% of total rainfall
7 (Caceres, 1981 in Stadtmuller, 1987, p 40). This could represent almost 1000 mm per year in Tapantí
8 (Bernard, 2005).

9 Tapantí NP is a key place for water supply as it provides the water for 25 per cent of the hydroelectricity
10 consumed in Costa Rica through the Río Macho, Cachí and Angostura plants. In addition, 2,1 m³.s⁻¹ of
11 water are used for drinking water production by AyA (Acueductos y Alcantarillados/ Institute of
12 Aqueducts and Sewers) amounting to annual withdrawals for drinking water over 66 million m³ of water
13 (see Figure 3). It is estimated that also about 25 per cent of Costa Rica's population benefit from the
14 drinking water supply service from Tapantí NP (Bernard, 2005).

15 **> Insert Figure 3 (Scheme of the infrastructure of Río Macho Plant in Tapantí NP) about here**

16
17 The ecosystems in Tapantí NP also have an important influence on water quality which constitutes an
18 important advantage for companies producing drinking water and hydroelectricity. For example, during
19 the rainy season, the amounts of sediments in water from Tapantí NP, are 5 times lower than in the Tiribí
20 river (which is coming from a watershed outside Tapantí NP and has a high rate of deforestation)
21 (personal communication, Guillermo J., Tres Rios Plant Manager, 2005)

22 **3.3 Recreation and tourism**

23 The area for public use only represents three percent of the park and is located in the Tapantí sector of the
24 National Park (see Figure 1). It contains four trails and a viewing point ("El Mirador") and receives an
25 average of 20,000 tourists a year of which about 80% are national visitors. (personal communication,
26 Mora F., Tapantí NP Director, 2005). Visitor numbers are low in comparison with the most visited
27 national parks of Costa Rica such as Manuel Antonio, located at the Pacific coast which receives up to 10

1 times more visitors a year. A study of the carrying capacity of the park by Tobar et al. (2002), showed that
2 the use of Tapantí NP for tourism has not reached the level of the effective carrying capacity.

3

4 **4. Stakeholder interests in the use of the selected ecosystem services of Tapantí NP**

5 To develop financing mechanisms for ecosystem services it is necessary to identify the main beneficiaries
6 of the ecosystem services delivered and to understand the different interests and perceptions of the main
7 stakeholders. Bernard (2005) identified seven main stakeholder groups (see table 1) based on two criteria:
8 the benefits they gain from services provided by Tapanti NP and the impacts they have on it. For the
9 purpose of this paper we only discuss four stakeholder groups (no. 1, 2, 4 and 7) in some detail.

10

11 **> Insert Table 1 (Stakeholder interactions with Tapantí NP ecosystem services) about here**

12

13 **Group 1: Stakeholders who benefit from the services and have a positive influence on the** 14 **Park**

15 INBio (INstitute for Biodiversity) directly benefits from the maintenance of biodiversity in Tapantí NP
16 because they carry out bioprospecting research in the park. In case of the commercialisation of any
17 discovery, Tapantí NP will benefit from the economic gains by receiving a share of any royalties that may
18 result. INBio also provides Tapantí NP with better knowledge about the current state of ecosystems and
19 its biodiversity.

20

21 **Group 2: Stakeholders who benefit from the services and have a neutral influence on the** 22 **Park**

23 (a) Drinking water companies

24 The uptake of water in Tapantí NP enables AyA (Tres Ríos Plant) and Cartago Plant to treat and deliver
25 181,440 m³ of drinkable water every day. Bernard (2005) estimated that the number of people benefiting
26 from drinkable water via Tapantí NP water supply service represented 58% of the population of San José,

1 74% of the population of Cartago and 73% of the population of Paraiso. In total, this represents about one
2 quarter of the entire population of Costa Rica.

3 (b) Hydro-electricity companies

4 The state company ICE (Costa Rican Institute of Electricity) with three generation plants (Río Macho,
5 Cachí and Angostura) and the consumers of electricity benefit from the contribution of the park to
6 produce hydroelectricity. The total amount of energy produced by the three plants of ICE, which can be
7 directly attributed to Tapantí NP, is 1614 GWh per year. It has been estimated that some 336,000 families
8 (41% of the population of Costa Rica) could benefit from this production of electricity if it was only
9 dedicated to domestic consumption. (Bernard, 2005).

10 (c) Tourism businesses

11 Many businesses involved in recreation and tourism benefit from Tapantí NP because most tourists who
12 come to visit the park stay in the surroundings for a few days. According to Bernard (2005), about 62 %
13 of foreign tourists stay in Orosi (See Figure 1) or its surroundings.

14 **Group 4: Stakeholders who do not benefit from the services and have a positive influence**
15 **on the Park**

16 'Baxter-Costa Rica' belongs to 'Baxter Healthcare', an international company that produces different
17 medical products to be used in hospitals all over the world. In 1997, Baxter - Costa Rica created the
18 Foundation Pro Tapantí. Basically Baxter wished to develop an environmental policy and they were
19 especially interested in implementing the ISO 14000 norm¹. One of their actions is the donation of about
20 US\$ 10.000 per year to support Tapantí NP.

21 **Group 7: Stakeholders who are negatively affected by the Park and have a negative**
22 **influence on the Park**

23 It is mainly the small communities living near the park who belong to this category. Bernard (2005)
24 showed that some inhabitants in the community of Villa Mills experience considerable limitations and

¹ ISO 14000 is a series of generic environmental management standards that provides a structure and system for managing environmental compliance and affect every aspect of a company's environmental operations

1 face many problems by living next to the park because they are now restricted in their traditional
2 subsistence activities such as coal production, firewood collection and harvest of mosses. The alternatives,
3 such as the cultivation and harvest of wild blackberries, the cultivation of colder climate fruits or cattle
4 breeding, are very unsatisfactory to them. The presence of the park is mainly seen as a constraint to their
5 livelihoods. Some inhabitants would like to develop more tourism in this sector by opening new trails.
6 Nevertheless MINAE (Ministry of Environment and Energy) and ACLAP can not give yet their
7 authorisation because there are some very vulnerable ecosystems in this area such as paramo where access
8 for the public should be carefully regulated and more studies are needed regarding the carrying capacity
9 of the area. The main threats to Tapantí NP are coming from some of the inhabitants who have a negative
10 effect on the park with illegal activities such as the extraction of plants, poaching and fishing.

11

12 **5. Financial benefits for beneficiaries of ecosystem services**

13 In order to develop acceptable financing strategies, economic valuation is important in determining the
14 relative importance or contribution of the benefits generated by different forest ecosystem services.
15 Among the many beneficiaries who have been identified in section 4, the beneficiaries who are likely to
16 benefit financially from Tapantí NP ecosystem services, are the state companies ICE and AyA, the
17 Cartago drinking water plant, tourism businesses and park managers.

18 **5.1 Financial benefits of water supply provided by Tapantí NP**

19 To estimate the additional production costs, which would occur for AyA and the Cartago drinking water
20 plant in case there would be a reduction in water quality delivered by Tapantí NP, the avoided cost
21 method was used. The additional production costs represent an approximation of the current benefits of
22 the water supply service of Tapantí NP. During the artificial treatment of water, one of the main and most
23 costly steps is the removal of sediments from water with specific reactants so that the parameters of colour
24 and turbidity reach the recommended values. Degradation of Tapantí NP forest ecosystems would
25 increase sediment content in water. To estimate the additional costs for AyA (Tres Ríos Plant) and
26 Cartago Plant for the removal of additional sediments, a comparison was made between the average dose
27 of reactants used in Tres Ríos Plant, to treat the daily quantities of water coming from Tapantí NP

1 (143.853 m³/day), and the water coming from the Tiribí River, which comes from a watershed which is
2 almost without forest cover due to previous deforestation and expansion of agriculture. The most costly
3 reactant mainly used to remove sediments is aluminium sulphate (US\$0,33/ kg). The average doses of
4 aluminium sulphate used to remove sediments from Tapantí NP water and Tiribí water are respectively
5 16,4 mg.l⁻¹ and 26,6 mg.l⁻¹, which make a difference of 10,2 mg.l⁻¹. If forest cover from Tapantí NP was
6 degraded, it can be assumed that the quantities of sediments would augment in water delivered from
7 Tapantí NP to some levels at least similar to the ones of Tiribí and it would be necessary to use a similar
8 dose of aluminium sulphate to remove sediments. Based on these considerations and assuming 15 days of
9 non-operation of the plant, it has been estimated that the annual avoided costs for AyA (Tres Ríos Plant)
10 by using the Tapantí NP water supply service represent US\$ 169,470. The same reasoning was applied to
11 the Cartago Plant and its annual avoided costs represent US\$ 30,100.

12 **5.2 Financial benefits from hydroelectricity generated in the Tapanti NP area**

13 There are three hydroelectricity plants of ICE (Río Macho, Cachí and Angostura) benefiting from Tapantí
14 NP. Cachí and Angostura plants have respectively 40% and 44% of their drainage area (32,230 Ha and
15 47,291 Ha) in Tapantí NP and the rest of their drainage area (47,330 Ha and 62,079 Ha) is outside the
16 park and partly deforested (Bernard, 2005). Deforestation in the drainage areas leads to an affluence of
17 sediments which reach 740 000 metric tonnes arriving annually to the Cachí Dam. (Sogreah ING, 2000).
18 The annual charge of sediments arriving to Angostura is 1 700 000 metric tonnes. The accumulation of
19 sediments in the dam lakes leads to a loss of dam capacity with associated costs due to reduction of
20 electricity production. Furthermore, the artificial removal of sediments in dams leads to additional costs
21 for operation and elimination of sediments and also leads to a general halt of the plant during on average
22 15 days a year. Annual costs associated to sediments problems in Catchi and Angostura Plants
23 respectively amount to US\$ 2,191,900 and US\$ 1,176,000 (Sogreah ING, 2000). Bernard (2005) assumed
24 that 70% of the total costs that plants have to face because of sediment increase in water was directly
25 associated to the part of the drainage area without forest cover. Based on this hypothesis, the avoided
26 costs for Cachí and Angostura plants from having part of their drainage area with forest cover in Tapantí
27 NP was proportionally calculated. It has been estimated that Catchi and Angostura plants are currently

1 avoiding the costs of respectively US\$ 1,482,580 and US\$ 637,567 for having part of its drainage area
2 with forest cover in Tapantí NP.

3 Compared with the Cachi and Angostura plants, the Río Macho plant does not face important problems
4 with sediments because its entire drainage area is within Tapantí NP but additional studies should be
5 performed to estimate the current associated avoided costs of ICE. As a result, ICE is currently avoiding
6 costs of US\$ 1,675,373 per year.

7 **5.3 Financial benefits of recreation and tourism in Tapanti NP**

8 A questionnaire was performed with tourism businesses to collect data to evaluate the financial benefits
9 they receive from their activity (frequency of tourists, price for accommodation, price for a meal, etc), the
10 costs they have to face to (electricity, water, food, drinks etc) and which percentage of their income
11 depended on the presence of the park. Based on their answers, an estimation of their total annual net
12 income or producer surplus (difference between the total amount earned from a good (price times quantity
13 sold) and the production costs) in relation to the presence of Tapantí NP was made. The total benefits of
14 the tourism businesses based on the recreation and tourism opportunities provided by Tapanti are
15 estimated at US\$ 662,200 per year.

16 **5.4 Financial benefits of biodiversity conservation in Tapanti NP**

17 Financially, the direct beneficiaries of biodiversity conservation are the park managers and INBio. The
18 park managers receive US\$ 57,600 in benefits in the form of salaries for their work related to the
19 protection and conservation of natural resources of the Tapantí NP. INBio will receive financial benefits
20 in case of commercialization of any discovery made from the park, which has not occurred yet.
21 Nevertheless, it should be realised that maintenance of biodiversity is actually a prerequisite for the
22 complete array of other forest ecosystem services and the previous identified beneficiaries of water supply
23 and recreation and tourism are actually benefiting indirectly as well from the maintenance of biodiversity.

24

25 **5.5 Total financial benefits provided by Tapanti NP**

1 The financial benefits of the three services combined were estimated at US\$ 2,594,743 per year (see Table
2 2), which represents around US\$ 44 per hectare annually. The main beneficiary is ICE, receiving 64,5 %
3 of the total financial benefits of the services of the park included in this study (see Figure 4).

4
5 > **Insert Table 2. (Total financial benefits received by the beneficiaries of three ecosystem services**
6 **from Tapantí NP) about here**

7
8 > **Insert Figure 4. (Distribution of the financial benefits for three ecosystem services (biodiversity,**
9 **water, tourism) from the Tapantí NP) about here**

10 11 **6. Mechanisms to finance ecosystem services provided by Tapantí NP**

12 The monetary benefits which are generated by Tapantí NP (section 4) should be captured by designing
13 and implementing effective financing mechanisms.

14 Powell et al. (2001) presented a typology of financing mechanisms according to the degree of government
15 intervention or public involvement in the administration of the mechanism. They distinguished three
16 indicative categories, including self-organised private deals or voluntary contractual arrangements, trading
17 schemes, and public payment schemes. IUCN (2000) proposed a classification of financing mechanisms
18 based on the level at which the financing was sought. Local sources of funding include among others user
19 fees, use of cause-related marketing and adoption programmes, individual donations and public good
20 service payment. Finally, it is possible to classify financing mechanisms according to the type of
21 ecosystem service on which the mechanism is based (Verweij, 2002). This paper chose as entry point the
22 ecosystem services to be financed and explored the possibilities of financing mechanisms based on the
23 typologies developed by IUCN (2000) and Powel et al. (2001).

24 The park rangers are benefiting financially from Tapantí NP because they receive salaries for their job
25 which consists of protecting and maintaining natural resources of the park. Thus, they are already
26 involved in a financial mechanism and therefore they were not considered any further in this part of the
27 study. The total estimated annual financial benefits for the different stakeholders (excluding park

1 managers) represent US\$ 2,537,143. The payment for ecosystem services should be done proportionally
2 to the financial gains of the main beneficiaries.

3 One important point to deal with when implementing financing mechanisms is the equity concerns
4 (winners and losers) of the involved financing mechanisms. The development of financing mechanisms
5 for Tapantí NP should not only benefit the park itself but also the small local communities in its
6 surroundings.

7 **6.1 Financing mechanisms involving beneficiaries of water supply**

8 ICE, AyA and Cartago Plant avoid important costs due to the quality of the water supply service from
9 Tapantí NP. Nevertheless, these state companies have benefited from a decree that exempted them from
10 paying user fees. However, recently a new presidential decree, aimed at internalizing the environmental
11 cost of producing water, has made explicit that these state companies will have to pay user fees (water
12 tax) as well. The water tax is calculated according to water uses and type of water and is aggregated to the
13 current water costs consumers have to pay for. Based on this tax, it has been calculated that US\$174,835
14 from AyA and Cartago Plant should be transferred to MINAE. When dividing this by the total area of
15 Tapantí NP, it represents a sum of US\$ 3 per ha.

16 The ICE contribution could not be estimated due to data uncertainty but considering its large use of
17 Tapanti water, it is expected that the participation of ICE would provide a very important financial
18 support for Tapanti.

19 **6.2 Financing mechanisms involving beneficiaries of recreation and tourism**

20 **(a) Financing mechanisms involving tourism businesses**

21 The suggested institutional set-up is the one of self-organised private deals or voluntary contractual
22 arrangements between Tapantí NP and private parties represented by tourism businesses. Six tourism
23 businesses were willing to give direct donations, or make tourists pay \$US 1 more per night, and dedicate
24 that money to the park (Bernard, 2005). Based on this survey, the annual potential payments would be
25 between approximately US\$45,700 and US\$128,000. Further communication and meetings are needed
26 with other tourism businesses whose willingness to become involved has been assessed as “medium”
27 (Bernard, 2005). The mechanism is very site-level oriented and people can meet easily to negotiate the

1 agreement. If people succeed to reach an agreement, the mechanism can be very quickly implemented. An
2 important constraint to the development of the mechanism is the complexity of multi-stakeholder
3 arrangements. It takes time and it requires patience, collaboration and compromise. This mechanism
4 depends on the willingness of tourism businesses. There is no enforcement of stakeholders to make
5 donations and as a result the sustainability and security of this funding is less strong.

6 **(b) Financing mechanisms involving tourists**

7 The results of the questionnaires performed with tourists gave an impression of the interest of people for
8 the development of new services in Tapantí NP, such as guided tours, sale of food and drinks, and
9 craftsmanship, their willingness to make donations and the amounts they would be willing to pay. The
10 instruments that could be used are user fees, individual donations, adoption programmes (e.g. hectares of
11 protected forests) and friend schemes. The potential funds that could be raised for the development of new
12 services have been estimated between US\$61,000 and US\$69,000 (Bernard, 2005). The potential
13 willingness to pay through donations and the development of an adoption programme and friend schemes
14 has been estimated between US\$24,000 and US\$32,000 (Bernard, 2005). One possible way to implement
15 new services could be through concessions. The use of concessions might result in a good way to involve
16 local people as “either owners of the concession, co-concessionaires with a more experienced tour
17 operator or employees of the concessionaire” (Drumm and Moore, 2003). This might greatly improve the
18 relations between communities and park managers. Nevertheless, the development of this mechanism
19 could especially benefit communities like Purisil, since it is located next to the Tapantí sector where
20 infrastructure for tourism is already developed, whereas the communities such as Villa Mills in the
21 Macizo de la Muerte sector where there is no public area will be left out. Further studies, and especially
22 market studies and business plans, should be prepared to ensure that the service developed will be viable
23 and that there will be enough demand. A study carried out by CATIE found that in the buffer zone of
24 Tapantí NP there is good potential for promoting eco-tourism based on bird watching that could
25 contribute to local development (Rodriguez, 2002).

26 **6.3 Financing mechanism involving beneficiaries of biodiversity**

1 The institutional set-up most suited would be self-private deals between INBio and MINAE-ACLAP.
2 Currently, the instrument used can be seen as kind of “user fee” which is paid only under specific
3 conditions. There are some research agreements between INBio, ACLAP and Tapantí NP: in case of
4 discoveries and commercialization, ACLAP and consequently Tapantí NP should benefit from the
5 financial gains by receiving a share of any royalties that may result from successful product development.
6 The contract between both partners should be reviewed so that INBio pays a fee each time they are
7 carrying out research; in this way Tapantí NP would benefit more frequently from this service. As an
8 example, INBio could be required to pay a fixed amount (fee) of US\$10 a day, i.e. US\$3650 a year or
9 US\$100 for each day they are actually prospecting. Furthermore, in case of commercialization of any
10 discovery, Tapantí should receive a share. With the revision of the mechanism, the financial support
11 would be more reliable.

12 **6.4 Financing mechanisms involving industrial companies**

13 Baxter is paying around US\$10,000 per year via the Foundation Pro Tapantí. The institutional set-up is
14 the one of self-private deals or voluntary contractual arrangements between Tapantí NP and industrial
15 companies. Three other companies have been identified as interested in financially supporting the park.
16 Following the example of Baxter, the potential payments to be made by the other companies could be
17 around US\$10,000 per year for each company. The advantage of the corporate donation instrument is that
18 if the different stakeholders succeed to reach an agreement, the mechanism can be very quickly
19 implemented. Nevertheless, it generally requires time and patience to arrange meetings with industrial
20 companies. Furthermore, the mechanism depends on the voluntary willingness of industrial companies to
21 become involved and there is no enforcement to make donations neither on the amount to be donated.

22 **6.5 Summary of financial benefits and potential payments**

23 Table 3 summarises the financial benefits and potential payments of stakeholders for Tapantí NP
24 ecosystem services, as well as the main characteristics of the financing mechanisms.

25 > **Insert Table 3 (Financial benefits and potential payments of stakeholders for ecosystem services)**
26 **about here**

1 The total annual payments to be made to Tapantí NP via these financing mechanisms have been estimated
2 at about US\$ 388,500 per year, which is more than the current budget (US\$ 245,000) plus the additional
3 US\$ 100,000 that is required by the park. These potential payments do not include ICE yet, which is one
4 of the major beneficiaries.

5 **7. Discussion**

6 **7.1 Uncertainty of results and margins of error**

7 The costs (operative costs, food, drinks, water, and electricity) linked to the activity of tourism businesses
8 were not always available which prevented more accurate estimations. To calculate the producer surplus
9 of tourism businesses, economic data used were based on the information the owners were willing to
10 provide. Some tourism businesses might purposely have under-estimated the visit rate of their business,
11 their incomes or the percentage of their income depending on Tapantí NP. It was not possible to ascertain
12 the accuracy and reliability of the quantities they stated. From the above it can be concluded that problems
13 encountered with data collection will have led to an under-estimation of the economic benefits of the
14 investigated services, rather than an over-estimation.

15 Regarding benefits from beneficiaries of water supply, only the costs they were avoiding were estimated
16 whereas if their benefit margin rate would have been known, more benefits could have been estimated
17 with the Market Price Method. Consequently there is probably an under-estimation of the economic
18 benefits they receive from the water supply service.

19 **7.2 Comparison of the results with other studies**

20 When dividing the total benefits of the three investigated services (US\$ 2,537,143) by the total park area,
21 the total financial benefits amounts to approximately US\$ 43 per ha. Reyes et al. (2002) estimated a range
22 of values for the ecosystem services provided by forests in four watersheds of Costa Rica: Peñas Blancas,
23 Reventazón, Savegre and Pejibaye; based on replacement and maintenance costs. Those values were
24 estimated at US\$100 per ha per year for Peñas Blancas, US\$133 per ha per year for Reventazón, US\$138
25 per ha per year for Savegre and US\$176 per ha per year for Pejibaye. The difference between the findings
26 of this study and the results of the study of Reyes et al. can be explained by the fact that only three
27 ecosystem services were considered in this study. Furthermore, the benefits that were estimated are

1 conservative, in particular for ICE, AyA and Cartago Plant as mentioned before. Yet, the difference
2 between the outcome of this study (US\$43 ha⁻¹ year⁻¹) with the range of values found by Reyes et al.
3 (2002) (US\$100–176 ha⁻¹ year⁻¹) is relatively small.
4 Another interesting comparison can be made with the global synthesis study by Costanza et al (1997) who
5 estimated the average annual global values of water supply services for tropical forests at US\$8 ha⁻¹ year⁻¹
6 ¹. The value of the benefits to ICE, AyA and Cartago Plant were estimated to US\$32 ha⁻¹ year⁻¹. The
7 difference between the findings of this study and the average annual global value given by Costanza et al.
8 (1997) for the water supply service illustrates the fact that Tapantí NP is a special site regarding water
9 supply. Due to the high rainfall (over 6.500 mm/year), Tapantí NP may be more important than other
10 protected areas regarding the water supply service. The opposite is the case for the recreation service.
11 Costanza et al (1997) estimated that the average annual global value of the recreation service for tropical
12 forests is around US\$112 ha⁻¹ year⁻¹ whereas this study found that the benefits of tourism businesses
13 amounted to about US\$11 ha⁻¹ year⁻¹. This difference illustrates the fact that the recreation service of
14 Tapantí NP is probably under-used but due to the high rainfall and remoteness, recreation will probably
15 remain relatively marginal.

16 **7.3 The diversification of financing mechanisms**

17 Tapantí NP relies mainly on the budget of the central government, which does not cover all financial
18 requirements of the park. It has been proposed in this study to diversify the financial resources by looking
19 for private financial resources to enhance the management effectiveness of the Tapantí NP and to reduce
20 problems due to dependency on only the national budget of the central government. Nevertheless, most of
21 the new financing mechanisms (except the water tax) suggested are based on voluntary participation of
22 stakeholders because there is no obligation for them to be involved in such mechanisms since in Costa
23 Rica management and financing of protected areas are currently the sole responsibility of the government.
24 From this study it seems feasible to develop a combination between public and private financing resources
25 and consider a new legal framework for financing protected areas in terms of co-responsibility including
26 the government and the private sector.

27 **8. Conclusions and recommendations**

1 Based on a comprehensive stakeholder analysis and economic valuation of three selected ecosystem
2 services (maintenance of biodiversity, water supply and recreation & tourism), this study explored the
3 development of new financing mechanisms to increase and secure financial support for Tapanti NP.

4 In the short term, priority should be given to financing mechanism based on individual donations, the
5 adoption programme and friend schemes and a revised payment mechanism by INBio because they are
6 relatively quickly to achieve. In the medium term, the development of new services in the park should be
7 envisaged as well as the implementation of the new water tax. Finally, the development of contractual
8 arrangements with tourism businesses and industries should be part of a long-term strategy because it is
9 expected to require more time and effort to establish.

10 Some considerations to keep in mind:

11 (1) Developing and implementing financing mechanisms may lead to high transactions costs that should
12 be identified previously and should be limited to ensure the effectiveness of the financial mechanism.

13 (2) Success of implementation and effectiveness of financing mechanisms will need continual monitoring,
14 enforcing and assessment so that the financing mechanisms contribute to sustainable forest, management,
15 forest conservation, sustainable livelihoods, and social equity objectives.

16 (3) Solely increasing financing resources of Tapanti NP would not ensure effective conservation and
17 management of the park if there is no further consideration and involvement of the small communities to
18 ensure their participation and commitment. If properly done, local communities could become good
19 partners in the effort to protect the park. It is important that rural communities respect legal restrictions
20 but it is also necessary for Tapantí NP to rethink their legal framework to allow more participation of the
21 local communities in a co-management arrangement of the area and to ensure economic transfers to these
22 communities.

23

24 **Acknowledgements**

25 This article is based on the results of a research project conducted by Florence Bernard (Bernard, 2005)
26 in the Tapantí National Park between November 2004 and February 2005 as part of her Master of Science
27 degree in Environmental Sciences with the Environmental Systems Analysis Group, Wageningen
28 University, supervised by Rudolf de Groot, and in collaboration with the Tropical Agricultural Research
29 and Higher Education Center (CATIE) based in Turrialba, Costa Rica, with supervision of José Joaquín

1 Campos and Roger Villalobos, and support of Francisco Mora (Director of the Tapanti National Park),
2 Geoffrey Venegas, and José Masis for fieldwork assistance. The study was part of the “Reventazón
3 Model Forest” project supported by CATIE and the Ministry of Environment and Energy in Costa Rica.
4

5 **Acronyms**

6 **AyA:** Acueductos y Alcantarillados. Institute of Aqueducts and Sewers

7 **ACLAP:** Área de Conservación La Amistad Pacífico. La Amistad Pacific Conservation Area

8 **CATIE:** Centro Agronómico Tropical de Investigación y Enseñanza. Tropical Agricultural Research and
9 Higher Education Center

10 **ICE:** Instituto Costarricense de Electricidad. Costa Rican Institute of Electricity

11 **INBIO:** Instituto Nacional de Biodiversidad. National Institute of Biodiversity

12 **MINAE:** Ministerio del Ambiente y Energía. Ministry of Environment and Energy

13 **MM:** Macizo de la Muerte. Death Mountain

14 **NGO:** Non Governmental Organization

15 **NP:** National park
16

17 References

18 **Bernard, F. 2005.** Ecosystem services of, and financing mechanisms for protected areas. A case study of
19 the Tapantí National Park, a tropical rainforest in Costa Rica. MSc Thesis, Environmental Systems
20 Analysis group, Wageningen UR PO Box 47, 6700 AA Wageningen, The Netherlands. (205 p.).

21 **Boza A., M. 1993.** Conservation in Action: Past, Present, and Future of the National Park System of
22 Costa Rica. *Conservation Biology*, Vol. 7, No. 2: 239-247

23 **Campos A., J.J., Alpizar, F., Louman, B., Parrotta, Porras, I. 2005.** An Integrated Approach to Forest
24 Ecosystem Services. 2005. In Mery, G., Alfaro, R.; Kanninen, M.; Lobovikov, M. *Forest in the Global
25 Balance -Changing Paradigms*. Vienna, Austria, IUFRO World Series Vol. 17: 97-116.

26 **Costanza, R., Arge, R., de Groot, R.S., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S.,**

27 **O'Neil, R.V., Paruelo, J., Raskin R.G., Sutton, P., van den Belt, M.1997.** The Total Value of the

28 World's Ecosystem Services and Natural Capital. *Nature* Vol 387:253-260.

1 **De Groot, R.S., Wilson, M., Boumans, R. 2002.** “A typology for the description, classification and
2 valuation of Ecosystem Functions, Goods and Services” (393-408). In: “The Dynamics and Value of
3 Ecosystem Services: Integrating Economic and Ecological Perspectives”. Special issue of Ecological
4 Economics Vol. 41, Issue 3: 367-567.

5 **De Groot, R.S., van der Perk, J.P., Chiesura, A., van Vliet., A.J.H. 2003.** “Importance and Threat as
6 Determining factors for Criticality of Natural Capital”. Ecological Economics Vol. 44, Issues 2- 3:
7 187-204 (March 2003)

8 **Farber, S.C., Costanza, R., Wilson, M.A. 2002.** Economic and ecological concepts for valuing
9 ecosystem services. In special issue: The Dynamics and Value of Ecosystem Services: Integrating
10 Economic and Ecological Perspectives. Ecological Economics (41) 375–392

11 **Hadker, N., Sharma, S., David, A., Muraleedharan, T.R. 1996.** Willingness-to-pay for Borivli
12 National Park: evidence from a Contingent Valuation. Ecological Economics 21 (1997) 105-122

13 **Holdridge, L.R. 2000.** Ecología basada en zonas de vida.. 5th. printing. San Jose, CR, IICA. 216 p.
14 Educational Books and Materials Collection no. 83.

15 **IUCN, World Commission on Protected Areas, 1998.** Economic values of protected areas. Guidelines
16 for protected area managers. Best Practice Protected Area Guidelines No. 2. Edited by A. Philips.

17 **IUCN, World Commission on Protected Areas, 2000.** Financing protected areas. Guidelines for
18 protected area managers. Best Practice Protected Area Guidelines No. 5. Edited by A. Philips.

19 **Jenkins, M., Scherr, S., Inbar, M. 2004.** Markets for Biodiversity Services. Potential Roles and
20 Challenges. Environment, 46 (4).

21 **Lette, H., de Boo, H. 2002.** Economic Valuation of Forests and Nature. A support tool for effective
22 decision-making. Intenational Agricultural Center (IAC), Wageningen.

23 **Perrot-Maître, D., Davis, P. 2001.** Case Studies of Markets and Innovative Financial Mechanisms for
24 Water Services from Forests. Washington, D.C.: Forest Trends. <http://www.forest-trends.org>.

25 **Powell, I., White, A., Landell-Mills, N. 2002.** Developing Markets For the Ecosystem Services of
26 Forests. Forest Trends. Washington,D.C.

27 **Ramírez, R.1999.** Stakeholder analysis and conflict management. Chapter 5 in: D. Buckles (ed)
28 Cultivating peace: Conflict and Collaboration in Natural Resource Management. IDRC/World Bank 1999

1 **Reitbergen-McCracken, J. ;Narayan, D. 1997.** Stakeholder Analysis - A Resource Kit for Participation
2 and Social Assessment: Compiled by of the Social Policy and Resettlement Division, Environment
3 Department, The World Bank, Washington DC 1997

4 **Reyes, V., Segura, O., Verweij, P.A., 2002.** Valuation of hydrological services provided by forests in
5 Costa Rica. In: Innovative Financing Mechanisms for conservation and sustainable forest management,
6 ETFRN news, 35/02, 42-44.

7 **Rodríguez Barahona, O.L. 2002.** Evaluación del potencial turístico de las aves como contribución al
8 desarrollo sostenible de las comunidades de Montana, en la zona de amortiguamiento del parque nacional
9 Tapanti Macizo de la Muerte-Costa Rica. MSc Thesis, CATIE, 7170 Turrialba, Costa Rica.

10 **Sogreah ING – Gómez Cajiao Y Asociados – Sinergia 69 S.A. 2000.** Plan de manejo integral de la
11 cuenca del río Reventazón. Instituto Costarricense de Electricidad (ICE), Sabana Norte, 10032-1000 San
12 José, Costa Rica.

13 **Stadtmuller, T. 1987.** Cloud Forests in the Humid Tropics. A Bibliographic Review. United Nations
14 University, Tokyo, and CATIE, Turrialba, Costa Rica.

15 **Tobar, D., Lopez, M., Morales, R. 2002.** Determinación de la capacidad de carga turística del Parque
16 Nacional Tapantí Macizo de la Muerte, Costa Rica. Turrialba, Costa Rica.

17 **Verweij, P. 2002.** Innovative financing mechanisms for conservation and sustainable management of
18 tropical forests. Issues and perspectives. In: Understanding and capturing the multiples values of tropical
19 forest. Proceedings of the International Seminar on Valuation and Innovative Financing Mechanisms in
20 support of conservation and sustainable management of tropical forest. Paper commissioned by
21 Tropenbos International, Wageningen.

22

1 **Table 1. Stakeholder interactions with Tapantí NP ecosystem services (Bernard, 2005)**

Stakeholder groups ¹	Benefit from Stakeholders of Tapanti NP			Impact of Stakeholders on Tapanti NP ²		
	B	W	T	B	W	T
Group 1	+			+		
- Park managers	+	+	+	+	+	5
- INBio (Institute of Biodiversity)	+	0	0	+	0	0
- Tourists	0	0	+	0	0	6
Group 2	+			0		
- AyA (Institute of Aqueducts and Sewers)/ Cartago Plant	0	+	0	0	0	7
- ICE (Institute of Electricity in Costa Rica)	0	+	0	0	0	0
- Consumers from the cities of San José, Cartago, Paraiso	0	+	0	0	0	8
- Tourism businesses in the community of Orosi	0	0	+	0	0	0
Group 3	+			-		
- Some tourists	0	0	+	-	0	-
Group 4	0			+		
- MINAE (Ministry of Environment)/ ACLAP	0	0	0	+	+	+
- NGO's	0	0	0	+	+	11
- Baxter Industry	0	0	0	+	+	+
Group 5	0			0		
- Some local inhabitants	0	0	0	0	0	0
- Some tourism businesses in the Macizo Sector	0	0	0	0	0	13
Group 6	0			-		
- Some farms	0	0	0	-	0	14
Group 7	-			-		
- Some local inhabitants	-	-	-	-	0	15

16 ¹ For explanation, see Text.

17 B: Biodiversity W: Water supply T: Tourism

Benefit

- + The stakeholder is benefiting from Tapanti NP ecosystem services
- 0 The stakeholder does not benefit specifically from Tapanti NP ecosystem services
- The stakeholder feels he is not benefiting from Tapanti NP ecosystem services whereas he feels should

Impact

- + The stakeholder has a positive impact on Tapanti NP ecosystem services
- 0 The stakeholder has no specific impact on Tapanti NP ecosystem services
- The stakeholder has a negative impact on Tapanti NP ecosystem services

1 **Table 2. Total financial benefits received by the beneficiaries of three ecosystem services from**
 2 **Tapantí NP (Bernard, 2005)**

Beneficiaries	Financial benefits³ (US\$ per year)
Total: beneficiaries of water supply ¹	1,874,943
AyA+ Cartago Plant (drinking water)	199,570
ICE (Hydroelectricity)	1,675,373
Total: beneficiaries of recreation ²	662,200
Tourism Businesses Orosi	99,000
Tourism businesses Orosi surroundings	558,100
Tourism Businesses MM	5,000
Total: beneficiaries of biodiversity	57,600
Park Managers ³	57,600
INBio	Not yet
Total beneficiaries	2,594,743

9 ¹ Avoided Costs
 10 ² Producer surplus dependent on Tapanti NP
 11 ³ Salaries

1 **Table 3. Financial benefits and potential payments of stakeholders for ecosystem services** (Bernard,
 2 2005)

Ecosystem Services	Beneficiaries	Financial Benefits (US\$)	Potential Payments to be made (US\$)	Mechanism
Water Supply	AyA+Cartago Plant via consumers of drinking water	199,570	174,800	Public Good Service Payment (Water Tax) Mechanism in development (Law) since 2002. National Mechanism
	ICE via consumers of hydroelectricity	1,675,373	Not applicable	
Recreation & Tourism	Tourism businesses	662,200	85,500 - 101,000	Donations with voluntary contractual arrangement
	Tourists ¹	0	45,700 - 128,000	User fees (development of new services → development of concession and involvement of local people as either owners of the concession or co-concessionaires Individual donations, adoption programme and friend schemes. → Support of local association
Maintenance of biodiversity	Industrial Companies ¹	0	30,000	Donations with voluntary contractual arrangement.
	INBio ²	0	3,650	(6) User fees for research activities and share of benefits for discoveries and commercialisation
TOTAL		2,537,143	339,600 - 437,400	-

3 ¹ The study focused on the avoided costs and financial benefits stakeholders received and from that point of view,
 4 tourists and industrial companies do not receive any financial benefit or avoided costs.

5 ² INBio will have financial benefits only if there is commercialization based on any discovery.

1 **Figure 2. Conceptual model for ecosystem services analysis and development of financing**
2 **mechanisms (adapted from de Groot et al., 2002)**

3

4 **Legend**

Step 1 Link between ecosystem processes and components of natural ecosystems such as Tapantí NP and ecosystem functions & services

Step 2 Link between stakeholders and ecosystem services

Step 3 Use of economic methods to value financial benefits of stakeholders

Step 4 Step towards a solution: development of financing mechanisms

5