The socio-economic assessment of a protected area in Vanuatu

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Abstract

The paper presents a socio-economic assessment of a protected area (PA) in Vanuatu. The specific approach to valuation adopted here is based on two premises. Firstly, the establishment of PAs designed to maintain biological diversity may contribute to the achievement of intergenerational equity. Secondly, the establishment of PAs contributes to the attainment of a safe minimum standard of conservation of biological diversity, which is in the interest of the current generation. The paper also highlights the importance of adopting a participatory approach to the valuation process.

1. Introduction

Biological diversity (biodiversity) contributes to the welfare of the current generation and of future ones by providing critical ecosystem life support functions. The growth in international concern about the loss of biological diversity culminated in the ratification of the Convention on Biodiversity at the United Nations Conference on Environment and Development (UNCED) in June 1992. Following this conference, an increasing number of organisations are devoting funds to help the less developed countries (LDCs) in conserving their biological diversity. For example, the Global Environmental Facility (GEF) biodiversity portfolio for the Asia-Pacific region amounts to about US$ 135 millions. Of these funds, about US$ 15 millions have been earmarked for Papua New Guinea and the South Pacific Islands. The European Union is also in the process of allocating funds for the protection of biodiversity in the Pacific.

Protected areas (PAs) are regarded as one of the most useful tools for the protection of biodiversity. For this reason, the establishment of systems of PAs contributes to guarantee a safe minimum standard of conservation of biodiversity and it also contributes to the achievement of intergenerational equity in natural resources distribution (Tacconi and Bennett, 1993). The establishment of PAs may however create conflicts in the distribution of resources within generations. In fact, it has been noted that there is often a mismatch in the distribution of costs and benefits arising from PAs. The costs tend to be borne at the local level, whereas the benefits often accrue at higher levels, such as the national or international ones (Wells, 1992).

In Vanuatu, the Constitution recognises the right of the customary owners to control their land. It also affirms their duty to safeguard the natural wealth, resources and environment in the interests of the present generation and of future generations. It is within this institutional context that since about 1986 the Department of Forests has been

discussing with the land owners and the people of Umpon Yelongi the feasibility of establishing a PA for the conservation of Agathis macrophylla (kauri). (For simplicity, throughout the text the proposed Kauri protected area is referred to as the PA.) Since the inception of this consultation process, it has been proposed that the Government would lease the land from the custom owners. For this purpose, in 1989 the European Union (then European Community) provided partial funding for the establishment of the PA.

For several reasons, one of which is probably the difficulty of reaching a settlement on financial details, the PA has never eventuated. This paper considers some of the issues involved in finding an agreement on the status of the forest area. In this specific case, it is important to determine the costs and benefits accruing to the land owners from the establishment of the PA. According to the land tenure system of Vanuatu, detailed below, land owners have an almost absolute right to decide on the use of their land (provided that it is not leased) and the resources on it. It could be expected that the land owners would not agree to the establishment of the PA if they do not receive from this land-use benefits that are at least equivalent to those arising from alternative uses of the same area (eg. logging).

The objective of the paper is therefore to assess the benefits derived by the land owners from the forests in its present state, from logging operations and from eventual uses of the forest that could follow logging operations. The establishment of the PA would impose costs on the land owners, for example in terms of foregone logging royalties. Thus, to induce the land owners to agree to the establishment of the PA, some compensation for the foregone benefits may have to be provided. This compensation may take the form of a payment of forgone royalties by the government, or payment through a land lease agreement. The level of the compensation to be paid and the eventual form that this may take are analyzed in the paper.

2. Land tenure and natural resources management

Chapter 12 of the Constitution, adopted at independence in 1980 by the Republic of Vanuatu, deals with the issue of land. The first three sections of this chapter state the fundamntal principles guiding the post-independence tenure system. They respectively affirm that: (i) all land belongs to the indigenous custom owners and their descendants (section 71); (ii) custom rules are the basis for the ownership and use of land (section 72); (iii) only indigenous citizens[1], who have acquired land in accordance to custom rules, can have perpetual ownership of the land (section 73).

Customary ownership of the land in Vanuatu is normally entrusted in individual land owners or in the members of a family (e.g. father and son, cousins). Customary ownership should therefore not be confused with common property. The system of land ownership in Vanuatu differs substantially from Papua New Guinea and the Solomon Islands, where the land is owned by clans (Rodman, 1987) usually under a common property regime. This

1 An indigenous citizen is a person having four ni-Vanuatu grandparents (Narokobi, 1981).

has important implications for the management of natural resources, for the assessment process of alternative uses of these resources and for the eventual form of economic incentive to be provided to land owners in order to establish a PA.

The area proposed for protected status on Erromango is under the control of two land owning units. One section, approximately 2042 ha, is owned by two cousins, hereafter land owning unit 1 (LU1). The other section, approximately 1215 ha, is currently under dispute. According to the local customary rules, land owners have extensive control over the resources. This is exemplified by the notice reported below, written by LU1 (and affixed on the tree situated in the centre of the village) following a land dispute concerning the area of the village school:

> " Public Notice
> Following [village] court sitting on 23/9/92, we two do not agree with the decision of the court. We are the custom owners of Naupunari [proposed PA]. We want to stop people from using Nampunari in the following ways:
> 1) Do not ask to go walk about [hunting]
> 2) Do not go to the river to fish
> 3) Do not take dogs to Nampunari
> 4) Do not fish Naura [fresh water prawns]
> 5) Do not take wood or bamboo
> 6) Do not use the road through Nampunari
> 7) People going to Dillon's Bay should only use the road through the village
> 8) 3,000 vatu fine applies to people breaking the above rules
> 9) If a person does not pay the fine, the village chief will pay for him/her
> May 1993 signed [LU1]" [Translated from Sie, local language.]

This notice shows the several claims to resources that land owners have. They control the use of the land and of the resources on that land (i.e. trees, fish and water) and the rights of access to the area. These rights are recognized and accepted by the people in the area.

The inalienability of the customary owners' rights to the land require their full agrreement to the establishment of the PA. It is for this reason that the participation of the land owners in all phases of the decision-making process is of fundamental importance to the successful implementation of any conservation project in Vanuatu.

3. Previous proposals and surveys of the proposed PA

The establishment of the Erromango Kauri PA was suggested in 1971 by the members of the Royal Society - Percy Sladen expedition. 'Members of the Expedition have submitted a proposal to the British and French administration in the New Hebrides for the preservation of this area, and the proposal has been supported by the Royal Society and by the International Union for the Conservation of Nature.' (Lee, 1975 p. 275). At the time of the proposal the loggging company Société Agathis was operating on Erromango. However, Société Agathis discontinued its operations in 1974. This decreased the urgency of establishing a PA.

Since 1980, four reports have been prepared on the need and/or feasibility of establishing a Kauri PA. These are reviewed below.

(Neil, 1985) reviews ecological aspects of Agathis macrophylla and puts forward a proposal for the establishment of a PA. He suggests to set up a PA of an area of about 1,500 ha, because this would preserve one of the most promising species of Agathis for plantation purposes. A PA would protect the species in its natural habitat and would also allow further ecological studies to be undertaken. Neil (1985) stresses that the Kauri PA is of international importance, given that there are no PAs in which A. macrophylla is found. (A. macrophylla also occurs in Fiji and the Santa Cruz islands in the Solomon Islands.) He remarks that compensation for the land owners, although difficult to assess, should probably reflect the foregone logging royalties.

Gillison and Neil (1987) further review the ecological status of Agathis and report on a survey of the PA carried out to assess the size of the PA needed to maintain a viable population of kauris. They conclude that an area of approximately 3,000 hectares should be considered for conservation status. They further note that:
a) the area should be considered for inclusion in the World Heritage List;
b) the issue of compensation should be further considered;
c) in order to assess the amount of compensation to be paid, and to attract funding from donor agencies, a forest inventory and a further ecological study should be undertaken.

A consultancy report commissioned by the Food and Agriculture Organization (FAO) affirms that the conservation value of the area has already been established and that the further studies suggested by Gillison and Neil (1987) would only further extend the assessment process that started in 1971 and has used up considerable resources (Leaver and Spriggs, 1989). They remark that attention should be directed to: (a) determining the appropriate conservation status of the area; (b) making the Kauri PA part of a national PA strategy; (c) devising a management plan for the area; (d) seeking appropriate international recognition; and (e) establishing a compensation framework.

In relation to the latter item, they criticize the suggestion that compensation should be tied to the value of foregone royalties from logging activities. Leaver and Spriggs (1989) note that: (a) the timber is not being used and will actually be returned to the land owners if the eventual lease agreement is terminated; and (b) the land owners see the value of not logging the area. 'The local community, including the customary owners, expressed a strong wish that the area not be logged and retained for enjoyment, traditional use and to educate their children. This is a classic community conservation aspiration and as such has an acceptable "cost" to that community in terms of revenue from exploitable resources foregone. A land rental is therefore an appropriate compensation.' (ibid., p. 8). The question of compensation for the case of Erromango is recognized by Leaver and Spriggs as a fundamental one, as it will probably determine the pattern for conservation decisions in Vanuatu.

The question of compensation is further dealt with by Barrance (1989), at the time Forest Research Officer with the Department of Forestry. He reports that the proposal of compensating the land owners on the basis of 'an arbitrarily chosen percentage' of the foregone timber royalties was abandoned because of the problems faced by land owners, in areas such as Erromango, in managing lump sums. (It should be noted that this may be considered a paternalistic approach and Barrance later remarks that it is not fair to assume that land owners will not be able to manage their financial resources.) Compensation based on foregone royalties is however criticized by Barrance on other grounds. He argues that compensation based on foregone royalties would over-estimate the actual opportunity cost to the land owners for at least two reasons:
a) the land owners value the forest in its undisturbed state, as it provides the opportunity for hunting, fishing, firewood collection, building materials, medicinal and food plants; it also provides more intangible benefits such as pride in having large kauri trees and providing children with the opportunity to see these trees;
b) the forest in its undisturbed state prevents soil erosion.

The issue of compensation will be further addressed later. The socio- economic characteristics of the study area are discussed in the following section.

4. Socio-economic features of the study area

Small human settlements are situated along the southern border of the PA. The 1989 national census found that the four villages had a total of 32 households and 143 inhabitants. Umpon Yelongi was the larger village with 13 households and 82 inhabitants. At the time of the survey conducted for this study 15 households and 77 inhabitants were enumerated. Of these households, only two did not have gardens. One household had its gardens in another village, and the teacher did not have gardens. The area has a low population density: 1 inhabitant/km^2.

The village of Umpon Yelongi was founded in 1942/43 when the people living in sparse settlements decided to move to a centralized location in order to be serviced by a doctor sent to Erromango by the Condominium government. The settlement is located at about forty minutes walk from Pongkil Bay (the nearest landing for a small boat) and about 4/5 hours walk from Dillon's Bay. There is no road access to the village. This obviously is a constraint on the development of the agriculture sector[2].

The economy of Umpon Yelongi is subsistence based. Traditional gardening is practised in the area. In the traditional gardening farming system (Weightman, 1989) there are no cash crops associated with traditional crops such as taro, yam, sweet potato, manioc and breadfruit; banana and sugarcane are also produced but for own consumption only. This farming system is not common in Vanuatu anymore, for most farmers combine traditional crops with cash crops such as coconut, kava, coffee and cocoa. The climate and the lack of roads are the two main factors contributing to the persistence of the traditional

[2] This is also a widespread opinion within the local population.

farming system in the area. The latter three crops where reported by the farmers as not growing well in the area. Coconuts would grow along the coastline but would not be very productive if planted close to the village, which is located at about 329 m a.s.l.

The garden area of the village was surveyed in order to ascertain whether the establishment of a PA according to the boundaries proposed here could conflict with subsistence farming. The gardens located close to the village are established on 'red soil' and those further away from the village, towards the Lampunari river, are on 'black soil' (these are the soil categories as described by the farmers). Black soil is reported to be suitable for all the different crops, whereas red soil is not suitable for yam. Also, while banana planted on red ground produces for only one year, that planted on black soil is productive for two years. The minimum fallow period needed to have good regeneration of trees and thus allowing a satisfactory production of garden crops was reported to be of four years. The gardens are located at a maximum walking distance from the village of about 20 minutes (it takes about 30 minutes to reach the Lampunari river). Gardens are also established on the terraces towards the sea; these gardens are located at a greater walking distance from the village (up to one hour). The fallow period is preferably not longer than eight to ten years. A longer fallow period would involve more work in clearing the area from relatively large trees, which would have developed thanks to the long fallow period.

The thirteen households had a total of 98 gardens (7.5 per household). In order to assess the total area of garden land, 44 gardens, belonging to ten of the thirteen households were surveyed. The mean size of a garden was found to be 537.88 m^3 (standard deviation 275.87). The total area of gardened land was derived by multiplying the number of the garden which had not been measured by the mean and adding this to the actual area of the 44 gardens which were assessed. This gives a total yearly gardened area of 54,326 m^3 (about 4,178 m^3 per household). Assuming an average fallow cycle of five years, the area required for gardening is about 271,630 m^3 (27.163 ha). The villagers have about 1,100 ha of land south of the PA. Even if it is assumed that only 50% of this area is suitable for agricultural activities, there appears to be sufficient land to be used for agricultural enterprises. This reflects the opinion of the villagers. Without a numerical quantification of the land available, they affirmed that the land outside the PA is sufficient for the expanding village population.

The sale of sandalwood was the main source of income declared by the villagers. Trade in sandalwood is problematic for two main reasons. There are few mature trees and these trees have to be carried by hand from the forest to Pongkil Bay. This may take several hours. The income earned last year from sandalwood varied from household to household: it ranged from few thousand vatu to a maximum reported of 75,000 vatu[3], for a household who cut sandalwood in northern Erromango.

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[3] 1 Australian dollar is worth approximately 80 vatu.

Expenditures are also very limited. There are no taxes or fees for primary school students to be paid. The few goods used, such as lamp fuel, sugar, tobacco and tea, have to be purchased at the cooperative store in Dillon's Bay. A weekly market takes place in the village but only the local people take part and the few things for sale are food crops, fish and cooked food. They sell for prices that are about one tenth of those registered at the market in Vila.

5. Potential benefits from logging operations

In order to assess the economic incentives faced by land owners, this section details the potential economic benefits that land owners could derive from logging operations.

The assessment of timber volumes in tropical forest ecosystems is notoriously difficult and the accuracy of the results of any such enterprise is highly uncertain. This is evident for the case of Erromango in the study undertaken by Johnson (1971). This study was commissioned by the Condominium government in order to assess the economic potential of the timber resources of that island. It was a very detailed study. The fieldwork was carried out over the period of one year (1966/67) and covered an area of 14,100 ha. The area presently considered for protected status was surveyed by the Johnson's team (Section 2, Subsection D, Ridge Unit Nos. 16, part of 15 and part of 17 in the Johnson's report). The results from this study are presented in Table 1.

The data presented by Johnson cannot be directly used to estimate the royalties foregone by the land owners. The frequency of cyclones in Vanuatu may have affected the volumes of timber occurring in the area. Also, a complete data set for the area is not provided by Johnson (1971). Furthermore, the merchantable timber volume was derived by Johnson by applying an ad hoc reduction factor to account for inaccessibility. One third of the forest area was considered inaccessible. The information from the Vanuatu Resource Information System (VANRIS) allows however a more detailed specification of the areas which are inaccessible, or of difficult accessibility, and in which only part of the timber could be extracted.

Rather than carrying out another full survey of the area (at a considerable cost and with the likelihood of obtaining data with a large statistical variability as in the case of Johnson's) it is attempted here to build on the information already provided by Johnson, that collected during the National Forest Resource Inventory (NFRI) and the information made available by VANRIS. A small supplementary survey was also carried out[4].

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[4] This survey would have been impossible without the assistance of Japeth Hidson (Forestry officer) and Livo Mele (Research assistant).

Table 1. Volumes of merchantable timber (60 cm d.b.h.)

Ridge No.	Unit[#] Total area (ha)	Species	Mean volume (m^3/ha)	Standard error (m^3/ha)	Percentage standard error	Reliable minimum estimate* (m^3/ha)
15	544	Kauri	7.0	11.3	161.7	-4.3
		Tamanu	36.0	19.3	53.6	16.7
		Other species	12.2	4.3	35.0	7.9
		All species	55.1	17.2	31.1	37.9
16	1266	Kauri	16.9	17.6	104.0	-0.7
		Tamanu	27.1	17.6	64.7	9.5
		Other species	16.9	11.5	68.1	5.4
		All species	60.9	22.3	36.6	38.6
17	345	Kauri	0.0	0.0	0.0	0.0
		Tamanu	29.8	15.7	52.5	14.1
		Other species	15.3	8.4	54.9	6.9
		All species	45.1	19.9	44.2	25.2

[#] Mapping area adopted in Johnson's study
* Reliable minimum estimate = mean - standard error
Source: Johnson (1971).

The large standard errors for the estimates of stocking volumes for kauri arise because of the uneven distribution of this species (Johnson, 1971). Kauris occur in scattered groups, thus some transects show high volumes of kauri whereas other transects present low volumes. To obviate to this problem stocking volumes of kauri where measured by placing six transects in areas designated as 'kauri forest' in the Johnson's vegetation map. This is thought to provide a more accurate estimate of the stocking volume of kauri. Six more transects were also placed in other forest vegetation types forest areas to supplement the data already available through the NFRIthat are described by Johnson (1971) as kauri forest.

Detailed information on the vegetation types of the PA and some physical parameters are reported in Tables 2 below.

Table 2. Description of the Kauri protected area.

RMU#	Vegetation type*	Area (ha)	Forest area (ha)	Strata	Slope (deg.)	Loggable %
316	FlMW	424	424	-	> 30	0
323	FmeClAg	5	5	17	20-30	0-20
324	FmeClAg	20	20	17	10-20	80
325	FmeAgCl	821	821	17	20-30	0-20
326	FmeAgCl	125	125	17	10-20	80
327	FmeAgCl	139	139	16	10-20	80
328	FloAsSV	49	32	15	20-30	0
329	FmeAgCl	90	90	16	2-10	90
330	FmeClAg	42	42	21	2-10	90
331	FmeClAg	268	268	-	> 30	0
333	FloAsSV	85	55	12	10-20	80
336	FloAsSV	7	5	10	10-20	80
338	G	41	0	-	10-20	0
339	FloAsSV	10	7	12	10-20	80
340	G	238	0	-	20-30	0
341	FmeAgCl	27	27	15	20-30	50-70
342	FloAsSV	202	131	11	10-20	70
344	FloAsSV	6	4	9	10-20	80
345	FloAsSV	33	21	-	> 30	0
346	FloAsSV	548	356	12	10-20	80
347	FmeAgCl	36	36	15	10-20	50-70
356	FloAsSV	27	18	411	> 30	0
369	FmeClAg	14	14	423	> 30	0
Total		3,257	2,641			

Resource Mapping Unit (RMU) adopted in the design of the Vanuatu Resource Information System (Bellamy, 1993).

* FlMW: Low, montane forest with *Metrosideros-Weinmannia.*
FmeClAg: Midheight forest with *Calophyllum-Agathis.*
FmeAgCl: Midheight forest with *Agathis-Calophyllum.*
FloAsSV: Low forest with an open canopy, dominated by *Acacia spirorbis*, associated with patches of the vegetation type low scrub of *Va[illegible]am-Cyperaceae.*
G: Grassland and/or herbaceous communities.
Source of vegetation types: Bellamy (1993).

The slope and 'loggability' parameters reported in Table 2 are of particular importance for the determination of the merchantable volume of timber standing in the PA. Logging on slopes with inclination greater than thirty degrees is not allowed in Vanuatu. The analysis excludes therefore RMUs with slope greater than thirty degrees. The landform and rocktype, together with slope, determine the loggability parameters. For instance, deeply dissected landforms associated with steep slope contribute to a low loggability parameter. The parameters presented in Table 2 are derived from Baldwin et al. (1993). In the table, some RMUs exhibit two parameters. Some of the parameters given by Baldwin et al. (1993) may appear to some too restrictive. For these parameters a higher value is considered in order to carry out sensitivity analysis. In the following tables, the timber volumes derived from the application of the two sets of parameters are referred to as Low range (low loggability parameters) and High range (high loggability parameters).

Six transects were established in kauri forests. The mean values derived are:

- kauri: 37.985 m^3/ha (standard deviation 8.608)
- tamanu 18.820 m^3/ha (standard deviation 6.742)
- other species 4.800 m^3/ha (standard deviation 3.000).

Table 3 reports the volumes of kauri, tamanu and other species in dense kauri forests.

Table 3. Merchantable timber in kauri forest.

RMU	Area (ha)	Loggability %	Kauri (m^3)	Tamanu (m^3)#	Other species (m^3)#
324	8	80	243	96	25
325	233	0	0	0	0
		20	1170	701	179
326	8	80	243	96	25
327	29	80	881	349	89
328	10	0	0	0	0
		20	76	30	8
346	9	80	273	108	28
347	13	50	246	98	25
		70	345	137	35
Total		Low range	1886	747	192
		High range	3831	1517	389

A reduction factor of 20% is applied to allow for defects.

Data collected during the national forestry inventory provides the basis for the assessment of merchantable timber standing in the other forest areas. For each RMU, the area of dense kauri forest (eventually found in the RMU) is subtracted to the area of forest. Then, the loggability parameter is applied. This gives the loggable area for the RMU.

Table 4. Merchantable timber for the other forest types.

RMU	Loggable area* (ha)	Kauri m^3/ha	Kauri total m^3	Tamanu m^3/ha	Tamanu total $m^{3\#}$	Other spp. m^3/ha	Other spp. total $m^{3\#}$
323	0	2.65	0	32.29	0	5.27	0
	1	2.65	2.65	32.29	26.32	5.27	4.22
324	9.6	2.65	25.44	32.29	247.99	5.27	40.47
325	0	2.65	0	32.29	0	5.27	0
	117.6	2.65	311.64	32.29	3037.84	5.27	495.80
326	93.6	-	-	32.29	2417.87	5.27	394.62
327	88	-	-	9.07	638.53	1.51	106.30
329	81	-	-	9.07	587.74	1.51	97.85
330	37.8	-	-	5.07	153.32	0.50	15.12
333	44	-	-	2.09	73.57	-	-
336	4	-	-	-	-	-	-
339	5.6	-	-	2.09	9.37	-	-
341	13.5	-	-	8.88	95.90	-	-
	18.9	-	-	8.88	134.27	-	-
342	91.7	-	-	10.70	784.95	2.44	223 75
344	3.2	-	-	-	-	-	-
346	277.6	-	-	2.09	464.15	-	-
347	11.5	-	-	8.88	81.7	-	-
	16.1	-	-	8.88	114.37	-	-
Total	Low range		25.44		5555.09		878.10
	High range		339.73		8690.29		1378.13

* See Table 2 for loggability parameter.
\# A reduction factor of 20% is applied to allow for defects.

The timber volumes derived in Table 3 and Table 4 are combined in Table 5. The value of royalties is derived by applying current royalty rates, formulated by the Department of Forests. These are: 1300 vatu/m^3 for kauri, 1000 vatu/m^3 for tamanu and 600 vatu/m^3 for other species.

Table 5. Value of timber royalties (vatu).

	Kauri (m^3)	Value	Tamanu (m^3)	Value	Other spp. (m^3)	Value	Total value
Low range	1911.44	2484872	6302.09	6302090	1070.10	642060	9429022
High range	4170.73	5421949	10207.29	10207290	1767.13	1060278	16689517

The value of timber royalties derived in Table 5 will be used to determine the economic incentive to be provided to the land owners.

6. Benefits from the natural forest

The benefits that the local people derive from the forest in its unlogged state are considered below. Information on this topic is needed in order to: (a) understand the current resource use patterns (eventually to be incorporated in the management plan for the PA); and (b) assess the economic incentive to be provided to land owners. These benefits are described by resource categories. The PA is currently 'closed off', as noted in a previous section. The questioning undertaken relates to past use of the PA. A quantitative analysis is currently foreclosed by the ban on the collection of products from the PA.

Subsistence gardens

It was noted above that the forest area outside the PA appears to be amply sufficient for the expanding village population. If the PA is logged, this would not imply costs in terms of lost garden production.

Firewood

Several species of timber are being used as firewood. However, five species have been reported as being the favorite and most commonly used ones: Nilaru (*Elattostachys falcata*), Nangal (*Cupaniopsis spp.*), Netor (*Syzygium spp.*), Novou (*Macaranga spp.*), and Pongnut (*Ficus adenosperma*).

With the exception of netor, these species grow in the garden areas. Novou is the first one to grow after the garden is abandoned, followed by nilaru and nangal after four to five years. Pongnut is normally found in garden areas that have been abandoned for a long period of time (ie. ten years or more).

Questioning about the place of collection evidenced that firewood is collected in the garden areas and in the secondary forest close to the village. In the words of one of the villagers 'the dark bush is too far away for collecting firewood'.

From the species used and from the declared pattern of collection, it is apparent that the PA, which is considered 'dark bush', cannot be considered a primary source of firewood.

Building materials

All the houses in the village are built with plant material with the exception of the school and three houses, whose roof was made of corrugated iron.

The most used species for the posts is Namariu (*Acacia Spirobis*) (which is found in garden areas and secondary forest close to the village) because it does not rot and can last for many years (a strongly built house may last between 15 and 20 years). Netor, novou, and namariu are commonly used to make rafters. The roof and the side walls are made with Deniun (a cane species to be identified) and also with leaves of the sugar cane. Deniun grows wild in the gardens. It is also planted in order to produce larger and stronger canes.

The gardens and the forest close to the village provide sufficient building material.

Medicinal plants

The assessment of the contribution of medicinal plants to local livelihood is a difficult task for several reasons. Firstly, people tend often to guard their knowledge on medicinal plants and it is therefore difficult to assess whether the information collected reflects the actual use of medicinal plants. Secondly, medicinal plants are not used on a recurrent basis such as, for example, firewood. Therefore, long periods of direct observation would be involved if a reliable estimate of their consumption was to be derived (whether this is indeed achievable is difficult to say, given the constraint just mentioned above). As for the previous resource categories, the derivation of the pattern of use of medicinal plants was attempted.

A list of plant species with their scientific and local language names was read to two respondents, knowledgeable of plant names and their uses. They recognized all the names of plants (135) which had been collected on the west coast of Erromango by forest botanists[5] and gave their generic use (eg. firewood, medicinal).

Forty-three plants were reported as having medicinal use. The locations (as defined by the respondents) where these plants could be collected can be subdivided into five categories. 1) 'Dark bush': it refers to primary forest essentially found in the PA and similar

[5] The botanists were Caballion P. and Sam C. (ORSTOM), Curry P. (Department of Forests).

forest types not included in the PA but at significant distance from the village. 2) 'Bush close up': it indicates secondary forest close to the village. 3) 'White grass': it indicates the grassland area that is found in the PA. 4) 'Garden': medicinal plants that are commonly planted are listed in this category; some plants included in the next category are also found in garden areas. 5) 'Everywhere': several plant species were widespread throughout the various vegetation types and their location was thus described by the informants.

The location of the medicinal plants used in the village is summarized in Table 6. It may be noted that it is likely that the answers provided by the informants about the location of the plants do not fully describe the distribution of these plants in the local environment. A bias towards the places of most frequent collection may exist. This however does not create a problem for the analysis, which in fact attempts to extrapolate the pattern of resource use.

Table 6. Place of collection of medicinal plants and their frequency distribution.

	Location				
	'Dark bush'	'Bush close up'	'White grass'	'Garden'	'Everywhere'
Only*	1	9	2	8	
Mix#	3	9	1	2	16

* Only one location was given for the plant.
# Two locations were given for the plant.

It is evident from Table 6 that the PA provides only a very limited number of the medicinal plants used in the village. Only three out of forty-three plants can be found in locations associated with the PA.

Food

Wild pigs are a major food item that can be derived from the PA. Currently, they cannot be hunted inside the PA because of the ban mentioned above. However, they can be found around the garden areas, where they are hunted with dogs or caught in traps set to limit the damage caused to crops.

Other food products that can be obtained from the PA include fresh water prawns, nuts (eg. *Canarium spp.*), edible leaves and wild yam. Villagers reported to have used wild yam after the occurrence of cyclones.

It should be noted that wild yam, nuts and edible leaves are also found in gardens and the forest close to the village. It is difficult to assess whether the eventual loss of those

located in the PA would have a negative impact on the villagers' livelihood. However, it appears that a negative impact could be excluded. In fact, the ban imposed on the utilization of the resources from the PA does not appear to affect the villagers.

Sandalwood

The people of Umpon Yelongi consider the sale of sandalwood a major source of income. However, according to their opinion, this resource presents a limited stock. The limited number of trees sold in 1992 by the villagers tend to confirm the current paucity of this resource. Apparently, only three trees were cut in the PA in 1992. A survey of the standing trees inside and outside the PA has not been carried out yet and would help in determining the status of this resource. Quantitative data regarding the total volume and value of sandalwood sales in Umpon Yelongi during 1992 is not available.

Research on the potential economic returns from sandalwood cultivation is currently being undertaken. This information will contribute to a better understanding of the possible economic benefits that may be derived from a multiple land-use management of the PA.

Other benefits from the forest

Logging in Vanuatu has mainly taken place on gentle slopes with soil of relatively low erodibility. Thus, soil erosion and water siltation have not been major problems. The PA presents however steep slopes. Logging operations carried out on this kind of terrain could cause siltation of the Lampunari and Pongkil rivers. There is no data available to determine the impact that this would have on the flora and fauna of the PA. Siltation of the rivers would also impact on the marine environment. In turn, this could have a negative repercussion on the livelihood of the local people, who fish and collect shellfish in the sea close to the Pongkil river.

7. Determining the economic incentive for the land owners

The Department of Forests has proposed to lease the land from the land owners. It has never been clear however whether this would represent a sufficient compensation for the logging royalties foregone by the land owners. This section is devoted to an analysis of this issue.

The value of the land lease is based on the current rate, set by the Department of Lands, for unimproved agricultural land on Erromango. This is 100 vatu/ha per year. Some islands of Vanuatu, that are more developed than Erromango, exhibit relatively higher rates (eg. unimproved agricultural land on Efate may be leased at 500 vatu/ha/year). If it is assumed that economic development in Erromango accelerates, the opportunity cost of land would rise. Eventually, the leasing rate would also increase over time. Table 7 presents the present value of the lease for the PA calculated at the fixed rate

of 100 vatu/ha/year and a hypothetical scenario in which this rate increases by 25 vatu/ha/year every ten years.

Table 7 also shows the present value of royalties which would be paid if the forest in the PA were to be logged. Both logging royalties and the lease are discounted at three different rates. The rate of 0 reflects the real bank deposit rate of Vanuatu, which averaged at 0.1% during the period 1983-90 (Reserve Bank of Vanuatu, pers. comm., 1993). The other two rates of 4% and 8% are also considered in order to better assess the impact of higher market rates, and also to account for the fact that the land owners might have positive discount rates. It should be noted that the rate of 8% is substantially higher than real market rates occurring in Vanuatu.

The value of logging royalties has been presented in Table 5. It is assumed that logging will take place in three years time, given that the current infrastructures (ie. roads) do not permit an immediate access to the area. It is assumed that the area could be logged in one year. It is further assumed that the forest could not be harvested again during the next 75 years. This seems to be a reasonable assumption, given the poor regeneration rates that occurred in Erromango following the logging operations undertaken by Société Agathis during the late 1960s and early 1970s.

Table 7. Present value of proposed protected area lease and timber royalty (vatu: vt).

Proposed protected area	3257 ha		
Discount rate	0	4%	8%
Present value of :			
Fixed rate lease (100 vt/ha/year; 75 years)	24,427,500	8,021,217	4,383,261
Increasing rate lease (100 vt/ha/year and 25 vt/ha/year increase every 10 years; 75 years)	44,376,625	11,364,178	5,303,464
Royalty Low range	9,429,022	7,485,062	8,382,366
Royalty High range	16,689,517	13,248,677	14,836,920

From Table 7 it appears that when the 'mid-range' discount rate is adopted, the present value of a lease agreement is comparable to that of logging royalties, in the low range scenario. If the high range scenario is considered, payment of a lease would be sufficient to counterbalance foregone royalties only when the discount rate adopted is 0. It may be noted that the in the high range scenario logging will take place on steep slopes (more than 20 degrees) and deeply dissected landforms. While this is legal in Vanuatu, logging on this kind of terrain may be expected to cause substantial soil erosion.

During the consultation process, the land owners expressed strong concern about the potential environmental damage that could be caused by logging activities. This seems to indicate that it is the low range scenario that should be adopted as a reference point for discussions on the level of the eventual compensation to be paid to land owners. The concluding section presents the current status of the consultation process and the land onwers' views about the 'acceptable' level of compensation.

8. Conclusion

The paper has shown that if the PA is established, it would not be in conflict with the local population's economic activities. The forest area proposed for PA status is currently the object of very limited subsistence use and the local people would be allowed to continue to carry out these activities.

Given the apparent limited importance of the PA for subsistence use, it could be expected that the land owners might decide to allow logging operations to take place if the PA is not established. However, the establishment of the PA would impose a cost on the land owners: they would have to forego logging royalties.

In order to limit the costs faced by the land owners, the government of Vanuatu has decided to provide them with financial compensation. It has been shown in the paper that a fixed rate lease agreement has a present value roughly equal to logging royalties in the low range scenario, at a discount rate of 4%. The present value of an increasing rate lease agreement falls short of about 3.5 million vatu respect to the logging royalties in the high range scenario, at a 4% discount rate.

These findings have been presented to the land owners and have been thoroughly discussed with them. It was pointed out to them that if they allowed logging operations to go ahead on their land, they would receive logging royalties but they would not be able to lease their land after these operations. In fact, apart from the fact that there is very limited demand for land on Erromango, their land has poor agricultural potential, that would be further reduced by the logging operations.

This clearly implies that the land owners would not be able to gain logging royalties and returns from a lease agreement. The land owners have decided that a leasing agreement satisfies their economic expectations and have agreed to offer their land for lease to the government of Vanuatu at the rate of 100 vatu/ha/year. This rate will be

revised in accordance with any increases in lease payments for unimproved agricultural land on Erromango decided by the Department of Lands. The lease agreement will be initially for a trial period of five years. This will allow the land owners to test the compatibility of the establishment of the PA with their lifestyles.

The funds provided by the European Community in 1989 will be just sufficient to finance the five year lease agreement. The provision of funds for biodiversity conservation by international donors show the concern and the demand existing for the protection of biodiversity at the international level. It is likely that developing countries like Vanuatu will be able to develop biodiversity conservation plans only if international support is forthcoming.

The establishment of a PA by leasing the land from the land owners appears to provide an agreement that mitigate the negative intragenerational implications often presented by PAs. It also contributes to the achievement of intergenerational equity in two distinct ways: a) it protect biological diversity that can be used by future generations; b) the financial benefits arising from the lease agreement can be enjoyed by the descendants of the current land owners.

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