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**International
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Discussion Paper 00-01



Fiscal Incentives for Biodiversity Conservation: The ICMS Ecológico in Brazil

Maryanne Grieg-Gran

December 2000



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ENVIRONMENTAL ECONOMICS PROGRAMME

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Abstract

This paper evaluates an innovative tax revenue-sharing scheme in Brazil, designed to promote the conservation and management of protected areas. Known as the “ICMS Ecológico”, the scheme was introduced by the state of Paraná in Brazil and subsequently by several other states. The scheme aims to compensate municipal governments for the loss of potential tax revenue from the designation of protected areas (mainly by the state and federal government). It is also intended to have an incentive effect, encouraging both better management of existing protected areas as well as the designation of new conservation areas. The paper examines the experience with the ICMS Ecológico in the states of Minas Gerais and Rondônia, two states which present a marked contrast in terms of land use, population density and forest resources. It considers the extent to which the compensation and incentive objectives have been achieved in the two states. The distributional impact of the ICMS Ecológico is also examined through an analysis of the characteristics of the counties which are winners or losers under the scheme.

1. Introduction

The ICMS (tax on sale of goods and services) which operates at state level in Brazil¹ constitutes an important source of revenue for local governments. The Federal Constitution of 1988 stipulates that 25% of the revenue raised by the ICMS should be allocated by the state government to the counties. A further requirement of the Constitution is that 75% of the total passed on to local governments should be allocated according to the value added generated by each county. The state governments have the authority to determine distribution criteria for the remaining 25%. This represents an opportunity for the state governments to influence the development process at county level as, by means of these criteria, they can encourage certain activities and discourage others. Typically, the state governments have utilised criteria based on population, geographical area and primary production. In 1992, the state of Paraná introduced an ecological criterion for the ICMS distribution, based on the area of land subject to protection. The new system became popularly known as the “*ICMS ecológico*”. Other states observed Paraná’s experience with the *ICMS ecológico* and decided to introduce similar systems. The states of Minas Gerais and São Paulo started operating the *ICMS ecológico* in 1996, followed in 1997 by the state of Rondônia.

The decision by the state of Paraná to include an ecological criterion in the ICMS distribution was taken as a result of pressure exerted by certain local authorities which had protected areas, or watershed protection areas, within their territories. The mayors of these counties argued that these land use restrictions were preventing them from developing productive activities and generating value added. Thus they were losing out in the allocation of the ICMS revenue as so much of it depended on value added. They stressed that without some form of compensation it would be difficult for them to maintain compliance with such land use restrictions. In response to their concerns, the new ICMS distribution system included an ecological criterion for 5% of the total distributed. Of this 5%, half would be for counties with watershed protection areas and half for those with protected areas.

While the major motivating factor for the introduction of the *ICMS ecológico* was the need to compensate counties subject to land use restrictions, it was envisaged that it could also act as an incentive for an increase in the area of land set aside for protection, or for improvement in the management of existing protected areas. Thus the *ICMS ecológico* can be considered to have two main objectives: to compensate for land use restrictions and to provide an incentive for protection.

The aim of this report is to evaluate the experience with the *ICMS ecológico* in Minas Gerais and Rondônia, two states which present a marked contrast in terms of land use, population density and forest resources. Reference is made to the *ICMS ecológico* in Paraná for comparative purposes.² The report focuses on the extent to which the compensation and incentive objectives have been achieved. The distributional impact of the *ICMS ecológico* is also examined through an analysis of the characteristics of the counties which are winners or losers under the new distribution regime for the ICMS. Finally, there is a discussion of the views of various stakeholders about the *ICMS ecológico*. The principal emphasis of the report is on protected areas, although the *ICMS ecológico* can cover other environmental aspects

¹ Brazil has 26 States, each with an elected government which has revenue-raising powers.

² For more details on the *ICMS ecológico* in Paraná see WWF, 1999, Loureiro, 1996, and Loureiro, 1994.

such as sanitation and watershed protection. The evaluation was based on analysis of data on ICMS distribution indices and socio-economic characteristics of the counties as well as interviews with the various stakeholders including representatives of state government departments of environment, planning and finance, local government and NGOs. The evaluation concentrates on changes in the ICMS consolidated index, which indicates the share that each county receives of the revenue passed on by the state government. It does not look at changes in the revenue actually received by each county. The approach to the analysis differs slightly between the two states, reflecting differences in characteristics. In Rondônia, there are relatively few counties so that it is feasible for the analysis to examine changes for each of them. In Minas Gerais where there are 853 counties, it was necessary to work either at a more aggregated level, examining changes for different groups of counties, or to focus on a selection of counties for illustrative purposes.

2. Principal Characteristics of the ICMS Ecológico

State governments in Brazil have adopted a range of different criteria for the distribution of ICMS revenue. As explained earlier, it is a legal requirement to distribute 75% according to value added generated in each county. The distribution of the remaining 25% gives an opportunity to the state governments to use other criteria such as geographical area, population, cultivated area etc. Some states, for example, Minas Gerais, were using value added as the principal criterion for the 25% until the introduction of the *ICMS ecológico*. In contrast, since 1982 Rondônia had been using a range of criteria before it introduced the ecological criterion. 19% was divided equally between the counties regardless of their size, population or production. Tables 2.1 and 2.2 show the criteria used in these two states before and after the introduction of the *ICMS ecológico*, and the percentage weights assigned to them. These differences are important because they have implications for the distributional impact of the new system. In Minas Gerais, the introduction of the ecological criterion was accommodated by a reduction in the weight assigned to the value added criterion. In Rondônia, it was necessary to reduce the weight given to the equal shares criterion.

Table 2.1: ICMS Allocation Criteria in Rondônia 1982-1998

	1982-1994	1995	1996	1997	1998
<i>Value Added</i>	75%	75%	75%	75%	75%
<i>Population</i>	5%	0.50%	0.50%	0.50%	0.50%
<i>Area</i>	9%	0.50%	0.50%	0.50%	0.50%
<i>Production</i>	8%	5%	5%	5%	5%
<i>Equal Share</i>	3%	19%	19%	14%	14%
<i>Area Protected</i>				5%	5%
Total	100%	100%	100%	100%	100%

Source: *Diario Oficial*

Table 2.2: ICMS Allocation Criteria in Minas Gerais 1989-2000

Criterion	Before the ICMS Ecológico					After the ICMS Ecológico				
	1989-1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
<i>Value added</i>	94.39	94.39	94.15	93.9583849	93.9645489	88.04702	83.457	79.48608	79.55072	79.61536
<i>Mining Counties</i>	5.61	0.11	0.11	0.11	0.11	1.50	0.75	0.11	0.11	0.11
<i>Equal Share</i>		5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
<i>Mateus Leme</i>			0.24	0.3252856	0.3022598	0.20383	0.1807	0.1355	0.09037	0.04518
<i>Mesquita</i>				0.1063295	0.1231913	0.08755	0.0778	0.05837	0.03891	0.01946
<i>Geographical Area</i>						0.333	0.666	1.00	1.00	1.00
<i>Population</i>						0.666	2.042	2.71	2.71	2.71
<i>50 counties with the highest population</i>						0.666	1.332	2.00	2.00	2.00
<i>Education</i>						0.666	1.332	2.00	2.00	2.00
<i>Area Cultivated</i>						0.333	0.666	1.00	1.00	1.00
<i>Cultural Heritage</i>						0.333	0.666	1.00	1.00	1.00
<i>Environment*</i>						0.333	0.666	1.00	1.00	1.00
<i>Health Expenditure</i>						0.666	1.332	2.00	2.00	2.00
<i>Own Revenue Generation</i>						0.666	1.332	2.00	2.00	2.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*Protected Area and extent of sanitation and waste disposal systems.

Source: State Finance Department, State Revenue Division, Municipal Affairs Area.

The *ICMS ecológico* in Paraná, Minas Gerais and Rondônia have certain points in common:

- Calculation of the ecological index for each county is based on the total area set aside for protection in relation to the total area of the county. Nevertheless, there are differences in the way the three states evaluate the different types of protected area.
- To be included in the calculation of the index, the protected areas have to be registered and legally defined.
- The protected areas can be designated at federal, state or county level. Privately owned protected areas also qualify (although any ICMS revenue associated with them accrues to the county and not to the owner of the land). Various types of protected areas qualify: both indirect use (such as biological reserves, ecological stations and parks), and direct use (such as indigenous areas, extractive reserves and sustainably managed forest).

The three systems differ in the following aspects:

1) Definition of the ecological criterion

In Rondônia, the criterion is based solely on the area set aside for protection. In Minas Gerais and Paraná, there are two sub-criteria:

- Paraná
 - 50% distributed to counties with protected areas within their territory
 - 50% distributed to counties with watershed protection areas within their territory
- Minas Gerais
 - 50% distributed to counties with protected areas within their territory
 - 50% distributed to counties which have solid waste disposal systems, or sanitation systems which attend to the needs of a certain proportion of the population

2) Weight given to the criterion for protected areas

- 5% in Rondônia
- 2.5% in Paraná
- 0.5% in Minas Gerais (from 1998 onwards)

3) Frequency of Calculation of the Indices

In Paraná and Rondônia, the indices are calculated on a yearly basis. In Minas Gerais, since the beginning of 1998, the ecological indices have been calculated every three months. Other indices used in the ICMS, such as health and education, are calculated on a monthly basis. The creation of a new protected area in a county can therefore affect its consolidated ICMS index in a period of 3 to 6 months. In Rondônia and Paraná, the county would have to wait until the following year before its index was recalculated.

4) Emphasis given to the Quality of Protected Areas

Currently, only Paraná has a system for evaluating the quality of protected areas and incorporating this into the calculation of the ecological index. In Minas Gerais, although the legislation provides for the inclusion of a quality factor in the calculation of the index, at the time of the evaluation no system had been set up to determine values for quality.

In Rondônia the legislation makes reference to the possibility of reducing the indices of the counties where cases of invasion or illegal land use have been detected. However, at the time of the evaluation no system had been established.

5) Calculation of the Index

Rondônia has the simplest system at the moment for calculating the index. It is based on the ratio between the total area set aside for protection within a county and the total area of the county. This ratio, known as the County Conservation Factor, is calculated for each county. All the County Conservation Factors are summed to give the State Conservation Factor. The ecological index of each county is then calculated by dividing its County Conservation Factor by the State Conservation Factor. The final step is to apply the 5% weight given in the legislation.

This calculation can be expressed as follows:

$$EI_i = MCF_i / SCF$$

Where :

EI_i is the ecological index of county i

MCF_i is the conservation factor of county i

$$= \text{Area } CU_i / \text{Area } M_i$$

$\text{Area } CU_i$ = total area of conservation units in county i

$\text{Area } M_i$ = area of county i

SCF is the State Conservation Factor

$$= \sum MCF_i$$

In Minas Gerais, the method of calculation is similar. The main difference is that an additional weight is applied according to the category of protected area and the degree of land use restriction involved, as shown in Table 2.3. The more restrictions imposed on the use of the land, the higher the conservation weighting. Thus, an ecological research station has a factor of 1, while an indigenous reserve which involves some extractive use has a factor of 0.5.

Table 2.3: Conservation Weights for Different Types of Protected Area

Management Category	Conservation Weight	
	Minas Gerais	Paraná
<i>Ecological Research Station</i>	1.0	1.0
<i>Biological Reserve</i>	1.0	1.0
<i>Park</i>	0.9	0.9
<i>Private Natural Heritage Reserve</i>	0.9	0.8
<i>National, State or County Forest</i>	0.7	0.7
<i>Indigenous Area</i>	0.5	0.5
<i>Environmental Protection Area I</i>		0.1
<i>Wildlife Zone</i>	1.0	
<i>Other Zones</i>	0.1	
<i>Environmental Protection Area II (without zoning)</i>	0.025	
<i>Special Protection Area</i>	0.1	
<i>Area of relevant ecological interest</i>		0.1
<i>Special, local areas of tourist interest</i>		0.1
<i>Buffer zones</i>		0.1

Source: Instituto Estadual de Florestas, Minas Gerais, Raymundo et al, 1996.

In Paraná, a conservation weighting system is also applied. The weights given and the categories of protected areas are very similar to those of Minas Gerais (as shown in Table 2.3). In addition, a quality factor is applied which is calculated for each protected area. Thus the formula for calculating the index has two components: one based on the total area of all the protected areas in the county, and one based on their quality.

3. The Compensation Impact of the ICMS Ecológico

The compensation impact of the *ICMS ecológico* is important because a large proportion of the protected areas are of federal or state jurisdiction. This implies that the local governments have little scope for influencing decisions made on the designation and maintenance of a large proportion of the area set aside for protection. In many cases they are obliged to accept decisions made at other levels of government which affect their ability to develop productive activities and to generate revenue. Table 3.1 shows the jurisdiction of the protected areas in the three states. It can be seen that in all three states, county protected areas account for only a small proportion of the total. There are also marked differences between the states. Rondônia has more than 30% of its territory designated as protected areas, significantly more than in the other two states. As a result the potential compensation impact of the ICMS should be particularly relevant in this state. In the other two states, the impact of the *ICMS ecológico* on incentives to create new protected areas is likely to be more relevant.

Table 3.1: Jurisdiction of Protected Areas, 1997

	Federal	State	County	Total
Paraná				
<i>Area protected (ha)</i>	502,471	1,013,421	69,699	1,585,590
<i>Percentage of total protected area</i>	32%	64%	4%	100%
<i>Protected areas as % of total state area</i>				2%
Minas Gerais				
<i>Area protected (ha)</i>	830,269	331,078	2,772	1,164,119
<i>Percentage of the total protected area</i>	71%	28%	0.24%	100%
<i>Protected areas as % of total state area</i>				2%
Rondônia				
<i>Area protected (ha)</i>	6,637,462	2,406,018	1,150	9,044,630
<i>Percentage of the total protected area</i>	73%	27%	0.01%	100%
<i>Protected area as % of total state area</i>				36%

Source: Estimated from data on protected areas from state environment agencies.

The introduction of the ecological criterion in the ICMS distribution implies that a reduction has to be made in the weights assigned to other criteria. Depending on local characteristics the impact of the *ICMS ecológico* is not likely to be positive in all cases, even where counties have protected areas within their territories. Other factors, such as changes in value added or the formation of new counties, can also affect the indices and obscure the effect of the *ICMS ecológico*. Therefore, it is important to examine whether all the counties with protected areas actually benefited from the new system.

The Compensation Impact of the ICMS Ecológico in Rondônia

How the Consolidated Indices Changed

In Rondônia, after the introduction of the *ICMS ecológico* in 1997, 22 counties had an increase in their consolidated ICMS indices and 26 had a reduction. In 1998, the situation was similar, with 21 counties showing an increase over their 1996 level. Four new counties, which were created in 1996, only began to receive the ICMS in 1997, and have therefore been excluded from the analysis. Table 3.2 shows the changes between 1996 and 1998 for the group that had increases in their consolidated ICMS indices. It can be seen that:

- All but three of these counties have protected areas within their territories
- The increase in the index was marked for some counties, more than 50% in three cases and more than 20% in 13 cases.

Table 3.2: Counties with Increases in their Consolidated ICMS Index after the Introduction of the ICMS Ecológico

County	Consolidated ICMS Index		Increase 1996-1998	Protected Area as % of total county area
	1996	1998		
<i>Jamarí</i>	0.3509	1.1041	214.65%	55.31%
<i>Alto Alegre dos Parecis</i>	0.4446	0.7815	75.78%	43.65%
<i>Guajara-Mirim</i>	1.1948	1.8441	54.34%	88.53%
<i>Monte Negro</i>	0.8323	1.2417	49.19%	5.96%
<i>São Miguel do Guaporé</i>	0.5568	0.8138	46.16%	62.00%
<i>Cerejeiras</i>	1.1735	1.6825	43.37%	42.36%
<i>Gov Jorge Teixeira</i>	0.4632	0.641	38.39%	66.82%
<i>Machadinho d'Oeste</i>	0.779	1.044	34.02%	17.42%
<i>Jaru</i>	3.2733	4.0989	25.22%	5.18%
<i>Vilhena</i>	7.4372	9.2413	24.26%	60.30%
<i>Seringueiras</i>	0.4931	0.6011	21.90%	45.13%
<i>Candeias do Jamarí</i>	1.49	1.8078	21.33%	8.68%
<i>Alvorada d'Oeste</i>	0.8362	1.0101	20.80%	35.51%
<i>Ji-Paraná</i>	9.528	10.8438	13.81%	51.94%
<i>Mirante da Serra</i>	0.5866	0.6662	13.57%	33.34%
<i>Colorado d'Oeste</i>	1.1949	1.3045	9.17%	0.00%
<i>Espigão d'Oeste</i>	1.5692	1.7072	8.79%	31.57%
<i>Nova Mamoré</i>	0.5947	0.6453	8.51%	53.00%
<i>Rolim de Moura</i>	2.7886	3.0027	7.68%	0.00%
<i>Vale do Anari</i>	0.4181	0.439	5.00%	32.63%
<i>Corumbiara</i>	0.5709	0.5942	4.08%	0.00%

Source: Estimated from data provided by the State Finance Department, Rondônia.

Table 3.3 shows the changes for the 27 counties that saw a decrease in their consolidated index. It can be observed that nine of these have protected areas within their territory. Thus in spite of the introduction of the *ICMS ecológico* they were worse off.

Table 3.3: Counties with Reductions in their Consolidated ICMS Index after the Introduction of the ICMS Ecológico

County	Consolidated ICMS Index		Reduction 1996-1998	Protected Area as % of total county area 1997
	1996	1998		
<i>Alta Floresta d'Oeste</i>	1.3561	1.2968	-4.37%	27.02%
<i>Porto Velho</i>	26.031	24.6299	-5.38%	32.97%
<i>Costa Marques</i>	0.8589	0.7959	-7.33%	38.89%
<i>Pimenta Bueno</i>	2.5607	2.3441	-8.46%	0.90%
<i>Teixeropolis</i>	0.4018	0.3664	-8.81%	0.00%
<i>Urupa</i>	0.4957	0.4494	-9.34%	0.00%
<i>Alto Paraíso</i>	0.6494	0.5732	-11.73%	0.00%
<i>Cacaulandia</i>	0.4324	0.3657	-15.43%	0.98%
<i>Cujubim</i>	0.4046	0.3414	-15.62%	12.73%
<i>Campo Novo de R</i>	0.4961	0.4182	-15.70%	24.56%
<i>Vale do Paraíso</i>	0.4253	0.3475	-18.29%	0.00%
<i>Presidente Medice</i>	1.2207	0.9613	-21.25%	0.00%
<i>Cabixi</i>	0.4712	0.3662	-22.28%	0.00%
<i>Ariquemes</i>	10.4668	8.0787	-22.82%	0.00%
<i>Ouro Preto do Oeste</i>	3.0738	2.3697	-22.91%	0.11%
<i>Theobroma</i>	0.5088	0.3766	-25.98%	0.00%
<i>Nova Brasilandia d'Oeste</i>	0.8569	0.6119	-28.59%	0.00%
<i>Parecis</i>	0.4148	0.287	-30.81%	0.00%
<i>Nova União</i>	0.3999	0.2749	-31.26%	0.00%
<i>Castanheiras</i>	0.3997	0.2743	-31.37%	0.00%
<i>Ministerio Andreazza</i>	0.9367	0.6425	-31.41%	0.00%
<i>São Felipe d'Oeste</i>	0.4018	0.2744	-31.71%	0.00%
<i>Primavera de Rondônia</i>	0.418	0.2762	-33.92%	0.00%
<i>Cacoal</i>	7.4734	4.8995	-34.44%	2.60%
<i>Novo Horizonte d'Oeste</i>	0.4601	0.287	-37.62%	0.00%
<i>Rio Crespo</i>	0.4571	0.2848	-37.69%	0.00%
<i>Santa Luzia d'Oeste</i>	1.3603	0.5138	-62.23%	0.00%

Source: Estimated from data provided by State Finance Department, Rondônia.

Separating out the Impact of the ICMS Ecológico

Changes in the consolidated index are the result of various factors and not just the *ICMS ecológico*. Value added which is the major determinant of the ICMS index can vary considerably. For example, in Jamarí, value added increased by 500% between 1995 and 1996. As the calculation of the value added index is based on the mean of the two preceding years, the index for Jamarí rose considerably between 1997 and 1998. It is therefore important to separate the effect of the ecological criterion from those of other factors. Table

3.4 presents such a separation of factors for the winning group of counties between 1996 and 1997. The first and second columns show the percentage growth and absolute growth in the index. The third and fourth columns show the ecological index for each county and the indirect effect i.e., the reduction in the equal shares index that they experienced because of the introduction of the *ICMS ecológico*. By definition this is the same for each county³. The final column is the residual and shows the change that cannot be attributed to the introduction of the *ICMS ecológico* but to other factors, such as changes in value added.

Table 3.4: Group with Increased ICMS Indices*, Direct and Indirect Impact of the Ecological Criterion and of other factors

County	Percentage Change in Consolidated Index 1996-1997	Absolute Change in Consolidated Index 1996-1997	Disaggregation of the Change in the Consolidated Index		
			Ecological Index 1997	Reduction in Equal Shares Weight	Change Caused by Other Factors
<i>Jamari</i>	62.67%	0.2199	0.273	-0.1266	0.0735
<i>Costa Marques</i>	57.76%	0.4961	0.192	-0.1266	0.4307
<i>Guajara-Mirim</i>	51.29%	0.6128	0.437	-0.1266	0.3024
<i>Monte Negro</i>	42.05%	0.35	0.0294	-0.1266	0.4472
<i>São Miguel do Guapore</i>	41.67%	0.232	0.306	-0.1266	0.0526
<i>Gov Jorge Teixeira</i>	36.05%	0.167	0.3298	-0.1266	-0.0362
<i>Alto Alegre dos Parecis</i>	32.21%	0.1432	0.2155	-0.1266	0.0543
<i>Ministerio Andreazza</i>	26.16%	0.245	0	-0.1266	0.3716
<i>Candeias do Jamari</i>	23.54%	0.3508	0.0428	-0.1266	0.4346
<i>Nova Mamore</i>	21.14%	0.1257	0.2616	-0.1266	-0.0093
<i>Machadinho d'Oeste</i>	20.49%	0.1596	0.086	-0.1266	0.2002
<i>Alvorada d'Oeste</i>	19.91%	0.1665	0.1753	-0.1266	0.1178
<i>Cerejeiras</i>	17.83%	0.2092	0.2091	-0.1266	0.1267
<i>Seringueiras</i>	16.55%	0.0816	0.2228	-0.1266	-0.0146
<i>Ji-Paraná</i>	14.58%	1.3896	0.2564	-0.1266	1.2598
<i>Espigão d'Oeste</i>	13.20%	0.2072	0.1558	-0.1266	0.1780
<i>Vilhena</i>	10.23%	0.7608	0.2976	-0.1266	0.5898
<i>Vale do Anari</i>	8.18%	0.0342	0.1611	-0.1266	-0.0003
<i>Rolim de Moura</i>	7.48%	0.2087	0	-0.1266	0.3353
<i>Jaru</i>	6.82%	0.2231	0.0256	-0.1266	0.3241
<i>Colorado d'Oeste</i>	3.60%	0.043	0	-0.1266	0.1696
<i>Santa Luzia d'Oeste</i>	1.16%	0.0158	0	-0.1266	0.1424

* Corumbiara does not appear here even though it is included in table 3.2 because its consolidated ICMS index declined between 1996 and 1997 and increased again in 1998.

Source: Estimated from data provided by State Finance Department, Rondônia.

³ This is calculated as follows: $19/48 - 14/52 = 0.1266$. Strictly speaking this includes the effect of the creation of four new counties, but the impact on the overall results is very small.

It can be seen that:

- For 14 counties with protected areas, their ecological index was high enough to offset the reduction in the equal shares index. As a result they were made better off by the *ICMS ecológico*.
- For the other four counties with protected areas (Monte Negro, Candeias do Jamari, Machadinho d'Oeste and Jaru), the reduction in the equal shares index was higher than their ecological index. However, the positive impact of other factors on the index was sufficiently high to offset this. These four counties were therefore better off after the new system was introduced but in spite of, rather than due to, the ecological criterion.
- Four counties, Ministerio Andreazza, Rolim de Moura, Colorado d'Oeste and Santa Luzia d'Oeste, none of which have protected areas, enjoyed increases in their consolidated ICMS index from 1996 to 1998. In these cases, the increases due to other factors were higher than the reduction in the equal shares index. This implies that without the ecological criterion their increases would have been even higher. Although they appear to be winners, they were in fact disadvantaged by the *ICMS ecológico*.

Table 3.5 shows the same breakdown for the group of counties which had reductions in their consolidated ICMS index after the introduction of the ecological criterion. It can be seen that:

- Six counties with protected areas suffered a decline in their consolidated ICMS index because their ecological index was smaller than the reduction in their equal shares index. The area set aside for protection was small in relation to the territory of the county.
- Another three counties with protected areas (Alta Floresta d'Oeste, Mirante da Serra and Porto Velho) also had a drop in their consolidated indices even though their ecological index was high enough to offset the reduction in the equal shares index. Thus changes in other factors, for example value added generated, must have caused the reduction in their consolidated index. This applies especially to Porto Velho, the state capital.
- For the majority of counties without protected areas, the reduction in the equal shares index was the principal cause of the decline in their consolidated ICMS index. The exception is Ariquemes where other factors were much more important.

Table 3.5: Group with Reduced ICMS Indices,* Direct and Indirect Impact of the ICMS Ecológico and Other Factors

County	Percentage Change in Consolidated Index 1996-1997	Absolute Change in Consolidated Index 1996-1997	Disaggregation of the Change in the Consolidated Index		
			Ecological Index 1997	Reduction in Equal Shares Weight	Change Caused by Other Factors
<i>Cacoal</i>	-0.07%	-0.0054	0.0128	-0.1266	0.1084
<i>Pimenta Bueno</i>	-0.38%	-0.0098	0.0044	-0.1266	0.1124
<i>Alta Floresta d'Oeste</i>	-1.81%	-0.0246	0.1334	-0.1266	-0.0314
<i>Alto Paraíso</i>	-2.23%	-0.0145	0	-0.1266	0.1121
<i>Mirante da Serra</i>	-5.73%	-0.0336	0.1645	-0.1266	-0.0715
<i>Campo Novo de R</i>	-7.10%	-0.0352	0.1212	-0.1266	-0.0298
<i>Presidente Medice</i>	-12.62%	-0.1541	0	-0.1266	-0.0275
<i>Porto Velho</i>	-12.65%	-3.2919	0.1268	-0.1266	-3.2921
<i>Cujubim</i>	-15.79%	-0.0639	0.0629	-0.1266	-0.0002
<i>Nova Brasilândia d'Oeste</i>	-16.89%	-0.1447	0	-0.1266	-0.0181
<i>Ouro Preto do Oeste</i>	-19.04%	-0.5852	0.0005	-0.1266	-0.4591
<i>Urupa</i>	-19.04%	-0.0944	0	-0.1266	0.0322
<i>Teixerópolis</i>	-19.41%	-0.078	0	-0.1266	0.0486
<i>Cacaulândia</i>	-20.86%	-0.0902	0.0048	-0.1266	0.0316
<i>Ariquemes</i>	-22.25%	-2.3284	0	-0.1266	-2.2018
<i>Theobroma</i>	-24.27%	-0.1235	0	-0.1266	0.0031
<i>Cabixi</i>	-25.85%	-0.1218	0	-0.1266	0.0048
<i>Primavera de Rondônia</i>	-30.41%	-0.1271	0	-0.1266	-0.0005
<i>Parecis</i>	-30.54%	-0.1267	0	-0.1266	-0.0001
<i>Rio Crespo</i>	-30.65%	-0.1401	0	-0.1266	-0.0135
<i>São Felipe d'Oeste</i>	-31.61%	-0.127	0	-0.1266	-0.0004
<i>Castanheiras</i>	-31.70%	-0.1267	0	-0.1266	-0.0001
<i>Nova União</i>	-31.71%	-0.1268	0	-0.1266	-0.0002
<i>Novo Horizonte d'Oeste</i>	-34.45%	-0.1585	0	-0.1266	-0.0319
<i>Vale do Paraíso</i>	-35.32%	-0.1502	0	-0.1266	-0.0236
<i>Corumbiara</i>	-38.64%	-0.2206	0	-0.1266	-0.0940

*Corumbiara appears here even though it is included in table 3.2 because its consolidated index declined from 1996 to 1997 and increased again in 1998.

Source: Estimated from data provided by State Finance Department, Rondônia.

The Compensation Impact in Minas Gerais

In Minas Gerais the introduction of the ecological criterion formed part of a radical restructuring of the ICMS distribution system (popularly known as the Robin Hood law, see Table 2.2, p.3). As the name suggests, the aim was to reduce the allocation to the richer counties and give more to the poorer ones. As can be observed in Table 2.2, various new criteria were introduced at the same time as the ecological one. In 1996, nine new criteria including an ecological criterion were given a combined weighting of 5%. The ecological

criterion was given a weight of only 0.333% of the distribution in the first year of operation, but in 1997 and 1998 this was increased to 0.666% and 1% respectively. It is therefore necessary to consider the effect of the ecological criterion on the consolidated index in the context of the changes in the other criteria introduced at the same time. Of the 135 counties which have protected areas, 33 suffered a reduction in their consolidated ICMS index between 1995 and 1996 in spite of the introduction of the *ICMS ecológico* and the Robin Hood Law. In 1998, even with an increase in the weight of the ecological criterion to 1% and the incorporation of county protected areas in the calculation of the indices⁴, the number of counties with protected areas, experiencing a reduction in their consolidated ICMS index relative to 1995 increased to 38. But 86 counties with protected areas benefited from an increase in their consolidated index after the introduction of the Robin Hood Law. In some cases the increases in indices were marked as shown in Table 3.6.

Table 3.6: Changes in the Consolidated ICMS Index for Counties with Protected Areas Minas Gerais

Change in Consolidated ICMS Index 1995-1998 %	Number of Counties (with protected areas)
<i>Increase</i>	
> 4,000	1
1,000-3,999	5
500-999	15
100-499	7
50-99	12
10-49	9
0-9	7
Subtotal	86
<i>Decrease</i>	
0-(9)	7
(10)-(49)	27
(50)-(99)	1
Subtotal	35
<i>Counties created after 1995</i>	14
Total	135

Source: Estimated from data provided by the State Finance Department and Association of Local Governments, Minas Gerais.

For some counties in Minas Gerais, the introduction of the ecological criterion proved to be extremely important. For 20 counties the ecological index in 1998 accounted for more than 20% of the consolidated index as shown in Table 3.3. For Marliéria where the increase in the consolidated index between 1995 and 1998 exceeded 2000%, it accounted for more than 70%. The other counties shown in Table 3.7, which were already in existence in 1995, also experienced significant increases in their consolidated indices.

⁴ In 1996 and 1997 the calculation was based on the area of protected land designated at federal and State level only.

Table 3.7: Contribution of the Ecological Criterion to the Consolidated Index 1998

County	Contribution to the Consolidated ICMS Index			Increase in the index
	Environment	Value Added	Other Criteria	% 1995-1998
<i>Marliéria</i>	71%	6%	23%	2031%
<i>São Gonçalo do Rio Preto</i>	61%	1%	38%	N/A *
<i>Alto Caparaó</i>	61%	23%	16%	N/A *
<i>São João das Missões</i>	58%	16%	26%	N/A *
<i>Morro do Pilar</i>	47%	3%	51%	2328%
<i>São Roque de Minas</i>	46%	12%	42%	856%
<i>Leme do Prado</i>	45%	6%	48%	N/A *
<i>Conêgo Marinho</i>	44%	11%	45%	N/A *
<i>Bocaina de Minas</i>	43%	9%	47%	969%
<i>Crucilândia</i>	37%	9%	54%	914%
<i>Araponga</i>	37%	12%	51%	780%
<i>Rio Manso</i>	34%	27%	39%	386%
<i>Itambé do Mato Dentro</i>	25%	4%	71%	1260%
<i>Jabuticatubas</i>	25%	26%	49%	313%
<i>Catas Altas</i>	25%	40%	35%	N/A *
<i>Formoso</i>	25%	28%	47%	193%
<i>Santana do Riacho</i>	25%	5%	71%	2315%
<i>Fervedouro</i>	22%	29%	49%	90%
<i>Santa Helena de Minas</i>	22%	8%	70%	N/A *

*N/A = Counties formed after 1995

Source: Estimated from data provided by the State Finance Department and Association of Local Governments, Minas Gerais.

Several of the counties with protected areas in the “losers” groups suffered a reduction in their ICMS indices not so much because they had very little protected area within their territories but because of other factors. This highlights the need to separate the effect of the ecological criterion from that of the other criteria such as health and education used in the ICMS redistribution. For this reason an estimation was made of the effect of replacing the ecological criterion by a 1% increase in the weight given to value added. The results were as follows:

- Forty-seven counties with protected areas would have been better off in terms of ICMS share if the weight given to value added was increased by 1% and the ecological criterion was eliminated. This group includes various urban counties such as Belo Horizonte (the state capital), Juiz de Fora, Governador Valadares and Araxá.
- Eighty-eight of the counties with protected areas would have received less if the ecological criterion had been eliminated and more weight given to value added. As expected this group includes rural counties like Marliéria. However, it also includes some urban areas such as Contagem, Ipatinga, Timóteo and Uberlândia, all of which experienced reductions in their ICMS share between 1995 and 1998 after the introduction of the Robin Hood law.

In these cases, it was not the ecological criterion but the other aspects of the Robin Hood law that caused the reduction.

How Effective has the ICMS Ecológico been as a Mechanism of Compensation?

The comparison between Minas Gerais and Rondônia. demonstrates the importance of the distribution system before the introduction of the *ICMS ecológico*. In Minas Gerais to introduce the new criteria it was possible to reduce the weight given to value added because this was above the 75% minimum required by the Constitution. In Rondônia., the weight given to value added was already at 75% when the new criterion was introduced. It was therefore necessary to make a reduction elsewhere, in this case in the weight given to the equal shares criterion. This would affect all counties, including those with protected areas. Nevertheless, the overall impact of the *ICMS ecológico* in the two states was quite similar. In both cases, roughly 60% of the counties with protected areas were better off as a result of the *ICMS ecológico*. For the other 40%, the negative impact of the reduction in the weight given to the equal shares criterion (in the case of Rondônia.), and to value added (in the case of Minas Gerais), offset the positive impact of the ecological criterion.

4. The Distributional Effect of the ICMS Ecológico

The effect of the *ICMS ecológico*, as with any change in distribution criteria, is to reduce the income of some counties to give more to others. It is important to examine the characteristics of the counties which gain and those which lose under the new system. The effectiveness and acceptability of the *ICMS ecológico* may be undermined if it results in a reduction of income for the poorest group of counties.

Rondônia

A comparison was made between the counties that lose and gain as a result of the *ICMS ecológico*. To exclude the effect of other factors, the winners and losers were defined in the following way:

- Winners - counties with ecological indices exceeding 0.1266, which equates to the reduction in the equal shares index that accompanied the introduction of the ecological criterion.
- Losers - the counties with an ecological index lower than 0.1266.

It should be mentioned that the formation of the four new counties in this period would also have had an effect on the equal shares index. With an increase in the total number of counties participating, the share received by each would decrease. However, the effect is small in relation to the 5% reduction in weight.

Tables 4.1 and 4.2 present some economic indicators for these two groups of counties. There is considerable variation but it can be observed that many of the counties without protected areas, and thus with a zero ecological rating, have low levels of value added per capita. In the group of 31 “losers”, 12 have less than R\$100 value added per capita. In the other group of 17 winners, only four have value added below this level. In addition, the average value added

per capita in the “winners” group was R\$800, somewhat higher than in the “losers group” where it was R\$610.

As for ICMS received per capita and population density, there are no marked differences. But the lowest levels of ICMS per capita are found in the “losers” group. Thus the introduction of the new system has not favoured the counties with the least resources. On the contrary, the tendency, at least in 1997, has been to favour the counties with the greatest resources. Nevertheless, some counties (Ariquemes, Candeias do Jamari and Monte Negro) with high levels of value added per capita, were also adversely affected by the *ICMS ecológico*. The distributional effect of the *ICMS ecológico* in Rondônia is complex and it is difficult to draw firm conclusions.

Table 4.1: Characteristics of the “Winners” Group of Counties, Rondônia

County	Ecological Index 1997	Population Density popn/ km2	Value added per capita 1995/6 (mean)	ICMS per capita 1997
<i>Guajara-Mirim</i>	0.4370	1.44	319.22	44.84
<i>Gov Jorge Teixeira</i>	0.3298	1.99	4.42	57.55
<i>São Miguel do Guapore</i>	0.3060	2.49	103.51	37.29
<i>Vilhena</i>	0.2976	2.83	2,137.33	172.32
<i>Jamari</i>	0.2730	1.26	1,119.04	103.71
<i>Nova Mamore</i>	0.2616	1.31	82.29	47.18
<i>Ji-Paraná</i>	0.2564	13.38	1,127.47	102.17
<i>Seringueiras</i>	0.2228	1.84	70.10	61.50
<i>Alto Alegre dos Parecis</i>	0.2155	2.38	121.29	55.74
<i>Cerejeiras</i>	0.2091	1.86	494.23	63.98
<i>Costa Marques</i>	0.1920	0.52	394.85	154.84
<i>Alvorada d'Oeste</i>	0.1753	6.10	261.61	45.66
<i>Mirante da Serra</i>	0.1645	10.14	141.06	39.13
<i>Vale do Anari</i>	0.1611	2.00	0.43	68.68
<i>Espigão d'Oeste</i>	0.1558	5.19	519.70	65.70
<i>Alta Floresta d'Oeste</i>	0.1334	5.22	307.13	49.08
<i>Porto Velho</i>	0.1268	7.25	877.38	69.17
Average		3.91	800.79	76.56

Source: Estimated from data provided by State Finance Department, Rondônia.

Table 4.2: Characteristics of the “Losers” Group of Counties, Rondônia

County	Ecological Index 1997	Population Density popn/ km2	Value added per capita 1995/6 (mean)	ICMS per capita 1997
<i>Campo Novo de R</i>	0.1212	1.08	0.17	69.50
<i>Machadinho d'Oeste</i>	0.0860	2.75	289.19	36.32
<i>Cujubim</i>	0.0629	0.95	0.00	80.56
<i>Candeias do Jamari</i>	0.0428	1.64	6,333.01	154.50
<i>Monte Negro</i>	0.0294	4.34	1,084.15	121.53
<i>Jaru</i>	0.0256	16.83	767.25	64.89
<i>Cacoal</i>	0.0128	18.78	608.99	91.57
<i>Cacaulandia</i>	0.0048	2.51	153.30	59.78
<i>Pimenta Bueno</i>	0.0044	3.11	754.96	83.68
<i>Ouro Preto do Oeste</i>	0.0005	21.66	443.78	54.73
<i>Ministerio Andreazza</i>	0	12.79	212.83	98.91
<i>Rolim de Moura</i>	0	28.57	602.12	60.97
<i>Colorado d'Oeste</i>	0	15.19	437.86	46.98
<i>Santa Luzia d'Oeste</i>	0	10.19	177.61	109.64
<i>Alto Paraíso</i>	0	5.73	187.38	52.76
<i>Presidente Medice</i>	0	20.16	213.31	33.73
<i>Nova Brasilandia d'Oeste</i>	0	13.18	216.02	41.63
<i>Urupa</i>	0	17.04	105.05	25.36
<i>Teixeropolis</i>	0	0.11	159.35	55.74
<i>Ariquemes</i>	0	14.84	1,092.43	106.26
<i>Theobroma</i>	0	3.76	138.69	41.50
<i>Cabixi</i>	0	4.29	97.69	40.42
<i>Primavera de Rondônia</i>	0	6.43	9.19	94.72
<i>Parecis</i>	0	1.72	27.98	62.17
<i>Rio Crespo</i>	0	1.52	16.78	105.27
<i>São Felipe d'Oeste</i>	0	12.70	0.43	36.61
<i>Castanheiras</i>	0	4.70	0.00	57.69
<i>Nova União</i>	0	7.81	0.70	38.00
<i>Novo Horizonte d'Oeste</i>	0	13.39	6.19	24.42
<i>Vale do Paraíso</i>	0	9.80	58.44	26.57
<i>Corumbiara</i>	0	2.49	64.68	29.95
Average		4.45	609.78	69.05

Source: Estimated from data provided by State Finance Department, Rondônia.

Minas Gerais

In Minas Gerais the *ICMS ecológico* was introduced together with other socially oriented criteria as part of the “Robin Hood” Law. It is therefore important to consider not just the

effect of the ecological criterion but also that of the whole package of criteria brought in by the new law.

According to official figures, only 28 counties in Minas Gerais received less money in the ICMS allocation in 1996 than in 1995 (Minas Gerais State Government). But, in terms of ICMS consolidated indices as opposed to funds received, the number of counties which experienced a reduction must have been greater, as the total amount of money allocated increased by 19% between 1995 and 1996. At the same time other factors, such as changes in value added generated by each county, will have affected the indices.

Thus it is necessary to examine specifically how the introduction of the new criteria, and the ecological criterion in particular, affected the indices. A comparison was made between the indices prevailing in January 1998 (current situation) and those that would result from some hypothetical situations as follows:

1. Application of a weight of 100% to value added i.e. ICMS would be redistributed entirely on the basis of value added.
2. Elimination of the ecological criterion and the other criteria introduced by the Robin Hood Law (population, geographical area, education, historical heritage, health, own revenue generation, food production) and an increase of 14.71% in the weight applied to value added. This would be representative of the situation in 1995 before the Robin Hood Law came into force.
3. The pre-Robin Hood situation and a 1% weight applied to the ecological criterion. This shows the impact of introducing the ecological criterion on its own without the other Robin Hood criteria.

In the first scenario where value added is the only criterion, 740 counties (86.75 of the total number) would have lower indices than in the current situation. The effect of the Robin Hood criteria and those already existing in 1995 is thus to reduce the funds given to 13% of counties in favour of the remaining 87%.

In the second scenario, which is more representative of the pre-Robin Hood Law situation, 725 counties would be worse off than under the current arrangements. It can thus be concluded that the Robin Hood Law has had a positive effect for 85% of the counties in the state.

In the third scenario, only 90 counties would be better off than under the pre-Robin Hood situation. This means that introducing the *ICMS ecológico* on its own without other social criteria would have made nearly 90% of the counties in the state worse off. When this scenario is compared with the post-Robin Hood situation, the picture is similar: only 129 counties would be better off than they are now if the ecological criterion had been applied without any other social criteria.

Thus it can be concluded that if the *ICMS ecológico* had been introduced without the other new criteria it would have adversely affected a large proportion of counties simply because such a small proportion have protected areas (16% of the total number of counties). The

advantage of the Robin Hood Law was that it involved a package of criteria which had the effect of significantly reducing the number of adversely affected counties.

Table 4.3: Counties with the Largest Share of the ICMS Allocation

County	Consolidated ICMS Indices January 1998			100% Value Added
	With the Robin Hood Law Criteria 79.486% VA*	Without the ecological criterion 80.486% VA*	Without the new criteria 94.2% VA*	
<i>Belo Horizonte</i>	10.6527	10.6530	11.415	12.111
<i>Betim</i>	7.261	7.235	8.335	8.841
<i>Uberlândia</i>	6.030	5.984	6.752	7.162
<i>Contagem</i>	4.795	4.769	5.327	5.648
<i>Ipatinga</i>	3.412	3.382	3.843	4.073
<i>Juiz de Fora</i>	2.093	2.116	2.145	2.270
<i>Itabira</i>	1.784	1.805	2.039	2.134
<i>Uberaba</i>	1.755	1.776	1.923	2.034
<i>Poços de Caldas</i>	1.427	1.443	1.599	1.686
<i>Montes Claros</i>	1.379	1.394	1.451	1.533
<i>Pouso Alegre</i>	1.071	1.084	1.211	1.279
<i>Sete Lagoas</i>	0.962	0.973	1.034	1.091
<i>Divinópolis</i>	0.923	0.933	0.972	1.025
<i>Timóteo</i>	0.922	0.904	1.007	1.062
<i>Governador Valadares</i>	0.886	0.895	0.898	0.947
<i>Nova Lima</i>	0.871	0.879	1.000	1.043
<i>Congonhas</i>	0.828	0.837	0.940	0.985
<i>Ouro Preto</i>	0.787	0.794	0.844	0.882
<i>Varginha</i>	0.738	0.747	0.812	0.855
<i>Araguari</i>	0.715	0.723	0.767	0.807
Total	49.292	49.326	54.313	57.465

*VA = Value Added

Source: Estimated from data provided by the State Finance Department and Association of Local Governments, Minas Gerais.

It is important to consider not only the number of counties affected, but also the impact on their share of ICMS revenues. In general, the counties most adversely affected by the Robin Hood Law were the urban ones, such as Belo Horizonte (the state capital), Betim, Contagem and Uberlândia. This can be seen in Table 4.3, which presents the ICMS indices for the 20 counties which have the largest share of the ICMS allocation. Their ICMS indices were calculated for the three scenarios mentioned above. It can be observed that:

- With a distribution based exclusively on value added, these 20 counties would receive 57% of the allocation.

- In the current situation, i.e. with the Robin Hood criteria, they receive 49% of the ICMS allocation.
- The elimination of the ecological criterion would not significantly affect their percentage allocation in comparison with the current situation. This implies that the other criteria of the Robin Hood Law have had more impact in terms of total share (as opposed to number of counties affected) than the ecological criterion.

In contrast, the groups of counties with the lowest share in the ICMS allocation would receive less under the three alternative scenarios than in the current situation, as shown in Table 4.4. They would receive slightly less as a group if the ecological criterion were removed, but the striking differences are between the current situation and the scenarios where all the new criteria are eliminated, or where allocation is based solely on value added.

Table 4.4: Distribution of the ICMS Allocation: Comparison Between the Robin Hood Law and Other Scenarios

Group of Counties	Percentage Share of the ICMS Allocation Based on Consolidated Indices of January 1998			
	Robin Hood Law 79.468% VA*	Without the Ecological Criterion 80.486% VA*	Without all the New Criteria 94.2% VA*	100% VA*
10 counties with highest share	40.59	40.56	44.82	47.49
20 counties with highest share	49.29	49.32	54.31	57.47
50 counties with highest share	62.68	62.85	68.50	72.29
200 counties with smallest share	2.70	2.67	1.73	0.47
400 counties with smallest share	6.94	6.82	4.44	1.97
600 counties with smallest share	14.28	14.02	9.59	6.03

*VA = Value Added.

Source: Estimated from data provided by the State Finance Department and Association of Local Governments, Minas Gerais.

These conclusions are consistent with the position taken by the larger counties in Minas Gerais which, according to the Association of Local Governments in the state, are protesting about the reduction in their income resulting from the Robin Hood Law. However, the ecological criterion is not considered to be the problem. Their most serious criticism is of the equal shares criterion. These counties have been pressuring the government to reduce the weight given to this criterion on the grounds that it does not create incentives, for example for counties to generate their own revenue (Souto, personal communication).

5. The Incentive Impact of the ICMS Ecológico

One of the objectives of the *ICMS ecológico* was to create incentives for the designation of new protected areas and for improving the quality of existing areas. In Paraná, where the *ICMS ecológico* has been in operation for several years, the incentive effect of the *ICMS ecológico* is already evident. New protected areas have been created and the introduction of a system to evaluate the quality of protected areas has had a positive effect on the interest of counties to improve their management (Loureiro, 1996).

In Minas Gerais and Rondônia, the *ICMS ecológico* was too recent at the time of evaluation to have had a noticeable effect on the area and management of land set aside for protection. In Rondônia, the new system came into operation only in 1997 and it appears that few counties are fully aware of the new ICMS allocation rules. In Minas Gerais, increased interest in protected areas on the part of some counties has been observed. In the first year of operation, only federal and state protected areas were considered in the calculation of the indices; county protected areas were excluded because they had not been formally registered by then. This highlights one immediate positive impact of the *ICMS ecológico*; that it has led to an official demarcation of protected areas. Ecological NGOs have observed that with this official process of demarcation, the counties have become more aware of the existence of protected areas within their boundaries.⁵

It is possible to examine the potential effect on the incentives for counties to create new protected areas. The decision to create a new protected area can have a positive effect on the ecological component of the county's ICMS index, and thus result in a higher share of the ICMS revenue allocation. On the other hand, the setting aside of land for protection involves restricting land use which can have a negative effect on value added generated in the county. As value added is the main criterion for allocation of the ICMS revenue, this negative effect might outweigh the positive effect on the ecological component of the consolidated index. In this case there would be no financial benefit to the county in creating a new protected area.

It is therefore necessary to compare the positive effect on the ecological component of the ICMS consolidated index with the negative impact on the value added and other land use related components, such as primary production. The challenge is to estimate the value added generated by a particular area of land, as much will depend on the characteristics of the land, its location and the available infrastructure. This can only be done on a case by case basis.⁶ A more approximate approach is to use the average value added per hectare in each county and average primary production per hectare as an indicator of the economic potential that is lost when an area of land is set aside for protection and hence the effect on the consolidated ICMS index.

For Rondônia, calculations were made of the changes in the ICMS consolidated index in each county that would result from the following scenarios:

- Productive use of an area of 1,000 ha which would generate value added and primary production equal to the current average for the county. The average is calculated by

⁵ A recent study (Veiga Neto, 2000), states that the area of officially registered protected areas increased by 48% between 1996 and 1998.

⁶ For an example of this type of analysis for three counties in Paraná see Loureiro, 1994.

dividing the total value added of the county (the mean of 1995 and 1996) by the total area of the county. The same applies to average primary production.

- Productive use of an area of 1000 ha which would generate value added and primary production equal to the current average for the county. The average is calculated taking into account existing protected areas. For example, the total value added of the county (the mean of 1995 and 1996) is divided by the total area not subject to land use restrictions. The average can thus be somewhat higher than in the first case.
- A conservation option i.e., creation of a protected area of 1,000 ha.

The two types of calculation of value added are made because, in the direct use type of protected areas which represent more than 70% of the total area protected in Rondônia, some productive activity is permitted.

Tables 5.1 and 5.2 present the results for the three scenarios for the 48 counties which participated in the allocation of ICMS in 1996. The four new counties were excluded from the analysis because they do not have, as yet, representative data on value added.

The last two columns show the ratio between the change in the ICMS consolidated index that would result from the productive option, and that resulting from the conservation option. Where the ratio is less than one, as in Table 5.1, it can be concluded that the option of protecting the land would generate more ICMS revenue for the county. A ratio greater than one, as in Table 5.2, implies that productive use of the land would generate more revenue for the county than protection.

From Table 5.1, it can be seen that for 28 counties it could be financially attractive, in terms of ICMS revenue, to create a protected area. These counties have such low average levels of value added and primary production that the conservation option would have more impact on the ICMS consolidated indices. Only twelve of these counties already have protected areas. Thus, 16 counties which currently do not have protected areas could be better off if they set aside some land for conservation.

From Table 5.2, it can be observed that for 20 counties in Rondônia, it would be more financially attractive to keep the land in production than to create a protected area. Eight of these counties would get more than five times as much from the productive option than the conservation option.

It should be noted that these calculations are based on the assumption that the total area of protected land in the whole state increases by only 1,000 ha. When examining the incentives for each county, it is assumed that no other county is increasing its protected area at the same time. If several counties were creating protected areas the calculations above, for the change in the ecological index, would be over-estimated. This highlights a potential disadvantage of the *ICMS ecológico*, which could become more relevant in the future. As more counties react to the *ICMS ecológico* and create more protected areas, the returns, in terms of additional ICMS revenue, are likely to diminish unless the total amount to be distributed increases at a similar rate.

Table 5.1: Impact on the ICMS Index in Rondônia: Comparison Between Productive Use and the Conservation Option in 28 Counties

County	Impact on the ICMS Index					Ratio Scenario 1 to Scenario 3	Ratio Scenario 2 to Scenario 3
	Scenario 1 Value Added	Production	Scenario 2 Value added	Production	Scenario 3 Protected Area		
<i>Cerejeiras</i>	0.0009	0.0003	0.0010	0.0003	0.0016	0.69	0.78
<i>Nova Brasilandia</i>	0.0026	0.0002	0.0026	0.0002	0.0042	0.69	0.69
<i>Alto Alegre dos Parecis</i>	0.0003	0.0005	0.0005	0.0008	0.0012	0.62	1.10
<i>Ministerio Andreazza</i>	0.0025	0.0018	0.0025	0.0018	0.0076	0.57	0.57
<i>Santa Luzia d'Oeste</i>	0.0017	0.0005	0.0017	0.0005	0.0042	0.52	0.52
<i>São Miguel do Guapore</i>	0.0002	0.0000	0.0007	0.0001	0.0006	0.50	1.41
<i>Mirante da Serra</i>	0.0013	0.0005	0.0020	0.0008	0.0038	0.49	0.73
<i>Corumbiara</i>	0.0001	0.0006	0.0001	0.0006	0.0016	0.48	0.48
<i>Urupa</i>	0.0017	0.0004	0.0017	0.0004	0.0058	0.36	0.36
<i>Theobroma</i>	0.0005	0.0002	0.0005	0.0002	0.0022	0.31	0.31
<i>Nova Mamore</i>	0.0001	0.00001	0.0002	0.00001	0.0005	0.24	0.50
<i>Costa Marques</i>	0.0002	0.00001	0.0002	0.00001	0.0009	0.22	0.25
<i>Seringueiras</i>	0.0001	0.0001	0.0002	0.0002	0.0012	0.18	0.29
<i>Cacaulandia</i>	0.0004	0.0001	0.0004	0.0001	0.0024	0.17	0.18
<i>Vale do Paraíso</i>	0.0005	0.0003	0.0005	0.0003	0.0050	0.16	0.16
<i>Cabixi</i>	0.0004	0.0001	0.0004	0.0001	0.0038	0.13	0.13
<i>Gov Jorge Teixeira</i>	0.0000	0.0001	0.0000	0.0002	0.0009	0.07	0.24
<i>Parecis</i>	0.0000	0.0000	0.0000	0.0000	0.0019	0.02	0.02
<i>Novo Horizonte d'Oeste</i>	0.0001	0.0001	0.0001	0.0001	0.0059	0.02	0.02
<i>Rio Crespo</i>	0.0000	0.0000	0.0000	0.0000	0.0028	0.02	0.02
<i>Campo Novo de R</i>	0.0000	0.0000	0.0000	0.0000	0.0013	0.02	0.02
<i>Primavera de Rondônia</i>	0.0001	0.0000	0.0001	0.0000	0.0078	0.01	0.01
<i>Vale do Anari</i>	0.0000	0.0000	0.0000	0.0000	0.0015	0.00	0.01
<i>São Felipe d'Oeste</i>	0.0000	0.0000	0.0000	0.0000	0.0083	0.00	0.00
<i>Castanheiras</i>	0.0000	0.0000	0.0000	0.0000	0.0055	0.00	0.00
<i>Nova União</i>	0.0000	0.0000	0.0000	0.0000	0.0059	0.00	0.00
<i>Teixeropolis</i>	0.0000	0.0000	0.0000	0.0000	0.0105	0.00	0.00
<i>Cujubim</i>	0.0000	0.0000	0.0000	0.0000	0.0012	0.00	0.00

Source: Estimated from data provided by State Finance Department, Rondônia.

Table 5.2: Impact on the ICMS Index in Rondônia: Comparison of the Productive Option and the Conservation Option for 1,000 ha in 20 Counties

County	Impact on the Indices					Ratio Scenario 1 to Scenario 3	Ratio Scenario 2 to Scenario 3
	Scenario 1 Value Added	Production	Scenario 2 Value added	Production	Scenario 3 Protected Area		
<i>Porto Velho</i>	0.0059	0.00003	0.0082	0.00004	0.0001	43.74	60.98
<i>Ji-Paraná</i>	0.0140	0.0004	0.0291	0.0007	0.0007	22.11	45.87
<i>Ariquemes</i>	0.0151	0.0018	0.0151	0.0018	0.0011	15.56	15.56
<i>Vilhena</i>	0.0056	0.0001	0.0104	0.0002	0.0004	14.32	26.45
<i>Candeias do Jamari</i>	0.0096	0.0000	0.0106	0.0000	0.0007	13.75	15.14
<i>Cacoal</i>	0.0106	0.0011	0.0109	0.0011	0.0013	9.19	9.43
<i>Jaru</i>	0.0120	0.0013	0.0127	0.0013	0.0017	7.96	8.40
<i>Rolim de Moura</i>	0.0160	0.0015	0.0160	0.0015	0.0032	5.41	5.41
<i>Ouro Preto do Oeste</i>	0.0089	0.0021	0.0089	0.0021	0.0023	4.74	4.74
<i>Pimenta Bueno</i>	0.0022	0.0001	0.0022	0.0001	0.0008	3.04	3.06
<i>Alta Floresta d'Oeste</i>	0.0015	0.0004	0.0016	0.0004	0.0007	2.85	3.06
<i>Espigão d'Oeste</i>	0.0025	0.0002	0.0036	0.0003	0.0011	2.58	3.71
<i>Guajara-Mirim</i>	0.0004	0.000002	0.0043	0.000019	0.0002	2.45	24.64
<i>Colorado d'Oeste</i>	0.0062	0.0004	0.0062	0.0004	0.0031	2.14	2.14
<i>Monte Negro</i>	0.0044	0.0003	0.0046	0.0003	0.0025	1.88	2.00
<i>Presidente Medice</i>	0.0040	0.0005	0.0040	0.0005	0.0029	1.53	1.53
<i>Machadinho d'Oeste</i>	0.0007	0.0000	0.0009	0.0001	0.0006	1.42	1.72
<i>Jamari</i>	0.0013	0.0002	0.0031	0.0004	0.0011	1.29	3.06
<i>Alto Paraíso</i>	0.0010	0.0006	0.0010	0.0006	0.0012	1.27	1.27
<i>Alvorada d'Oeste</i>	0.0015	0.0002	0.0022	0.0003	0.0016	1.10	1.66

Source: Estimated from data provided by State Finance Department, Rondônia.

In the case of Minas Gerais similar calculations were made for a selection of counties, some with protected areas (Table 5.3) and some without (Table 5.4). These are based on a comparison with value added only, as the production criterion in Minas Gerais is more complicated than in Rondônia, as it has a number of subcomponents and the weight allocated to it is much lower. These calculations serve to show the diversity of situations in the state. There are some counties with low levels of value added where the creation of a protected area could be extremely financially attractive. For example, in São Sebastião do Rio Preto, productive land use would have to generate at least 226 times the average value added per hectare in the county for it to be more remunerative in terms of ICMS revenue than creation of a protected area. In the more urbanised counties such as Itabira, Nova Lima and Governador Valadares, productive land use would be more financially attractive than creation of a protected area.

Table 5.3: The Incentive Impact of the ICMS Ecológico in Minas Gerais (Counties with Protected Areas): Creation of a Protected Area of 1,000 ha or Productive Use

County	Area Protected (ha)	Total County Area (ha)	Value added per ha Based on:		Impact on the Indexes			Ratio between the increase in value added index and the ecological index	
			Total area (A)	Total non-protected area (B)	Ecological Index	Value Added Index (A)	Value Added Index (B)	(A)	(B)
<i>Arinos</i>	950	527,347	17.27	17.30	0.0167	0.0037	0.0037	0.22	0.22
<i>Delfinópolis</i>	6,640	138,032	174.82	183.65	0.0636	0.0370	0.0388	0.58	0.61
<i>Governador Valadares</i>	6,000	234,890	1,515.40	1,555.13	0.0374	0.3206	0.3290	8.57	8.79
<i>Itabira</i>	12,543	125,449	6,367.69	7,075.11	0.0700	1.3470	1.4966	19.24	21.38
<i>Lambari</i>	353	21,334	612.71	623.02	0.4089	0.1296	0.1318	0.32	0.32
<i>Marliéria</i>	29,450	54,368	31.07	67.78	0.1613	0.0066	0.0143	0.04	0.09
<i>Nova Lima</i>	2,103	42,845	9,087.50	9,556.57	0.2044	1.9223	2.0215	9.40	9.89
<i>Ouro Preto</i>	21,306	124,856	2,644.59	3,188.73	0.0703	0.5594	0.6745	7.95	9.59

Source: Estimated from data provided by the State Finance Department and Association of Local Governments, Minas Gerais.

Table 5.4: The Incentive Impact of the ICMS Ecológico in Minas Gerais: Counties without Conservation Units

County	Total area of county (ha)	Value added/ha	Impact on Indices with creation of protected area of 1,000 ha or productive use		Ratio of increase in value added index to increase in ecological index
			Increase in Ecological Index	Increase in Value Added Index	
<i>Abadia dos Dourados</i>	74,300	61.36	0.1181	0.0130	0.11
<i>Diamantina</i>	388,000	41.68	0.0227	0.0088	0.39
<i>Itau de Minas</i>	15,400	6,272.21	0.5647	1.3268	2.35
<i>Montes Claros</i>	357,700	1,611.54	0.0246	0.3409	13.87
<i>Pouso Alegre</i>	54,300	8,862.24	0.1615	1.8746	11.61
<i>São Sebastião de Rio Preto</i>	12,800	14.13	0.6778	0.0030	0.004

Source: Estimated from data provided by the State Finance Department and Association of Local Governments, Minas Gerais.

6. Perspectives on the ICMS Ecológico

To complement the preceding analysis, interviews were held with the representatives of the various stakeholders, such as state government's environment, finance and planning departments, county government and NGOs. In general, the reaction to the *ICMS ecológico* in both states was positive. Various people interviewed in Rondônia and Minas Gerais believe that the new ICMS system has been beneficial, particularly in terms of environmental awareness. The counties have not necessarily reacted by creating new protected areas and it would be rather early for such a reaction. In Minas Gerais, however, according to one NGO (Fundação Biodiversitas), the counties are more aware now of the existence of protected areas within their territories and are beginning to change their attitudes towards them. Instead of regarding them as an obstacle to development they are starting to see them as an opportunity to generate revenue. Both the government department in charge of protected areas and the Fundação Biodiversitas, report that there have been a significant number of enquiries from counties who want to find out how to take advantage of the new system. In Rondônia there is widespread recognition of the potential of the *ICMS ecológico* to support the management of protected areas, but it is too early to detect any tangible effects.

Nevertheless, in both states, the people contacted mentioned the following concerns about the *ICMS ecológico*:

- The control of protected areas and the incentives to improve their management
- The dissemination of the *ICMS ecológico*
- The need to earmark funds derived from the *ICMS ecológico*
- Dilution of the incentive effect in the future given that the amount to be redistributed is fixed in terms of the percentage allocated to the ecological criterion.

Control of the Quality of Protected Areas

As mentioned in Section 2, Rondônia and Minas Gerais have not yet implemented a system to evaluate the quality of protected areas. In order to qualify for the *ICMS ecológico*, all the counties have to do is ensure that their protected areas are fully registered. What happens afterwards, in terms of management, or invasions, will not necessarily affect the ecological index of the county. This implies that the *ICMS ecológico* can create incentives to designate new protected areas, or to register existing ones, but not necessarily to keep them fully protected. For this reason Paraná implemented a system to evaluate quality, and if necessary to disqualify and remove from the register the protected areas that were not being adequately managed. In both Minas Gerais and Rondônia there is concern amongst NGOs and government representatives about the lack of attention given, to date, to the quality of the protected areas. However, it is recognised that in both cases the *ICMS ecológico* is relatively new. The experience of Paraná shows that it is feasible to adopt a stepwise approach, starting by getting a simple area-based system established, and then introducing more complexity in the form of a quality evaluation scheme.

In Rondônia, it was emphasised that it was important to include in the evaluation criteria, not just ecological criteria, but also social ones (Amaral Borges, 1996; Arruda Lisboa, personal communication). It is argued that the conditions of communities inside, or bordering, the protected areas, have implications for environmental management. It is these communities that have most influence in terms of preventing invasions or inappropriate land use. For these reasons the criteria should take into account the welfare of such communities.

Earmarking of Funds

Some people believe that the ICMS funds generated by protected areas should be earmarked for ecological purposes and, in particular, to support the management of protected areas. It is argued that in Minas Gerais a county has to spend money in order to qualify for the health or education criteria, but to qualify for the ecological criterion all the county has to do is register its protected areas without spending anything. This however, ignores the opportunity cost of the land use restrictions.

For various reasons it would be difficult to earmark the funds of the *ICMS ecológico*. Firstly, the Constitution does not permit interference by the state government in the way that counties spend their ICMS allocation. This is a serious legal obstacle. Secondly, because of the way the ICMS operates, it is very difficult for the counties to distinguish between those funds which result from the ecological criterion and those which result from others. The counties receive their ICMS allocation on a weekly basis without separation by criterion, while the amounts received vary considerably by week and by year. Thus, in the Porto Velho county, it was explained that it is not possible to perceive the impact of the *ICMS ecológico* because of such variation. Finally, in calculating the “ecological” funds, some would argue that it would be necessary to take into account the amount that is lost from the reduction in the weights on other criteria, made to accommodate the ecological criterion. If these losses were included, in some cases the “ecological” funds would be negative.

These difficulties are recognised, principally the legal obstacle. It is likely that the introduction of a system to evaluate quality could go some way to address this concern, as the

counties would have to make some type of contribution in order to maintain or improve the quality of protected areas.

The Potential for Dilution of the Incentive Effect

There is concern that the counties which qualify first for the *ICMS ecológico* will receive considerably more than those who come on board some years later. As more counties create protected areas, the number of counties with a share in the *ICMS ecológico* “cake” will increase, but the amount to be distributed is unlikely to increase at the same rate. While, in the initial years, the amounts available through the *ICMS ecológico* might seem attractive and constitute an incentive, in later years, the amounts offered may be so small that they will have little effect on county land use decisions.

For Minas Gerais this issue was examined based on a variation of the calculations presented in Section 5. As more protected areas are created, the State Conservation Factor increases. As the county ecological index is calculated by dividing the County Conservation Factor (protected area as percentage of total county territory) by the State Conservation Factor, a county can create a new protected area but still have a decrease in its ecological index if many other counties are also restricting land use to achieve protection.

For the counties included in Table 5.3, the impact of a doubling of the State Conservation Factor can be considered. This would be the equivalent of a situation in which all the counties which currently have conservation units decided to double their area. Given the way the ecological index is calculated, a doubling of the State Conservation Factor implies a 50% reduction in the county ecological index. As can be seen in Table 6.1, this reduction could be crucial in some cases, but in the majority it does not make much difference. The variation in average value added is still much more important.

For the moment, the dilution problem seems to be more perceived than real. In Minas Gerais, the increases in the ICMS share were so significant for some counties, for example Marliéria, that rather unrealistic expectations were created on the part of other counties. They assumed that they too would generate huge increases in ICMS revenue by creating a protected area and this was often not the case.

The transparency of the incentive may be more of an issue than its potential dilution. It is not straightforward to estimate the effect on a county’s ICMS revenue of creating a protected area. Besides calculating the new ecological index it is necessary to consider the reduction in value added and production associated with the land use restrictions imposed and in turn their effect on the ICMS consolidated index. It is not surprising that some counties have overestimated the revenue effect of creating a protected area. In part this is a problem inherent in the ICMS, which is a complex tax. On the other hand it could also be a problem of dissemination.

Table 6.1: Implications for Selected Counties of an Increase in the Total Area Protected in Minas Gerais

County	State Conservation Factor Constant		State Conservation Factor Increases by 100%	
	Ratio of the increase in the value added index with productive use of 1,000 ha to the increase in the ecological index if this area is protected.		Ratio of the increase in the value added index with productive use of 1,000 ha to the increase in the ecological index if this area is protected.	
	(A) *	(B) *	(A) *	(B) *
<i>Arinos</i>	0.22	0.22	0.44	0.44
<i>Delfinópolis</i>	0.58	0.61	1.16	1.22
<i>Governador Valadares</i>	8.57	8.79	17.13	17.58
<i>Itabira</i>	19.24	21.38	38.45	42.72
<i>Lambari</i>	0.32	0.32	0.63	0.64
<i>Marliéria</i>	0.04	0.09	0.08	0.18
<i>Nova Lima</i>	9.4	9.89	18.77	19.74
<i>Ouro Preto</i>	7.95	9.59	15.89	19.16

*(A) VAF/ha calculated by dividing total value added of the county by the total area of the county.

*(B) VAF/ha calculated by dividing total value added of the county the total non-protected area of the county.

Source: Estimated from data provided by the State Finance Department and Association of Local Governments, Minas Gerais.

Dissemination

The effectiveness of an incentive like the *ICMS ecológico* depends critically on the publicising of the new system. In Rondônia there is concern about the general lack of awareness about the new system. Most people recognise that the ideal would have been to organise an awareness raising programme when the *ICMS ecológico* was introduced, or better still, to have had a consultation process beforehand. But the political and financial constraints are acknowledged. Other government departments have helped to inform the counties about the *ICMS ecológico*. For example, the Coordinator of the Planafloro⁷ sent a letter to all the Mayors in Rondônia, informing them about the new system of allocating the ICMS revenue, and presenting a table showing the counties which would have the greatest changes in their indices (Herrmann, personal communication).

However, even with information about the rules of the new system, it will be difficult for counties to distinguish between the effects of the new ecological criterion and those of other factors, such as variations in value added. The allocation of the ICMS revenue, with or without an ecological criterion, is extremely complex. There has been a tendency to attribute all of the changes in the indices since 1996 to the introduction of the *ICMS ecológico*. But, as noted in Section 3, for some counties such as Ariquemes in Rondônia, the major part of the reduction in their indices was caused by other factors. What is needed is not only information about the *ICMS ecológico* but also about the operation of the ICMS in general.

⁷ Planafloro (*Plano Agropecuário e Florestal de Rondônia*) aims to plan socioeconomic activities to achieve rational exploitation of natural resources and to promote sustainable development.

7. Conclusions

The *ICMS ecológico* was introduced in Rondônia and Minas Gerais with two main objectives:

- to compensate counties with protected areas
- to act as an incentive to the counties to extend the area set aside for protection

Effectiveness as an Instrument of Compensation

The *ICMS ecológico* was partially successful in compensating counties for the restrictions on land use implied by the presence of protected areas. The problem is that the inclusion of a new criterion in the ICMS allocation implies that the weight given to an existing criterion has to be reduced. As a result, some counties with protected areas can be adversely affected by the new system instead of receiving a net benefit. The analysis shows that in both Minas Gerais and Rondônia about 60% of the counties with protected areas benefited from the introduction of the *ICMS ecológico*. For the other 40%, the negative impact of the reduction of the weights given to other criteria outweighed the positive impact of the introduction of the ecological criterion. In spite of the difference between the two states in the allocation criteria before the introduction of the *ICMS ecológico*, with Minas Gerais reducing the weight given to value added, and Rondônia that of the equal shares criterion, the result in terms of the percentage of counties with protected areas which benefited is broadly similar.

In Rondônia, the counties that lost out were those with less than 25% of their territory set aside for protection. In Minas Gerais, counties lost out for one or more of the following reasons:

- They had only a small percentage of their territory designated as a conservation area
- their protected areas were mainly of the direct use type with low conservation factors
- they generated high levels of value added and thus were particularly affected by the reduction in the weight given to this criterion.

Nevertheless, the effect of the *ICMS ecológico* on the two groups of counties is not easy to isolate from the variation caused by the impact of other factors and changes in other criteria. There has therefore been a certain amount of confusion over the impact of the new ecological criterion.

It is difficult to avoid a situation in which some counties including those with protected areas, lose out with the introduction of the *ICMS ecológico*. But the decision on which criteria are reduced in weight to accommodate the ecological criterion is crucial in influencing which counties will be adversely affected. If the weight given to value added is reduced this will have most effect on those counties which have most productive activities. The reduction of the weight of the equal shares criterion could have a regressive impact adversely affecting the poorest counties as these are likely to have the greatest dependence on this criterion. For this reason it is important to consider the distributional impact of the new system.

Distributional Impact

The experience of the two states was quite different. In Rondônia, the counties which lost out because of the *ICMS ecológico* included some of the poorest in the state but also some of the richest. Nevertheless, in general the “losers” group had an average value added per capita somewhat lower than that of the “winners” group. In Minas Gerais, although the introduction of the ecological criterion implied losses for almost 90% of the counties in the state, it had the effect of increasing slightly the overall share of the poorest counties. But the effect of the package of new criteria introduced by the Robin Hood Law was much more striking. The share of the poorest 200 (measured by ICMS received per capita) is 56% higher with the Robin Hood law than in a scenario representative of the situation before the Law was introduced. This implies that the regressive effects of a measure such as the *ICMS ecológico* can be minimised or avoided if this measure forms part of a package of new criteria with environmental and social objectives.

Incentive Impact

The *ICMS ecológico* has the potential to create incentives for conservation but the effect appears to be highly variable. This is because the value added generated by a particular area of land depends on a number of factors and varies from county to county. Using average value added per hectare as an indicator of the productive potential of land in each county an analysis was made of the incentives created by the *ICMS ecológico*. The results showed considerable variation. For some counties which currently have low average levels of value added and primary production, the conservation option seems more attractive in terms of ICMS revenue. For 11 counties in Rondônia, the value added and primary production of an area of land of 1,000 hectares would have to be at least 50 times the current average in order to generate more ICMS revenue than the creation of a protected area. At the other extreme, for eight counties, if the area could generate at least the current average value added and primary production per hectare this would result in eight times more ICMS revenue than if it were set aside for protection. In Minas Gerais the calculations made covered a selection of counties with and without protected areas. The results also show considerable diversity within the state. For some counties it would be very financially attractive to create protected areas. For others, the motivation for setting aside land for protection would have to come from other factors.

General Reaction to the ICMS Ecológico

The *ICMS ecológico* received few criticisms from the people interviewed. The general consensus was that it could promote environmental awareness and greater appreciation of the importance of protected areas. The principal concerns about the *ICMS ecológico* related to the management and control of protected areas. It was considered a priority to establish a system for evaluating quality as soon as possible after the preliminary operating period. Another factor highlighted as important was the dissemination of the new system. This was particularly relevant to Rondônia where the counties and the public in general had very little knowledge about the new system.

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The importance of international trade in the global economy is expanding, not only for primary products but also for recyclable waste. The main objectives of this study were to determine the economic, social and environmental impacts of international trade of waste paper for recycling purposes in India. The report addresses three main sectors: (i) the world market for waste paper, (ii) the local waste paper market and (iii) the Indian paper industry. It also makes recommendations for policy makers at an international, national and local level: international agreements should distinguish between hazardous and non-hazardous waste; national trade barriers to waste imports should be eliminated; and existing local informal recovery sectors should be favoured over formal Western-style recycling systems.

Mangroves or Fishponds? Valuation and Evaluation of Alternative Uses of a Mangrove Forest in the Philippines. Ron Janssen and Jose Padilla. September 1997. 258 pages. £25.

One of the major threats to mangroves in the Philippines is the rapidly increasing aquaculture industry. This study includes a review of valuation methodologies and their application to the case study area of the Pagbilao experimental mangrove forest in the Philippines. Valuations of goods and services and environmental functions of the forest are employed to assess alternative management regimes using both cost-benefit analysis as well as a multi-criteria approach. Much depends on the management objectives: conversion to aquaculture is the most economically efficient management option. However, if equity and sustainability objectives are included, commercial forestry is the preferred alternative.

Incentives for Eco-Efficiency. Market Based Instruments for Pollution Prevention: A Case Study of the Steel Sector. Ritu Kumar, Nick Robins, A.K. Chaturvedi, R. Srinivasan and J. Gupta. December 1997. 96 pages. £20.

Mounting pressures on industry to reduce pollution, to remain globally competitive and to meet the requirements of international standards, require fundamental changes in government policy and corporate approaches to environmental management. This report presents the results of an international study assessing the potential for market-based instruments for pollution prevention in the steel sector in India. It recommends a set of policy measures to reduce discharge levels in the most cost effective manner, to induce firms to adopt cleaner technologies and to encourage firms to economise on energy and water resources. In this regard, the importance of achieving coherence with existing policies, building trust among key stakeholders and gradually phasing in market-based instruments is emphasised.

Economic Incentives for Watershed Protection: A Case Study of Lake Arenal, Costa Rica. Bruce Aylward, Jaime Echeverria, Alvaro Fernandez Gonzalez, Ina Porras, Katherine Allen, Ronald Mejias. February 1998. £30.

Conventional wisdom holds that cutting down tropical forests for livestock production is not only bad business but bad for the environment. In particular, it is thought that conversion of natural forest to pasture leads to a rise in the sedimentation of waterways and reservoirs, increased risk of flooding and loss of dry season water supply. In the case of Lake Arenal, Costa Rica, this conventional view is stood on its head by research showing that ranching, dairy farming and associated downstream hydrological effects represent important positive values to the Costa Rican economy, values that significantly outweigh expected returns from reforestation.

Plastics Recycling in China: An International Life Cycle Approach. Edited by Pieter van Beukering. April 1999. £20.

BOOKS and REPORTS

Blueprint for a Green Economy

David W. Pearce, Anil Markandya and Edward B. Barbier

This book was initially prepared as a report to the Department of Environment, as part of the response by the government of the United Kingdom to the Brundtland Report, *Our Common Future*. The government stated that: '...the UK fully intends to continue building on this approach (environmental improvement) and further to develop policies consistent with the concept of sustainable development.' The book attempts to assist that process.

Earthscan, London, 1989. £6.95

Elephants, Economics and Ivory

Edward B. Barbier, Joanne C. Burgess, Timothy M. Swanson and David W. Pearce

The dramatic decline in elephant numbers in most of Africa has been largely attributed to the illegal harvesting of ivory. The recent decision to ban all trade in ivory is intended to save the elephant. This book examines the ivory trade, its regulation and its implications for elephant management from an economic perspective. The authors' preferred option is for a very limited trade in ivory, designed to maintain the incentive for sustainable management in the southern African countries and to encourage other countries to follow suit.

Earthscan, London, 1990. £8.95

After the Green Revolution: Sustainable Agriculture for Development

Gordon R. Conway and Edward B. Barbier

The Green Revolution has successfully improved agricultural productivity in many parts of the developing world. But these successes may be limited to specific favourable agro-ecological and economic conditions. This book discusses how more sustainable and equitable forms of agricultural development need to be promoted. The key is developing appropriate techniques and participatory approaches at the local level, advocating complementary policy reforms at the national level and working within the constraints imposed by the international economic system.

Earthscan, London, 1990. £12.95

Sustainable Development: Economics and Environment in the Third World

David W. Pearce, Edward B. Barbier and Anil Markandya

The authors elaborate on the concept of sustainable development and illustrate how environmental economics can be applied to the developing world. Beginning with an overview of the concept of sustainable development, the authors indicate its implications for discounting and economic appraisal. Case studies on natural resource economics and management issues are drawn from Indonesia, Sudan, Botswana, Nepal and the Amazon.

Earthscan, London, 1990. £14.95

Blueprint 2: Greening the World Economy

David W. Pearce, Edward B. Barbier, Anil Markandya, Scott Barrett, R. Kerry Turner and Timothy M. Swanson

Following the success of *Blueprint for a Green Economy*, LEEC has turned its attention to global environmental threats. The book reviews the role of economics in analysing global resources such as climate, ozone and biodiversity, and considers economic policy options to address such problems as global climate change, ozone depletion and tropical deforestation.

Earthscan, London, 1991. £7.95

Economics for the Wilds: Wildlife, Wildlands, Diversity and Development

E.B. Barbier and T.M Swanson (eds.)

This collection of essays addresses the key issues of the economic role of natural habitat and wildlife utilization in development. The book argues that this role is significant, and composes such benefits as wildlife and wildland products, ecotourism, community-based wildlife development, environmental services and the conservation of biodiversity.

Earthscan, London, 1992. £12.95

The Economics of the Tropical Timber Trade

Edward B Barbier, Joanne C Burgess, Joshua Bishop and Bruce Aylward

This book is based on a major study of the economic linkages between the trade in tropical timber products and sustainable forest management prepared for the International Tropical Timber Organisation by the London Environmental Economics Centre. It examines current and future market conditions in the tropical timber trade, the linkages between trade and tropical deforestation, and the role of trade and forest sector policies in encouraging sustainable forest management. Through the use of extensive case studies and empirical evidence the authors argue that, although the timber trade is not the major source of tropical deforestation, policy distortions encourage excessive timber related deforestation whilst discouraging sustainable management. The book concludes by examining the necessary international policy measures required to improve the role of the timber trade in sustaining tropical production forests.

Earthscan, London, 1992. £14.95

Beer and Baskets: The Economics of Women's Livelihoods in Ngamiland, Botswana

Compiled by Joshua Bishop and Ian Scoones

This report examines the economics of basket making and beer production in two sites on the western edge of the Okavango delta in Ngamiland, Botswana. Using Participatory Rural Appraisal methods, the study focused on the priority concerns expressed by villagers and explored women's use of wild species. Income generating activities based on the use of wild resources were situated and evaluated in a total livelihood context. Based on this analysis, options for resource conservation and management are then identified. The work forms part of the research project *The Hidden Harvest: The value of wild resources in agricultural systems*, conducted jointly by the Sustainable Agriculture and Environmental Economics Programmes of IIED.

IIED 1994. £8.00

Whose Eden?: An Overview of Community Approaches to Wildlife Management

A report by IIED to the UK Overseas Development Administration.

This report challenges the traditional practice of separating the management and conservation of wildlife from the livelihood of local communities. It shows there is a growing recognition that a community's rights to ownership and tenure of wildlife resources is integral to sustainable wildlife management. Wildlife management will only be sustainable ecologically, socially and economically if it can be made sufficiently attractive to local communities for them to adopt the practice as a long-term livelihood strategy.

IIED 1994. £16.50

Economic Evaluation of Tropical Forest Land Use Options: A Review of Methodology and Applications.

A draft Report prepared for the UK Overseas Development Administration

Rapid deforestation in the tropics and increasing public concern about the social and environmental consequences of land use changes have created demand for methods to evaluate alternative land use options in a way that reflects social and environmental impacts, as well as economic costs and benefits. This report reviews a wide range of methods which may be used to carry out a comprehensive assessment of the economic, environmental and distributional consequences of alternative tropical forest land use options, including copious examples from recent empirical studies.

Environmental Economics Programme, 1994. £21.00

Towards a Sustainable Paper Cycle

A report by the International Institute of Environment and Development (IIED)

A major piece of work completed in 1995-96 the report *Towards a Sustainable Paper Cycle* represents the culmination of over two years of research co-ordinated by the *Environmental Economics Programme* with extensive input from the *Forestry and Land Use Programme*, *European Programme* and IIED's Executive Director, Richard Sandbrook.

Funded by over 40 donors from industry, government and international agencies, the report involved extensive inputs and consultation with private enterprise, public agencies, technical and academic experts, environmental advocacy groups and others. It attempts to answer such questions as: *will there be enough fibre to meet future demand for paper products? How should the world's forests be managed? Should the rich countries try to consume less paper? What are the environmental effects of different bleaching methods? Is recycling the best use of waste paper?* And most importantly: *What policies and practices should industry and governments adopt to achieve a more sustainable paper cycle?*

258 pages, 1996

ISBN: 1 899825 40 1

£30 IIED

Conservation, Management and Development of Forest Resources: Proceedings of the Malaysia-United Kingdom Programme Workshop 21-24 October 1996

Edited by Lee Su See, Dan Yit May, Ian D Gauld and Joshua T Bishop

This book records the results of a five-year collaborative research programme involving more than 60 scientists in Malaysia and the United Kingdom. Sponsored jointly by the governments of Malaysia and the United Kingdom, the programme aimed to strengthen the capacity of collaborating institutions to assess and develop sustainable forest management systems through: exchange of experts and information; transfer of appropriate technology; training of personnel; methods to monitor and evaluate the environmental impacts of forest operations; methods for forest resource valuation and accounting.

The research was carried out under two sub-programmes: *A - Conservation of Biodiversity and Sustainable Use of Forest Genetic Resources*, and *B - Valuation of the Costs and Benefits of Non-timber Forest Products and Services*. The programme culminated in a workshop in October 1996 which was jointly organised by the Forestry Department Peninsular Malaysia, the Forest Research Institute Malaysia and the Environmental Economics Programme of IIED. *Conservation, Management and Development of Forest Resources*, which records the proceedings of this workshop, contains 22 papers on forest ecology and economics in Malaysia and includes concrete recommendations of potential interest to forest managers and policy-makers in Malaysia and other countries.

Forest Research Institute Malaysia 1998. £15.00.

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