UFZ-Discussion Papers

Department of Economics

12/2004

Integrating local ecological services into intergovernmental fiscal transfers: the case of the ICMS-E in Brazil

Irene Ring [*]

November 2004

[*] UFZ Centre for Environmental Research Leipzig-Halle GmbH,
Permoserstr. 15, 04318 Leipzig, Germany

Email: Irene.Ring@ufz.de

Integrating local ecological services into intergovernmental fiscal transfers: the case of the ICMS-E in Brazil

Irene Ring

Keywords

Intergovernmental fiscal transfer, spillover effects, ecological services, economic incentives, local conservation benefits, Brazil

Abstract

Local conservation efforts are often related to benefits at higher governmental levels. On the one hand, these efforts are strongly connected to local land-use decisions. On the other hand, activities such as sustainable water management or biodiversity conservation are associated with regional, national or even global public goods. Therefore spatial externalities or spillovers exist that – if not adequately compensated – lead to an underprovision of the public goods and services concerned. This article investigates intergovernmental fiscal transfers as an innovative instrument to compensate local jurisdictions for the ecological goods and services they provide across local boundaries. From a public finance perspective, fiscal transfers are a suitable instrument to internalise spatial externalities. However, most federal states predominantly use this feature for social and economic public functions rather than ecological public functions. This article investigates the case of the "ICMS-E" that has first been introduced by a few states in Brazil during the 1990s. Part of the revenue of this value-added tax is redistributed to the local level based on ecological indicators. In this way, the state level uses fiscal transfers to compensate municipalities for the existence of protected areas and other ecological services provided within their territory. The Brazilian experience illustrates that such fiscal transfers can represent both a compensation for land-use restrictions to be born and an incentive to appreciate and engage in more conservation activities at the local level.

Introduction

Sustainable land use requires a variety of conservation efforts and services, not least at the local level. Dealing with environmental pollution is as necessary as focusing on precautionary tasks such as soil, water and biodiversity conservation. The environmental quality of a landscape is closely linked to its land-use pattern and the type of management performed by public jurisdictions and private land users. However, there are few incentives for local actors to encourage in conservation activities when ecological benefits cross local boundaries (Perrings & Gadgil 2003). This is the case for a number of ecological services, for example water protection or nature reserves. Decisions on the designation of the respective protected areas are often taken by institutions above the local level, whereas the concrete consequences in terms of restrictions in land use are to be born by local actors, often without any or sufficient compensation.

The aim of this contribution is to present innovative instruments that are able to address this basic problem. We will analyse the role intergovernmental fiscal transfers can play in federal systems for compensating local ecological services. From a public finances perspective, it is the "value-added" of local ecological services, i.e. the benefits crossing the boundaries of local jurisdictions which are of special interest. Therefore, the first part of this chapter gives a short introduction into public finances principles as relevant to ecological goods and services (Ring 2002). The second part presents a case study from Brazil, focusing on the status quo and the incentive effects of integrating ecological public functions into intergovernmental fiscal transfers. Since the 1990s, several states in Brazil have introduced fiscal transfers that explicitly compensate municipalities for certain ecological services, such as watershed protection and conservation areas (Bernardes 1999; Grieg-Gran 2000; May et al. 2002). The positive experiences with introducing ecological indicators into the Brazilian system of intergovernmental fiscal transfers make it worth to present it as an innovative example for potential transfer to other federal systems.

Compensating the value-added of local ecological services

Principles of fiscal federalism

The basic task of fiscal federalism is one of effectively and efficiently assigning public functions, expenditures and revenues to the central, state, and local governmental levels in

federal systems, or, in other words, determining the optimal size of jurisdiction for the various public functions concerned. As Oates (1999, p. 1120) puts it, "... we need to understand which functions and instruments are best centralised and which are best placed in the sphere of decentralised levels of government". Concerning the allocation function of the public sectors, the basic principle of fiscal decentralisation has been put forward (Musgrave 1959; Oates 1972). The provision of most public goods and services is more efficiently guaranteed when production and consumption are limited to the lowest governmental level possible. In this way, the regionally differing preferences of the population can be more adequately reflected (Tiebout 1956).

The general decentralisation rule for allocating public goods and services to lower governmental levels only applies in the absence of economies of scale. If economies of scale exist, the provision of public goods and services concerned should be moved to the cost-efficient centralised level (Postlep & Döring 1996). In addition, due to the characteristics of non-rivalry and non-excludability of many public goods, some of them are associated with spatial externalities or spillovers between jurisdictions. Here, the principle of fiscal equivalence comes into play which advocates achieving a "match between those who receive the benefits of a collective good and those who pay for it" (Olson 1969, p. 463). Social welfare is increased through the differentiation of public services in accordance with local costs and preferences. The implementation of fiscal equivalence may require the shifting of competence to a more centralised level of government. However, regional cooperation, e.g., in the form of negotiations between the parties concerned, can also bring along the potential for an efficient Coasian type of resolution of jurisdictional spillovers (Bergmann 1999; Oates 2001). Furthermore, the formation of administrative institutions mapping the spatial range of costs and benefits are also discussed to internalise spatial externalities (e.g., Breton 1965; Frey 1996). Olson (1969) has suggested still another solution to this kind of problem. Provided diseconomies of large-scale operation call for local provision, spillovers can be internalised through government grants from more centralised levels. In this way, fiscal transfers in the form of grants compensate the local government for the external benefits of its expenditures.

Intergovernmental fiscal grants play a substantial role in fiscal federalism that can serve different functions. The literature emphasises the role of the internalisation of spillover benefits to other jurisdictions. Based on normative considerations of equity, they can also serve the purpose of fiscal equalisation among different jurisdictions. These equalising grants play an important role in the fiscal system of Germany, as well as in other federal systems such as Canada and Australia (Oates 1999). Before moving on to the case studies, we will first intro-

duce the field of environmental federalism and discuss how the principles of fiscal federalism generally apply to ecological goods and services.

Environmental federalism and the role of fiscal transfers

Environmental federalism links environmental issues with the basic theory of fiscal federalism. Both the general principle of sustainable development as adopted by international conventions and the numerous public ecological functions as already assigned to the various governmental levels within nation states call for consideration of ecological goods and services in intergovernmental fiscal relations (Ring 2002). On the one hand, ecological public functions consist in the conservation and sustainable use of resources and landscapes. These precautionary type functions comprise fields such as soil, water and biodiversity conservation. However, they also include activities aiming at the conservation of nature as a sound living basis for humans, including recreational aims. On the other hand, ecological public functions include discharging activities such as sewage and waste disposal or the rehabilitation of contaminated sites and landscapes, in short dealing with all aspects of environmental pollution. The implementation of the concept of sustainable development requires the consideration and adequate financing of these ecological public functions at appropriate governmental levels.

What are the consequences of the decentralisation rule and the principle of fiscal equivalence for environmental issues? Following the general decentralisation rule for the allocation function of public services, the provision of ecological goods and services should be assigned to lower levels of government where appropriate. However, due to the characteristics of natural resources and environmental quality, the implementation of this rule calls for a differentiated approach. This is reflected in the on-going discussion on the responsibilities of the national or even supranational governmental level versus the state or local level in setting environmental standards, or carrying out other environmental functions (Döring 1997; Scheberle 1997; Oates 1999, 2001).

In the European Union for example, fiscal decentralisation is connected to the term “subsidiarity”. According to the subsidiarity principle as consolidated and adopted by the Treaty of Maastricht on European Union of 1992, public policy and its implementation should be allocated to the smallest jurisdiction with the competence to achieve the objectives. Since the Maastricht Treaty, environmental federalism has been rediscovered and widely debated (e.g. Huckestein 1993; Hansjürgens 1996; Döring 1997; Oates 1998). Despite the fundamental strengthening of the subsidiarity principle in the new Article 3b of the Treaty, a fair amount of

leeway is left for interpretation. Any concrete implementation of environmental policy has to consider the specific details of the subject matter.

For example, the basic research function, the dissemination of information on environmental damages and pollution control techniques or the effectiveness of various environmental policy instruments need to be assigned to a more centralised level of government, for this kind of public good tends to be under-provided at decentralised levels (Oates 2001). Further issues pointing to a fundamental role of centralised governments relate to global change problems such as climate change. Highly mobile environmental compartments and associated pollutants that easily cross national boundaries create far-reaching spatial externalities. The depletion of the ozone layer, the emissions of carbon dioxide and other air pollutants associated with climate change require more centralised if not global emission policies.

In contrast, environmental policy associated with less mobile environmental compartments is better suited for assignment to decentralised levels of government (Ring 2002). This is due to the lower probability of causing spatial externalities. Problems of land use and soil conservation, as well as public functions associated with inland waters, can usually be solved within national boundaries.

Considering spatial externalities

Despite the general suitability of land-use questions to be assigned to lower governmental levels, spatial externalities may require appropriate solutions. This is especially the case for priority areas, e.g. for the protection of natural resources, that may cause costs within the concerned jurisdiction, but externally also benefit others. In contrast to certain local costs, be it in terms of land-use restrictions or measures for keeping up and improving the quality of the respective reserves, benefits from some of these activities cross local boundaries.

For example, water protection zones are often located in rural areas, mostly providing drinking water far beyond local demand. Especially urban agglomerations and capital regions with high population densities and industrial activities heavily rely on water resources lying outside own municipal borders. In the case of water resources, an important task consists in properly valuing these resources and their functions which then, as far as possible, should be reflected in water prices (Hansjürgens & Messner 2002). However, for various reasons this option is not yet fully implemented, and, concerning certain tasks of long-term resource protection might even not be a feasible solution.

The conservation and sustainable use of biodiversity is another example for the widespread existence of spatial externalities (Ring 2004). On the one hand, the loss of biodiversity belongs to the very serious global change problems, demanding centralised standard setting and policies. This is reflected in the Convention on Biological Diversity and related activities. On the other hand, decentralised activities related to local land use have – if accumulated – a tremendous influence on the state of biodiversity worldwide. Reflecting the value of ecological services in market prices is even more difficult if not impossible for many fields of biodiversity conservation. This is especially true for benefits related to non-use values such as existence and option values that may accrue to people everywhere. The practical consequences of spatial externalities related to species protection are illustrated by an empirical study of List et al. (2002). They found in their study of federal and state spending under the Endangered Species Act in the U.S. a free-riding behaviour on the part of the states. States tend to spend less (relative to the federal government) on those species that demand a large habitat area and those whose preservation causes conflicts with economic development. Perrings and Gadgil (2003) address a number of reforms necessary to reconcile both local and global public benefits of biodiversity conservation. One of them is adjusting incentives to allow local communities to be rewarded and paid for their conservation efforts (Unnerstall 2004).

In the following case study, the focus for solving such discrepancies will be on fiscal transfers. Provided diseconomies of large-scale operation call for local provision, which is usually the case for public goods and services associated with land use, spillovers can be internalised through government grants from more centralised levels. These grants compensate the local government for the external benefits of its expenditures or restrictions to be born. This is especially necessary for social benefits accruing in the long term where public and private actors are coming up for today's costs. In this way, the "value-added" of local ecological goods and services is socially acknowledged which at the same time can provide an incentive for local actors to engage in more conservation activities.

Fiscal transfers for local ecological services in Brazil

Brazil is a federal state with 27 states. Each state has an elected government with revenue-raising powers. The tax called ICMS (*Imposto sobre Circulação de Mercadorias e Serviços*) represents the largest source of state revenues in Brazil with approximately 90% of overall state tax revenues (Loureiro & Moura 1996). It also constitutes an important source of revenue for local governments. The ICMS is a tax on goods and services, similar to the value-

added taxes in other countries. It is collected on commercial transactions and exchanges of goods and services, such as energy, transportation and communication (May et al. 2002). The Federal Constitution of Brazil as of 1988 decrees that 25% of the revenues raised by this tax have to be allocated by the state to the local level of government. The Federal Constitution further stipulates that 75% of the total amount passed on to the municipalities should be distributed according to the value added generated by each municipality, the latter being represented by an index of municipal economic output. The state governments determine the indicators for the allocation of the remaining 25%. Typical indicators used to be based on population, geographical area and primary production (Grieg-Gran 2000). It is through the authority of the states to define these additional indicators that ecological indicators were introduced in the 1990s as part of the State Constitutions of several Brazilian states. Paraná was the first state to introduce the ICMS-E (ICMS-Ecológico; that means ICMS with allocation of revenues based on environmental indicators)[1]. In 1990 and 1991, the relevant laws and implementing regulations were adopted that allowed for the consideration of ecological indicators in the ICMS (Bernardes, 1999). Following Paraná's experience that actually started using ecological indicators in 1992, the states of Minas Gerais (1996), São Paulo (1996), Rondônia (1997), Mato Grosso do Sul (2002), Tocantins and Pernambuco (2003) started operating a similar system a few years later (Grieg-Gran 2000; May et al. 2002; Villar Martins 2003; CPRH 2003; Loureiro 2004). The state of Rio Grande do Sul passed an ICMS-E Law in 1993, followed by implementing laws and regulations in 1997 and the final adoption in 1999 (Freitas 1999). ICMS-E legislation also exists in the states of Amapá (1996) and Mato Grosso (2001) (Loureiro 2004). Concerning initiatives in other Brazilian states, Santa Catarina, Espírito Santo and Goiás drafted an ICMS-E legislation, Bahia and Ceará submitted ICMS-E legislation to their respective state legislatures. In the states of Rio de Janeiro, Pará and Amazônia, the ICMS-E has been under serious discussion (Bernardes 1999; Freitas 1999; Loureiro 2001; MMA 2002).

[1] The ICMS-E is usually known under the term "ecological value-added tax". This holds both for scientific literature and common language use in Brazil. From a public finance perspective, however, this term is misleading. An ecological tax would be a tax of which the assessment basis is related to ecological indicators. The ICMS-E, in contrast, uses ecological indicators for the allocation of its revenues. Therefore, economically speaking, the term ecological grants or ecological fiscal transfers is more appropriate and will be further used in this article.

Paraná: Valuing watershed protection areas and conservation units

Following the implementation of more strict environmental legislation in the early 1980's, a number of municipalities in Paraná which had protected areas in their territories exerted pressure on the state legislature and government agencies (Loureiro & Moura 1996). The land-use restrictions connected to large conservation and watershed protection areas were preventing the municipalities from developing productive activities and thereby generating value added. The municipality of Piraquara is a typical example of this situation: 90% of municipal territory protects a major watershed for the Curitiba metropolitan region (1.5 million inhabitants), and the remaining 10% occupy protected areas (May et al. 2002).

In response to these concerns, the ICMS-E was introduced as an instrument to compensate municipalities with large protected areas for the land-use restrictions they faced, while providing incentives for conservation. In the case of Paraná, state decision-makers considered the long-term costs of water treatment needed due to uncontrolled development around water sources. They also were worried about the serious deterioration of the state's land cover with respect to biodiversity protection (Loureiro, cited in Echavarría 2000). Following the approval of the Ecological ICMS Law in 1991, from 1992 on, 5% of the total amount distributed to the local level is based on ecological indicators. Half of it (2.5 %) is distributed to municipalities with watershed protection areas in their territories that partly or completely provide services for public drinking water systems of neighbouring municipalities (Loureiro in Echavarría 2000). The other half is for those municipalities with "conservation units". Conservation units (CUs) are conservation areas including totally protected and restricted sustainable use areas that can be publicly managed (federal, state or municipal level), privately owned or managed by public-private partnerships. The ICMS-E revenue accrues to the municipality and not to the owner of the land. Therefore, the incentive effect primarily addresses local public authorities. However, as we will see later, there is also an incentive effect to encourage public-private partnerships in terms of more environmentally sound land uses. The protected areas can be indirectly (biological reserves, ecological stations and parks) or directly used (indigenous areas, extractive reserves and sustainably managed forests). In any case, they have to be registered and legally defined for being considered (Grieg-Gran, 2000). In Paraná, the ICMS-E programme is administered by the Paraná State Environmental Institute (*Instituto Ambiental do Paraná, IAP*).

Synopsis of existing approaches

The states of Paraná, Minas Gerais, Rondônia and São Paulo now operate the ICMS-E for several years. Mato Grosso do Sul, Pernambuco and Tocantins just recently introduced the new system. For each state is autonomous to decide upon the indicators for distributing 25% of the ICMS to the local level, different operating systems are in place. This is important to know when comparing various effects among the states. The indicator "conservation units" has been introduced by all states with ICMS-E legislation. Although the states use slightly different methods to calculate the ecological index of a municipality, the basic procedure is the following:

The revenues allocated are based on the ecological index EI_i of municipality i multiplied by the total amount of ICMS-E revenues dedicated to conservation units. The ecological index EI_i is calculated by dividing the municipal conservation factor MCF_i by the state conservation factor SCF. For each municipality i ($i = 1, \ldots, z$) the ecological index EI_i can be written as:

$$EI_i = \frac{MCF_i}{SCF} \tag{1}$$

EI_i	Ecological index of municipality i
MCF_i	Municipal conservation factor of municipality i
SCF	State conservation factor
z	Total number of municipalities in the state

The municipal conservation factor MCF_i is based on the total area set aside for protection in terms of conservation units CU in relation to the total area of the municipality:

$$MCF_i = \frac{Area\,CU_i}{Area\,M_i} \tag{2}$$

$Area\ CU_i$	Total area of conservation units in municipality i
$Area\ M_i$	Total area of municipality i

The CUs of a municipality are calculated according to equation (3) where the protected areas are weighted according to the different categories of management. Table 1 shows the conservation weights CW_n for different types of protected areas in Paraná.

Table 1. Conservation weights CW_n for different management categories n of protected areas in Paraná.

Management category	**Conservation weight**
Ecological research station	1.0
Biological reserve	1.0
Park	0.9
Private natural heritage reserve	0.8
National, state or municipal forest	0.7
Indigenous area	0.5
Environmental protection area I	0.1
Area of relevant ecological interest	0.1
Special, local areas of tourist interests	0.1
Buffer zones	0.1

Source: adapted from Grieg-Gran 2000.

If n denotes the different categories of management,

$$Area\ CU_i = \sum_n protected\ area_n \times CW_n \tag{3}$$

CW_n Conservation weight for management category n

The state conservation factor SCF is given by the sum of all municipal conservation factors in the state:

$$SCF = \sum_{i=1}^{z} MCF_i \tag{4}$$

Paraná is currently the only state that is evaluating the quality of protected areas and including this into the calculation of the ecological index (Grieg-Gran 2000; May et al. 2002). The additional quality index of each protected area is assessed by regional officers of the state environmental agency based on variables such as the physical quality; biological quality (fauna and flora); quality of water resources (within the CU and in its surroundings); physical

representativeness; quality of planning, implementation and maintenance[2]. Minas Gerais also intends to consider a quality factor. However, the quality evaluation system has not yet been developed far enough, and the quality factor is still set at 1.0 for all protected areas.

Table 2 illustrates the types and shares of all ecological indicators adopted so far for ICMS-E allocation by the respective states. Concerning the indicator of waste management in Minas Gerais, funds are allocated to those municipalities which show operating solid and liquid waste management systems, duly licensed by the State Environmental Policy Council (Bernardes 1999).

Differences are to be noticed in the way the states introduced ecological indicators into the ICMS allocation system. In Rondônia, allocation of ICMS based on value added (75%), population (0.5%), area (0.5%) and agricultural production (5%) did not change (Freitas 1999). It was the "equal share" indicator being reduced from 19 to 14% to allow for the introduction of the ecological indicator with a share of 5% (Grieg-Gran 2000).

Table 2. ICMS allocation for ecological indicators in the states operating the ICMS-E.

State	**Ecological share of total ICMS [%]**	**Allocation to resp. indicators [%]**	**Ecological indicators**
Paraná	5	2.5	Watershed protection areas
		2.5	Conservation units
Minas Gerais	1	0.5	Conservation units
		0.5	Solid waste disposal and sanitation systems
Rondônia	5	5	Conservation units
São Paulo	0.5	0.5	Conservation units
Mato Grosso do Sul	5	5	Conservation units
Pernambuco	1	1	Conservation units
Tocantins[3]	13	3.5	Conservation units
		3.5	Solid waste disposal and sanitation systems; water protection
		2	Slashing and burning control
		2	Local environmental policy
		2	Soil protection

Sources: Bernardes 1999; Grieg-Gran 2000; Villar Martins 2003; CPRH 2003; SEPLAN 2003.

[2] A more detailed description is provided by May et al. (2002, p. 195).
[3] Final implementation state in 2007.

Whereas Rondônia changed its allocation system within one year (between 1996 and 1997), Minas Gerais introduced its new allocation system step-wise, starting to apply new indicators in 1996 with full operation of the new system in 1998. In Minas Gerais, the introduction of the ICMS-E was part of a substantial change of the whole ICMS allocation system, popularly known as the "Robin Hood Law" (Bernardes 1999). The allocation based on value added was gradually reduced from about 94% (1995) to 80% (1998) to allow for the consideration of other indicators. Apart from the introduction of ecological indicators, eight further indicators were implemented: geographical area (1%), population (2.71%), 50 municipalities with highest population (2%), education (2%), area cultivated (1%), cultural heritage (1%), health expenditure (2%) and own revenue generation (2%). Here, the reform of the ICMS system did not only cover ecological aspects, it also included resources redistribution for social reasons, aiming at making poorer municipalities better off. For this reason, it is a lot more difficult to clearly illustrate the effects of the introduction of ecological indicators in Minas Gerais compared to Rondônia (Grieg-Gran 2000).

The state of Tocantins also decided to introduce the ICMS-E in a gradual manner. Having started in 2003 with an overall percentage of 3.5% for ecological indicators, Tocantins will allocate a total of 13% in 2007 for conservation units and indigenous areas, local environmental policy, slashing and burning control, water and soil protection as well as waste and sewage disposal (SEPLAN 2003).

Before investigating the specific effects of the ICMS-E, a short overview is presented regarding the existence and respective categories of protected areas for the states of Paraná, Rondônia and Minas Gerais. Table 3 shows the jurisdiction of protected areas in these states in 1997, differentiating according to federal, state, and municipal level of jurisdiction. All states have in common a very low percentage of protected areas under municipal jurisdiction. In Paraná, more than 95%, in Minas Gerais and Rondônia even more than 99% are protected under jurisdiction higher than municipal level.

Rondônia represents a very special situation. This state has an extraordinary high percentage of 36% protected areas with more than 50% of all of its municipalities holding protected areas (total number of municipalities: 52 in 1998). In contrary, Minas Gerais possesses 2% protected area with only about 16% of its municipalities including protected areas as part of their municipal area (total number of municipalities: 853 in 1998) (Grieg-Gran 2000). Paraná also has about 2% protected areas (total number of municipalities: 400 in 1999).

Table 3. Jurisdiction of protected areas in Paraná, Rondônia and Minas Gerais (1997).

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

Source: Grieg-Gran 2000, p. 7.

Participation in the programme

Participation of municipalities in the ICMS-E programme is voluntary. Therefore, an important prerequisite for the success of the programme is a good information policy. Municipalities need to know about the programme and also expect benefits from participation for actually making an effort to apply. In Minas Gerais for example, the decentralised structure of the State Forest Institute that is responsible for monitoring all information related to ICMS-E transfers based on conservation units turned out to be extremely helpful for publicity of the new law. With its 150 local and 14 regional offices it acted as an important source of information for municipalities with an interest in participation (Bernardes 1999).

May et al. (2002) indicate that since its inception, Minas Gerais showed a 100% increase in the number of municipalities that benefited from ICMS-E revenues. Currently, about 30% of all municipalities in Minas Gerais participate in the programme. In Paraná, the ICMS-E Programme began with a participation of 112 municipalities and grew to 192 in 1998, with an estimated rise to 220 in 1999. Over 50% of all municipalities are participating in the programme with an increase of over 45% in the number of municipalities benefiting from ICMS-E revenues (May et al. 2002).

The ICMS-E has greatly improved relations between protected areas and the surrounding inhabitants (Bernardes 1999). Instead of perceiving protected areas as an obstacle to development, they are starting to see them as an opportunity to generate revenue. More municipalities are now aware of the existence of protected areas within their territories and are beginning to change their attitude towards them. They are more open to create new reserves and, depending on the design of ecological indicators, also care about the quality of these areas. During the first year of operating the ICMS-E in Minas Gerais, only federal and state protected areas were considered, protected areas at municipal level were excluded because they lacked formal registration. Already the following year brought about the official registration of existing municipal protected areas and they were included in the ICMS-E programme (Grieg-Gran 2000).

Increase in protected areas

In Rondônia, the introduction of the ICMS-E was too recent to show a significant effect on the area and management of land set aside for protection. In Paraná and Minas Gerais, where it is now in operation for several years, there is a clear incentive effect in a way that new protected areas have been created, especially at local and state level. For public protected areas, the ICMS-E has become an important stimulus for the creation of new conservation units and for improved environmental management and quality of these areas.

In Paraná, the total area in conservation units grew by over one million hectares in the year of 2000, representing an overall increase of 165% during the 9 years since its inception in 1992 (May et al. 2002). Table 4 shows that municipalities developed a strong interest in designating new public protected areas at the local level. The introduction of the quality evaluation of conservation units had a positive effect on the interest of municipalities to improve their management (Grieg-Gran 2000, p. 21). Some of the municipalities and their mayors also started supporting private land users in managing conservation units, including provision of staff, equipment and vehicles for managing the areas.

In Minas Gerais, conservation units grew by slightly over one million hectares in 5 years, representing a 62% increase (see Table 5, May et al. 2002). As for public protected areas, the designation of new protected areas was exclusively carried out at the state and municipal level of government. In Minas Gerais, however, the ICMS-E is not the only reason for the increase in protected areas: part of the initial growth is due to the efforts by local governments to register existing units that had not been regulated by the state before.

Table 4. Public and private protected areas in Paraná before and after the ICMS-E.

Protected areas	Until 1991 [ha]	Created after 1991 [ha]	Total by 2000 [ha]	Increase [%]
Public				
Federal	289,582	50,846	340,428	18
State	39,859	13,804	53,663	35
Municipal	1,429	2,740	4,169	192
Private/mixed				
APA	306,693	905,631	1,212,324	295
RPPN	0	26,124	26,124	
Other	0	53,607	53,607	
Total	637,563	1,052,752	1,690,315	165

Source: May et al. 2002, own calculations. APAs (Environmental Protection Areas) can be designated at federal, state or municipal level. RPPNs (Private Natural Patrimony Reserves) can be designated at federal or state level.

Table 5. Public and private protected areas in Minas Gerais before and after the ICMS-E.

Protected areas	Until 1995 [ha]	Created after 1995 [ha]	Total by 2000 [ha]	Increase [%]
Public				
Federal	268,147	0	268,147	0
State	295,151	196,436	491,587	67
Municipal	3,851	9,076	12,927	236
Private/mixed				
APA	1,023,566	785,894	1,809,460	77
RPPN	20,261	13,808	34,069	68
Total	1,610,976	1,005,214	2,616,190	62

Source: May et al. 2002, own calculations. APAs (Environmental Protection Areas) can be designated at federal, state or municipal level. RPPNs (Private Natural Patrimony Reserves) can be designated at federal or state level.

In Paraná and Minas Gerais, intra-state allocations favour municipalities with large areas dedicated to state or federal indirect use conservation units (May et al. 2002). Parks, reserves and forests are highly weighted by allocation criteria. Nevertheless, substantial volume of financial resources has been allocated to municipalities with Environmental Protection Areas (APAs). APAs alone account for 86% (Paraná) respectively 78% (Minas Gerais) of the incremental increase in total new conservation units in these states, the vast majority being

dedicated to state and municipal APAs. APAs are easily created and a relatively low level of control is exerted within them. They may cover large areas within a municipality with restricted zoning, in spite of far less rigorous enforcement than other conservation units, which is reflected by rather low weights by allocation criteria.

Following the introduction of the ICMS-E, new state legislation in Paraná and Minas Gerais has enabled the generation of a wider range of conservation units, including areas established under municipal jurisdiction as well as the Private Natural Patrimony Reserves (RPPN). The private reserves are established and run by their owners. Owners are fully responsible for their maintenance and management, yet they may indirectly benefit from the revenues, municipalities receive based on the ICMS-E. Since the introduction of the ICMS-E, RPPNs have increased in number and area: By the year 2000, Paraná created some 26,124 ha, Minas Gerais designated 34,069 ha of private reserves. Both states are actively promoting RPPNs as part of an integrated public-private partnership in buffer zones surrounding public protected areas (Bernardes 1999). The positive experience with these reserves was triggered by the ecological fiscal transfers which motivated local governments to assist landowners in measures to protect and maintain the environmental quality of their areas, as well as helping them to prepare the necessary registration documentation (Bernardes 1999). May et al. (2002) mention for Paraná that mostly large farmers were prioritised for RPPN creation due to their size of property and the volume of resources to be generated thereby. Although small farmers can also be interested in RPPN creation, their lands are not usually eligible due to the small size and high transaction costs associated with it.

Bernardes (1999) presents figures of protected areas in Minas Gerais until June 1999 that further break down the categories of Environmental Protection Areas (APA) and Private Natural Patrimony Reserves (RPPN) according to their governmental levels (Table 6)[4]. These figures clearly show how strong an incentive effect the ICMS-E exercised on the initiative at state and local levels to create new protection areas. The largest absolute increase (552,976 ha) in protected areas until June 1999 was due to new conservation units at state level. However, the largest relative increase of 1,619% took place at municipal level, where 120,294 ha of protected areas existed in June 1999 compared to only 6,997 ha before the introduction of the ICMS-E.

[4] Bernardes (1999) and May et al. (2002) slightly differ in their base figure of protected areas in Minas Gerais until 1995. Due to the little difference of less than 1% this is not further considered here.

Table 6. Protected areas in Minas Gerais before and after the ICMS-E according to governmental levels.

Protected areas	Until 1995 [ha]	Created after 1995 [ha]	Total by June 1999 [ha]	Increase [%]
Federal	909,467	5,710	915,177	0.6
State	695,610	552,976	1,248,586	79.5
Municipal	6,997	113,297	120,294	1,619.2
Total	1,612,074	671,983	2,284,057	41.7

Source: Bernardes 1999, own calculations. In this table, public and private/mixed protected areas such as APAs and RPPNs are already included in the figures presented according to their governmental level of designation.

Changing municipal revenues

The total amounts passed through to municipalities are appreciable. In the state of São Paulo, distributions through ICMS-E amounted up to 70,241 million Brazilian Real (R$) between 1994 and 1996, averaging over R$ 23.4 million annually. It is estimated that participating municipalities in São Paulo received about R$ 2.45 per month and ha protected area (Bernardes 1999).

In Paraná, amounts averaged over R$ 50 million annually between 1994 and 2000[5] (May et al. 2002). Individual municipalities increased their revenues considerably such as Piraquara in Paraná. 90% of the municipal territory protects a major watershed for the Curitiba metropolitan, and the remaining 10% occupy protected areas. This municipality increased its earnings by 84% in 1995 (Loureiro, cited in Echavarría 2000).

May et al. (2002) investigated municipal revenues in the Paraná floodplain, so-called "Varjão". Located in the northwestern part of the state, it lies within the Paraná, Paranapanema and Piquiri watersheds. Here, the ICMS-E constitutes a high percentage of overall municipal revenues and became a solution to the financial problems of the municipalities. For example, impacts of ICMS-E resources are especially significant in the municipality of São Jorge do Patrocínio that has 52% of its total area in conservation units (May et al. 2002, p. 185). In 1998, the ICMS-E transfers represented 17.6% of the overall municipal budget and in 2000, the ICMS-E revenue amounted up to 71% of total ICMS transfers for this year. Conservation

[5] In June 2001: Brazilian Real R$ 1.00 = US$ 0.41

began to become a important part of the municipal agenda, also of neighbouring municipalities. It led to the creation of Brazil's first municipal consortium for biodiversity protection in 1995 and 2 years later of the Ilha Grande National Park. Differences in ICMS-E pass-throughs are mainly due to the proportion of the Park area in the total area of municipality. Local population perceives the financial importance of the ICMS-E for revenue generation, and behaviour of the community towards the environment changed. ICMS-E resources are nowadays used for numerous environmental activities, such as well drilling to provide drinking water, cleaning and landscaping of the urban area, garbage collection, landfills, environmental education or enforcement of land use controls in parks and APAs. They are also used for other activities, such as the acquisition of tractors or the construction of industrial facilities. "All these benefits, provided by ICMS-E revenues, are disclosed to the community to make the public aware of the link between environmental protection and day-to-day-problems." (May et al. 2002, p.185).

Grieg-Gran (2000) investigated the detailed financial effects of the ICMS-E for the states of Rondônia and Minas Gerais. Due to the relatively low number of municipalities in Rondônia, a full picture for the whole state is available. Here, the 5% ecological share of total ICMS was introduced between 1996 and 1998 in combination with the equivalent reduction in the equal share indicator. As a consequence, municipalities must have at least 25% protected areas within their territory to outweigh reduction in the equal shares indicator. Municipalities with more than 25% protected areas can significantly benefit from the new type of grants. The winners of ICMS-E introduction are 7 municipalities with more than 50% protected areas, 3 municipalities between 40 and 50%, 6 municipalities between 30 and 40% protected areas, and one municipality between 25 and 30%. To sum up, in Rondônia roughly 60% of the municipalities with protected areas benefited from the introduction of the ICMS-E. The other 40% experienced a negative impact due to the reduction in the weight given to the equal shares indicator.

In Minas Gerais, amounts between 1998 and 2000 reached about R$ 15 million annually (May et al. 2002). In 1998, 86 municipalities with protected areas benefited from the increase in their consolidated index for ICMS allocation due to the ecological indicator (Grieg-Gran 2000). 38 municipalities with protected areas experienced a reduction in their overall index. The reduction in revenues resulted not so much because of little protected area but because of other factors. Partly, this was due to the reduction in the weight given to value-added, partly this resulted from the introduction of other new indicators such as health and education. In the case of Minas Gerais, it is important to separate effects of the ecological indicator from other

indicators. For some municipalities, though, the introduction of the ecological indicator turned out to be extremely important. In 1998, the ecological index accounted for more than 20% of the consolidated index in some 20 municipalities. The municipality of Marliéria, for example, has 55% of its territory within the Rio Doce State Park as the largest contiguous area of Atlantic Forest in Minas Gerais. Here, the ecological index accounts for 70% of the overall index for ICMS allocation (Grieg-Gran 2000), and in the first year after introducing the ICMS-E, revenues from it accounted for around 68% of the total municipal ICMS revenues, increasing from R$ 36,648 in 1995 to R$ 811,335 in 1996 (Bernardes, 1999).

Grieg-Gran (2000) presents calculations for Rondônia and Minas Gerais in order to identify the potential benefits to be expected for municipalities that set aside further 1,000 ha of protected area.[6] Especially for municipalities with very low average levels of value added and primary production, the conservation option would turn out to be beneficial. In the case of Rondônia, it would be attractive for 28 municipalities to create protected areas. Among these, only 12 already have protected areas, 16 are without and could be financially better off with protected areas. Comparative calculations for Minas Gerais are more complicated due to complex changes in overall ICMS-E allocations. Still, there are municipalities with low levels of value added where the creation of protected areas would be extremely financially attractive. São Sebastião do Rio Preto with no conservation units would have to generate at least 226 times the average value added per hectare in the municipality for it to be more beneficial in terms of ICMS revenues than the creation of 1,000 ha protected area (Grieg-Gran 2000, p. 24).

Recommendations based on the Brazilian experience

Although the basic features of the ICMS-E are rather uniform across the various states, the way of implementing it, its operation in practice and the reactions on the side of municipalities can greatly vary. In-depth empirical studies show that ICMS-E allocations appear to have substantial impacts on conservation decisions in some areas, while in others only a limited impact can be observed (May et al. 2002). Particularly municipalities with a high share of protected areas can substantially benefit from the ecological grants, and therefore, appreciate the ecological services they provide across local boundaries. Many municipal governments, and depending on their information policy, also the public, are now aware of the natural assets

[6] Grieg-Gran (2000) assumes that the municipality in concern is the only one in the whole state adding 1,000 ha of protected area within its territory.

they preserve and maintain. However, the type of indicator chosen also determines the incentive effect. The example of Paraná shows that not only the quantity, but also the quality of the respective areas should be taken into consideration. Here, not only the number and surface area of conservation units have increased, there are also noted improvements in the quality of conservation units (Loureiro & Moura 1996). The implementation of a quality evaluation waits to be implemented for all other states except Paraná, representing a major challenge due to the regular controls of the registered areas by decentralised environmental institutions.

Another critique refers to the way the ICMS-E revenues are currently allocated to municipalities. So far, they are given as lump-sum transfers, to be used in any way the recipient wishes. Some authors argue that ear-marking for environmental purposes should be considered (Grieg-Gran 2000; May et al. 2002). However, from a general public finances perspective there are also a number of arguments in favour of lump-sum transfers, such as guaranteeing maximum financial autonomy to local jurisdictions.

Perspectives for compensating local ecological services

One way of counteracting the underprovision of local ecological goods and services would be to integrate ecological functions into intergovernmental fiscal transfers to the local level. Concerning the suitable types of ecological functions, precautionary ecological functions must be stressed whose benefits cross local boundaries, such as nature conservation and water protection. These ecological services are mostly provided by designating more or less large protected areas that play a significant role in sustainable watershed management and biodiversity conservation in the long run. Usually, 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. Due to the regional, national or even international importance of these areas, municipalities are obliged to accept decisions made at higher levels of government. In this way, the local sovereignty in land-use planning and management is restricted in the long term. These decisions also affect the ability to develop productive activities and to generate revenue in a variety of ways, both for private land users and local governments.

In this chapter, the focus was on the role of public institutions, i.e., the local government in its need to be compensated for the ecological goods and services it provides. The “forced” provision of ecological goods and services in terms of protected areas without compensating for positive spillovers is neither effective nor efficient. Provided relevant framework regulation exists, concrete decisions on the immobile factor “land” are best to be taken at most de-

centralised levels. This is reflected in the decentralisation of land-use planning in many countries where concrete implementation is mostly assigned to the local level. From an economic view, it is rational for local governments not to be interested in or even be against water and nature protection areas if associated costs are to be born locally whereas a number of benefits cross local boundaries. Apart from intrinsic motivation in local conservation activities that shall not be overlooked here, the majority of municipalities will not support the existence of protected areas within their territory. Even though protected areas might exist, lack of enforcement, control or just information can easily lead to the deterioration of the quality of these areas. Therefore, a prerequisite for long-term sustainable land use consists in the integration of protected areas with positive spillovers into intergovernmental fiscal transfers to the local level. This would keep concrete decisions on land use at the most suitable local level. The financial acknowledgement of the provision of ecological services across local boundaries would raise local awareness for the cross-boundary significance of these protected areas. By way of the internalisation of positive spatial externalities, it brings local interests in line with supra-local interests, thereby making incentives for local behaviour consistent and contributing to economic efficiency.

The Brazilian case showed that various mechanisms already exist for acknowledging ecological goods and services in intergovernmental fiscal transfers. In other federal system, for example in Germany, only very few states have implemented ecological aspects in their fiscal system (Ring 2002). The special relevance of protected areas has not yet been recognised. Therefore, the majority of German municipalities still perceive them as an obstacle to development (Bauer et al. 1996, p. 334; Stoll-Kleemann 2001).

In Brazil, a few states started to compensate municipalities for the existence of protected areas within their territory. During the 1990s, ecological indicators were introduced into the system of redistributing the value-added tax from the state to the local level. In the meanwhile, the effects are striking, both in terms of increased protected areas and changing revenues. Especially municipalities with a high share of protected areas can considerably benefit from the new ecological fiscal transfers, and therefore, appreciate the ecological services they provide across local boundaries. However, attention is asked for regarding the choice of indicators allocations are based on. The example of Paraná shows that not only the quantity, but also the quality of the respective areas should be taken into consideration.

Although this chapter presented a national case study, the general message can be transferred to other federal systems. Köllner et al. (2002), for example, present a case study for integrating biodiversity into intergovernmental fiscal transfers for Switzerland. However, the

kinds of recommendations to be made for considering protected areas of supra-local significance strongly depend on the type of federal system investigated, the general role and functions of different jurisdictions within these systems, and the specific environmental legislation in force.

Research at the interface of ecological public functions and the economic theory of federalism is still more or less in its infancy. There are relatively few studies that investigate intergovernmental fiscal relations for their potential to adequately consider ecological aspects in terms of public functions and appropriate financing (Ring 2002). Whereas economic and social public functions have a rather long tradition in intergovernmental fiscal relations of federal systems, ecological functions have only been considered comparatively recently. Both the theoretical analysis of principles of the economic theory of federalism related to spillovers of protected areas and the respective empirical investigations of the Brazilian federal system have shown that there still is a great need for adequately rewarding ecological services provided by the local level.

References

Bauer, S., Abresch, J.-P., Steuernagel, M., 1996. Gesamtinstrumentarium zur Erreichung einer umweltverträglichen Raumnutzung. Metzler-Poeschel. Stuttgart.

Bergmann, E., 1999. Lenkung der Flächenausweisung über Zuweisungen? Informationen zur Raumentwicklung 9, 555-564.

CPRH (State Agency of the Environment of Pernambuco), 2003. Decret Nr. 25.574 of June 2003. http://www.cprh.pe.gov.br/ctudo-secoes-sub.asp?idsecao=178, 27 May 2004.

Bernardes, A.T., 1999. Some mechanisms for biodiversity protection in Brazil, with emphasis on their application in the State of Minas Gerais. World Bank, Washington, D.C., September 1999.

Breton, A.: A Theory of Government Grants. The Canadian Journal of Economics and Political Science, Vol. 31, No. 2, 1965, pp. 175-187

Döring, T. 1997. Subsidiarität und Umweltpolitik in der Europäischen Union. Metropolis, Marburg.

Echavarría, M., 2000. Valuation of water-related services to downstream users in rural watersheds: Determining values for the use and protection of water resources. FAO Background Paper No. 4, presented at the Electronic Workshop “Land-Water Linkages in Rural Watersheds”, 18 Sept. – 27 Oct. 2000, Rome.

Ewers, H.-J., Rehbinder, E., Wiggering, H., 1997. Umweltbezogene Erweiterung des Finanzausgleichs. Zeitschrift für Gesetzgebung 2, 135-147.

Freitas, A., 1999. ICMS ecológico – Um Instrumento Ecônomico para Conservação da Biodiversidade. WWF Brasil, Brasilia.

Frey, B., 1996. FOCJ: Competitive Governments for Europe. International Review for Law and Economics 16: 315-327.

Grieg-Gran, M., 2000. Fiscal Incentives for Biodiversity Conservation: The ICMS Ecológico in Brazil. International Institute for Environment and Development, Discussion Paper 00-01, London.

Hansjürgens, B., 1996. Föderalismustheorie und europäische Umweltpolitik. Ökonomische Kriterien für die Verteilung umweltpolitischer Kompetenzen in der EU. In: Postlep, R.-D. (Hrsg.): Aktuelle Fragen zum Föderalismus: Ausgewählte Probleme aus Theorie und politischer Praxis des Föderalismus. Metropolis, Marburg, S. 73-98

Hansjürgens, B., Messner, F. 2002. Die Erhebung kostendeckender Wasserpreise in der Wasserrahmenrichtlinie, in: von Keitz, S. und Schmalholz, M. (Hg.), Handbuch der Wasserrahmenrichtlinie – Inhalte, Neuerungen und Anregungen für die nationale Umsetzung, Erich-Schmidt-Verlag, Berlin, 293-319.

Huckestein, B., 1993. Umweltpolitik und Föderalismus – ökonomische Kriterien für umweltpolitische Kompetenzen der Europäischen Gemeinschaft. Zeitschrift für angewandte Umweltforschung, 6 (3), 330-339.

Köllner, T., Schelske, O., Seidl, I., 2002. Integrating biodiversity into intergovernmental fiscal transfers based on cantonal benchmarking: a Swiss case study. Basic and Applied Ecology 3, 381-391.

List, J.A., Bulte, E.H., Shogren, J.F., 2002. "Beggar thy Neighbor:" Testing for Free Riding in State-Level Endangered Species Expenditures. Public Choice 111(3): 303-315.

Loureiro, W., 2001. O ICMS Ecológico na biodiversidade. IAP – Regional de Campo Mourão.

Loureiro, W., 2004. ICMS Ecológico – a consolidação de uma experiência brasileira de incentivo a conservação da biodiversidade. Curso de Engenharia Florestal, Seminário de Pós-Graduação em Engenaria Florestal, Universidade Federal do Paraná, Setor de Ciências Agrárias, Paraná. http://www.floresta.ufpr.br/posgraduacao/eventos.html, 12.08.2004.

Loureiro, W., de Moura, R.P.R., 1996. Ecological ICMS (tax over circulation of goods and services): A successful experience in Brazil. Presentation at the Workshop "Incentives for Biodiversity: Sharing Experiences". 30.08.-01.09.1996, Montreal, Canada.

May, P.H., Veiga Neto, F., Denardin, V., Loureiro, W., 2002. Using fiscal instruments to encourage conservation: Municipal responses to the 'ecological' value-added tax in Paraná and Minas Gerais, Brazil. In: Pagiola, S., Bishop, J. Landell-Mills, N. (Eds.): Selling Forest Environmental Services: Market-based Mechanisms for Conservation and Development. Earthscan, London, pp. 173-199.

MMA (Ministry of the Environment), Biodiversity and Forest Secretariat – SFB, 2002. National Program for the Conservation of Biodiversity – DCBIO. Second National Report of Brazil to the Convention on Biological Diversity, preliminary version. Brasilia.

Musgrave, R.M., 1959. The Theory of Public Finance. McGraw-Hill, New York.

Oates, W.E., 1972. Fiscal Federalism. Harcourt Brace Jovanovich, New York.

Oates, W.E., 1998. Environmental policy in the European Community: Harmonization or national standards? Empirica 25, 1-13.

Oates, W.E., 1999. An essay on fiscal federalism. J. Econ. Lit. 37, 1120-1149.

Oates, W.E., 2001. A Reconsideration of Environmental Federalism. Discussion Paper 01-54. Resources for the Future, Washington, D.C.

Olson, M. Jr., 1969. The principle of "fiscal equivalence": The division of responsibilities among different levels of government. Am. Econ. Rev. 59, 479-487.

Perner, A., Thöne, M., 2002. Naturschutz im Finanzausgleich. Erweiterung des naturschutzpolitischen Instrumentariums um finanzielle Anreize für Gebietskörperschaften. Studie im Auftrag des Bundesamtes für Naturschutz, Bonn. Finanzwissenschaftliches Forschungsinstitut an der Universität zu Köln, Köln.

Perrings, C., Gadgil, M., 2003. Conserving biodiversity: Reconciling local and global public benefits. In: I. Kaul, P. Conceição, K. Le Goulven & R.U. Mendoza (Eds.). Providing global public goods: Managing globalization. Oxford: Oxford University Press, 532-555.

Postlep, R.-D., Döring, T., 1996. Entwicklungen in der ökonomischen Föderalismusdiskussion und im föderativen System der Bundesrepublik Deutschland. In: Postlep, R.-D., (Ed.), Aktuelle Fragen zum Föderalismus: Ausgewählte Probleme aus Theorie und politischer Praxis des Föderalismus. Metropolis, Marburg, pp. 7-44.

Ring, I., 2002. Ecological public functions and fiscal equalisation at the local level in Germany. Ecological Economics 42, 415-427.

Ring, I., 2004. Naturschutz in der föderalen Aufgabenteilung: Zur Notwendigkeit einer Bundeskompetenz aus ökonomischer Perspektive. Natur und Landschaft, 79. Jg., Heft 11, S. 494-500.

Rose, M.T., 1999. Überlegungen zur Berücksichtigung der ökologischen Ausgleichsfunktion ländlicher Räume im kommunalen Finanzausgleich – dargestellt am Beispiel des Landes Nordrhein-Westfalen. Zeitschrift für angewandte Umweltforschung 12 (2), 267-279.

Scheberle, D., 1997. Federalism and Environmental Policy: Trust and the Politics of Implementation. Georgetown University Press, Washington, D.C.

SEPLAN (Secretário do Planejamento e Meio Ambiente), 2003. ICMS Ecológico Tocantins. SEPLAN, Palmas, Tocantins.

SRU (Der Rat von Sachverständigen für Umweltfragen), 1996. Konzepte einer dauerhaft-umweltgerechten Nutzung ländlicher Räume. Sondergutachten. Metzler-Poeschel, Stuttgart.

Stoll-Kleemann, S., 2001. Barriers to nature conservation in Germany: A model explaining opposition to protected areas. Journal of Environmental Psychology 21 (4), 369-385.

Tiebout, C.M., 1956. A pure theory of local expenditures. J. Pol. Econ. 64, 416-424.

Unnerstall, H., 2004. Rechtliche Grundlagen gegenwärtiger und zukünftiger ökonomischer Instrumente im Naturschutz und in der Flächenhaushaltspolitik. In: Döring, R. and Michael Rühs, M. (Eds.), Ökonomische Rationalität und praktische Vernunft. Gerechtigkeit, Ökologische Ökonomie und Naturschutz. Königshausen & Neumann, Würzburg, 249-274.

Villar Martins, Gabriela Isla (2003). Análise do Efeito da Implantação do ICMS Ecológico no Pantanal Sulmatogrossense. Governmental School of Mato Grosso do Sul Secretary of Public Relations (SEGES). http://www.escolagov.ms.gov.br/inicial/index.php?id=29&art_id=78, 27.05.2004.

Als UFZ–Diskussionspapiere sind seit 2001 erschienen:

Published UFZ-Discussion Papers:

1/2001	Frank Messner	Towards a Sustainable Copper Industry? Trends in Resource Use, Environmental Impacts and Substitution in the Global Copper Industry
2/2001	Bernd Klauer	Welchen Beitrag können die Wirtschaftswissenschaften zum Erhalt der Biodiversität leisten?
3/2001	Sigrun Kabisch	Wenn das Kleid der Stadt nicht mehr passt – Strategien im Umgang mit dem Wohnungs-leerstand in ostdeutschen Städten
4/2001	Karin Johst, Martin Drechsler, Frank Wätzold	An ecological-economic modelling procedure to design effective and efficient compensation payments for the protection of species
1/2002	Frank Gagelmann, Bernd Hansjürgens	Climate Protection through Tradable Permits: The EU Proposal for a CO_2 Emissions Trading System in Europe
2/2002	Bernd Klauer, Martin Drechsler, Frank Messner	Multicriteria Analysis Under Uncertainty with IANUS – Method and Empirical Results
3/2002	Frank Wätzold, Martin Drechsler	Spatial differentiation of compensation payments for biodiversity enhancing land-use measures
4/2002	Ralf Nordbeck, Michael Faust	European Chemicals Regulation and its Effect on Innovation: an Assessment of the EU's White Paper on the Strategy for a Future Chemicals Policy
5/2002	Matthias Bernt	Risiken und Nebenwirkungen des „Stadtumbaus Ost"
1/2003	Felix Rauschmayer	Integrated Assessment of Biological Invasions
2/2003	Malte Faber, Karin Frank, Bernd Klauer, Reiner Manstetten, Johannes Schiller, Christian Wissel	Eine allgemeine Theorie der Bestände
3/2003	Guillermo Angel Velázquez	Quality of Life in Argentina – The Heritage of the Nineties
4/2003	Martin Drechsler, Frank Wätzold	Species Conservation in the Case of Political Uncertainty
5/2003	Dieter Rink	Ersatznatur – Wildnis – Wohnstandortfaktor: Soziale Wahrnehmungen und leitbildhafte Vorstellungen von Stadtnatur
6/2003	Frank Messner, Oliver Zwirner, Matthias Karkuschke	Participation in Multicriteria Decision Support – the Case of conflicting Water Allocation in the Spree River Basin
7/2003	Torsten Frohwein	Die Porter-Hypothese im Lichte der Neuordnung europäischer Chemikalienregulierung – Does it hold?
8/2003	Wolfgang Köck	Risikoverwaltung und Risikoverwaltungsrecht – Das Beispiel des Arzneimittelrechts
9/2003	Wolfgang Köck	Invasive gebietsfremde Arten – Stand und Perspektiven der Weiterentwicklung und Umsetzung der CBD-Verpflichtungen unter besonderer Berücksichtigung der Umsetzung in Deutschland
10/2003	Wolfgang Köck	Die städtebauliche Eingriffsregelung – Ausgewählte Probleme unter besonderer Berücksichtigung der Auswahl und Sicherung von Ausgleichsflächen und -maßnahmen
11/2003	Randi Thum, Kathleen Schwerdtner, Irene Ring	Artenschutz und Teichwirtschaft – Rechtliche und institutionelle Rahmenbedingungen in Deutschland unter besonderer Berücksichtigung des Freistaates Sachsen

12/2003	Bernd Hansjürgens, Frank Gagelmann	Das Handelssystem im europäischen CO_2-Emissionsrechtemarkt – Vorschläge zur institutionellen Ausgestaltung in Deutschland
13/2003	Frank Gagelmann	E.T. and Innovation – Science Fiction or Reality? – An Assessment of the Impact of Emissions Trading on Innovation
1/2004	Frank Wätzold, Kathleen Schwerdtner	Why be wasteful when preserving a valuable resource? – A review article on the cost-effectiveness of European biodiversity conservation policy
2/2004	Holger Bergmann	Berechnung von Kosten für Maßnahmen zum Schutz von gefährdeten Maculinea-Arten
3/2004	Henning Nuissl, Dieter Rink (Hrsg.)	Schrumpfung und Urban Sprawl – Analytische und Planerische Problemstellungen
4/2004	Fabian Thiel	Das Erbbaurecht – Ein verkanntes Instrument zur Steuerung der kommunalen Flächennutzung
5/2004	Katharina Kern	Umweltauswirkungen von Arzneimitteln – Bestandsaufnahme und Reformbedarf
6/2004	Gerhard Hartmuth unter Mitarbeit von Katja Huber und Dieter Rink	Nachhaltige Entwicklung im lokalen Kontext – Schritte zur Entwicklung eines kommunalen Nachhaltigkeits-Indikatorensystems
7/2004	Wanda Born, Felix Rauschmayer, Ingo Bräuer	Economic evaluation of biological invasions – a survey
8/2004	Jaroslav Myšiak, Kathleen Schwerdtner, Irene Ring	Comparative analysis of the conflicts between carp pond farming and the protection of otters (*Lutra lutra*) in Upper Lusatia and South Bohemia
9/2004	Katja Huber	Kommunale Politikziele in den Städten Leipzig und Halle (Saale) unter dem Leitbild einer nachhaltigen Entwicklung
10/2004	Dorothee Ortner	Zur naturschutzrechtlichen Verpflichtung der Verwendung autochthonen Saat- und Pflanzguts bei der Straßenbegleitbegrünung
11/2004	Wolfgang Köck	Governance in der Umweltpolitik
12/2004	Irene Ring	Integrating local ecological services into intergovernmental fiscal transfers: the case of the ICMS-E in Brazil

UFZ–Diskussionspapiere können jeweils bei den Autoren am UFZ–Umweltforschungszentrum Leipzig–Halle, PF 500136, 04301 Leipzig bezogen werden.

UFZ–Discussion Papers can be ordered from the authors at the UFZ Centre for Environmental Research Leipzig–Halle, P.O. Box 500136, D–04301 Leipzig, Germany.