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Ecological fiscal transfers at the provincial level in Indonesia

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Abstract

A region of ecological importance which generates uncompensated cross-territorial positive spillovers has a comparatively higher fiscal need due to the direct and indirect costs it incurs for nature conservation. In order adequately to acknowledge fiscal needs relating to nature conservation, we propose an indicator based on protected area as a means of distributing general-purpose transfers and model the consequences of this for Indonesia's current system of fiscal transfer from the national to the provincial level. The results suggest that about a third of the country's provinces would benefit from the new transfer regime and that the equalizing effect of the transfers increases as the proportion of protected area increases.

Keywords: Ecological fiscal transfers, intergovernmental fiscal transfer, biodiversity conservation, protected areas, fiscal equalization, Indonesia

JEL codes: H77, Q57

1. Introduction

Ecological fiscal transfers have been proposed in a number of countries to compensate decentralized jurisdictions for the costs of providing ecological goods and services which generate spillover benefits beyond their boundaries (e.g. for Germany: SRU, 1996; Ring, 2002; Perner and Thöne, 2005; Ring 2008a; for Switzerland: Köllner *et al.*, 2002; and for India: Kumar and Managi, 2009). In the literature on environmental federalism, nature and biodiversity conservation are indisputably among those public functions that are performed

predominantly at decentralized levels and yet provide benefits up to the global level (Revesz, 2000; Perrings and Gadgil, 2003; Ring, 2008b). Without adequate compensation of the relevant actors, public goods and services related to nature and biodiversity conservation tend to be underprovided. To date, only Brazil (Ecological ICMS at state level) and, more recently, Portugal (Local Finances Law of 2007) have incorporated an explicitly ecological dimension into the distribution of fiscal transfers from national or state levels to local governments (Grieg-Gran, 2000; May *et al.*, 2002; Ring, 2008b; Santos *et al.*, 2012). Both countries use the quantity (and, in some cases, the quality) of designated protected areas as an easily available indicator for calculating lump-sum transfers to local governments in order to take account of the unevenly spread costs and benefits of nature and biodiversity conservation.

In this paper, we propose the introduction of an indicator based on protected area in the existing system of fiscal transfers from the national to the provincial level in Indonesia. The archipelago state of Indonesia is one of the world's most important biodiversity hotspots. This is due in part to its vast tropical forests which, as a carbon reservoir, are acquiring ever increasing significance in the climate change debate, but also to its extensive marine areas of high conservation value (e.g. Myers *et al.*, 2000). In the following, we provide a brief overview of the country's existing fiscal transfer system, including the ways in which ecological issues are currently taken into account in fiscal transfers. We then discuss, from a theoretical standpoint, the importance of area-based approaches and the relevance of protected area as a direct and easy-to-use indicator for public functions associated with nature conservation. Last but not least, we provide theoretical arguments in favor of using general purpose or lump-sum transfers instead of specific-purpose transfers when including a conservation-related indicator in the calculation and distribution of the relevant transfers. In the main part of the paper, we present and discuss various simulations of Indonesia's lump-sum transfers from the national to the provincial level (DAU transfers) in order to exemplify the fiscal, spatial and equalizing effects of various weightings of the newly introduced protected area indicator as opposed to the existing general area indicator. We conclude by pointing to potential shortcomings and offering some perspectives for future research.

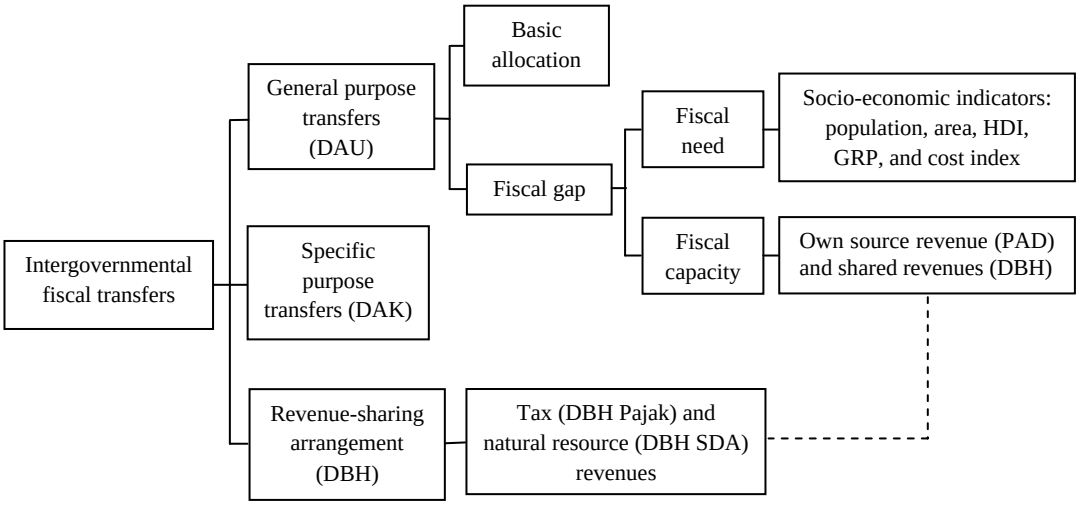
2. Intergovernmental fiscal transfer system and environment in Indonesia

2.1. Overview

Indonesia is a democratic unitary state. It has a three-tier administrative structure comprising national, provincial and local governments. The local government level comprises the municipality (*kota*) and the district (*kabupaten*). At the same time, Indonesia is a large country in the process of decentralization. Since 2001 it has been implementing wide-ranging decentralization measures, including measures relating to fiscal matters (Hofman and Kaiser, 2006). Fiscal decentralization now allows provincial governments to exercise more responsibility than they were previously able to, although they play a lesser role in comparison to local governments.

The country's intergovernmental fiscal transfer system has two main channels: a grant and a revenue-sharing arrangement (Figure 1). Grants encompass two types of transfers: general purpose transfers (DAU, *Dana Alokasi Umum*) and specific purpose transfers (DAK, *Dana Alokasi Khusus*).

Figure 1. Intergovernmental fiscal transfers in Indonesia



General purpose transfers cover salary expenses for public employees, the so-called basic allocation, but the bulk of DAU is allocated on the basis of a jurisdiction's fiscal capacity and fiscal need – i.e. a fiscal gap approach. The formula-based fiscal need of a jurisdiction is defined by a number of socio-economic indicators, including population, area, Human

Development Index, Gross Regional Product (GRP) as a proxy for economic potential, and a cost index. Fiscal capacity is defined by own source revenues and shared revenues. The revenue-sharing arrangement (DBH, *Dana Bagi Hasil*) comprises transfers from taxes and natural resources. General purpose funds (DAU) constituted the most important source of finance in the structure of local government revenue prior to decentralization and continue to do so now (Lewis, 2005). Specific purpose transfers (DAK) are allocated on the basis of specified criteria and finance targeted activities linked to central government priorities, ranging from education and health to rural facilities and the environment.

2.2. Fiscal transfers for ecological purposes in Indonesia

Indonesia's intergovernmental fiscal transfers already incorporate ecological dimensions in various ways. Forest-related conservation has become an important part of the transfer system over time, both before and after implementation of the decentralization process. At present, fiscal instruments that explicitly incorporate an ecological dimension are organized mainly under (i) specific purpose transfers for the environment (*DAK Lingkungan*) and (ii) revenue-sharing schemes (DBH SDA) for forest and land-related conservation and rehabilitation. Present specific purpose transfers for the environment are directed toward measures relating to water quality and pollution control. These measures are largely focused on end-of-pipe functions and are thus less conservation oriented. Regarding the revenue-sharing scheme, the source of funds is derived from *dana reboisasi*, a reforestation fund based on the polluter pays principle and financed from forest resource extraction activities. In addition to these two concrete instruments, the calculation of fiscal need as part of the allocation of general purpose transfers (DAU) is based on an area indicator consisting of terrestrial and marine areas. This can be interpreted as an indirect means of taking ecological dimensions into account.

Like most developing countries (e.g Bruner *et al.*, 2004), Indonesia suffers from a general lack of fiscal capacity to enact its ecological public measures (e.g Vincent *et al.*, 2002). However, its fiscal need to finance these measures is relatively high, for example, in terms of protected area management and extension (KLH, 2008).

3. Area, protected area and general purpose transfers

3.1. The importance of area-based approaches

Area has been one of the common indicators in grant formulas in many countries, largely due to the availability of data (Bahl and Linn, 1992). In Indonesia, land area has been an important indicator in the country's fiscal transfer system for many years. Prior to decentralization, provincial development transfers were allocated to local governments in the form of INPRES (presidential instruction) grants. These were based on two criteria, namely, an area indicator and an 'equal share' arrangement (Qureshi, 1997). In the 1990s, the INPRES grants relied on an allocation formula whose indicators were land area and island status (Silver *et al.*, 2001). Since decentralization began, the calculation of the fiscal need of a jurisdiction for general purpose transfers has rested *inter alia* on an area approach – area cover is one criterion of the fiscal need formula. Indonesia's large marine area explains the importance of having both a land and marine area-based approach. Since the fiscal year 2007, 25 percent of marine area (measuring 12 nautical miles from the coastline) has been included in the area indicator in addition to the existing terrestrial area indicator for the purpose of determining the provincial fiscal needs of the world's largest island country.

Area is an essential feature in both fiscal and ecological terms. Consider the urban-rural interface. While some observers judge that rural beneficiaries of economic and cultural services 'exploit urban taxpayers' (Bradford and Oates, 1974) and others believe that urban governments are generally neglected by state governments in fiscal terms (Morgan, 1974), in numerous cases of ecological public service provision urban jurisdictions are dependent on and benefit from rural jurisdictions. Viewed in metabolic terms (e.g. Kane and Erickson, 2007), rural interactions generate externalities to urban third parties. These externalities may manifest in the form of 1) negative environmental spillovers, such as cross-border toxic emissions or nutrient enrichment from upstream land-use runoff, or 2) positive spillovers such as a sustained supply of off-stream hydro power from a plant that generates electricity for the whole region, benefiting both the jurisdiction in which the power plant is located as well as neighboring jurisdictions. Comparable spatial linkages also exist in the context of broader cross-spatial, inter-jurisdictional interdependencies. Such positive and negative externalities can be found, for instance, in the context of Indonesia's 472 water basin systems spread across its 33 provinces: here, systems of water, land, forest, and marine estuaries are

organically interlinked and include a host of urban agglomerations in the downstream jurisdictions (Dephut RI-RLPS, 2008).

Area-based approaches can thus have wide-ranging fiscal and ecological relevance in determining fiscal needs. The relationship between area cover and population density is a case in point. Quite unlike urban areas, rural jurisdictions often contain larger area coverage. However, the latter have comparatively fewer inhabitants, usually resulting in lower population densities. Moreover, in many cases rural hinterland is home to a range of valuable natural processes which function as a provider of ecosystem services – urban areas and their inhabitants are the dependent clients of such services. Regarding habitat area for animal and plant species, the size of the areas in question is also connected to levels of biodiversity. The number of species within a taxonomic group tends to increase with habitat area size (Connor and McCoy, 1979). Empirical observations in ecology have documented this tendency in terrestrial (e.g. Rosenzweig, 1995) and marine systems (e.g. Chittaro *et al.*, 2009). In cases where a proportion of the rural area under discussion is designated for nature conservation purposes, economic developments are generally restricted, thereby limiting the jurisdiction's opportunity to realize potential for economic rent and thus to bolster fiscal revenues. Finally, urban areas also typically develop agglomerations that attract and concentrate economies, resources and facilities, creating a substantial advantage in terms of tax revenue raising capacity (Bardhan, 2002).

Given this situation, it is clear that the impacts on both fiscal capacity and fiscal need are considerable. In this situation, the incidence of the benefits and costs of service provision – who pays and who gains – can be highlighted. Lower population density can mean that a rural area of ecological significance bears higher costs of conservation or ecosystem services provision than urban areas do, implying a higher per capita fiscal need. Lower population density simultaneously implies a relatively lower per capita fiscal capacity. Both effects on fiscal capacity and need may constrain local jurisdictions in performing so-called ecological public functions whose benefits extend beyond their own territorial boundary. Examples of ecological public functions include the protection and sustainable use of natural resources, ecosystems and landscapes, and the rehabilitation of deforested areas, degraded land, and critical coastal zones (Ring, 2002).

The presence of protected areas in rural jurisdictions may intensify the joint effects even further, namely, by combining a higher fiscal need to cover conservation costs with a lower fiscal capacity due to fewer opportunities to secure economic returns from land use. Conversely, densely populated urban jurisdictions have a higher fiscal capacity and a lower fiscal need for ecological public functions. As a consequence, urban jurisdictions shoulder a per capita lower cost burden while enjoying ecosystem services produced from beyond their boundaries.

Many inter-jurisdictional ecosystem services are non-excludable, which reduces the tax burden on consuming jurisdictions with regard to financing these services. Thus we may anticipate other effects as well, either directly or indirectly [see Dahlby (1996) on fiscal externalities]. A direct effect can be expected on the expenditure side of the jurisdiction providing the services, leading to sub-optimal provision of those public functions that engender positive ecological spillovers for other jurisdictions. Indirect fiscal effects occur, for instance, through a reduction in the tax base of a province providing ecological services, as is the case for designated conservation areas, in which further economic developments are constrained. This indirect effect brings with it, in turn, a reduced capacity to finance ecological public functions.

Throughout this paper, we apply the area approach to substantiate our argument for the introduction of an explicit ecological dimension in the general purpose transfer mechanism in a way that maintains the operational efficiency and practicality of that mechanism. Including a protected area indicator in the formula for general purpose transfers delivers two advantages at the same time. First, it constitutes a proxy for an ecological indicator and thus addresses the ecological dimension in fiscal transfer instruments in a more direct way than a general area indicator does. Second, by containing several different ecological criteria, the protected area indicator is still broad enough to satisfy the generality criteria of the DAU. We would expect this area-based policy proposal to meet with resounding political approval because protected area as an indicator does not entail any qualitative difference compared with the existing general area indicator. As the proposal retains most of the major features of existing fiscal institutions in Indonesia, it would incur *prima facie* no significant additional administrative or transaction costs. As such, it also ensures that no dramatic changes are likely to occur in the new transfer distribution as a result of introducing an area-based ecological indicator.

3.2. Extending the present area approach to acknowledge protected area

Although the use of a jurisdiction's area as an indicator for its fiscal transfers can be considered as a first step in acknowledging ecological public functions, this constitutes only an indirect approach (Ring, 2002). A general area indicator does not necessarily guarantee that relevant ecological public functions would subsequently be acknowledged explicitly. For instance, a jurisdiction endowed with large area cover – and hence in receipt of higher transfers – might still make fewer efforts or even invest nothing in conservation. In this case, such a jurisdiction ends up being a recipient of area-based transfers which other regions of ecological importance should have received.

Issues related to incentive structure and opportunity costs are imperative at this point. If all jurisdictions act in their own self-interest, namely, by declining to cooperate in the costly provision of ecological services, then no sufficient level of conservation would take place. At the level of society as a whole, every jurisdiction would move to a Pareto-inferior position. Because rational jurisdiction(s) with significant ecological resources would theoretically have every reason not to participate in conservation or sustainable land use, the positive externalities they generate should be compensated for in order to induce an incentive effect. List *et al.* (2002) observe in the US that some states tend to 'free-ride' in terms of expenditure for endangered species protection because preservation requires large habitat areas and restricts economic development. Therefore, jurisdictions offering ecological services need to be compensated for the spillover benefits they generate, for example through fiscal transfers, in order to induce behavior that favors an optimal and sustained provision of ecological public goods and services. For this purpose, a more direct approach such as a protected area indicator seems justifiable to compensate for the production costs incurred when undertaking public ecological activities. In the case of Germany, Ring (2008a) explores the possibility of fiscal transfer allotment to the local government level on the additional basis of protected area as a way of compensating municipalities for the provision of local ecological services.[1]

[1] In addition to protected area, various other ecological indicators have been proposed alongside socio-economic indicators to allocate intergovernmental fiscal transfers. They include indicators such as a biodiversity index (Köllner *et al*, 2002), forest, mangrove and tree cover (Kumar and Managi, 2009), observed deforestation and carbon emissions (Busch et al, 2011), ecosystem threats, water use, water quality, landscape health (Hajkowicz, 2007), and landscape area type and nature conservation (Perner and Thöne, 2005).

As for opportunity cost, consider a case in which a jurisdiction is expected to set aside a proportion of its area for conservation. The jurisdiction concerned would weigh the best alternative land uses. This weighing may take into account, for instance, the benefits of doing conservation, the potential gain (or loss) of fiscal revenues, and the share of protected area as a proportion of the jurisdiction's are cover. All these factors would probably increase both the opportunity costs of doing conservation and the need for fiscal transfers. In Brazil, one of the very few countries to have implemented ecological fiscal transfers, the impact of land-use restrictions applied to protected areas is taken into account by acknowledging the resulting limitations on realizing economic potential imposed on the jurisdiction concerned. Due to the possible economic loss that a jurisdiction may incur, the existence of protected area is taken into account in the country's fiscal transfer mechanism. This involves revenue-sharing from value-added tax from the state to the municipal government level (May *et al.*, 2002). Given the need for jurisdictions with large protected areas to consider their potential opportunity loss, a considerably larger weighting is applied to the protected area compared to the area indicator in general. In the state of Rondônia, for example, the weighting is 5 percent compared with 0.5 percent for general area (Grieg-Gran, 2000). A further factor influencing the relative importance of opportunity cost is that the higher the present value of an area and the more extensive the use of land there, the higher the switching cost for conservation will be. In the case of Indonesia, high-value plantations of palm oil and rubber in Sumatra (Grieg-Gran, 2008) and similar plantations of coconut and cloves in Sulawesi would be a case in point. Similarly, the presence of an alternative economic opportunity for land use within local jurisdictions, such as commercial forest logging in Kalimantan, can make opportunity costs higher and conservation thus more costly (Engel and Palmer, 2008).

An area-based approach has an additional important feature regarding the mechanism for allocating transfers. Protected area as an ecological indicator fulfils the requirement of simplicity in the design of a fiscal need formula. An area approach for nature conservation – such as a protected area indicator linking ecological considerations to land or area uses – simplifies the complexity of expressing ecological performance in the modeling of fiscal transfers for ecological equalization among jurisdictions (Rose, 1999). A protected area indicator reduces such complexity, translating it into a comprehensible and clear signal of ecological performance relating to, *inter alia*, nature conservation or biological regeneration,

recreation, as well as water and climate. This signal provides information about the ecological performance capacity of a specified area (Rose, 1999).

Another consideration is historically driven. There was a time when Indonesia incorporated forest land area as an indicator into its fiscal transfer system (Azis, 1990; Qureshi, 1997). A proportion of municipal or provincial forest area was also a criterion for allocating the now-concluded INPRES grants in the 1980s. In the present transfer system, revenue sharing from natural resources complies with a sharing arrangement under which provinces and local governments (in the case of forestry-related revenues) or local governments only (in the case of the reforestation fund) are the recipients.

3.3. Arguments for general purpose transfers (DAU)

As just noted, an area-based indicator related to the forest proportion of a jurisdiction was once included in the country's fiscal transfer system. However, this indicator was introduced within the allocation structure of special purpose transfers. We provide a number of theoretical and practical arguments in favor of general purpose transfers to incorporate protected area as a new area-based indicator.

The conceptual basis for specific purpose transfers draws in large part on the allocative assumption that a resource system and its corresponding externalities can be fully demarcated (e.g. Baumol and Oates, 1988). Compensation mechanisms can be established accordingly in order to equalize an additional unit of cost and benefit. Conditional matching grants would be a preferable instrument for this task. While many use and emission rights can technically be demarcated, in many complex, interdependent and organic resource systems the costs of human-made emissions can be only partially demarcated (Vatn, 2005). Some costs may be considered through specific purpose transfers, whereas other costs would be simply shifted either unintentionally or intentionally (Vatn and Bromley, 1997). In a complex ecological system, an economic decision will generally affect more than a single ecological element, even if it is initially intended to have an impact on only one particular natural resource. As a result, the interdependence of economic activities occurring at different points in space and time often makes it difficult to appropriately assess the impact of such a decision. The repercussions of this are relevant in decision making at different levels of government (Dalmazzone, 2006). Furthermore, as Vatn and Bromley (1997) argue, any

recognition of externalities would usually arise after they have been generated. Precautionary or time-dependent public ecological measures may thus appear inappropriate in the allocative reasoning of special purpose transfers.

In the presence of externalities which, as pointed out above, cannot be fully demarcated, inefficiency arises in resource allocation. Even though originally intended to foster efficiency, specific purpose transfers could turn out to be an inefficient instrument in this particular context. In order to perform ecological public functions, a jurisdiction may either have to face a higher fiscal need and a limited ability to finance these functions, or else substitute some of its fiscal resources from other functions, such as from socio-economic activities. In this light, a general purpose transfer (based to some degree on environmental considerations) or a broad open-ended conditional transfer for environmental purposes would be suitable alternatives. Moreover, unconditional grants such as general purpose transfers often result in an increase in local public expenditure (Slack, 1980). General purpose transfers may facilitate the implementation of a wider range of choices and more meaningful ecological public measures.

The second argument for general purpose transfers stems from the assumption that the incorporation of protected area into the fiscal need formula would spell out the perceived need of a jurisdiction even more clearly. Thus far this kind of need has been veiled within the existing general area indicator. Additionally, the consideration of a jurisdiction's tax base would certainly be better addressed by a protected area indicator linked to the fiscal gap approach, where both the fiscal need and fiscal capacity of a jurisdiction determine the general purpose transfers it receives. By contrast, specific purpose transfers tend by definition to ignore the dimension of fiscal capacity or own revenue raising capacity (e.g. Searle and Martinez-Vazquez, 2007), which is likely to send a misleading signal regarding the actual fiscal need for ecological measures.

The third argument relates to one of the key intentions of intergovernmental fiscal transfers. The equalization of fiscal imbalances between jurisdictions is among the major purposes of fiscal transfers. Although this purpose is not necessarily easy to achieve, unconditional general purpose transfers appear to fulfill this policy objective better than special purpose transfers, as the literature on fiscal federalism commonly suggests (e.g.

Oates, 1994; Boadway and Shah, 2008). Empirical evidence drawn from Indonesian data seems to be consistent with this proposition (Ravallion, 1988; Azis, 1996).

The final argument concerns emerging critical tendencies post-decentralization. Among other things, provinces and localities demand more autonomy and thus more public revenues to be assigned to subnational governments. It is not uncommon for specific purpose transfers – determined centrally and imposed top-down – to be associated with central priorities and not with those of the province or local government. Against the backdrop of this important drift, proposing general purpose transfers for ecological purposes in the country's intergovernmental transfer system seems to involve both a certain degree of incentive compatibility and policy applicability. DAU gives full discretion to provinces over the use of funds and hence grants more autonomy. Admittedly, however, this argument posits its own predicament. Given the lump-sum nature of DAU, the degree of effectiveness in attaining a specific expected outcome depends considerably on the province under discussion. In its hands rests the decision on the design of subnational ecological public functions and, more importantly, upon the final use of the DAU transfers.

4. Simulations and discussions

4.1. The simulation

On basis of Indonesia's existing mechanism of assigning general purpose transfers, we have conducted simulations to analyze the effects of introducing an ecological dimension into DAU transfers. In the spirit of an area-based approach, we suggest protected area as a plausible indicator and introduce it into the fiscal need calculation of the provincial fiscal gap. While DAU 2007 serves as the baseline for comparison, we develop different scenarios using various coefficients of area in general and protected area, leaving all other socio-economic indicators untouched. In what follows we present the details of the simulation mechanics.

The fiscal need formula

General purpose funds (DAU) for all provinces (DAU^p) are funneled into the salary expenses of public employees, that is, the basic allocation (BA), and are based on the fiscal gap (*FG*),

$$DAU^p = BA^p + FG^p \ . \tag{1}$$

Let FG^p be the size of available funds for financing the fiscal gap of all provinces, then province *i* yields general purpose transfers equal to:

$$DAU_i = BA_i + \frac{FG_i}{\sum^n FG_i} FG^p \ . \tag{2}$$

The Fiscal Gap (FG) approach conceptually fills the gap between the fiscal capacity (*FC*) and the fiscal need (*FN*) of a given province, i.e. $FG_i - (FC_i - FN_i) = 0$. At this point it is appropriate, however, to notice that in practice this need not necessarily mean a *full* gap filling. The reasons for this are as follows. First, limited available funds (FG^p) imply a constraint upon such an endeavor. In other words, the fiscal gap is not to be filled in its entirety. Second, the fiscal capacity formula is not set as a function of the richest region but as a function of the weighted sum from provincial own source and shared revenues (Eq. 3). Third, the fiscal need of a province, in addition to the function of socio-economic indicators (Eq. 4), does not refer to the expenditure level of the poorest province but rather to the average of all provincial expenditures (δ). Fourth, in the formula of fiscal need the values of the GRP indicator (which serves as a proxy for the economic potential of a province) from Jakarta and East Kalimantan, the first and the second wealthiest provinces respectively, are set to be equal to the third wealthiest province, Riau.[2] Fifth, the indicator of economic potential in the fiscal need formula by no means represents the factual figures because it is already rendered operational by excluding the mining, industrial and processing sectors, which are highly concentrated in certain jurisdictions. And sixth, the funds allocated for fiscal gap financing are determined together with the Basic Allocation (Figure 1), so the funds

[2] In practice, the derivation of average values for equalizing transfers that aim at reducing fiscal disparities sometimes excludes extreme values, such as the values of the richest or the poorest province(s). Canada, for instance, excludes the rich province of Alberta and four other relatively poor provinces to derive a national average for its equalization transfers (Clark, 1997).

available for the fiscal gap depends on the funds remaining after the Basic Allocation for all provinces.

Fiscal capacity (*FC*) is derived from own source revenue (*OR*), as well as from revenue-sharing transfers from taxes (RS^T) and natural resources (RS^N). Each element of fiscal capacity is assigned to a predetermined weight Φ. Fiscal capacity can be expressed as follows:

$$FC_i = \Phi_1 OR_i + \Phi_2 RS_i^T + \Phi_3 RS_i^N \tag{3}$$

Fiscal need (*FN*) of province *i* is defined as

$$FN_i = \left(\alpha_j \frac{\beta_{ih}}{\beta_h^*} + ... + \alpha_m \frac{\beta_{in}}{\beta_n^*} \right) \delta, \qquad \forall i \tag{4}$$

Fiscal need in this equation is a function of socio-economic indicators, β_{ih}, where *h*= 1,..*n*, and $\beta_h^*,..,\beta_n^*$ stand for unweighted averages of the respective indicators across provinces. α denotes the coefficient of indicator *h* where $\sum_j^m \alpha_j \leq 1$. The average expenditure of all provinces is denoted by δ.

We now introduce an ecological indicator into Eq. (4) and the suggested new fiscal need formula becomes

$$FN_i = \left[\left(\alpha_j \frac{\beta_{ih}}{\beta_h^*} + \cdots + \alpha_m \frac{\beta_{in}}{\beta_n^*} \right) + \left(\alpha_a \frac{A_i}{A_i^*} + \alpha_{pa} \frac{E_i}{E_i^*} \right) \right] \delta, \qquad \forall i \tag{5}$$

Eq. (5) has two elements. The first term represents the socio-economic indicators. It is in principle the existing fiscal need formula in use by the Ministry of Finance, as in Eq. (4), only without the existing area indicator. The second term now comprises all area-related indicators, namely, the existing area indicator, *A*, and the suggested protected area indicator, *E*.

The coefficient values

With reference to Eq. (5), we now discuss the coefficient values of the indicators in the fiscal need formula. In the simulations that follow, all coefficients basically remain the same, as they are currently used in the present calculation of fiscal need of the provinces.

This implies for the overall value of area-related coefficients that $(\alpha_a + \alpha_{pa}) \leq 1 - \sum_j^m \alpha_j$, and thus, building on the coefficients for socio-economic indicators in the existing fiscal need formula $\alpha_a + \alpha_{pa} = 0.15$. The focus of the simulations is only on the coefficient variation of area-related indicators. By focusing just on the coefficients of area in general (α_a) and of protected area in particular (α_{pa}), the fiscal need of a given province in terms of area simplifies to

$$FN_i^{area} = \left((1 - \alpha_{pa}) \frac{A_i}{A_i^*} + \alpha_{pa} \frac{E_i}{E_i^*} \right) \delta, \qquad \forall i \tag{6}$$

Drawing on this, the proposed selected combinations of coefficient values for general area and protected area are presented in Table 1. While DAU 2007 serves as a point of reference, representing real lump-sum transfers as of fiscal year 2007, three further scenarios are selected to illustrate different coefficient variations. Consider one example scenario, say, DAU 1. This scenario is generated from a fiscal need formula whose proportion of the general area indicator is 75 percent (the coefficient value is thus 0.1125) and that of the protected area indicator is 25 percent (with a coefficient value of 0.0375). In the discussion, the indicator's proportion (rather than the indicator's coefficient) will be used because of its practicality.

Table 1. Scenarios and the area-related coefficients

Simulation	Scenario (A:PA)	α_a	α_{pa}	$\alpha_a + \alpha_{pa}$
DAU 2007*	Scenario 100:0	0.1500	0.0000	0.15
DAU 1	Scenario 75:25	0.1125	0.0375	0.15
DAU 2	Scenario 50:50	0.0750	0.0750	0.15
DAU 3	Scenario 25:75	0.0375	0.1125	0.15

Notes: A= Percentage proportion for area indicator, PA = Percentage proportion for protected area indicator, * Reference scenario representing real lump-sum transfers as of fiscal year 2007.

Assumptions, data and simulation process

Our fiscal need assumptions correspond to the calculation of the country's actual general purpose transfers in 2007, unless otherwise indicated. In that fiscal year, 26 percent of the total Net Domestic Revenues (NDR), amounting to IDR 164.8 trillion, is channeled into the pool of DAU fund.[3] 10 percent of this sum is allocated for distribution among all the provinces (n=33). The area indicator in the fiscal need formula includes marine area, namely 12 nautical miles around the coastline. In the calculation, 25 percent of marine area is added along with terrestrial area cover, making up the total area indicator. The coefficients of the various indicators (i.e. the α in Eq. 4) are as follows: 0.3 (population), 0.15 (area), 0.1 (Human Development Index), 0.15 (per capita GRP),[4] and 0.3 (cost index). In the simulations, we are chiefly interested in changes in general purpose transfers, given the coefficient changes in the area indicator, which now comprises the general area and the protected area of a jurisdiction.

Fiscal capacity comprises revenue elements (i) from own source revenue as well as realized shared revenues, (ii) from natural resources, and (iii) from taxes. The weight for each variable (i.e. the Φ in Eq. 3) is 0.5, 0.5, and 0.75 respectively. All data regarding the variables related to fiscal need and fiscal capacity in this simulation are identical to the data in use by the Indonesian Ministry of Finance (MOF).

This simulation applies an area approach, as mentioned previously. The determination of which indicator to use in allocating fiscal resources to meet ecological objectives will depend on the technical value of nature conservation attached to a certain type of area within a jurisdiction (Perner and Thöne, 2005; Rose, 1999). The task of such an area indicator involves a degree of ambiguity (Perner and Thöne, 2005). On the one hand, it must depict the various layers of nature conservation objectives to the widest possible extent. On the other hand, it must simultaneously reduce the complexity of the indicator system as much as possible, which itself develops as a result of attempting to fulfill the afore-mentioned task. A trade-off thus occurs between achieving the objective and having a relatively simple indicator

[3] The total DAU pool funds should be at least 26 percent of the net domestic revenue in the national budget, as regulated in Law 33/2004 (Art. 27).

[4] The Indonesian Ministry of Finance (MOF) excludes mining, industry and processing sectors from the calculation of average per-capita GRP, the intention being to reduce the inter-provincial gap. The same applies to so-called outlier provinces. Both procedures affect the average values in Eq. 4.

system. Any indicator system for nature conservation will inevitably entail a greater or lesser compromise between ecological objectives and practicability (Perner and Thöne, 2005).

In the simulations, protected area (*PA*) is defined as a designated protected area which has been legally declared as such by ministerial decree and is dedicated to the protection and maintenance of biological diversity and natural resources. The PA data here include *kawasan konservasi* (conservation areas) of terrestrial and marine origin. For the present purpose, conservation areas defined in other ways are excluded, such as the emerging local initiatives for protected area at the district and municipal levels. The Ministry of Forestry's *Data Strategis Kehutanan 2007* is our source for the 2006 protected area data. It provides information on the size of both terrestrial and marine/littoral protected areas for nature reserves, wilderness areas, national parks, and natural parks, in addition to forest parks and hunting parks. Data for the newly established province of West Papua are not available. An approximation has been made nonetheless, based on the protected area of its parent province, Papua, in 2006.

For reasons of maintaining simplicity and transparency in the fiscal need calculation,[5] the various categories of protected areas are not differentiated in the simulations – all of them are unweighted and additive. It should be acknowledged that, by doing so, 1) some protected areas which may belong to more than one category could overlap, resulting in a higher than actual fiscal need, and 2) differing conservation costs and spillover benefits resulting from differing land-use restrictions and conservation values related to the various categories of protected areas are not taken into account. Furthermore, the simulation does not perform the whole set of iterations as in the actual DAU calculation. We exclude the adjustment process (in case the differential between the current formula-based DAU and the previous year's DAU is positive) since our interest is in examining the effect of introducing an ecological dimension into the mechanics of the fiscal need calculation and the resulting changes in general purpose transfers.

[5] For discussions on simplicity and transparency requirements for fiscal transfer mechanisms, see e.g. Bahl and Linn (1992) and Lenk (1993). An explicit reference to these requirements in the case of fiscal transfers for nature conservation can be seen in Perner and Thöne (2005).

4.2. Discussion of results

The impact on fiscal distribution

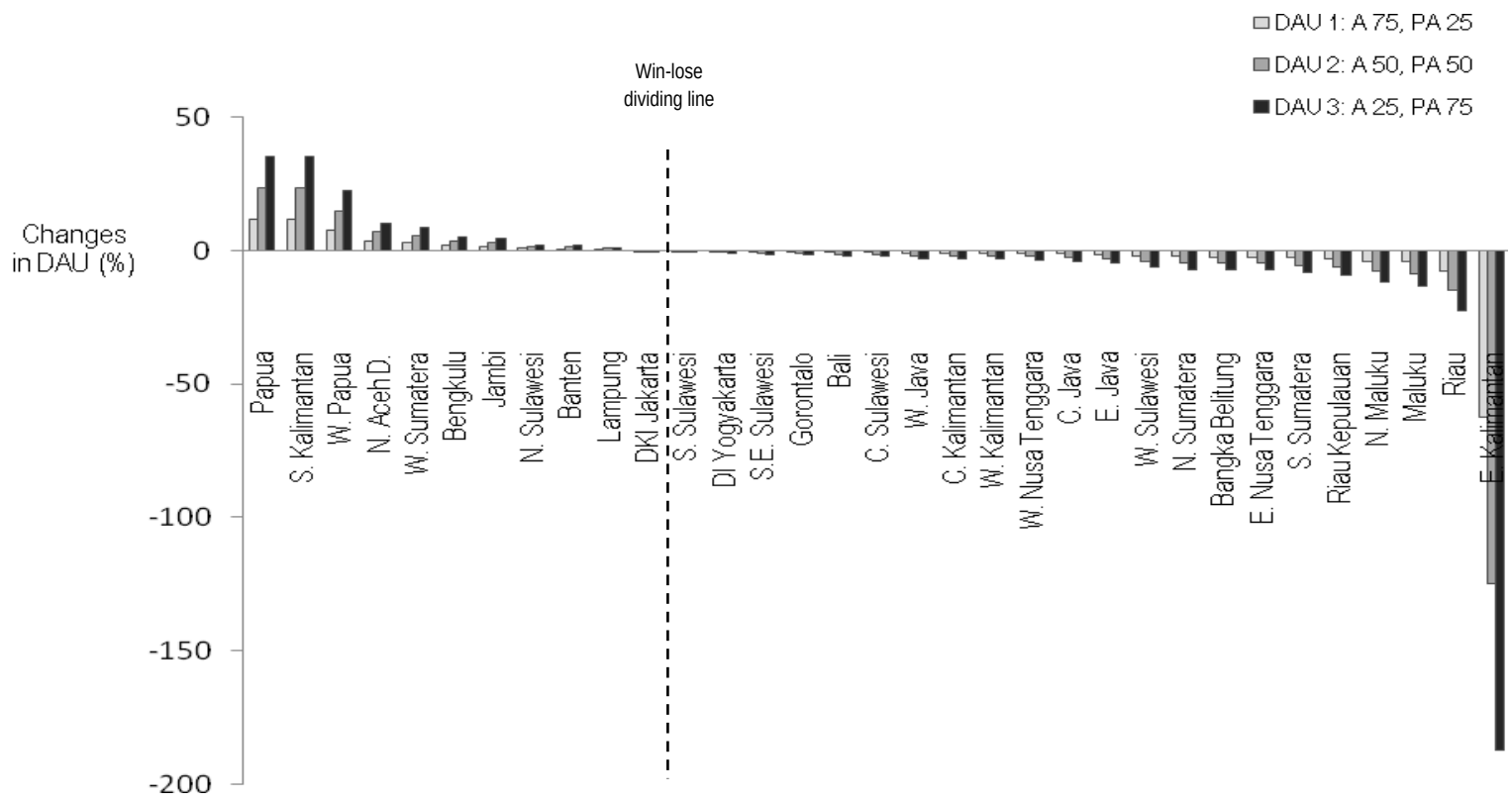
A zero-sum distribution of transfers is implied in the simulation. This inevitably leads to a new transfer configuration in which some provinces gain and others lose from the suggested redefinition of fiscal need. The so-called outlier provinces – DKI Jakarta and East Kalimantan – are differentiated from the other provinces. The reason behind this is that a compatible comparison cannot be established on the basis of the inverse fiscal balance (i.e. capacity being higher than need) of these provinces and a very high per capita fiscal capacity.

The main results of the simulation indicate that the number of losing provinces is more than twice the number of winning ones. The configuration of the new fiscal distribution on the basis of percentage change is presented in the graph shown in Figure 2.

In total, 22 provinces would lose from the new ecological fiscal transfers, while the remaining 11 provinces would be better off. Arranged in *descending* order, the winning provinces are Papua, South Kalimantan, West Irian Jaya, Nanggroe Aceh Darussalam, West Sumatra, Bengkulu, Jambi, North Sulawesi, Banten, Lampung and DKI Jakarta. The losing provinces, in *ascending* order, are South Sulawesi, DI Yogyakarta, South East Sulawesi, Gorontalo, Bali, Central Sulawesi, West Java, West Kalimantan, Central Kalimantan, West Nusa Tenggara, Central Java, East Java, West Sulawesi, North Sumatra, East Nusa Tenggara, Bangka Belitung, South Sumatra, Riau Kepulauan, North Maluku, Maluku, Riau, and East Kalimantan.

The case of East Kalimantan merits closer attention since, as the figure shows, this province would suffer a dramatic decrease in DAU transfers (in DAU 3 scenario, as much as a 187 percent decrease). Because its fiscal capacity and fiscal need do not differ by a large magnitude, East Kalimantan lies on the edge of the fiscal gap boundary. As a result, up to a certain point of proportion between general area and protected area, the province still receives a positive transfer before starting to have negative transfers, as the proportion of protected area indicator in the fiscal need calculation gets larger. Moreover, Figure 2 shows the percentage change of transfers from DAU 2007. In absolute terms, the change would be relatively less dramatic (about 70 million IDR, a negligible amount).

Figure 2. The simulation of ecological fiscal transfers in Indonesia: Percentage changes from DAU 2007



Notes: (1) The baseline for comparison is DAU 2007. (2) Basic Allocation is excluded. (3) A = Percentage proportion of the area indicator; PA = Percentage proportion of the protected area indicator.

Note that the magnitude of percentage change in DAU transfers among the losing provinces increases less drastically in comparison to the winning provinces. In consequence, the number of losing provinces with lower percentage changes in DAU tends to predominate, as the relatively flat figure indicates. On average, the winning provinces have a relatively much larger per capita protected area – by a factor of more than (Table 2).

Table 2. Summary of descriptive statistics on fiscal characteristics

	Protected area (thousand ha)	Protected area per capita (ha)	Fiscal capacity		Fiscal need	
			Nominal (billion IDR)	Per capita	Nominal (billion IDR)	Per capita
The winning provinces, n=10						
Mean	1,551.7	0.92	247.1	78,058	1,421.2	654,268
Median	823.4	0.27	240.5	69,683	1,371.9	402,474
Std. Deviation	1,991.5	1.48	141.0	38,422	433.6	668,642
Maximum	6,759.9 (Papua)	4.00 (W. Papua)	553.4 (Banten)	159,706 (W. Papua)	2,549.3 (Papua)	2,320,792 (W. Papua)
Minimum	175.4 (Banten)	0.02 (Banten)	69.1 (Bengkulu)	43,405 (Lampung)	981.3 (Bengkulu)	155,175 (Banten)
The losing provinces, n=21						
Mean	396.9	0.14	445.7	64,263	1,630.3	512,659
Median	234.5	0.09	158.9	48,273	1,293.9	347,864
Std. Deviation	430.6	0.18	575.4	51,720	829.2	354,984
Maximum	1,507.3 (W. Kalimantan	0.73 (C. Kalimantan)	1,883.9 (W. Java)	264,760 (Riau)	3,671.7 (W. Java)	1,173,103 (N. Maluku)
Minimum	2.0 (W. Sulawesi)	0.001 (C. Java)	28.8 (Gorontalo)	21,845 (NTT)	866.2 (Gorontalo)	92,606 (W. Java)
The outliers, n=2						
DKI Jakarta (winning)	27,105	0.003	8,804.9	982,339	1,603.2	178,866
E. Kalimantan (Losing)	212.6	0.072	1,716.1	584,436	1,988.5	677,186

Source: Author's calculation based on data from the Ministry of Finance (2007) and the Ministry of Forestry (2006). Notes: (i) Fiscal need calculation refers to the original formula (without protected area). (ii) Protected Area (in thousand ha) comprises 100 percent terrestrial area and 25 percent marine area, referring to the practice by the MOF. The marine area constitutes 12 nautical miles around the coastline. (iii) The outliers are provinces with a fiscal capacity greater than their fiscal need, yielding a negative general purpose transfer. In addition, the per capita GRP of these provinces is relatively high.

In addition, they have a higher per capita fiscal need, which is likely to confirm the preconception that provinces with higher fiscal need would benefit once protected area is considered in the general purpose transfers. However, these provinces also

exhibit a higher fiscal capacity per inhabitant than the losing provinces. This observation appears to run counter to theoretical conjectures that the per capita fiscal capacity of winning regions is lower than that of losing regions, given their proportion of protected area. The best tentative explanation for this is the presence of provinces rich in natural resources within the grouping – Papua, West Papua, Nanggroe Aceh Darussalam – which seem to contribute to the overall higher fiscal capacity. At the same time, a number of losing provinces, such as West Kalimantan and Central Kalimantan, appear to have a relatively higher proportion of protected area. The negative effect from the reduction in weight of the general area criteria seems to outweigh the positive effect of the protected area indicator.

At the level of the individual province, East Kalimantan loses the most and undergoes a relatively drastic change under the new fiscal need calculation, given its low figure of per capita protected area. The province shows a somewhat sensitive response to changes in the parameter value of the protected area indicator in the transfer calculation (Table 3). For instance, in the DAU 1 scenario (with 75 percent for general area, 25 percent for protected area) it would receive 62 percent less than its original 2007 DAU transfer. Notice, however, the province's absolute change in transfer in nominal terms as well as its unique position regarding fiscal capacity and fiscal need, as argued above. Among the winning provinces, Papua would gain the most from the transfer simulation if the protected area is introduced into the allocation mechanism of a DAU transfer. In the DAU 3 scenario, Papua would see a 35 percent increase (about 950 billion IDR). Meanwhile, the DAU transfers to Jakarta, a province on the edge between the winning and the losing provinces, increase slightly.

As regards the policy proposal, a transfer configuration which entails a higher proportion of losing provinces may seem to be politically untenable. Indonesia's experience during its transition to decentralization is instructive here: the losing 11 provinces (out of 30 provinces at the time) opposed the proposed DAU transfer regime in 2002 (Fane, 2003). Moreover, assuming that maximizing transfer is the sole objective, transfer-maximizing provinces would probably have a strong incentive to stick to the status quo arrangement without ecological indicators in order to ensure they experience no reduction in transfer receipts. A transfer configuration of the kind proposed may offer different explanations though. Although such a configuration may appear less desirable

from the point of view of *ex post* losing provinces, it might highlight the importance of concealed ecological production and provision costs. The provinces which are now winners would most probably be losing provinces *ex ante* given their higher fiscal need due to the costs incurred – and uncompensated – of undertaking ecological public functions. Conversely, the provinces which are now losers might *ex ante* free ride and inflict costs on the winning provinces.

Table 3. DAU transfer simulations: Absolute and relative changes

Scenarios	DAU 2007 Without PA	DAU 1 75:25	DAU 2 50:50	DAU 3 25:75
The winning provinces, n=10				
Mean	356.3	374.7	393.1	411.6
		(4.20)	(8.40)	(12.60)
Median	316.1	321.7	335.1	341.2
		(2.27)	(4.54)	(6.80)
Std. Deviation	132.2	156.1	180.3	205.0
		(4.48)	(8.97)	(13.45)
Maximum	701.2	783.7	866.4	949.0
		(11.79)	(23.58)	(35.37)
Minimum	266.4	268.0	269.7	271.3
		(0.35)	(0.69)	(1.04)
The losing provinces, n=21				
Mean	359.5	353.2	346.8	340.5
		(-1.96)	(-3.93)	(-5.89)
Median	326.4	324.9	323.4	321.8
		(-1.37)	(-2.74)	(-4.11)
Std. Deviation	116.9	116.3	115.8	115.5
		(1.76)	(3.51)	(5.27)
Maximum	605.5	597.2	588.9	580.6
		(-0.06)	(-0.13)	(-0.19)
Minimum	120.1	111.0	101.9	92.8
		(-7.57)	(-15.15)	(-22.72)
The outliers, n=2				
DKI Jakarta (winning)	-2,185.5	-2,185.36	-2,185.2	-2,185.0
		(0.01)	(0.01)	(0.02)
East Kalimantan (losing)	82.6	31.0	-20.6	-72.2
		(-62.45)	(-124.89)	(-187.34)

Source: Author's calculation based on MOF data. Notes: (i) All numbers are in billion IDR. (ii) The numbers in parentheses are percentage changes to the DAU transfer compared to DAU 2007; the transfer excludes the Basic Allocation. (iii) The outliers are provinces with a fiscal capacity greater than their fiscal need, yielding a negative general purpose transfer. Additionally, the per capita GRP of these provinces is relatively very high.

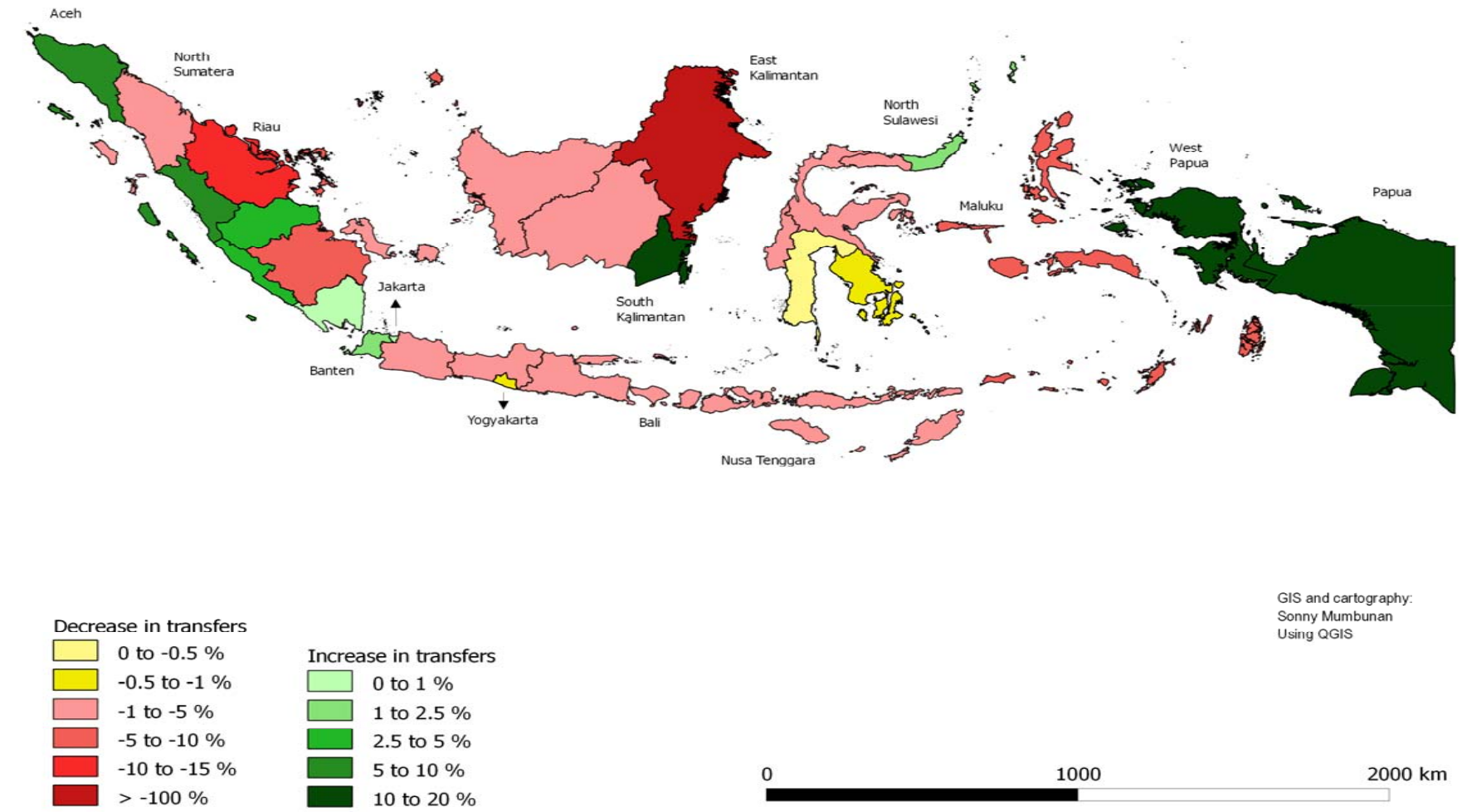
The above explanation suggests that the effects of the new transfer configuration seem to go both ways, affecting both the winning *and* losing provinces. Bearing this in mind, there is cause to anticipate that, in such a less desirable new transfer configuration (i.e. the presence of losing provinces), the introduction of an ecological dimension in the general purpose transfer can still be brought about. However, this requires a number of enabling conditions. We envision the following possibilities: (i) The proposed scenario entails a formula-based fiscal regime that seeks to ensure the least sensitivity to changes, so that there would be no abrupt changes in transfers. (ii) The regime's introduction could proceed in stages, in that the proportion of area cover is reduced over consecutive years, while at the same time the proportion of protected area is gradually increased. Brazil has pursued this step-by-step approach by introducing a protected area indicator into its value-added tax revenue-sharing arrangement in many of its federal states (May *et al.*, 2002). (iii) The introduction of ecological fiscal transfers should be timed to take place when Net Domestic Revenue (NDR), such as from oil or natural gas surpluses, is on the rise and is sufficient to offset the magnitude of losses from transfers. The additional increase of NDR allocated for general purpose transfers should be at least no less than the average level of all losing provinces. (iv) An adjustment fund with a defined time frame should be established in order to ensure that a jurisdiction receives no fewer general purpose transfers than the level of transfers received in the previous year.

Spatial distribution of transfers

Figure 3 illustrates the results of DAU 2 scenario (with 50 percent for general area, 50 percent for protected area). This particular scenario is selected for the sake of explanation. Provinces on the island of Papua (i.e. Papua and West Papua) would obviously benefit from the new fiscal transfer regime. These provinces have a relatively large proportion of terrestrial protected areas whose effects seem to outweigh the effects of their relatively small proportion of marine protected areas in the calculation of their fiscal need. At the other end of the spectrum, most provinces in Java and Sulawesi and also those in Bali and Nusa Tenggara would suffer transfer reductions from the new fiscal transfer regime. For Java and Sulawesi, however, exceptions apply (surprisingly) to Jakarta and Banten – both in the western part of Java – as well as North Sulawesi.

Figure 3. Ecological fiscal transfers in Indonesia:

Spatial distribution of relative changes in lump-sum transfers for DAU 2 (with A= 50% and PA= 50 %)



Jakarta, the densely-populated capital of Indonesia whose proportion of terrestrial protected areas is among the smallest of all provinces, benefits from the new transfer model due to its comparatively large marine protected areas. Indeed, Jakarta has the highest proportion nationwide of marine protected area relative to its total marine area. The same seems to apply to North Sulawesi, whose proportion of terrestrial nature conservation areas relative to its total area is the second highest in Indonesia.

The islands of Kalimantan and Sumatra, areas which belong to the lowland forest of the Sunda Shelf, the richest forest on Earth, show mixed patterns of winning and losing provinces. Whereas South Kalimantan would rank among the most winning provinces from the new transfer regime, East Kalimantan would be the most disadvantaged. South Kalimantan constitutes a province with the largest proportion of protected area (46 percent of its land area). By contrast, East Kalimantan, which comes second to Jakarta in terms of having the highest fiscal capacity, joins the group of provinces with the lowest proportion of protected areas.

Sumatra exhibits a rather complex configuration. In the western part of the island – West Sumatra and Bengkulu – habitats belonging to some of the world's most distinct megafauna, such as the Sumatran rhinoceros, the Sumatran tiger and the Asian elephant, tend to benefit from the new fiscal transfer scheme. Aceh in the north and Lampung in the south are also favored by the new scheme, as is Jambi. Somewhat contrasting to these descriptions, the eastern side of the island – Riau, Kepulauan Riau, Bangka Belitung, and South Sumatra – along with that of North Sumatra would receive fewer transfers if the ecological indicator was introduced. Riau is particularly interesting, since this province (located within the highest fiscal capacity bracket) would receive comparatively less with the introduction of DAU-based ecological fiscal transfers.

The equalization effect

The objective of equalization, as the term implies, is in essence to equalize the fiscal capacities of jurisdictions in order to finance their expenditures and to perform public functions. This objective is also often associated with the distributive dimension, such as fiscal inequalities that result from fiscal decentralization (e.g. Rao and Das-

Gupta, 1995). Our concern here is to investigate the causal relationship between fiscal capacity and fiscal transfer – the main tenets of fiscal equalization. More precisely, how and to what extent does the ecological dimension in the transfers play a role in explaining fiscal equalization? Table 4 shows OLS estimates to explain DAU transfers with independent variables of Gross Regional Product (GRP), the area in general and the protected area. All variables are measured in per capita terms and in a natural logarithmic form. The main explanatory variable is GRP, which serves as a proxy for fiscal capacity. In the estimation model, the effects on DAU transfers are examined by testing different variables. Furthermore, we also examine the effects of omitting outlier provinces from the observation.[6] In general, the estimation is undertaken with the intention of investigating the causal relationships between fiscal-related aspects such as fiscal capacity on the one hand and fiscal transfers when the protected areas indicator is incorporated into the transfers on the other.

Various models with different specifications are presented. The complete *Model 1* includes GRP, the area in general and the protected area. *Model 2* controls only GRP and the area in general. *Model 3* includes GRP and the general area. In *Model 4*, GRP is the only explanatory variable. The results show that, first, in all models the coefficients of GRP from different DAU transfer scenarios show the anticipated sign (i.e. negative), generally implying that all transfers in the simulations are equalizing: an increase in fiscal capacity means a decrease in the DAU transfer. To gauge the magnitude of the equalization effect, consider *Model 1*: if an annual per capita fiscal capacity increases by 1 percent, the fiscal transfer falls by 1.8 percent (with DAU 1 scenario) to 3.2 percent (with DAU 3 scenario). Second, the higher the proportion of protected area in the fiscal transfer, the more the transfer tends to equalize (as transfer decrease is larger in e.g. DAU 3 than in DAU 1).

[6] In the last three decades, the outlier provinces of DKI Jakarta and East Kalimantan have been very wealthy and indeed, along with Riau, consistently wealthy in that their per capita non-mining GRP has been far above the national average over time (Hill *et al.*, 2008). In the actual calculation of fiscal need the MOF sets the GRP per capita of these two provinces at equal to that of Riau.

Table 4. OLS estimates for equalization effects (dependent variable: log DAU transfer)

DAU transfer	GRP per capita		General area per capita		Protected area per capita		Adjusted R2	
	All provinces	No outliers	All provinces	No outliers	All provinces	No outliers	All provinces	No outliers
Model 1: Transfer=*f*(grp, area, protected area, others)								
DAU 2007	-1.713 (-2.46 **)	-0.398 (-1.42)	1.112 (4.44 ***)	0.707 (6.71 ***)	-0.173 (-0.92)	-0.118 (-1.66)	0.558	0.703
DAU 1	-1.847 (-2.56 **)	-0.391 (-1.35)	1.050 (4.05 ***)	0.696 (6.42 ***)	0.131 (-0.67)	-0.104 (-1.41)	0.525	0.691
DAU 2	-3.195 (-2.72 **)	-0.385 (-1.29)	0.544 (1.29)	0.685 (6.12 ***)	0.143 (0.45)	-0.090 (-1.19)	0.271	0.678
DAU 3	-3.187 (-2.71 **)	-0.380 (-1.23)	0.534 (1.27)	0.674 (5.82 ***)	0.156 (0.49)	-0.077 (-0.98)	0.272	0.663
Model 2: Transfer=*f*(grp, area, others)								
DAU 2007	-1.731 (-2.49 **)	-0.431 (-1.49)	0.940 (5.66 ***)	0.576 (8.02 ***)			0.551	0.684
DAU 1	-1.861 (-2.60 **)	-0.420 (-1.43)	0.919 (5.38 ***)	0.581 (7.95 ***)			0.534	0.680
DAU 2	-3.180 (-2.75 **)	-0.410 (-1.37)	0.687 (2.48 **)	0.586 (7.84 ***)			0.291	0.673
DAU 3	-3.171 (-2.73 **)	-0.402 (-1.30)	0.690 (2.49 **)	0.589 (7.68 ***)			0.290	0.664
Model 3: Transfer=*f*(grp, protected area, others)								
DAU 2007	-1.968 (-2.22 **)	-0.525 (-1.17)			0.450 (2.83 ***)	0.241 (3.17 ***)	0.266	0.235
DAU 1	-2.088 (-2.36 **)	-0.516 (-1.14)			0.456 (2.87 ***)	0.250 (3.29 ***)	0.281	0.248
DAU 2	-3.320 (-2.81 ***)	-0.508 (-1.12)			0.448 (2.11 **)	0.258 (3.38 ***)	0.255	0.259
DAU 3	-3.310 (-2.80 ***)	-0.501 (-1.10)			0.455 (2.14 **)	0.266 (3.46 ***)	0.257	0.268
Model 4: Transfer=*f*(grp, others)								
DAU 2007	-2.094 (-2.14 **)	-0.481 (-0.93)					0.100	-0.004
DAU 1	-2.216 (-2.26 **)	-0.471 (-0.90)					0.113	-0.006
DAU 2	-3.445 (-2.77 ***)	-0.461 (-0.88)					0.172	-0.008
DAU 3	-3.438 (-2.76 ***)	-0.453 (-0.85)					0.171	-0.009

Notes: (1) Next to t-statistics is the significance level: * .05 < p < .10, ** .01 < p < .05, *** p < .01. (2) Observations: $n = 33$ (all provinces) and $n = 31$ (without the outlier provinces of DKI Jakarta and East Kalimantan). (3) A constant is included in the model but not reported in the table. All variables are in natural logarithm. If the fiscal gap of a province is negative (i.e. fiscal capacity is larger than fiscal need), the province receives a zero DAU transfer.

Third, intuitively the equalizing effect is higher if only GRP and the protected area are considered (as in *Model 3*); the effect is statistically significant in those cases where the model takes account of all provinces, including those with the highest fiscal capacity. Moreover, the results suggest that treating DAU transfers merely as a function of GRP may not be appropriate (cf. Ahmad *et al.*, 2002). *Model 4* shows that GRP explains little about the variation in DAU transfers, as exemplified by a very low R^2 value.

These findings are of some economic relevance. Regarding the role of the ecological dimension in fiscal transfer allocation, the introduction of the protected area indicator into the structure of the general purpose transfer as well as the increased proportion of that indicator both contribute to the equalizing effect of the DAU transfers. This effect of equalization holds especially true when provinces with very high fiscal capacity are controlled in the model. A further relevant finding is this: although the model does not make a clear distinction between vertical and horizontal fiscal imbalances (cf. Bird and Tarasov, 2004) – especially given that the core of the fiscal gap approach relates more to problems of vertical fiscal imbalance[7] – the results suggest that, to a certain extent, horizontal equalization is evident between the richest and the poorest provinces, as highlighted by the relationship between fiscal transfers and fiscal capacity of the outlier provinces. Hence, in this particular case the distributive rationale of DAU transfers could be justified.

5. Potential shortcomings and perspectives for future research

It is appropriate at this point to highlight the potential shortcomings of the simulations – both conceptual and technical. *First*, the definition of protected area refers to the Ministerial Decree which excludes the possibility of taking into account emerging initiatives at provincial and local levels for protected areas, such as that of local Marine Protected Areas (MPAs), in the expenditure needs of a given jurisdiction. Additionally, a mere 25 percent of marine area is currently taken into account in the area indicator of fiscal need. Viewed in this light, the results from the present simulation are likely to be a conservative estimate and they are in no way a comprehensive representation of fiscal need. In fact, empirical evidence indicates that an increase in the size of marine area tends to increase the extent of species richness (e.g. Chittaro *et*

[7] Even if general purpose transfer is theoretically geared towards tackling vertical fiscal imbalance, in the Indonesian case the elements of the general purpose transfer (DAU) also entail dimensions of horizontal fiscal equalization. This complicates any attempt to distinguish between the two kinds of fiscal imbalances.

al., 2009). Moreover, Indonesia's island characteristics may also give rise to the importance of archipelagoes for nature conservation, given their unique assemblages and evolution of species as well as habitat diversity, for example (e.g. Ås *et al.*, 1992).

Second, the data on protected areas are additive: all protected areas in different management categories are combined to form the total amount of protected area cover. This issue calls for more precise types of protected area and relevant methods based, for example, on Geographical Information Systems (GIS), which help in detecting overlaying areas of different protected area management categories (e.g. GIS application in Ring, 2008a). Due to a lack of data this is not possible for the present study. In terms of the design of fiscal transfer instruments, however, more detailed data and categories may undermine the simplicity and transparency criteria which are required in the design of a formula-based lump-sum general purpose transfer.

Third, the area covered by protected areas determines the new DAU transfers a jurisdiction will receive. In this way a general purpose transfer is not a function of the magnitude, extent and quality of ecological public functions that such a jurisdiction will perform. However, this relates to the nature of the fiscal gap approach and the calculation of general purpose transfers, which seeks to maintain simplicity in the determination of transfers. A specific purpose transfer may better satisfy the need for more articulated and complex criteria capable of incorporating considerations beyond area cover.

Fourth, the point of reference for the DAU pool of funds in this simulation is a proportion of Domestic Net Revenue (DNR) in a particular fiscal year (here, 2007). Annual DNR may increase (or decrease) and will affect the options available for 'fiscal maneuvering'. An increase in DNR, for example, due to a factor such as a rise in the international oil price, may increase the total number of winning provinces and at the same time reduce the number of losing ones, in proportion to the revenue changes in DNR. However, while interesting from a practical point of view, the dependence of transfers on the annual revenue realization of DNR may violate another criterion of an appropriate intergovernmental fiscal transfer mechanism, namely, the temporal independence of transfer allocation: theoretically, the amount of transfers should not change if the timing of their allocation changes.

6. Conclusion

A region of ecological importance which produces uncompensated cross-spatial positive spillovers often has a comparatively higher fiscal need due to the costs it bears for nature conservation. This is a phenomenon observed in both developed and developing countries as well as in centrally organized and decentralizing countries, including Indonesia. There are a number of policy options for acknowledging and introducing fiscal needs for nature conservation into the system of intergovernmental fiscal transfers in an appropriate way. To date, only Brazil and, more recently, Portugal have implemented an explicit ecological indicator for the distribution of fiscal transfers from state or national levels to local levels of government respectively. In a number of other countries, such as Germany, Switzerland and India, ecological fiscal transfers have been suggested as a suitable instrument to take account of the local costs and spillover benefits of biodiversity conservation. In this article, the fiscal instrument of a lump-sum or general purpose transfer is proposed, by introducing an explicit ecological indicator into Indonesia's existing fiscal formula of deriving a jurisdiction's fiscal need.

In addition to present socio-economic dimensions, protected area – as a plausible proxy for the ecological dimension that fulfils the required condition of simplicity for fiscal need calculation – is incorporated into the country's existing and functioning fiscal transfer system. Building on the already existing area-based approach in the calculation of a jurisdiction's fiscal need, we run simulations of different proportions of a newly introduced indicator related to protected area and area in general. The purpose is twofold: (i) to examine the impact of new ecological fiscal transfers on the configuration of transfer distribution, and (ii) to examine the equalization effect of the ecological fiscal transfers. Both examinations are carried out at the level of provincial government.

Our results suggest that – compared to the baseline scenario of real DAU transfers in the fiscal year 2007 – the new ecological fiscal transfers would benefit roughly a third of the Indonesian provinces due to their protected area coverage, with an average increase of DAU transfers from approx. 4.2 to 12.6 percent, depending on the weighting of protected area relative to general area. As the simulations do not assume extra funds for ecological fiscal transfers but are modeled with available funds for DAU transfers, about two thirds of the provinces would receive lower transfers in the range of -1.7 to -5.9 percent. However, taking a different line of interpretation, this means that all those provinces that would lose out if a protected area indicator were introduced into the fiscal transfer system are presently free riding on those provinces that

stand out for their high protected area coverage. This being the case, they are currently contributing to nature and biodiversity conservation of national and global relevance without receiving any financial compensation for the costs they incur in doing so. From a public finance perspective and with regard to the dimension of distributive equity, our results suggest, interestingly, that the new ecological fiscal transfers are more equalizing than the existing general purpose transfers. Furthermore, the equalizing effect increases as the proportion of protected area increases.

These results are especially interesting in view of the allocative and distributive functions of public finance. Conservation policies are increasingly evaluated not just with regard to their allocative efficiency, but also with regard to their distributive equity. Intergovernmental fiscal transfers, and specifically general purpose transfers, when calculated on the basis of a fiscal gap approach, are designed to address fiscal imbalances by equalizing fiscal needs and fiscal capacities, in order to allow all jurisdictions in a country to provide adequate public goods and services. In the light of the above results, the introduction of a protected area-based indicator into the fiscal need formula for distributing general purpose transfers promises to improve both the allocative efficiency and distributive equity of a fiscal transfer system. Increasing distributive equity is an important requirement for all fiscal transfer systems with a strong equalizing component, but it is also of special relevance for all countries with a strong divide between rich and poor jurisdictions. In this spirit, ecological fiscal transfers represent an instrument that can serve both conservation policies and a fairer distribution of financial resources among decentralized governments.

7. References

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