연구논문 「환경정책」 제29권 제4호 2021. 12: 243-274
DOI http://dx.doi.org/10.15301/jepa.2021.29.4.243
pISSN 1598-835X eISSN 2714-0601

Factors Affecting Allocation of Biodiversity Aid Commitment

생물다양성 원조 배분에 영향을 미치는 요인에 관한 연구

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Abstract: Based on biodiversity-related aid distribution patterns, this study explores the factors that affect aid eligibility and volume to determine whether biodiversity ODA is actually allocated to countries that require more conservation and biodiversity development. Compared to previous studies, this study investigates a longer period of 18 years, dividing the process into two criteria (eligibility and volume), while including countries that were previously excluded because of lacking data. Using a two-stage model, this study examines the relationship between ODA commitment and need for biodiversity, development, and governance in developing countries from 2002 to 2019. Consequently, developing countries with a higher number of threatened species are more likely to be selected as recipients and receive larger aids, when the principal objective of the ODA is biodiversity. In contrast, GDP per capita does not determine eligibility and the extent of biodiversity aid. Other developmental factors such as basic sanitation service was insignificant for both criteria, whereas total population and governance standards were found to significantly affect both criteria. Our findings indicate that biodiversity aid does not account for developmental needs, particularly the recipient's income, even though current international biodiversity initiatives emphasize integrating development and biodiversity goals.

Key Words: Biodiversity, Aid Allocation, Development, Environmental Development, Official Development Assistance

요약: 본 연구는 생물다양성 보존이 필요하고 개발 수요가 높은 국가에 실제로 생물다양성 ODA가 배분되고 있는지 확인하기 위해 생물다양성 분야 원조 적격성 및 원조 규모에 영향을 미치는 요인을 파악하고자 하였다. 본 연구는 이전 연구들보다 오랜 기간인 18년 간의 데이터(2002-2019)를 바탕으로 ODA 배분단계를 지원자격 선정단계와 지원규모 결정단계로 구분하고 데이터 부족으로 과거 연구에서 제외되었던 국가들까지 포함하여 생물다양성 ODA 승인액과 개발도상국의 생물다양성 분야 필요(멸종위기 종 수), 개발수요(GDP, 인구, 기본적인 위생) 및 거버넌스 간의 관계성을 2단계 모델로 분석했다. 분석결과, 멸종 위기종이 많은 개발도상국이 생물다양성 ODA수원국으로 선정되고 더 많은 금액을 지원받았다. 개발 수요를 상징하는 1인당 국내총생산(GDP)과 기본적인 위생은 생물다양성이 주목적인 ODA의 경우, 생물다양성 ODA 수혜적격성과 원조규모에서 통계적으로 유의하지 않은 반면 인구는 적격성과 규모 모두에 유의한 영향을 미쳤다. 한편 거버넌스는 적격성과 규모 모두에 유의한 영향을 미쳤다. 본 연구는 현재 국제적으로 수

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행되는 생물다양성 보전 이니셔티브는 개발 목표와 생물다양성 목표를 통합하는 것이 강조되어 왔지만, 실제 생물다양성 원조에서는 개발수요(특히 수원국의 소득)에 대한 고려가 미흡함을 확인하였다.
핵심주제어: 생물다양성, 원조배분, 개발, 환경개발, 공적개발원조

Ⅰ. Introduction

Biodiversity and ecosystem functions and services have been declining globally at rates unprecedented in human history, and the pressure on the environment (e.g., increasing deforestation, loss of wetlands, and unsustainable agriculture, forestry, and fishing practices) has increased, resulting in rapid species loss, damaging the natural resource base of humanity (IPBES, 2019). Additionally, the global international community has made little progress on the Convention on Biological Diversity (CBD) to significantly halt biodiversity loss (Pattberg et al., 2019). According to the Global Biodiversity Outlook-5 (2020), most countries have failed to achieve the 2020 Aichi Targets (a set of 20 global targets under the Strategic Plan for Biodiversity 2011–2020), which were determined under the CBD to preserve and use natural resources in a sustainable manner.

A plethora of biodiversity hotspots and critical habitats are located in developing countries (Brooks, 2006). The loss or degradation of biodiversity poses serious threats to human well-being because it affects food security, public health, local livelihoods, and economic development (Millennium Ecosystem Assessment, 2005). People in developing countries are especially vulnerable to biodiversity loss because of their proximity to and daily contact with natural resources, as well as the lack of replacements for natural resources (Drutschinin et al., 2015; Roe et al., 2013). Therefore, protecting

biodiversity is directly related to sustainable development and poverty alleviation.

Developing countries face at least two challenges in their efforts to reduce biodiversity loss. First, exploitation and conversion of ecosystems are inevitable in the pursuit of economic development. Second, the available funds and technical, institutional, and personnel capacities are insufficient to implement measures for reducing biodiversity loss (Stepping and Meijer, 2018). Specifically, biodiversity-rich developing countries are highly underfunded to execute biodiversity conservation programs (Richerzhagen, Rodríguez and Stepping, 2016) and procuring funds from domestic budgets is arduous (Waldron et al., 2013). Additionally, biodiversity destruction negatively impacts people in developing countries who rely on natural resources, creating a vicious circle of poverty and biodiversity destruction. Therefore, international assistance remains the best source of financing for biodiversity conservation projects in biodiversity-rich developing countries (Waldron et al., 2013; Hein, Miller and De Groot, 2013), which encourage their involvement in global environmental agreements for biodiversity conservation.

The availability of evidence regarding the interrelationship of biodiversity destruction and poverty has led to a global consensus on integrating biodiversity conservation with the development agenda. The United Nations Sustainable Development Goals (UN SDGs) include two biodiversity-related stand-alone goals to "conserve and sustainably use the oceans, seas and marine resources for sustainable development" (SDG 14) and "protect, restore and promote sustainable use of terrestrial ecosystems and halt biodiversity loss" (SDG 15), in addition to other development goals integrating biodiversity and

ecosystem services (CBD, 2016). The CBD also calls on countries to integrate biodiversity considerations into their development processes to make biodiversity conservation a mainstream agenda. Additionally, the OECD's Development Assistance Committee (DAC) has suggested options to make biodiversity more mainstream globally (OECD, 2018). Despite these efforts, the CBD's 2020 goal of achieving a significant reduction in current biodiversity loss at the global, regional, and national levels has not been met (2020). Additionally, the extent to which the DAC should focus on conserving biodiversity as opposed to local development is unclear and definitive criteria for aid allocation to support biodiversity conservation activities in developing countries do not exist. Therefore, undetermined or non-existent definitive directions for official biodiversity finance necessitate the examination of past allocation patterns of biodiversity aid. However, there is little evidence-based information on how fund allocation is influenced by needs, specifically the extent to which some developing countries' socio-cultural characteristics determine the eligibility and extent of fund allocation.

This study analyzes whether aid is actually allocated to countries with higher biodiversity assets and developmental needs and seeks a desirable forward direction for biodiversity ODA. To this end, we examined the current funds allocation pattern and identified the factors that influence allocation decision and aid volume, by categorizing biodiversity conservation needs, developmental needs, and institutional capacities of the recipient countries. This study assesses the eligibility and amount of biodiversity ODA from bilateral DAC donors to those developing countries. However, we did not evaluate the most cost-effective sets of criteria, or propose a set of

allocation criteria, as both are beyond the scope of this study. This study solely aims to identify the hitherto unidentified determinants of biodiversity finance.

II. Literature Review

Different views and perspectives have been applied in biodiversity aid allocation depending on their objectives and priorities. On the one hand, a nature-centric approach prioritizes biodiversity preservation and conservation so as to deliver maximum biodiversity benefits (Miller, 2014). It focuses on "biodiversity protection" issues to improve the condition of "global commons." On the other hand, a poverty -centric approach focuses on how biodiversity and ecosystem services can be instrumental in alleviating poverty. This approach often addresses areas outside the realm of biodiversity, targeting "brown" issues; local problems, such as land degradation and water/air pollution (Shiva, 1993) are included as the primary concerns. As the poverty-centric approach is integral to the broader concept of developmental aid, it promotes "the economic development and welfare of developing countries as its main objective" (OECD, 2002).

There exists a longstanding debate on the extent to which biodiversity conservation and poverty alleviation can or should be combined (Roe et al., 2013). Environmentally destructive development activities imperil human well-being by threatening the stability of Earth's life-support systems (Cardinale et al., 2012; Griggs et al., 2013) whereas conservation at the expense of the poorest is ethically, and likely practically, unfeasible (Agrawal and Redford, 2006; Wilshusen et

al., 2002). Although nature- and poverty-centric approaches are not mutually exclusive, they receive differing levels of governmental commitment (Agrawal and Redford, 2006; Miller, Agrawal and Roberts, 2013; Roe et al., 2013). However, this debate—as well as the current policy and practice—occurs in the absence of knowledge about definitive criteria to achieve a social–ecological synergy. Hence, the investigation of the current allocation pattern of biodiversity-related ODA can improve the understanding of the overall allocation prioritization trajectory.

Several empirical studies have examined the allocation patterns of environmental ODA; however, few studies have specifically examined the distribution of biodiversity-related aid. The resource allocation strategy of the Global Environment Facility explicitly recognizes the recipient country's needs. Lewis (2003) found that environmental aid is distributed primarily to countries with more unexploited natural resources. Research on environmental aid (Hicks, Parks, Roberts and Tierney, 2010) has revealed that aid allocation is based on the environmental needs of recipient countries. Furthemore, Miller, Agrawal, and Roberts (2013) specifically investigate biodiversity aid allocation and state that aid is allocated based on the biodiversity conservation needs of recipient countries.

A recipient's developmental needs are also considered to a considerable degree, given the poverty-oriented characteristic of international ODA policies and discourse (Roe, 2008), and donors' responsiveness to this agenda (Clist, 2011). Hicks, Parks, Roberts and Tierney (2010) showed that a recipient's economic performance determines its decisions related to environmental aid and green investment (Eyraud et al., 2011; Lewis, 2003). Alesina and Dollar

(2000) argued that recipients' developmental needs and system of governance—Hoeffler and Outram (2011) refer to them as recipients' performance—balance environmental factors.

A recipient's governance system also influences donors' aid allocation decisions. Hicks, Parks, Roberts, and Tierney (2010) found that donors identify credible beneficiaries by examining their government's effectiveness, environmental policies, and democratic values. Research suggests that donors direct their developmental assistance depending on how well the recipient country is governed (Wright and Winters, 2010; Neumayer, 2003). For example, donors may avoid politically unstable countries and prefer delivering emergency aid rather than making long-term infrastructure investments in countries with corruption, governmental inefficiency, or non-democratic practices (Wright and Winters, 2010). Effective governance enables donors to ensure the appropriate implementation of biodiversity-related interventions for their intended impact (Manzoor Rashid et al., 2013; Vaz and Agama, 2013; Sandker, Ruiz-Perez and Campbell, 2012). In line with research findings on environmental ODA, biodiversity-related aid is also more likely to be delivered to countries with good governance (Miller, Agrawal and Roberts, 2013).

Just as economic aid is provided to promote economic and trade relations between the donor and recipient countries and strengthen trade ties (Buchner, Brown and Corfee-Morlot, 2011), aid allocation mechanisms are also designed to fulfill the interests of donor countries. Donor self-interest is particularly relevant in the case of bilateral donors, who are more sensitive to their political and economic interests than multilateral donors (Hicks, Parks, Roberts and

Tierney, 2010). Large bilateral donors, particularly the United States, are seen to be more likely to allocate aid according to their strategic concerns (Alesina and Dollar, 2000).

Interestingly, the allocation of aid has been shown to influence its ultimate effectiveness–that is, who received the aid, how much, and in what frequency (Wright and Winters, 2010). Examining the flow of biodiversity aid, therefore, is critical in the context of the synergetic interrelationship of biodiversity and poverty. However, little empirical evidence exists on the distribution pattern of biodiversity aid as most existing research has focused on either selectively observing particular donor types or specific conservation practices, and, therefore, does not yield uniform results. Therefore, empirical research on this topic is necessary to discover the factors influencing the pattern of biodiversity aid distribution, thereby determining how well biodiversity aid is balanced with development agendas.

Ⅲ. Trends In Biodiversity-Related Aid

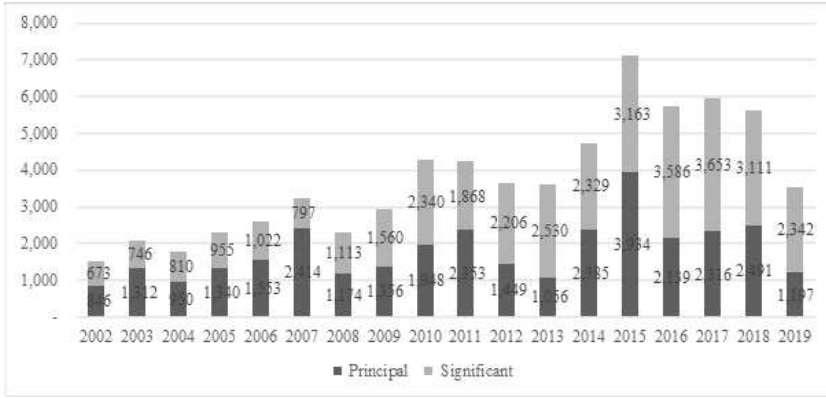
Faced with a multitude of threats to global biodiversity–deforestation, climate change, among others–the international community is increasingly focusing on conserving natural assets. This is demonstrated by a significant surge in aid for biodiversity conservation projects in developing countries. According to the bilateral commitment data on biodiversity aid from the CRS database, total bilateral biodiversity-related aid by members of the OECD's DAC has risen from USD 1.5 billion in 2002 to USD 3.5 billion in 2019 (〈Figure 1〉). However, according to Secretariat of the Convention on

Biological Diversity (2020), this increase was substantially short of achieving the 2020 Aichi Biodiversity Targets, indicating the insufficiency of the current level of resource mobilization to tackle biodiversity loss.

Out of this total amount, more than half (51.9%) was marked as "significant" aid, which suggests that biodiversity conservation was not the primary motivation for dispensing the aid; the remaining amount (48.1%) was the "principal" biodiversity aid, with an exclusive focus on biodiversity conservation–but without delineating the specific goals. Looking at the trends, the proportion of principal aid was slightly higher during the 2002–2008 period; however, significant aid represents an increasing share of total biodiversity aid, albeit with slight fluctuations.

〈Figure 1〉 Official development assistance to developing countries targeting biodiversity conservation

(Constant 2018 USD, Millions)

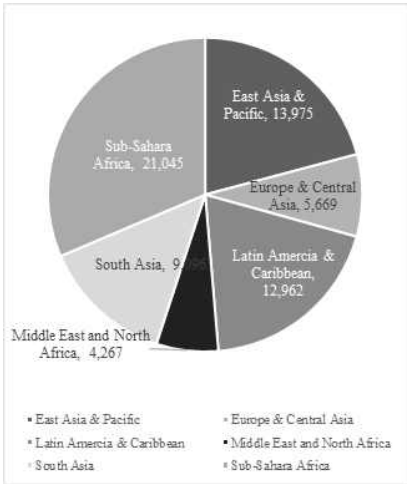


Source: Compiled by the author based on the DAC CRS database (OECD)

To achieve biodiversity conservation goals in a restricted budget, biodiversity aid has to be focused on regions where conservation efforts are most needed. An investigation of the region-based

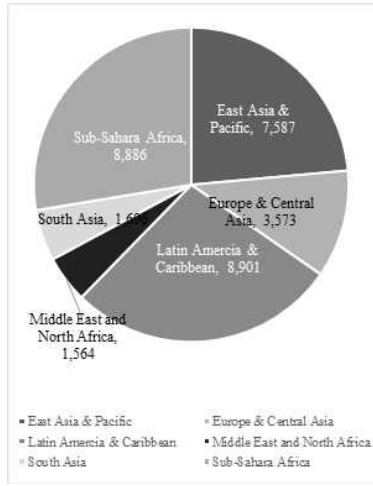
allocation pattern of biodiversity aid (〈Figure 2〉) reveals that countries in Sub-Saharan Africa, East Asia, and the Pacific region received more than half of the total global biodiversity aid between 2002 and 2019–followed by Latin America, the Caribbean, and South Asia, who cumulatively received about 30% of the total biodiversity aid. In order to match the total ODA allocation capacity and the conservation needs of individual countries, the number of threatened species in each recipient country was considered to measure their respective biodiversity conservation needs. 〈Figure 3〉 shows that threatened species are concentrated in Sub-Saharan Africa, Latin America, and the Caribbean, followed by East Asia, the Pacific region, Europe, and Central Asia. This pattern indicates that Europe and Central Asia, Latin America and the Caribbean, and East Asia and the Pacific region received a smaller proportion of biodiversity aid compared to their number of threatened species, whereas South Asia, Sub-Saharan Africa, the Middle East, and North Africa received a large proportion. This pattern indicates a possible discrepancy between a country's actual biodiversity conservation needs and the corresponding aid received by it.

〈Figure 2〉 Pattern of biodiversity aid allocation by region, 2002–2019
(Constant 2018 USD, Millions)



Source: Compiled by the author based on the DAC CRS database (OECD)

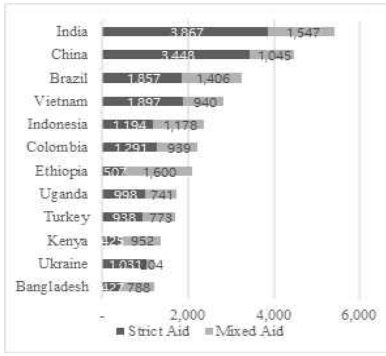
〈Figure 3〉 Regional distribution of threatened species, 2018



Source: Compiled by the author based on the IUCN Red list

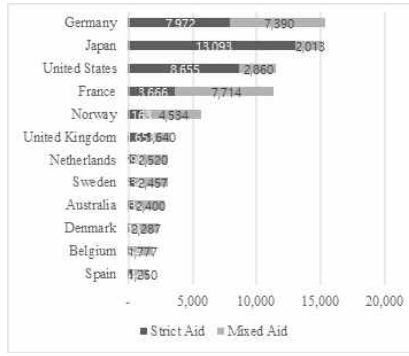
When narrowing the scope to the country level, the allocation patterns still show a discrepancy between the aid amount received and the number of threatened species. More than a quarter of the total biodiversity aid has been allocated to countries such as India, China, Brazil, Vietnam, and Indonesia (〈Figure 4〉)–mainly from Germany and Japan (〈Figure 5〉). The top-ranked recipient countries of biodiversity conservation aid do not have more threatened species compared to Ecuador, Madagascar, Indonesia, Malaysia, and Tanzania (〈Figure 6〉). These discrepancies necessitate further research to examine whether the current ODA is allocated to countries with the greatest biodiversity conservation needs.

〈Figure 4〉 Main recipient countries of bilateral biodiversity aid, 2002–2019
(Constant 2018 USD, Millions)



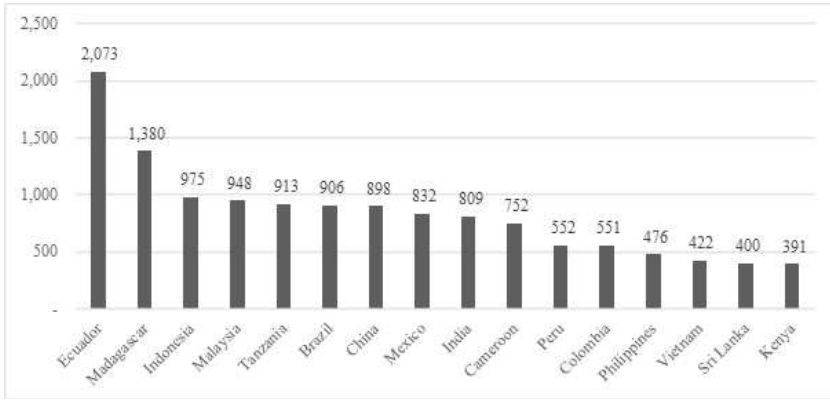
Source: Compiled by the author based on the DAC CRS database (OECD)

〈Figure 5〉 Main donor countries of bilateral biodiversity aid (Commitments), 2002–2019
(Constant 2018 USD, Millions)



Source: Compiled by the author based on the IUCN Red list

〈Figure 6〉 Number of threatened species by country



Source: Compiled by the author based on the IUCN Red list

Ⅳ. Research Methods and Data

1. Empirical Framwork

This study investigated the factors explaining bilateral aid allocation for biodiversity conservation for 158 aid recipient countries from 2002 to 2019 (35 countries were excluded due to data deficiencies). Based on previous studies on aid allocation, we investigated whether key factors such as recipients' biodiversity conservation needs, developmental needs, and governance standards were associated with the biodiversity aid received.

This study employed a two-stage model with the assumption that a developing country is assessed each year in terms of eligibility for and extent of volume of biodiversity aid. The two-stage model was used for two reasons. First, this model is employed in general aid allocation studies, such as that of Clist (2011). Second, separating the steps for determining eligibility and the amount of aid may avoid biased parameters. Specifically, the first stage involves recipient selection using a logit model to identify factors influencing a developing country's eligibility for biodiversity aid; the second stage is the volume of aid applying panel regression model, excluding all zero and non-selected countries. The second stage identifies which recipient receives more aid from donors.

In the first stage, recipient countries that met the eligibility criteria were screened as aid recipients set to receive a positive amount of aid. This stage used the logistic regression model to identify which parameters to use to select recipients. Aid eligibility was denoted as 0 or 1, depending on whether the recipient country received aid or not.

$$\ln\frac{P}{1-p} = A_i\pi, where\ A_i$$
$$= \left[X_i^{Biodiversity}\ X_i^{Development}\ X_i^{Governance}\ X_i^{control}\right] \text{and}\ \pi = [\alpha\ \beta\ \gamma\ \delta]$$

where $\ln P/1-P$ is a variable for eligibility for biodiversity aid; Ai is the explanatory variable set, consisting of $X_i^{Biodiversity}\ X_i^{Development}$ and $X_i^{Governance}$, which represent recipients' biodiversity conservation needs, developmental performance, governance standards, and control variables; and $\alpha\ \beta\ \gamma$ and δ are the corresponding coefficient vectors.

In the second stage, recipient characteristics were investigated to identify the parameters used to decide which recipients receive more biodiversity aid. This stage employs panel regression to investigate the countries that received a positive amount of biodiversity aid at time t, by excluding non-aid recipients. The aid amount was transformed into the natural log of the annual biodiversity-related ODA. The panel model Y=BX+E was operationalized, wherein Y is the amount of biodiversity aid, X consists of a suite of causal and control variables, and E is a randomly distributed error term. The Breusch-Pagan-Lagrange multiplier test was performed to determine the most appropriate model.

$$\ln Y_{it} = a_{it} + \beta B_{it} + \epsilon_{it}, where\ B_{it}$$
$$= [X_i^{Biodiversity}\ X_i^{Development}\ X_i^{Governance}\ X_i^{Control}] \text{and}\ \pi = [\alpha\ \beta\ \gamma\ \delta]$$

where $\ln Y_{it}$ is a variable of the amount of aid for biodiversity conservation; *Bi* is the explanatory variable set consisting of $X_i^{Biodiversity}\ X_i^{Development}$, and $X_i^{Governance}$, which represent recipients' biodiversity conservation needs, developmental needs, governance standards, and control variables; $\alpha\ \beta\ \gamma$ and δ are the corresponding coefficient vectors.

2. Data

This study examined the factors that affect the allocation patterns of biodiversity aid. The factors were classified into four categories, which can represent the recipients' characteristics: (1) biodiversity conservation needs, (2) developmental needs, (3) governance (4) Donors' interest, which are commonly found in political science, economics, and sociology literature on the allocation of environmental aid (Figaj, 2010; Hicks, Parks, Roberts and Tierney, 2010). Aid data related to bilateral commitments on biodiversity aid are obtained from the OECD CRS database. Furthermore, the flows to recipient countries are aggregated on an annual basis in US $ 2018 constant price values, which have been available since 2002. The World Bank's World Development Indicators is the main data source for the number of threatened species, gross domestic product (GDP) per capita and population, the percentage of people using at least basic sanitation services, and the amount of ODA received. The data for governance standards are extracted from the World Governance Indicators database. All nominal amounts were logarithmically transformed. The tested variables are listed in 〈Table 1〉 with data sources. Twenty-one of the 158 countries were excluded because of lack of data. In the case of countries with only a few years of data, we included those with complete data and excluded those with missing values. In all, 35 countries were excluded because of data deficiency.

〈Table 1〉 Definition and source of variables

Variable	Definition	Source
ln(Total ODA$_{it}$)	Natural logarithm of the summation of biodiversity targeted aid with principal or significant score in Rio markers	OECD Stat
ln(Principal ODA$_{it}$)	Natural logarithm of the amount of biodiversity targeted aid in Rio markers with principal score	OECD Stat
ln(Significant ODA$_{it}$)	Natural logarithm of the amount of biodiversity targeted aid in Rio markers with significant score	OECD Stat
ln(Threatened species$_{it}$)	Natural logarithm of number of threatened species including birds, fish, mammals, and plant species	World Development Indicators
ln(PCGDP$_{it}$)	Natural logarithm of GDP per capita PPP (constant 2017 international $)	World Development Indicators
ln(Population$_{it}$)	Natural logarithm of population	World Development Indicators
Basic Sanitation Service (%)	The percentage of people using at least basic sanitation services	World Development Indicators
The percentage of bilateral aid (%)	The percentage of biodiversity aid from net official aid received	World Development Indicators
Governance	The average of Kaufmann Institution measures	World Governance Indicators

3. Dependent Variable

In this study, biodiversity aid refers to a donor's commitment to finance developmental projects listed under the OECD Rio markers. There are three Rio Conventions: on biodiversity, climate change (adaptation and mitigation), and desertification. The CRS captured only bilateral flows under the Rio Convention on biodiversity and marked unspecific flows in which it is difficult to ascertain which country received assistance. The CRS data are a comprehensive measurement of biodiversity aid; however, activities such as general budget support, debt relief, administrative costs, development awareness, and refugees in donor countries are not screened.

The DAC has tracked development financing flows targeted at meeting the Rio Conventions' objectives using the Creditor Reporting System (CRS). The Rio markers were created to identify development cooperation activities that combine the Conventions' goals, and DAC members are expected to report whether each development financing activity has an environmental goal. Principal aid are those that explicitly declare that motivation or design is the basic aim of biodiversity. The Significant aid, on the other hand, is clearly stated the biodiversity purpose, but it is not the major goal of the action, and it can be carried out without concern for biodiversity. This paper uses bilateral commitment data on aid to biodiversity from DAC CRS database. The data is based on the donors' reports, which can be broadly viewed as donors' intended contribution on biodiversity.

This study compared "total," "principal," and "significant" biodiversity aid. The stated objectives that match the "criteria for eligibility" of the Rio markers are screened as principal aid or significant purposed biodiversity aid (〈Table 2〉). Activities undertaken with other developmental objectives are marked as significant; however, activities whose only objective is biodiversity conservation are marked as principal. Furthermore, treating the allocation of each type of aid as a separate outcome allows for more extensive investigation of whether the factors affecting allocation are similar or different, depending on how the biodiversity target is pursued.

〈Table 2〉 Criteria for biodiversity eligibility

The activity contributes to:
a) protection or enhancing ecosystems, species, or genetic resources through in-situ or ex-situ conservation, or remedying existing environmental damage
b) integration of biodiversity and ecosystem service concerns within recipient countries' development objectives and economic decision making, through institution building, capacity development, strengthening regulatory and policy framework, or research
c) developing countries' efforts to meet their obligations under the Rio Convention

Note: OECD DAC (2018), Review of the definition and eligibility criteria for the Rio marker for biodiversity, DAC Working Party on Development Finance Statistics

4. Independent Variable

1) Biodiversity Conservation Needs

There is "no single, comprehensive metric" to monitor and assess the state of biodiversity (OECD, 2012). Purvis and Hector (2000) noted that any attempt to express biological diversity as a single number would inevitably lose information. Biggs et al. (2007) distinguished three types of biodiversity indicators at the impact level: (1) species-based indicators, (2) abundance-based indicators, and (3) indicators that provide an overall measure of ecosystem intactness (integrity indicators). However, the second and third indicators seem to be assessed infrequently and in only a few countries. Therefore, large international agencies, including the Global Environment Facility, use the Red List data from the International Union for Conservation of Nature (IUCN) to measure conservation needs of countries and to develop biodiversity investment priorities (Vié, Hilton-Taylor and Stuart, 2009). this study measures the magnitude of a country's biodiversity conservation needs based on the total number of threatened species from four globally assessed taxa: mammals, birds, plants, and fish, in that country in line with previous studies.

This paper follows the Red List classification criteria of the IUCN which divides all species into nine categories depending on a different level of risk; particularly, critically endangered, endangered, and vulnerable species are classified as threatened species.

The IUCN compiles the most recent statistics on the total number of threatened species, covering numerous countries. However, the Red List data has some limitations (Rodrigues et al., 2006), notably, missing species, such as those recently categorized or from other less-studied world regions or ecological habitats (e.g., freshwater or marine), and data-deficient species, including those from taxa where information is insufficient to assess the risk of extinction. However, this indicator assumes that donors would respond to the available scientific knowledge of threatened species when making funding decisions. In this study, the number of threatened species from four available taxa were analyzed. In terms of the number of threatened species, the Red List figures from 2018 were applied uniformly across all years. The variables representing biodiversity conservation needs lead to the hypothesis: the greater the number of threatened species in developing countries, the greater the likelihood that they are deemed more suitable for biodiversity aid, and subsequently receive more aid.

2) Developmental Needs

Developmental needs of recipient countries are included in the analysis to investigate whether the development agenda was considered in the aid allocation process targeting biodiversity. Specifically, the GDP per capita and population size were included to test whether biodiversity aid also has a developmental mission of enhancing economic growth and reducing poverty. The hypothesis is that the

lower the income per capita and higher the population of developing countries, the greater the likelihood that they will be selected as biodiversity aid recipients and will receive more aid. GDP per capita in PPP terms and population figures for the period 2002–2019 were used as indicators of a recipient country's development needs. GDP PPP represents an adjusted version of GDP that corrects differences in exchange rates and the cost of living among countries. GDP per capita and population figures from 2002 to 2019 were accessed from the World Bank database; years with missing values were excluded.

Additionally, the percentage of population receiving at least basic sanitation services was the main indicator to measure the developmental needs of a recipient country in terms of local environmental concerns, which is the proxy for environmental "poverty" of a nation (World Bank, 1998). The Joint Monitoring Programme of the World Health Organization (WHO) and the United Nations Children's Emergency Fund (UNICEF) compiles data on drinking water, sanitation, and hygiene based on administrative sources, national censuses, and globally representative household surveys. The percentage of people using at least basic sanitation services was used for local environmental problems. We assumed and applied the same figures as the most recent available figures in the absence of data. Data for the percentage of people using at least basic sanitation services for 2018 and 2019 were unavailable, which was populated using the latest available year's figures. According to previous research, some countries have received more aid for global public goals such as biodiversity conservation, whereas others have received more aid for local public goals such as safe drinking water, soil erosion control, and sanitation (Hicks, Parks, Roberts and

Tierney, 2010). Therefore, the following was hypothesized: The level of sanitation would statistically significant relationship with the possibility of being selected to receive biodiversity aid.

3) Governance

This study examined how the governance standards in developing countries affect the allocation of biodiversity aid. Donors may prefer more open and stable governance contexts as they are more conducive to the successful implementation of aid activities. The following hypothesis was generated: Well-governed developing countries are more likely to be selected as recipients of, and receive more, biodiversity aid. To measure a country's governance standards, the average of the six Worldwide Governance Indicators (WGI) on "good governance" were included: control of corruption, voice and accountability, rule of law, government effectiveness, political stability, and quality of regulatory measures (Kaufmann, Kraay and Mastruzzi, 2009). Each of these six aspects is in units of a standard normal distribution, with a mean value of zero, standard deviation of one, and a range of approximately 2.5–5 higher values corresponding to higher performance in governance (Kaufmann, Kraay and Mastruzzi, 2009). All figures were added to a constant number and converted to positive numbers before being converted to natural logarithms.

4) Control Variavle: Donor's Interest

The percentage of bilateral aid as part of the total amount of international assistance was used as control variable to assess donors' influence on aid allocation. Although donor self-interest has

particular relevance to bilateral donors (Headey, 2008; Hicks, Parks, Roberts and Tierney, 2010), Biodiversity aid is less useful tool to advance their geo-strategic interests abroad than other forms of aid. Hicks, Parks, Roberts and Tierney (2010) showed that a greater volume of non-environmental aid was provided to allies, trading partners, or former colonies than environmental aid. If the percentage of bilateral aid is greater, donors are more likely to allocate less principal biodiversity aid that improves global environmental benefits. The amount of bilateral aid was divided by the total ODA commitments received in developing countries, which was extracted from the CRS aid activity database.

Ⅴ. Resutls

This study investigated factors influencing biodiversity aid allocation using the CRS data from 2002 to 2019. This section presents the factors affecting the recipients' eligibility for biodiversity aid and the amount of aid received (〈Table 3〉). The first stage employed a logit model to analyze the factors that determine a developing country's eligibility for biodiversity aid. The second stage used the panel regression model to identify the factors influencing biodiversity aid value, excluding all zero and non-selected countries. The Breusch-Pagan-Lagrange multiplier test was rejected, so we determined that a panel regression model is more appropriate to a pooled OLS model. To demonstrate the robustness, we present the result of pooled OLS.

First, the number of threatened species was statistically significant

only if biodiversity was the sole objective of aid activities. In terms of the principal biodiversity aid, developing countries with more threatened species are not only more likely to be chosen as recipients, but they are also more likely to receive a larger amount of aid. However, biodiversity aid marked significant did not reflect biodiversity conservation needs at both stages, indicating that biodiversity aid that includes goals other than biodiversity are not statistically associated with the number of threatened species. This implies that donors will consider the number of threatened species to make their funding decisions when biodiversity aid is the primary goal.

In addition, we assessed GDP per capita, population, and local environmental problems for the recipient's development needs. GDP per capita was not statistically significant for the recipient eligibility and the volume of aid. In terms of total population, the greater the developing country's population, the more likely it will be chosen and get more aid, regardless of its aims. That is, the size of population affected the likelihood of being selected and receiving larger financial aid for biodiversity-ODA. Other developmental factors, the percentage of people using at least basic sanitation services, produce slightly different result depending on the stages. The improvement of basic sanitation services only influenced the probability of a developing country enjoying a higher eligibility only for aid marked significant. However, basic sanitation services do not affect recipients' aid volume. The development factors in general were playing a less effect than the biodiversity conservation needs.

Governance standard is another influential factor for both the eligibility and amount of aid and is statistically considered in the overall process of aid decisions. Donor countries were likely to select

and allocate more aid to countries with good policy environments and effective governance mechanisms. The degree of governance had the largest influence on both aid eligibility and volume process.

The percentage of bilateral aid in total aid was used to control for donor interest. The higher percentage of bilateral aids negatively influenced on aid eligibility and aid volumes. Biodiversity aid is difficult to create tangible outcomes, hence it should be supplied through long-term projects. Because aid from multilateral institutions is more effective in complicated initiatives, bilateral aid is less commonly chosen for overall biodiversity aid.

〈Table 3〉 Factors affecting recipients' eligibility of biodiversity aid

Variable	First stage – Aid eligibility					
	Principal aid for biodiversity		Significant aid for biodiversity		Total aid for biodiversity	
	Pooled OLS	Random effects	Pooled OLS	Random effects	Pooled OLS	Random effects
ln(Biodiversity needs $_{it}$)	0.944***	1.229***	0.132	0.203	0.743***	0.833*
	(0.16)	(0.27)	(0.17)	(0.27)	(0.21)	(0.35)
ln(PCGDP $_{it}$)	−0.310	0.168	−0.739***	−0.483	−0.750**	−0.514
	(0.23)	(0.28)	(0.21)	(0.30)	(0.27)	(0.36)
ln(Population $_{it}$)	0.392***	0.593***	0.650***	0.984***	0.450***	0.766***
	(0.07)	(0.11)	(0.07)	(0.14)	(0.08)	(0.16)
People using basic sanitation services (% of total population)	−0.360	−0.284	1.514*	2.283*	1.591	2.367*
	(0.66)	(0.85)	(0.72)	(0.93)	(0.89)	(1.19)
ln(Governance $_{it}$)	4.222***	4.116**	4.525***	4.356**	2.627	2.756
	(1.10)	(1.35)	(1.34)	(1.44)	(1.88)	(1.75)
Percentage of bilateral aid (%)	0.878	−1.711***	0.181	−2.195***	−0.176	−2.962***
	(0.50)	(0.49)	(0.39)	(0.50)	(0.57)	(0.67)
Constant	−19.65***	−25.51***	−17.67**	−22.83***	−9.860	−15.14*
	(4.17)	(5.22)	(5.40)	(5.57)	(7.19)	(6.88)
Pseudo R squared	0.2238	0.00	0.2219	0.00	0.2043	0.085
No. of observations	2362	2362	2362	2362	2362	2362

Note: Standard errors are shown in parentheses, and *, **, and *** represent statistical significance levels of 0.1, 0.05, and 0.001, respectively

〈Table 4〉 Factors affecting recipients' amount of biodiversity aid received

Variable	Second stage – Aid amount					
	Principal aid for biodiversity		Significant aid for biodiversity		Total aid for biodiversity	
	Pooled OLS	Random effects	Pooled OLS	Random effects	Pooled OLS	Random effects
ln(Biodiversity needs $_{it}$)	0.508***	0.369**	0.191	0.0925	0.298*	0.181
	(4.48)	(2.57)	(1.80)	(1.04)	(3.10)	(1.61)
ln(PCGDP $_{it}$)	−0.289	0.0607	−0.597***	−0.141	−0.464**	−0.106
	(−3.59)	(−2.39)	(−5.42)	(−4.90)	(−5.02)	(−4.84)
ln(Population $_{it}$)	0.513***	0.660***	0.578***	0.681***	0.631***	0.775***
	(8.02)	(9.94)	(10.40)	(11.09)	(11.32)	(13.16)
People using basic sanitation services (% of total population)	−0.572	−0.431	−0.289	−0.240	−0.427	−0.179
	(1.04)	(2.70)	(1.20)	(4.18)	(1.33)	(5.42)
ln(Governance $_{it}$)	2.282*	2.396**	3.730***	3.080***	3.524***	3.284***
	(2.13)	(2.71)	(3.98)	(3.85)	(3.66)	(4.37)
Percentage of bilateral aid (%)	0.599	−0.579*	−0.435	−1.539***	0.112	−1.326***
	(3.52)	(11.95)	(1.76)	(8.25)	(1.67)	(10.54)
Constant	−15.30***	−19.79***	−15.79***	−18.14***	−17.25***	−20.57***
	(−3.84)	(−6.29)	(−4.57)	(−6.09)	(−4.92)	(−7.69)
R squared	0.34	0.32	0.30	0.27	0.40	0.37
No. of observations	2000	2000	2072	2072	2222	2222

Note: Standard errors are shown in parentheses, and *, **, and *** represent statistical significance levels of 0.1, 0.05, and 0.001, respectively

Ⅵ. Discussion

Developing countries with a greater number of threatened species are not only more likely to be selected as recipients but are more likely to receive more aid in the case of the principal ODA for biodiversity conservation. In line with previous studies (Miller, Agrawal and Roberts, 2013; Lewis, 2003), donors are more likely to select and provide more aid to countries with a higher number of

threatened species. However, in case of a "significant" aid, which have other developmental goals other than biodiversity conservation, a recipient country's biodiversity conservation needs are not statistically significant. That is, Biodiversity needs are considered only for principal aid, not significant aid, which account for a larger part of total aid. This can potentially obstruct the integration of biodiversity conservation and development cooperation, while also contradicting the biodiversity mainstreaming discourse. This implies that biodiversity conservation needs should be considered more severely in the development aid process even for significant aid in order to accomplish the purpose of Rio marker.

Additionally, developmental factors were examined to investigate whether biodiversity aid was provided in response to the developmental needs of the recipient. The results show that GDP per capita does not appear to be a determinant for eligibility and the extents of volume for biodiversity-focused aid, which implies that biodiversity aid did not flow to low-income countries. This differs from the previous studies, which found that GDP per capita has a significant impact on overall environmental aid (Hicks, Parks, Roberts and Tierney, 2010; Lewis, 2003). Other developmental factors, the percentage of people using at least sanitation services, do not present statistically significant effects, while total population significantly affect the allocation of biodiversity aid in all stage. The result of population size is in line with previous studies, implying that aid is targeted toward countries with greater environmental pressure. The findings suggest that biodiversity aid allocation does not achieves the developmental mission well despite different emphasis in each stage based on the indicator.

The quality of governance shows statistical significance with regard to both eligibility and volume of aid. This finding shows that more opportunities and larger aid amounts were prioritized for well-governed developing countries. As suggested in a previous study, countries with strong policies and effective governance systems ensure that they attain their project goals (Manzoor Rashid et al., 2013; Vaz and Agama, 2013; Sandker, Ruiz-Perez and Campbell, 2012). The governance level of developing countries has been shown as an important factor in international cooperation as it signals trustworthiness, capacity to deliver, and greater likelihood of future success (Martin, 2000). Donors may find more open and stable governance contexts as being more conducive to the successful implementation of biodiversity conservation objectives.

Through this study, we discovered that biodiversity aid marked "significant" is less concerned with the biodiversity conservation needs of the recipient country. Therefore, greater effort is required to examine the biodiversity conservation needs of developing countries so as to successfully integrate developmental goals with biodiversity conservation objectives in order to achieve the goal of sustainability.

Ⅶ. Conclusion

The purpose of this study was to evaluate the factors that influence the eligibility and the volume of aid received by developing countries. Current international biodiversity conservation initiatives emphasize the importance of achieving sustainability by integrating developmental and biodiversity goals. However, the study's findings indicate that

biodiversity aid in general does not take development needs into account, particularly recipients' per capita income. Furthermore, "significant" biodiversity aid is unconcerned with the conservation needs of recipients. The findings of this analysis indicate not only a lack of progress in biodiversity mainstreaming, but also the potential ineffectiveness of biodiversity aid in developing countries, which are also crucial for biodiversity. As a result, further efforts are required to consider both aims.

As the OECD CRS data were collected over an 18-year period, this study could cover a relatively longer period than previous studies. We also separated the aid eligibility and volume of aid stages during the allocation process and included countries that were excluded from previous studies because of the absence of biodiversity aid volumes. The study can contribute to research on biodiversity aid allocation because it covers a longer period and examines more countries than in previous studies.

Based on the insights obtained from this study, a continuous follow-up assessment of the allocation mechanisms in specific bilateral aid agencies from each DAC country, or a specific international organization, would assist the transition to sustainable future development. Further research is required for more frequent and consistent assessment of biodiversity status across countries, more precise quantification of biodiversity vulnerability, and a more comprehensive understanding of biodiversity loss and the role of biodiversity aid. Longer-term and finer-grained data that measure biodiversity vulnerability and the effectiveness of aid can further refine the pattern of aid allocation. In this way, studies on the assessment of biodiversity aid and development will be improved.

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투 고 일: 2021년 11월 15일
심 사 일: 2021년 11월 23일
게재확정일: 2021년 12월 24일