

## Article

# Determinants of Bilateral REDD+ Cooperation Recipients in Kyoto Protocol Regime and Their Implications in Paris Agreement Regime

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**Abstract:** A cooperative approach for REDD+ between developing and developed countries can be a sound means to achieve national and global mitigation targets. To accomplish the Nationally Determined Contribution (NDC) of countries and the global 2 °C climate target more effectively, it is necessary to explore the coordination options, based on the understanding of bilateral REDD+ cooperation. This study explains the current status of bilateral REDD+ cooperation and investigates determinants affecting REDD+ recipient decisions of donor countries, by analyzing bilateral REDD+ arrangements, which has been promoted for 10 years under the the Kyoto Protocol regime from 2006 until 2015. The results show that Norway and Japan supported more than half of the total financial pledges for bilateral REDD+ projects for 10 years. Out of 87 REDD+ recipients, four countries—Brazil, India, Indonesia, and China—accounted for more than half of the 10-year financial pledges. Approximately 78% of total financing was found to be concentrated in the top 10 recipients. The aid darlings and orphans problem, the concentration of bilateral supports in a few developing countries and the exclusion of several developing countries from the recipient selection process, which has been discussed in ODA researches, was also observed. Applying a shared frailty model, recipient need, recipient merit, and donor interest was found to be the main determinants of donors' REDD+ recipient decision. Donor interest and recipient merit were found to have more significant effects on the decision than recipient need. A balanced two-track approach is further required, in which, along with the bilateral REDD+ cooperation in the REDD+ darling countries, international organizations and multilateral funds for REDD+ need to increase financial accessibility, including the result-based compensation system for the REDD+ orphan countries.

**Keywords:** bilateral REDD+; climate change cooperation; donor interest; Paris Agreement regime; recipient merit

## 1. Introduction

The global target of limiting the global temperature rise to below 2 °C is expected to be difficult to achieve if the emission gap is not reduced by 2030 [1]. In 2015, the Parties to the United Nation Framework Convention on Climate Change (UNFCCC) agreed on the Paris Agreement, limiting

global temperature rise to 2 °C through both national and international efforts based on the principles of Common But Differentiated Responsibilities (CBDR). The Parties submit their national emission reduction targets by reporting the Nationally Determined Contributions (NDCs), which consist of an unconditional target to be achieved by their own effort and a conditional target premised on international support. However, it is expected that it will be difficult to achieve the mitigation target for 2030 by just reaching the unconditional target [2,3]. Additional GHG reduction of at least three times the existing annual mitigation effort, or 15 GtCO<sub>2</sub>e, is required [2,3]. This corresponds to about 46% of 33 GtCO<sub>2</sub>e, which was the global energy sector's GHG emissions in 2018 [4]. Cooperation between the Parties is pivotal to accelerate mitigation efforts and to set more ambitious NDC targets. The cooperative approaches specified in the Article 6.2 of the Paris Agreement is expected to serve as an effective means for the Parties to achieve their NDCs through Internationally Transferred Mitigation Outcomes (ITMO), with voluntary climate change mitigation cooperation between Parties [5].

Reducing emissions from deforestation and forest degradation and the role of conservation, the sustainable management of forests, and the enhancement of forest carbon stocks in developing countries (REDD+) is an incentive mechanism offering result-based payments (RBP) for GHG mitigation in the forest sector of non-annex I countries that have no mitigation obligations under the UNFCCC Kyoto Protocol regime [6]. The efforts of developing countries to have their mitigation outcomes recognized and receive RBP through the implementation of REDD+ are still ongoing. According to [7], on the other hand, 56 of the 162 Parties that agreed to the Paris Agreement would use REDD+ to achieve their NDC. Thus, GHG mitigation efforts through REDD+ are expected to continue. There are still technical issues and controversies to be resolved, such as the environmental integrity of GHG mitigation outcomes from REDD+, accounting and corresponding adjustment of the outcomes [7]. REDD+ can be a more cost-effective mitigation means for developed countries, whose domestic mitigation costs are rather high [8]. In addition, it has been drawing attention as a means of climate change mitigation with high potential, which can contribute to the sustainable development of developing countries through socio-economic beneficial activities aligned to REDD+ activities [9,10]. Therefore, bilateral REDD+ based on cooperative approaches of the Paris Agreement can serve as an important means that can be applied to climate cooperation between developing and developed countries to achieve mitigation targets, capable of deriving from all of them a "higher ambition in their mitigation and adaptation actions and to promote sustainable development and environmental integrity," as specified in Article 6.1 of the Paris Agreement.

The main prerequisites for the recognition of REDD+ mitigation outcomes as a result of each party's NDC achievement agreed at the international climate negotiation are stated in the UNFCCC Warsaw Framework on REDD+ [6], which stipulates the establishment of the National Strategy Action Plan (NSAP), the development of the National Forest Monitoring System (NFMS), the submission of the Forest Reference Level/Forest Reference Emission Level (FRL/FREL), and the satisfaction of the implementation conditions of Safeguard Information System (SIS). However, in order to implement the Warsaw Framework in developing countries, the financial and technical support of the international community is necessary. To date, seven countries, including Brazil, Colombia, and Indonesia, have met the requirements of the Warsaw REDD+ framework implementation [11]. The rest of the developing countries are still in need of support and international cooperation to prepare and build the necessary infrastructure for REDD+ implementation [12].

Due to the different national situations faced by each developing country, the level and scale of technical and financial support required to meet the requirements of the Warsaw Framework are inevitably different [13]. At the 16th UNFCCC Conference of the Parties (COP 16), the Parties agreed to support REDD+ implementation in developing countries (10/CP.19). Subsequently, a variety of international cooperation activities are on-going such as the UN-REDD Programme, and multilateral organizations, such as Forest Carbon Partnership Facility (FCPF), have been arranged to support developing countries' REDD+ implementation by several developed countries, including Norway. However, the REDD+ financing that has been pledged or implemented so far is very

insufficient, considering the level of demand for financing requested by developing countries for REDD+ implementation [14]. The REDD+ cooperation so far has been implemented independently by countries and international organizations in different environments to achieve their respective targets [15]. Given this issue of fragmented or duplicate REDD+ cooperation and support, the need for international coordination has emerged [16–18].

Under the Paris Agreement regime, we need to better understand the characteristics of bilateral REDD+ cooperation to utilize REDD+ as an efficient and effective means for achieving the NDCs and global 2 °C targets of the Parties. Until now, researches on the status of international REDD+ financing have been conducted [13,19–22]. However, there have been few quantitative studies on how the purpose and motivation of the donors affect their decision on REDD+ cooperation. The reasons for the lack of research on the former are as follows.

The first reason is the fragmentation and complexity of international REDD+ cooperation. REDD+ implementation of developing countries is premised on predictable, and appropriate financial and technical support [6]. Until now, however, individual countries and multilateral organizations have supported the REDD+ implementations of developing countries independently. The fragmentation and complexity of REDD+ support by the individual country and international organization, and the lack of relevant information, are thought to have been a limiting factor for implementing the quantitative research.

Second, the international community lacks a comprehensive, integrated information collection and reporting system for REDD+ support and international cooperation. Information related to the international REDD+ cooperation so far has been compiled independently for each country or international organization. Efforts have been made to integrate data from databases such as the Food and Agriculture Organization's (FAO) Voluntary REDD+ Database, and the Overseas Development Institute's (ODI) Climate Finance Update. However, there is still a lack of consistent data for empirical analysis.

Third, there is a problem of a time gap between the timing of when there are changes in the climate policies of each country, according to the changes in the international climate change regime, and the timing of when the REDD+ support for the developing countries is implemented. Due to the time differences between the changes in international climate regimes, national climate policy, and REDD+ implementation support for the developing countries, it is difficult to quantitatively analyze and design a model to examine how the changes in the climate regime and policies can directly affect the international cooperation.

Considering the abovementioned limitations of quantitative analysis, this study aims to analyze the characteristics of the bilateral REDD+ arrangements promoted over the past 10 years from 2006 to 2015 and suggest implications for coordination of international REDD+ cooperation to achieve the global-level GHG mitigation target. We have analyzed the impact of the recipients' needs for support (recipient need), the characteristics of recipients (recipient merit), and donor interest on the donors' recipient support decision (donor interest). Since comprehensive data for earmarked multilateral REDD+ supports of the donors, which should be considered as indirect bilateral supports, is not available, not the amount but the presence/absence of financial commitments was considered in this study.

## 2. Theorizing Bilateral REDD+ Financing

### 2.1. Linking Bilateral REDD+ Finance and ODA

Climate financing, including REDD+ financing, and Official Development Assistance (ODA) have different background, purpose, and principles of financing, but both are led by public sector rather than private sector [23–25]. On the one hand, climate finance can utilize resources from various sources with the aim of supporting climate change mitigation and adaptation. On the other hand, ODA aims to support economic and social development with a focus on poverty reduction

in developing countries and utilizes the finance of donor government of Organization for Economic Co-operation and Development-Development Assistance Committee (OECD-DAC). However, since much of the initial climate finance is financed by the public sector resources of developed countries, and it is difficult to distinguish climate financing from the existing ODA, climate finance shares similarities with ODA [23].

Developing countries that are preparing and implementing REDD+ have consistently requested international financial and technical assistance through a variety of channels. The phased approach for REDD+ has been agreed and supported internationally [6]. The readiness phase, the first step in the phased approach, focuses on establishing national infrastructure and capacity building for REDD+ implementation without the transfer of mitigation outcomes. Securing resources for REDD+ readiness phase of developing countries relies on a cooperative relationship with their donors. Evidence suggests that donors are supporting the REDD+ implementation in developing countries by disbursing financial resources through the ODA agency in each country and applying the criteria of ODA [15]. In this regard, REDD+ financing through bilateral cooperation is thought to have the characteristics of the ODA for climate change mitigation. Based on these characteristics, donor interest, recipient merit, and recipient need will have a significant impact on donor's bilateral REDD+ cooperation decisions, as identified in previous studies on ODA and climate financing.

## 2.2. Motivation for ODA and Climate Finance Supply

In research on ODA, several studies were conducted to analyze the determinants affecting the donors' recipient selection [26–28]. In the initial stages of research, studies were conducted to independently analyze models composed of variables related to recipient needs required for their development, and to donor interest of ODA [26,29,30]. Thereafter, to overcome the methodological problems of independently analyzing the two models, analyses were conducted in which recipient merit and donor interest were integrated into one model [31–34].

Recipient needs are related to the ideal international relations that support countries' development need, such as the alleviation of poverty and starvation. Evidence suggests that there is a relationship between the donor's support of recipient and variables, including per capita income and poverty level, infant and child mortality, and the population development index [35]. Other studies use variables that consider recipient merit for analysis, taking the donors' consideration of the effectiveness and efficiency of the assistance aid in their decisions on recipients into account [33,36].

As a part of foreign policy, donor's support via foreign aid can seek potential benefits from recipients, especially through strengthening economic and political ties. The donor interest represents such benefits and interests. As a representative variable for analyzing economic benefits, trade volume, including export and import between recipient and donor have been used in previous studies [37]. The political benefits expected from recipients through assistance can change the attitude of recipients to be favorable to donors in the international community [32]. Specific geopolitical variables, such as the colonial history shared by donors and recipients [38], the relationship between the United States and Latin countries, and between Japan and Asian countries, have been identified as political benefit determinants [33].

The model for donors' recipient decision determinants discussed in ODA studies was also applied in environmental aid [39] studies, including biodiversity aid [40,41], to confirm the relationship between the determinants and decisions. This model was also applied to research on the allocation of resources for climate change [42–44]. For recipient need, the country's economic level (GDP per capita), the size of the forest sinks (forest cover), and GHG emissions were considered, and determinants related to climate change vulnerability were introduced [44–46].

## 2.3. Distribution of ODA and Bilateral REDD+ Finance

As the bilateral foreign aid is essentially the own decision of respective donor countries, and there is a lack of coordination among donors in their foreign aid policy, the distribution of aids could be

unequal across the recipient countries. The recipient countries to whom the foreign aid are concentrated are referred to as ‘darlings,’ and the recipient countries who are relatively isolated from the aids are called as ‘orphans’ [47]. The reason for this phenomenon is the crowd-in of donor countries to certain recipient countries—that multiple donors provide aid to a certain recipient country at the same time—as donors select countries with favorable conditions for aid effectiveness, such as a high level of governance, and they compete to maintain ties with recipient countries who are considered as economically and politically important [47,48]. It has been pointed out that inefficiency and inequity of aid could be exacerbated, due to this pattern of aid distribution [49].

As bilateral REDD+ financing shares the characteristics of the bilateral aids, it is also possible that ‘darlings’ and ‘orphans’ exist in the bilateral REDD+ cooperation. Therefore, it is important to investigate whether this phenomenon is observed, and if so, what are the underlying reasons and the ways to improve the coordination of bilateral REDD+ cooperation that need to be discussed.

### 3. Methodology

#### 3.1. Scope and Data Collection

This study identifies the trend and status of REDD+ cooperation and evaluates variables affecting developed countries’ REDD+ recipient decision with a shared frailty model. This model aims to explain the determinants of the donors’ recipient selection in recurrent bilateral REDD+ cooperation, in consideration of donors’ heterogeneity. The relative effect on recipient selection is also analyzed using the variables, which represent recipient need, recipient merit, and donor interest. Previous studies on ODA and environment aid, including climate aid, mainly used data from the OECD DAC’s Creditor Reporting System (CRS) or Project-Level Aid Data. Instead, this study conducts the analysis based on FAO’s Voluntary REDD+ Database (VRD) [50], which have accumulated the REDD+ cooperation arrangements and have been continuously updated. Among the REDD+ arrangements reported to the FAO VRD, the cases of bilateral REDD+ committed from 2006 to 2015 were decided as the scope of analysis. This corresponds to 38.7% of the total case and 40.8% of the total commitment amount within the same period (as shown in Table 1). Various project activities were financed through bilateral REDD+ (as shown in Table 2). Of the 747 confirmed bilateral REDD+ arrangements, donors and recipients were identified to be 16 and 90 countries, respectively. Among the recipients, the cases of Germany and the Netherlands, which are the recipients of North-North cooperation, and Syria, where data available for analysis is limited, have been excluded. Finally, 738 cases of projects involving 16 donors and 87 recipients were analyzed.

**Table 1.** REDD+ financial commitments between 2006–2015 (Data source: Food and Agriculture Organization (FAO), 2016).

	No. of Cases	Total Amount (Mill. USD)	Mean (Mill. USD)	Median (Mill. USD)	Largest Contribution (Mill. USD)
Donor Countries to Institutions	476	6735.41	13.42 ( $\pm 35.88$ )	2.38	300.30
Between Institutions	123	598.25	4.90 ( $\pm 7.18$ )	2.65	45.36
Institutions to Recipient Countries	582	2539.10	4.08 ( $\pm 8.64$ )	2.20	80.00
Bilateral	747	6422.60	8.64 ( $\pm 52.86$ )	1.20	1029.69
Total	1928	15,755.36	8.21 ( $\pm 37.93$ )	1.88	1029.69

#### 3.2. Variables and Research Model

The presence of bilateral REDD+, the dependent variable, was coded based on data reported to the FAO VRD. Among the 1392 pairs of 10-year potential cooperation combination between 16 donors and 87 recipients, the actual bilateral cooperation between the two countries per year is indicated as 1, if it exists, or 0, if it does not exist. Of the 13,920 potential cooperation pairs, 1120 pairs of REDD+ cooperation were confirmed.



The dimensions of determinants of the international ODA and environmental aid allocation analyzed in previous studies are classified into the three categories: recipient need, recipient merit, and donor interest. In this study, the variables used in the previous studies were reflected in the bilateral REDD+ cooperation model. Based on the premise that the donor uses the information available when making decisions on the bilateral REDD+ cooperation, the time lag for the independent variables against the dependent variables was applied as one year [31] (Table 3).

**Table 2.** Types of actions for Bilateral REDD+ financing reported to FAO Voluntary REDD+ Database (VRD).

Category	Actions
National Strategy/Action Plan	REDD+ Strategy or Action Plan Sectoral transformation
National Forest Monitoring System/National Forest Inventory	Greenhouse Gas Inventory and National Forest Inventory Conceptualization and structure of the National Forest Monitoring System Forest Reference Emissions Level (FREL) Satellite Land Monitoring System Monitoring, Reporting and Verification system (MRV)
Safeguard Information System	Capacity building and local awareness including Governance Land tenure and rights Social and environmental benefits Stakeholder consultations and engagement System for Informing Safeguards, including web dissemination platforms/portal Web dissemination platforms/portal
Others	Biennial Update Report (including REDD+) Demonstration and pilot activities Nationally Appropriate Mitigation Action (NAMA) Research Results-based payments

**Table 3.** Variables of the model.

	Variable	Hypothesis	Reference
Recipient need	REDD+ Country Group		
	- High Forest Cover, High Deforestation (HFHD)	+	Author estimation based on FAO Global Forest Resources Assessment
	- High Forest Cover, Low Deforestation (HFLD)	•	
	- Low Forest Cover, High Deforestation (LFHD)	•	
	- Low Forest Cover, Low Deforestation (LFLD)		
	GDP per Capita	–	World Bank Developmental Indicators
	Human Development Index (HDI)	–	UNDP
Recipient merit	Governance		
	- Voice and Accountability <sup>a</sup>	+	World Bank: World Governance Index
	- Government Effectiveness <sup>b</sup>		
	- Regulatory Quality <sup>c</sup>		
	- Rule of Law <sup>d</sup>		
	- Political Stability and Absence of Violence/Terrorism <sup>e</sup>		
	- Control of Corruption <sup>f</sup>		
	Submission of proposal to FCPF, UN-REDD PROGRAMME	+	Forest Carbon Partnership Fund UN-REDD PROGRAMME
	Other bilateral commitments	+	Author estimation based on FAO Voluntary REDD+ Database
Donor interest	Import in USD of all products	+	World Integrated Trade Solution
	Export in USD of all products	+	World Integrated Trade Solution
	Colonial Tie	+	Centre d’Etudes Prospectives et d’Informations Internationales
	US-Latin Tie	+	•
	Japan-Asia Tie	+	•

<sup>a</sup> Awareness of the public choice of a government, freedom of speech, freedom of the press, and freedom of association; <sup>b</sup> awareness of the quality of public service, policy formation and implementation, and on the policy credibility; <sup>c</sup> awareness of sound policies and regulations establishment, and implementation related to private sector development; <sup>d</sup> awareness of the observance of social regulations such as contract implementation, property rights, and law; <sup>e</sup> awareness of political instability, political violence, and terrorism; <sup>f</sup> awareness of the corruption of governmental authority in pursuit of private interest or elitism.

### 3.2.1. Recipient Need

GDP per capita and the Human Development Index (HDI), which are variables reflecting the economic level of the recipient and the need for humanitarian assistance, were included. Considering the objectives of REDD+ support aiming for the prevention of deforestation and forest preservation, the REDD+ Country Group variable based on the national forest cover ratio and deforestation rate of the recipient was introduced. Applying the classification method used by [51], if the average forest cover against the national land area during 1990–2015 reported to FAO Global Forest Resource Assessment was 50% or higher, the country was classified as high forest (HF). If it was lower, then the country was classified as low forest (LF). When the annual average deforestation rate was higher than 0.38% of the mean value of all countries to be analyzed, the country was classified as high deforestation (HD), and when it was lower, the country was classified as low deforestation (LD). In this way, countries were included as dummy variables in the model consisting of HFHD, HFLD, LFHD and LFLD [22,51].

As evidence in previous studies suggests, it is expected that the lower the GDP per capita gets—indicating the need for economic assistance—and the lower the HDI is—indicating the need for humanitarian assistance is—the more likely the donor will support recipients. Additionally, in the case of the REDD+ Country Group of recipients, since the purpose of REDD+ is to mitigate climate change through the reducing deforestation and forest degradation, it is expected that the higher the national forest cover ratio and deforestation rate gets, the higher the probability of support will be. What needs to be noted in this case is that the importance of countries with abundant forest cover but low deforestation rate (HFLD) can be overlooked compared to countries with rich forest cover and high deforestation rates (HFHD) [51]. To confirm the relationship between the recipient's national forest cover ratio and the deforestation rate to donor's support decision, we investigated the relative importance of HFHD and HFLD compared to LFLD.

### 3.2.2. Recipient Merit

World Governance Indicators (WGI) [52], which provides six governance indicators for a country, were used, and the impact of each indicator was examined (Table 3). According to the previous ODA studies, the better the recipient's policy and governance level become, the higher the donor's support potential is expected. This is because the donor may seek better performance of the support. Paradoxically, however, poorer recipient's policy and governance may be rather judged as needing more support [53]. In the case of REDD+ supports, developing countries need to strengthen policies and governance related to the mitigation of deforestation and forest degradation. Therefore, to establish the forest monitoring and reporting system to estimate the mitigation outcomes in the forest sector, and to induce governance-related stakeholder engagement, it can be thought that the better the governance system of the country gets, the higher the probability will be to receive the support. On the contrary, it can also be thought that more support can be provided, to strengthen and develop the poor governance status for REDD+ countries.

The commitment amount for bilateral REDD+ supported by other countries for recipients was reflected. As a dummy variable, the submission of REDD+ proposals (FCPF Project Idea Note and/or UN-REDD+ Programme Joint Program Proposal) was used as an indicator for judging REDD+ related policy efforts of the recipient countries.

### 3.2.3. Donor Interest

The key motivation for the donor's selection on the ODA recipient was identified to be the economic and geopolitical benefits of the donor from recipient [31,33,34,54]. Similar to the case of ODA, this trend can also appear in bilateral REDD+ financing. For analysis, the amount of imports and exports between a donor and a recipient represent the donor's economic interest variables, and past colonial ties between the donor and recipient, US-Latin tie, and Japan-Asia tie represent geopolitical interest variables that were included as dummy variables.

### 3.3. Analysis

The determinants of the donor's decision to support REDD+ countries were analyzed with a shared frailty model, which fits the time-series data and makes it possible to consider heterogeneity between the donors. Frailty models are more developed than the proportional hazard model [55], which has been used widely in survival analysis [56]. The frailty models make it possible to take account of the heterogeneity of a sample or a group of samples, which is caused by unmeasured covariates [56]. The models estimate effects of the frailty term, a random effect which is not included in the proportional Cox hazard model, and the covariate on the baseline hazard. In a shared frailty model, the observations are correlated when entities are in the same group, or recurrent events occur; thus, they share the same frailty [56,57].

The shared frailty model for this research was analyzed with 'frailtyEM' package version 1.0.1 (22 September 2019) [58] in R version 4.0.1 (6 June 2020) [59]. According to [58], in 'frailtyEM', the shared frailty model framework is composed of  $I$  clusters with  $J_i$  subjects within cluster  $i$ ,  $i = 1, \dots, I$ . A counting process  $N_{ij}$ , denotes subject  $j$  from cluster  $i$ 's event history, and  $N_{ij}(t)$  represents the frequency of events until time  $t$ . The baseline hazard function  $Y_{ij}(t)$  is 1 when the subject ( $ij$ ) is included in the observation period and 0 otherwise.  $X_{ij}(t)$  represents a vector of time-dependent covariates. The hazard function  $N_{ij}$  is specified as

$$\lambda_{ij}(t|Z_i) = Y_{ij}(t)Z_i \exp(\beta^\top x_{ij}(t))\lambda_0(t)$$

where  $Z_i$  is the shared frailty, an unobserved random effect shared to cluster  $i$ 's observations,  $\beta$  is a vector of regression coefficients, and  $\lambda_0(t)$  is an unspecified baseline hazard function. More explanation about the shared frailty model is available in [56,58,60].

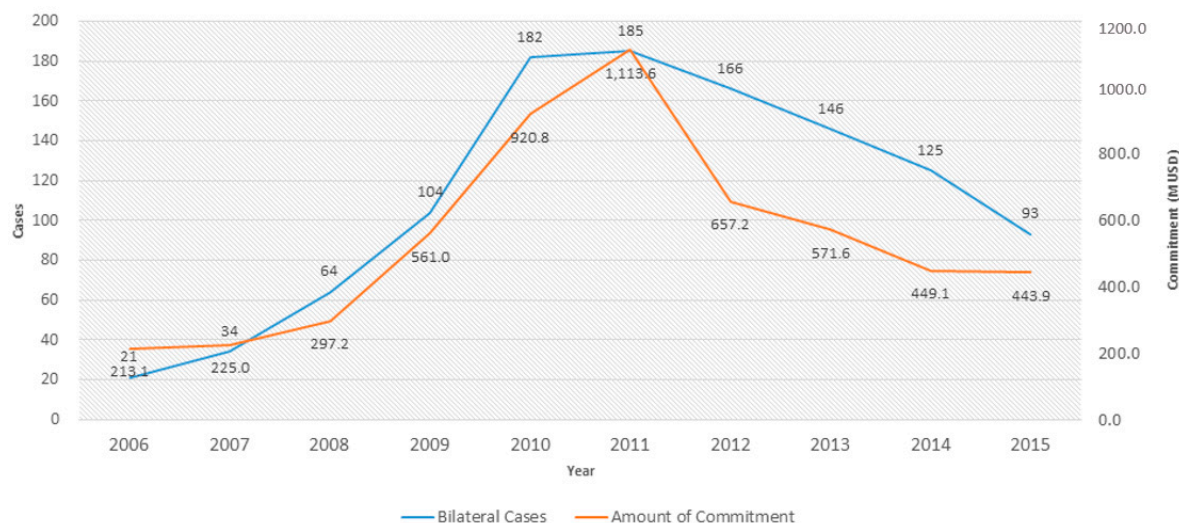
In the model of this research, variables representing recipient need, recipient merit, and donor interest are included as covariates. Groups of bilateral REDD+ cooperation (recurrent REDD+ supports from the same donor) share the same frailty, and their time periods are assumed to be conditionally independent, given the frailty variable. A shared unobservable quantity in the hazard induces a correlation among the presence time of the  $j$ th subject (REDD+ support) in the  $i$ th cluster (donor). The model was fitted as a gamma frailty model to estimate regression coefficients to identify the effects of each variable. The Commenges-Anderson test for heterogeneity and variances of frailty are also assessed, to confirm the degree of heterogeneity in the data and relevancy of the random effect distribution.

## 4. Results

### 4.1. Status of Bilateral REDD+ Financing

Figure 1 shows the trend of annual project frequency and the commitment amount of 738 bilateral REDD+ projects analyzed, reflecting the project period. Both the increase and decrease in project frequency and commitment amount showed similar trends. The frequency of bilateral projects was 21 in 2006, but then gradually increased to reach a peak at 185 in 2011, and then decreased to 93 in 2015. In 2006, the commitment amount of the bilateral REDD+ project was USD 2.131 million, which then increased until 2011, reaching USD 11.136 million, but then continued to decrease until 2015. The frequency and commitment amount of bilateral REDD+ projects increased around 2010, as discussions on REDD+ in international climate negotiations progressed. The 2009 Copenhagen Accord and the 2010 Cancun Agreements encouraged REDD+ financing for developing countries by developed countries. In addition, financing is thought to have increased during this period, due to the optimistic expectation about the global REDD+ mechanism [15]. For example, since 2010, the Fast Start REDD+ Financing, a bilateral commitment from developed countries, such as Australia, Canada, and Denmark, to support REDD+ was in progress. In particular, our analysis suggests that financing has increased in this period, as Norway committed a large-scale amount of support to Brazil, Guyana, and Indonesia [13].





**Figure 1.** Trends in bilateral REDD+ project cases and amount of commitment between 2006–2015.

Table 4 shows the top 10 countries that committed the largest amount of bilateral REDD+ projects from 2006 to 2015. The commitment amount of the top 10 donors among 16 donors accounted for 97.17% of the total commitment amount. In particular, a small number of countries, such as Japan and Norway, led bilateral REDD+ financing. During the period, Norway committed approximately USD 1932 million, accounting for 35% of the total commitment amount, and Japan contributed about USD 1572 million, supporting 28% of the total commitment amount. The bilateral REDD+ commitment amount from Norway and Japan accounted for over 63% of the total amount.

**Table 4.** The amount of financing commitment and the associated ranking of the donor countries (2006–2015).

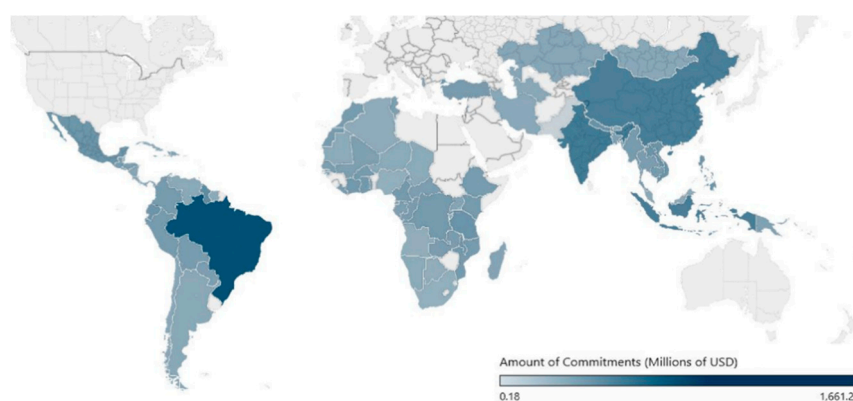
Rank	Donor Country	Commitment between 2006–2015	
		Total Amount (M USD)	%
1	Norway	1932.48	35.44
2	Japan	1571.68	28.83
3	United States of America	434.74	7.97
4	Germany	419.91	7.70
5	France	357.26	6.55
6	Australia	179.44	3.29
7	Finland	131.22	2.41
8	United Kingdom	125.58	2.30
9	Italy	99.29	1.82
10	Switzerland	46.75	0.86
Total		5298.35	97.17

Table 5 shows the top 10 countries based on the total allocated commitment amount among the recipients of bilateral REDD+ projects from 2006 to 2015. Among the 87 recipients, 78.6% of bilateral cooperation-based REDD+ financing is concentrated in the top 10 countries, as shown in Table 5 and Figure 2. This lends evidence to the darling and orphan phenomenon, where large-scale REDD+ funding is concentrated in a few developing countries. In particular, the amount of support funding for REDD+ implementation in Brazil was USD 1661.3 million, accounting for approximately 30.5% of the total amount of bilateral cooperation-based REDD+ financing. The core objective of REDD+ is to reduce GHG emissions through the prevention of deforestation and forest degradation. Thus, evidence suggests that international financing is concentrated on tropical rainforest countries with large forests [51]. Our results also provide support to this argument, as the top 10 REDD+ recipients

were mostly tropical rainforest countries with relatively large forests. However, through Figure 2, it can be seen that REDD+ financing was committed to non-tropical countries as well, including Middle East Asia, especially, China, which ranked second in terms of its total commitment amount.

**Table 5.** The amount of financing commitment received and the associated ranking of the recipient countries, with forest status (2006–2015).

Rank	Recipient Country			Commitment between 2006–2015	
	Name	Forest Area in 2015 (ha)	Mean Annual Forest Area Change 1990–2014 (%)	Total Amount (M USD)	%
1	Brazil	4,935,380	−0.42	1661.29	30.47
2	India	706,820	0.41	633.18	11.61
3	Indonesia	910,100	−1.06	583.90	10.71
4	China	2,083,213	1.15	566.99	10.40
5	Guyana	165,260	−0.03	255.30	4.68
6	Nepal	36,360	−1.16	133.39	2.45
7	Tanzania	460,600	−0.77	128.32	2.35
8	Viet Nam	147,730	1.88	110.77	2.03
9	Philippines	80,400	0.74	107.20	1.97
10	Lao PDR	187,614	0.22	106.54	1.95
Total				4286.88	78.62



**Figure 2.** Amount of Commitment allocated to Recipient countries of Bilateral REDD+ projects between 2006–2015.

#### 4.2. Determinants of Bilateral REDD+ Financing

Table 6 summarizes the results of the shared frailty model analysis on the determinants of recipient selection of donors in bilateral REDD+ projects. The random effect in the model was found to be significant by results of the Commenges-Andersen test for heterogeneity ( $p < 0.05$ ), and the likelihood ratio test ( $p < 0.05$ ). The 95% confidence interval for the frailty variances did not include 0, which also supports the random effect in the model.

The results suggest that REDD+ Country Group, ln (GDP per capita), and HDI among the variables related to the recipient need, affect the donor-recipient decision. Among REDD+ Country Group, countries with high forest cover ratio against the land area and deforestation rate (HFHD), and countries with high forest cover ratio but low deforestation rate (HFLD) were found to be more likely to be selected as recipients than those with a low forest cover ratio and a low deforestation rate (LFLD) by 52.3% ( $p < 0.05$ ) and 29.4% ( $p < 0.05$ ), respectively. When ln (GDP per capita) and HDI increases by a unit, a recipient is less likely to be selected as a recipient by 12.5% ( $p < 0.05$ ) and 87.7% ( $p < 0.05$ ), respectively.

As for the variables on recipient merit, political stability and voice and accountability are found to have an effect on recipient decision. REDD+ support request proposal (R proposal) to the international community, which represents the capabilities and determination towards REDD+ implementation, and the commitment amount by other bilateral donors to the recipients were also found to have an impact as well. The impact of governance sub-indicators on donor's recipient decisions did not show consistent patterns. Governance sub-indicators presented by WGI [52] indicate that as each indicator

increases, governance grows better. As for the political stability indicator, a recipient country is more likely to be selected by 14.2% ( $p < 0.05$ ) with a unit increase of the indicator. However, with a unit increase of the variable voice and accountability, the chance to be selected as a recipient decreased by 36.3% ( $p < 0.05$ ). The other WGI indicators, including control of corruption, regulatory quality, rule of law, and government effectiveness, were found to have no effect. In addition, the chance of being selected as a recipient was 17% higher when the amount of the bilateral REDD+ commitments of the other donors increases by 1 unit ( $p < 0.05$ ). Through this, as in the case of ODA, we found that bilateral REDD+ cooperation also has a crowding-in effect. Lastly, the chance to be a recipient was 82.4% higher ( $p < 0.05$ ) for the countries, which expressed their intention to participate in the FCPF, or UN-REDD PROGRAMME, or requested support (R proposal), compared to those who have not indicated such an intention.

**Table 6.** Result of the shared frailty model for bilateral REDD+ recipient country selection.

Variable	Coefficient	Hazard Ratio	se (coef)	adj. se	z
REDD+ Country Group	LFLD <sup>a</sup>	-	-	-	-
	HFHD <sup>b</sup>	0.421 *	1.523	0.090	4.668
	HFLD <sup>c</sup>	0.258 *	1.294	0.099	2.610
	LFHD <sup>d</sup>	-0.144	0.866	0.094	-1.541
ln(GDP per capita)	-0.134 *	0.875	0.047	0.047	-2.879
HDI <sup>e</sup>	-2.099 *	0.123	0.465	0.465	-4.516
Political Stability	0.133 *	1.142	0.053	0.053	2.507
Control of Corruption	0.123	1.130	0.128	0.128	0.960
Regulatory Quality	0.087	1.091	0.091	0.091	0.964
Rule of Law	-0.160	0.852	0.152	0.152	-1.052
Government Effectiveness	0.129	1.138	0.104	0.104	1.248
Voice and Accountability	-0.450 *	0.637	0.077	0.077	-5.836
ln(Other's Commits) <sup>f</sup>	0.157 *	1.170	0.026	0.026	6.080
R proposal(1) <sup>g</sup>	0.601 *	1.824	0.079	0.079	7.610
ln_Import	0.002	1.002	0.017	0.017	0.087
ln_Export	0.180 *	1.197	0.025	0.025	7.296
US-Latin tie(1)	0.174	1.190	0.232	0.232	0.751
Japan-Asia tie(1)	0.811 *	2.249	0.158	0.158	5.121
Colonial tie(1)	1.014 *	2.757	0.113	0.113	8.982
Summary Statistics					
Fit Summary	Commenges-Andersen test for heterogeneity Log-likelihood				( $p < 0.05$ ) -7430.051 *
Frailty summary		Estimate	lower 95%	upper 95%	
	Var(Z)	0.690	0.373	1.406	
	Var(logZ)	0.978	0.452	2.763	
	theta	1.450	0.711	2.678	

Note: <sup>a</sup> Low Forested Low Deforestation rate country; <sup>b</sup> High Forested High Deforestation rate country; <sup>c</sup> High Forested Low Deforestation rate country; <sup>d</sup> Low Forested High Deforestation rate country; <sup>e</sup> Human Development Index; <sup>f</sup> Amounts of other donors' bilateral commitments; <sup>g</sup> Recipient's submission of proposal/participation document to UN-REDD PROGRAMME and/or FCPF; \*  $p < 0.05$ .

Among the donor interest variables, we found that the variables export volume of the donor, Japan-Asia tie, and colonial ties affected the recipient decision. The trade volume variables between donor and recipient representing economic benefits, when the export volume increased by 1 unit, the chance of being determined as a recipient increased by 19.7% ( $p < 0.05$ ). However, the import size was found to have no effect. Recipients have had a colonial experience of the donor in the past showed 175.7% higher chance ( $p < 0.05$ ) to be selected than the recipients without the colonial tie. For Asian recipients, the chance of being selected by Japan increased by 124.9% ( $p < 0.05$ ). However, the US-Latin tie showed no effect.

## 5. Discussion

Similar to previous studies on ODA and environmental ODA, we found that the recipient's needs and merits, and donor's interest indeed affected the decision of the donors on the recipient selection in bilateral REDD+ supports. Given the results of the shared frailty model analysis and the hazard ratio of the variables, the donor's economic and geopolitical benefits (e.g., export volume, Japan-Asia tie, and colonial tie) and recipient merit (e.g., submission of international REDD+ proposal) had more effects on the bilateral REDD+ cooperation than that of the recipient need.

### 5.1. Determinants of Bilateral REDD+ Financing

Similar to previous studies on climate change ODA, which identified that the larger the forest cover got, the more financing was allocated [61], we found that the donors were more likely to support countries with a higher ratio of forest cover than those with lower forest cover ratios as recipients. There also have been concerns reported that the financing for REDD+ tends to be concentrated on the countries with large forest cover and high deforestation rate (HFHD), compared to the countries with large forest cover but a low deforestation rate (HFLD), which have been left out from donor support [51]. In this study, when comparing hazard ratios of HFHD countries and HFLD countries, HFHD countries were more likely to be determined as REDD+ recipient than HFLD countries. However, HFLD countries were also highly likely to be designated as recipients. Therefore, it is difficult to judge that HFLD countries were neglected from REDD+ support. In general, the target of the bilateral cooperation-based REDD+ support project is GHG mitigation through forests. In terms of the mitigation efficiency, HFHD countries with large mitigation potential are the most preferred recipients. Additionally, REDD+ can be expected to create various environmentally beneficial effects, such as promoting biodiversity, protecting water resources, and preventing disasters, as well as increasing forest sinks [62]. If the forest ratio in the country is high, even if the deforestation rate is low, various ecosystem service enhancement effects can be expected through forest conservation and, thus, are more likely to be determined as a REDD+ recipient.

Based on GDP per capita and HDI, the probability of being selected as a recipient of bilateral REDD+ cooperation becomes higher in countries with lower economic power or quality of life. For the success of the REDD+ project, it is of prime importance to prepare alternative incomes, such as new industries and jobs that can mitigate deforestation in countries or communities where there is a high level of livelihood or economic dependence on forests, and that show seriously high levels of deforestation. Successful implementation of REDD+ not only reduces GHG emissions but also changes a country from a forest-dependent socio-economic structure, with much consumption of forest resources, to a structure of sustainable forest resource use, indicating that the possibility of improving the quality of life would increase. Norway is pursuing poverty reduction as a goal, as well as GHG mitigation through REDD+ cooperation [63]. From this point of view, developing countries with abundant forest resources but with low national economic power and quality of life, and in urgent need of support to enhance the capabilities of human resources, could be considered as major characteristics to be REDD+ recipients.

### 5.2. Recipient Merit

Since countries with outstanding recipient merit are more likely to increase their outcomes through various international supports, the likelihood of those countries being determined as a bilateral cooperation-based ODA recipient will also increase. However, in previous studies, among the several variables that comprise the recipient merit, the governance characteristics of recipients have been shown to have different effects on donor's decision to support the recipients depending on the circumstances [36,40,41]. For example, one may expect that, the higher the government's corruption index is, the less likely the country is to receive ODA. However, there have been reports that there is no relationship between the corruption level and ODA allocation [64]. For example, [65]

found that a country with a high level of corruption received more ODA. The results of these studies can be understood as follows: the impact on ODA recipient decisions varies depending on whether the recipient's governance characteristics are regarded as targets for improvement through ODA support (for support purposes) or as an infrastructure for improving ODA outcome. Similarly, our results showed that, when donors determine the REDD+ recipients, the level of political stability was considered as infrastructure, which can be taken as an advantage for REDD+ implementation. Another governance factor, voice and accountability, was pointed out as a support target that needs to be improved and enhanced through REDD+ support. The recipient's governance characteristics are an important factor in terms of the Warsaw REDD+ framework implementation. For the successful REDD+ implementation, the governments of developing countries are required to enact and enforce the related laws, enhance the capabilities for policy establishment and implementation, coordinate and manage conflicts between stakeholders surrounding the issue of resources use, and increase the communication and participation of native people residing in the forests, for the sustainable use and management of forest resources [66]. However, except for a few countries, such as Brazil, the majority of developing countries yet to implement REDD+ still remain in the REDD+ readiness phase, and various financial and technical supports are needed to strengthen their governance capabilities. In this context, enhancing the capacity of governance of the recipient government for the REDD+ implementation can be the target of the bilateral REDD+ project (as shown in Table 2).

In this study, we also found that the higher the recipient's intention for REDD+ support becomes, the higher the probability will be to be selected as a recipient. Recipients who voluntarily submitted their proposals to FCPF and UN-REDD PROGRAMME to receive REDD+ support from the international community are more likely to be determined as a bilateral cooperation-based REDD+ recipient. To get support from the FCPF or the UN-REDD PROGRAMME, developing countries must voluntarily fill out and submit their REDD+ implementation and action plans, along with detailed support requests for such implementation. In other words, the voluntary requests for support from these developing countries announce their determination and the support needed for REDD+ implementation to the international community. We found that this characteristic of the recipient also affects the decision of the bilateral REDD+ support.

This study found that a donor is more likely to decide a developing country as a recipient when the other donors provide more supports to the developing country. This is attributed to the fact that REDD+ financing is concentrated on specific recipients. The authors of [47] found that, in bilateral ODA allocation, as the aid of the other donors focused on specific recipients, the amount of aid to a recipient of a donor increased. Analyzing this phenomenon for ODA support, it is observed that the effect of donor cartel and herding have been developed between donors, in order to reduce the failure risk of ODA and increase the potentially expected benefits through ODA, through which the darling and orphan phenomenon has occurred [47]. This study also found that, in bilateral cooperation-based REDD+ support, the darling and orphan phenomenon has occurred. As can be seen from Table 6, 79% of total financing is concentrated on the top 10 recipients.

### 5.3. Donor Interest

This study's results suggest that the opportunity of being determined a REDD+ recipient increased as the export volume from donor to recipient increased. These results indicate that donors consider potential economic benefits from recipients when deciding REDD+ recipients. Existing ODA studies claim that donors are using ODA as a strategic means to expand trade relations with recipients, and the larger the export and import trade volume between donor and recipient, the more likely it is that additional ODA projects will be promoted [33]. In this context, it is believed that, in determining REDD+ recipients, donors consider the potential economic benefits through REDD+ support, as well as maintaining and enhancing trade relations with recipients through REDD+ cooperation.

In the case of bilateral REDD+ cooperation, the past colonial tie between donor and recipient also showed a positive effect on recipient decision. On the surface, these characteristics can be interpreted



as the implementation of compensation and responsibility for colonization of specific developing countries after the end of the colonial era of developed countries. However, delving deeper reveals that donors utilize rich information and a high understanding of the forests and other resources of developing countries (or recipients) obtained through the colonial rule period, and also use political solidarity with the political, economic, and social leaders in developing countries, which still remains to this date [33]. In the bilateral REDD+ support, Japan supported developing countries in the Asian region, while European countries support African and Asian countries with colonial ties. Japan has been providing ODA support for a long period of time to developing countries in the Asian region, with the concentration of countries that had previously been colonized by Japan in Asia. This bilateral cooperation infrastructure that Japan has established with Asian countries still has an impact on REDD+ cooperation and support, and, in line with this, additional geopolitical and economic benefits through REDD+ support can be expected. European donors, which had colonial policies, also promoted ODA based on political interests with recipients with past colonial ties, and these political interests are thought to have affected REDD+ cooperation. In contrast, in the REDD+ support relationship between the United States and Latin American countries in Central and South America, which are geographically close, those ties are found to exhibit little impact. The Global Climate Change Initiative, a major REDD+ assistance agency, provides REDD+ support for major continental rainforest countries such as Africa (Congo, etc.) and Southeast Asia (Indonesia), as well as the Americas, such as Mexico and the Amazon.

#### *5.4. Coordinating Bilateral REDD+ Efforts*

To implement national-level REDD+, developing countries need to adjust their national plans and allocate a significant amount of their national budgets for each REDD+ phase. In addition, the REDD+ countries face various political-economic risks in REDD+ policy process, which hinder effective, efficient, and equitable REDD+ policy implementation [67]. Therefore, sufficient financial funding or technical support is required to satisfy the participation constraints of the developing countries for joining REDD+.

Although there is a high demand for financing for REDD+ implementation in developing countries, the international REDD+ financing has not been able to meet such a high demand for support in developing countries. Under these circumstances, the bilateral REDD+ support of developed countries can be used as a strategic means to seek political and economic benefits. For example, Norway's International Climate and Forest Initiative (NICFI), which has been provided with a huge amount of REDD+ grants, might have provided political offsets to alleviate criticisms on the lack of domestic emissions reduction efforts [68]. In addition, under the Paris Agreement regime, REDD+ cooperation might become more strategic to secure Internationally Transferred Mitigation Outcomes (ITMO), which can be used toward NDCs.

In the bilateral REDD+ cooperation to support REDD+ RBPs conducted until 2015, recipient need, recipient merit, and donor interest were considered together. However, an imbalance appeared, in which support was concentrated on specific recipients. Even if a developing country had high potential for GHG mitigation through REDD+, when its merit as a recipient was not sufficient and might decrease the potential for mitigation (mitigation efficiency) against the same amount of investment, or when complex economic and political interests were involved, the countries could be left out from the REDD+ supports.

Through the UNFCCC climate change negotiations, the international community agreed to support the REDD+ implementation efforts of developing countries, and the result-based compensation and institutional arrangement were discussed centered on the Global Climate Fund (GCF). To reduce GHG emissions and achieve the 2 °C target on a global level, more integrated financial and technical support with capacity building is required for the REDD+ implementation of developing countries. However, as a result of analyzing characteristics of the bilateral cooperation-based REDD+ support promoted in the past 10 years, the REDD+ darling and orphan phenomenon was found in the pattern

of support. Under the Paris Agreement regime, which will start in 2021, the Parties should achieve their NDC. It is more likely that the REDD+ cooperation between the Parties would further pursue their own economic and environmental interests such as concentrating on securing the REDD+ mitigation outcomes, which would be estimated to have high cost-effectiveness through voluntary cooperation between the parties under the cooperative approach mechanism, based on the Paris Agreement Article 6.2.

The imbalance of REDD+ support concentrated on the REDD+ darling countries would cause inefficiency in the global level GHG mitigation to tackle climate change. The coordination of bilateral REDD+ cooperation, however, could be very difficult because a country's decision of support on the bilateral cooperation is a matter of national sovereignty. Therefore, the role of multilateral cooperation through international organizations and international funds becomes even more important to alleviate the problem of bilateral-based REDD+ support being concentrated on specific developing countries, and the issue of multiple developing countries being neglected from REDD+ support. To achieve the global GHG mitigation target effectively, it is necessary not only to attempt approaches to enhance efficiency of multiple bilateral cooperation for the REDD+ darlings, such as a climate team approach [69], but also to prepare alternatives and solutions to support the REDD+ orphans to increase their access to financing.

## 6. Conclusions

This study explains the trends and status of bilateral REDD+ cooperation and investigates determinants affecting REDD+ recipient decisions of donor countries by analyzing bilateral REDD+ arrangements, which has been promoted for 10 years under the Kyoto Protocol regime from 2006 until 2015. Furthermore, it analyzes the trends of coordination of providing international REDD+ support for the developing countries to achieve GHG mitigation targets on a global level.

According to the analysis results, Norway and Japan have supported more than 63% of the total financial pledges for bilateral REDD+ arrangements. Out of 87 REDD+ recipients, four countries—Brazil, India, Indonesia, and China—accounted for more than 63% of the 10-year REDD+ financial pledges, and about 78% of total financing was concentrated in the top 10 recipients. Thus, the REDD+ darlings and orphans problem was observed. As a result of the shared frailty model analysis, recipient need, recipient merit, and donor interest have been shown to be the determinants of donor's REDD+ recipient decision. In particular, donor interest and recipient merit were found to have a more significant impact on REDD+ support than recipient need.

In terms of GHG mitigation efficiency, it is expected that the bilateral REDD+ cooperation could serve as an effective means for achieving the mitigation targets of Parties. Under the Paris Agreement regime—in which the Parties agreed on the use of the ITMOs toward NDCs, though it has not been decided yet whether the REDD+ outcomes can be recognized as the ITMOs—the tendency of imbalance in the bilateral REDD+ cooperation concentrating on certain REDD+ darling countries is expected to increase. In terms of global GHG mitigation, however, it is very important for several REDD+ orphan countries to strengthen their REDD+ implementation capabilities and directly participate in mitigation actions. The operation of a system for building and sharing information for bilateral REDD+ cooperation under the cooperative approach needs to be considered to reduce the fragmentation of REDD+ support, and to be utilized in the coordination of the REDD+ cooperation among others. International REDD+ support for the REDD+ orphan countries is in need, so that the result-based compensation system can be more effectively implemented for the developing countries who have been isolated from the bilateral REDD+ cooperation. A balanced two-track approach is further required, in which, along with the intensive bilateral REDD+ cooperation focused in the REDD+ darling countries, international organizations and multilateral funds for REDD+ need to increase financial accessibility, including the result-based compensation system for the REDD+ orphan countries.

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