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Are national commitments to reducing emissions from forests effective? Lessons from Indonesia[☆]

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ABSTRACT

For Indonesia to achieve its greenhouse gas emission reduction commitments, it will have to reduce emissions from deforestation, forest degradation and peatland degradation. The National Action Plan for Greenhouse Gas Emissions Reductions was Indonesia's first comprehensive plan. It reflected Indonesia's emission reduction commitments to 2020, and the first phase ran from 2010 to 2014. This research evaluates its design and implementation. It assesses seven out of thirteen actions that were implemented to reduce emissions from forestry and peatland degradation. It is shown that only two actions had a direct, evidence-based link to emission sources. Three actions had some evidence of a link, albeit dependent on many factors. For the remaining two actions, focused on emissions from agriculture in peatland, there was no information to demonstrate clear and targeted implementation of the actions. The analysis also shows that the indicators listed in the National Action Plan were insufficient to demonstrate meaningful reductions of emissions. Part of the explanation for the problematic design of the actions is that many of them were pre-existing policies, aimed at achieving a variety of different objectives that were just rebadged as climate change actions.

1. Introduction

In 2015, Indonesia committed to an unconditional reduction of 29% and conditional reduction up to 41% of its emissions of greenhouse gases (GHG) by 2030 (Tacconi and Muttaqin, 2019). As the Indonesian government prepares the detailed design of the policies to deliver on its commitment, it is important to learn lessons about its previous commitments to reducing emissions. Learning those lessons can inform policies in Indonesia, in other countries that have committed to reducing emissions, as well as the process of development of reporting about whether the pledges presented in the Nationally Determined Contributions (NDCs) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) are being delivered.

At the G20 meeting in 2009, the Indonesian President committed to reducing GHG by 2020 by 26% unconditionally and by a further 15% conditional on international financial support (GoI, 2011). Presidential regulation No. 61 of 2011 on the National Action Plan for Greenhouse Gas Emissions Reductions (GoI, 2011) (hereafter RAN-GRK, based on the Indonesian acronym) was designed to guide the implementation of policies to reduce emissions of GHG. The RAN-GRK was the culmination of several action plans, roadmaps and communications. It outlined specific targets for the reduction of emissions in industry, energy, waste, agriculture and land use change and forestry. It detailed actions to achieve the sectoral targets, identified indicators for achieving those actions, and assigned the Ministries (and Directorates within them) responsible for implementation. Unlike previous policy statements by the government, which often lacked detail, the RAN-GRK was a Presidential regulation, which gave it a strong mandate. It had a coordinating secretariat located in the Ministry of National Development Planning, a requirement for sub-national planning and implementation, and identified timelines for implementation and revision of emission reduction actions. The first stage of implementation ran from 2010 to 2014. A second phase was originally planned to be prepared after the assessment of the first phase and to commence implementation in 2017. However, it was superseded by the NDC process (BAPPENAS, 2015a).

Agriculture, forestry and land use change (including peat fires) accounted for about 59.2% of Indonesia's annual emissions in 2014, making it the largest source of emissions by sector (Ministry of

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Environment and Forestry, 2017) Without effectively reducing emissions in this sector, it will be impossible for Indonesia to meet its and/or unconditional conditional targets. Given its significance, this paper focuses on the RAN-GRK's actions to reduce emissions from forestry and peatland.[1]

The government of Indonesia has undertaken several reviews of the RAN-GRK, or aspects thereof (including BAPPENAS, 2015a; MoEF, 2015; PPN/Bappenas, 2017). For example, the official review carried out as part of the UNFCCC process, the Biennial Update Report (MoEF, 2015) reported that 40 of the actions (out of 45 actions)[2] in the RAN-GRK had been fully implemented. For the forest and peatland sector, it was reported that five actions had been completed, two had been completed but were ongoing and the final four had not been completed (MoEF, 2015). There was no reporting about the actual emissions reductions achieved by the implementation of those actions. The lack of reporting on actual reduction of emissions could be due to the lack of detailed and high-quality data on the amounts of emissions, both baseline and changes, due to the implementation of activities. The reported reductions of emissions were based on overall assessments such as a change in the deforestation rate.

The academic literature assessing Indonesia's mitigation efforts in the LULUCF sector has largely focused on assessing individual policies, such as the moratorium on forest concessions (Busch et al., 2015) or the development of forest management units (FMUs) (for example Kim et al., 2016; Sloan, 2014).[3] Busch et al. (2015) found that whilst the moratorium on forest concessions led to a reduction in emissions, the total reductions were likely to be far less than the expected ones, and policies such as moratoria are best thought of a stop-gaps, rather than sustainable solutions. There has not been an academic examination of the actions in the RAN-GRK, their relationship to emission sources, and of the indicators used to assess success in the implementation of the actions.

This research contributes to filling this gap by evaluating the content of the actions outlined in the RAN-GRK as well as the appropriateness of the indicators used to measure success. Evaluation of the actions chosen—their ability to effectively address drivers of emissions from LULUCF—is needed to assess the likelihood that successful implementation leads to emissions reductions. This is also necessary to assess whether the indicators such as those outlined in the RAN-GRK are appropriate. This study asks two questions: i) could the actions adopted in the RAN-GRK for the LULUCF sector have been expected to plausibly reduce emissions? ii) Were the indicators for each action appropriate to demonstrate a reduction in activities that cause GHG emissions?

The paper is structured as follows. Section 2 presents the background to the Indonesian context, including a breakdown of sources in the LULUCF sector and a description of the RAN-GRK and its formulation. Section 3 presents the research methods, including a review of the monitoring and evaluation literature and develops a framework for assessing the RAN-GRK. Section 4 outlines the key findings based on the analysis of documents and interviews before the discussion of policy implications in section 5.

[1] The RAN-GRK uses the category of forestry and peatland separately from agriculture. There is no explicit information about how this aligns with the category of LULUCF from previous reporting under the UNFCCC.

[2] It is unclear whether the remaining five were not implemented, or whether they were not accounted for.

[3] The moratorium was part of the letter of Intent with Norway and is not directly included as a mitigation activity under the RAN-GRK framework.

2. Emissions and policies aimed at reducing them

2.1. Indonesia's GHG emissions

According to Indonesia's Second National Communication to the UNFCCC (Ministry of Environment, 2010) —which was the basis for the RAN-GRK—Indonesia emitted between 1.2 and 2.6 $GtCO_{2e}$ per year between the years 2000–2005 (average of 1.67 $GtCO_{2e}$ per year), and had projected emissions to 2020 of 2.95 $GtCO_{2e}$. At the time the RAN-GRK was prepared, key emissions sources were forest and grassland conversion, which contributed between 48% and 65% of emissions from LULUCF, followed by peat fires and peat oxidation, accounting between 15% and 32% of emissions from LULUCF (Ministry of Environment, 2010, Figure 2.21).[4]

Those estimates were contested, as different authors employ different data sets, assumptions and methodologies (see for example Busch et al., 2015; van der Werf et al., 2008). The Third National Communication estimated emissions in 2000 at about 1 $GtCO_{2e}$, about 1.85 $GtCO_{2e}$ in 2014 - with forestry emissions including peat fires contributing 53.1%, energy 32.6% and agriculture 6.1% of total emissions - and projected emissions for 2020 of about 1.97 $GtCO_{2e}$ (MoEF, 2017).[5]

Recent research also highlights other key areas of concern. For example, whilst annual deforestation of mangroves amounts to only 6% of total forest loss, it has been estimated to contribute up to 31% of estimated annual emissions from LULUCF (Murdiyarso et al., 2015). Whilst that and other new research on the sources of emissions will need to be taken into account to formulate new policies and actions to achieve the emissions reductions pledged in the NDC for 2030, for the purpose of this paper it is important to stress that we focus on the actions that were included in the RAN-GRK.

2.2. Policies to reduce emissions

Following the publication of the First National Communication to the UNFCCC (GoI, 1999), the Indonesian government produced successive reports and plans to reduce emissions from the LULUCF sector (Badan Perencanaan Pembangunan Nasional (Bappenas), 2013; BAPPENAS, 2015b; GoI, 2010; Ministry of Environment, 2010; SatgasREDD+, 2012). The early versions of the plans were broad, highlighting key strategies, for example strengthening the regulatory framework, reducing forest fires through better preparation (GoI, 1999, p. 75), but largely failing to describe how such improvements would be made.

As noted in the introduction, the RAN-GRK was the first action plan to address emissions with a strong mandate and specific implementation and review details. In addition to specific actions, a range of mechanisms to ensure implementation and evaluation supported the RAN-GRK. The RAN-GRK required national government agencies and ministries to assist subnational governments to develop their own action plans. There was supposed to be a system to monitor activities at the subnational level, with data collated by the Ministry of National Development Planning (BAPPENAS) and verified by the Ministry of Environment.[6]

In relation to LULUCF, the RAN-GRK outlined several actions to reach emissions reduction targets. In the Forestry and Peat Land

[4] Apparently, The World Bank (2008) found 54% of emissions from LULUCF were from peat fires, 20% from peat drainage, 22% from deforestation and 5% from oil palm and timber plantation establishment (Ministry of Environment, 2010, p. 23). However, the reference is not included in the Second National Communication and the authors were unable to find a World Bank document from 2008 with these data.

[5] For a recent assessment of the reasons for differences among land-based greenhouse gas flux estimates in six national inventories see Austin et al. (2018).

[6] The Ministry of Environment and the Ministry of Forestry were merged in 2015.

Table 1
RAN-GRK actions related to Forestry and Peatland (*Actions analysed in this study).

No.	Action	Activity/objective and indicator	Period	Indication of emissions reduction (million tonne of CO_{2e}) (Target)	Responsible institution
1	Establishment of Forest Management Units (FMUs)*	120 FMUs established	2010–2014	31.15	Ministry of Forestry
2	Planning for forest area utilization and business improvement	2.1 Grant Business Licenses for the Utilization of Timber Forest Products-Natural forest/Ecosystem restoration (IUPHHK-HA/RE) on Logged over areas of 2.5 million ha	2010–2014	22.94	Ministry of Forestry
		2.2 Improvement in non-timber forest product/environmental services is achieved	2010–2014	1.38	Ministry of Forestry
3	Development of the utilization of environmental services	Two demonstration activities of emission reduction from deforestation and forest degradation (REDD) in conservation areas (peat forests0 are implemented	2010–2014	3.67	Ministry of Forestry
4	Inauguration of forest areas*	25,000 km of Forest Area Boundary (outer boundary and boundary of forest area function) are established	2010–2014	123.41	Ministry of Forestry
5	Improvement, rehabilitation, operation and maintenance of marsh reclamation network (including peatland)	5.1. Marsh reclamation network is improved in an area of 10,000 ha	2010–2014	5.23	Ministry of Public Works
		5.2. Marsh reclamation network is rehabilitated in an area of 450,000 ha			
		5.3. Marche reclamation network is in operation and maintained in an area of 1.2 million ha			
6	Management of peatland for sustainable agriculture*	Research and development of land resources of 325,000 ha (including peatland) for agricultural land management development	2011–2020	103.98	Ministry of Agriculture
7	Development of agricultural land management in abandoned and degraded peatland areas to support plantation, livestock and horticulture subsectors*	Rehabilitation, reclamation and revitalization of abandoned and degraded peatland in agricultural areas and optimized use of non-food crop lands of 250,000 ha	2011–2014	100.75	Ministry of Agriculture
8	Implementation of a forest and land rehabilitation and forest reclamation in the prioritized watersheds*	8.1 500,000 ha of forest in prioritized watershed are rehabilitated	2010–2014	18.35	Ministry of Forestry
		8.2 Critical areas of 1,954,000 ha in prioritized watersheds are rehabilitated	2010–2014	71.71	Ministry of Forestry
		8.3 6000 ha of city forest is planted	2010–2014	0.22	Ministry of Forestry
		8.4 40,000 ha of mangrove/coastal forest is rehabilitated	2010–2014	1.47	Ministry of Forestry
9	Development of social forestry*	9.1 Facilitated designation of Community/Village Forests management area of 2,500,000 ha	2010–2014	91.75	Ministry of Forestry
		9.2 Facilitated setting up of business partnership in 250,000 ha of people's forest	2010–2014	9.18	Ministry of Forestry
10	Forest fire control*	Decreased number of hotspots in Kalimantan, Sumatra and Sulawesi islands by 20% on average from 2005 to 2009, with level of success 67.20%	2010–2014	21.77	Ministry of Forestry
11	Forest investigation and protection	Handling of new cases of forest criminal acts (illegal logging, illegal mining and fires), at least 75% are settled	2010–2014	2.3	Ministry of Forestry
12	Development of conservation and essential ecosystem areas and management of protected forests	12.1 Improved management of essential ecosystems as life support by 10%	2010–2014	41.5	Ministry of Forestry
		12.2 Conservation and protected forest clearing in 12 prioritized provinces are controlled	2010–2014	49.77	Ministry of Forestry
13	Enhancement of plantation forest activities	Industrial plantation forest and people's plantation forest areas of 3 million ha are reserved	2010–2014	110.1	Ministry of Forestry

category, there were 13 actions coordinated by the (then) Ministry of Forestry, the Ministry of Agriculture and the Department of Public Works (Table 1). In addition, there were three actions in other sectors that were related to Forestry and Peat land. In this paper, we concentrate only on seven of the thirteen actions in the Forestry and Peat land category.[7] Each of the actions outlined the general (and sometimes specific) policies to be implemented. The RAN-GRK also detailed the indicator for each action, e.g. establish 120 Forest Management Units (FMUs) by 2014. The target outcome, that is emission reductions, were also provided for each action. The modeling conducted by the Ministry of National Development Planning included emissions reductions for each category under both the unconditional 26% target as well as the conditional 41% target. Table 1 is drawn directly from the English version of the RAN-GRK. Some of the terms that were used are unclear and will be discussed further in the Results section.

3. Research methods

3.1. Monitoring and evaluation framework

Program theory evaluation has emerged in the past two decades with the aim of understanding whether, and sometimes how, interventions—policies or programs— achieve the desired changes. A program theory should describe a particular program, explain why, how and under what conditions the program effects occur. In doing so, it can also identify the necessary conditions to bring about the desired program effects (Sharpe, 2011; Sidani and Sechrest, 1999). Researchers can draw on existing literature and expert opinions to better detail the theory—and associated assumptions—behind interventions. In doing so, it is possible to build models, often called logic or program models, that detail the program theory and illustrate theoretical causal links between interventions and desired outcomes. These models ideally 'explain the mechanisms believed to influence the achievement of the desired program outcomes' (Mertens and Wilson, 2012, p. 34). Such a process can be used for formative evaluation, that is, ensuring that a program is feasible and appropriate. It can also be used to evaluate the implementation of a program and as such provide evidence to improve future programs. This is because, unlike evaluation which may be based solely on statistical analysis, using program theory allows the specification of what program outcomes were achieved but also how and why they were delivered (Weiss, 1998).

There is a very long list of terms associated with program theory—theory-driven, theory of change, intervention theory, program theory, logic modeling and program logic, to name a few (Brousselle and Champagne, 2011; Donaldson and Gooler, 2003). Each term is defined differently according to the author and in many cases the actual differences may be subtle. For this paper, we follow the logic analysis framework (Brousselle and Champagne, 2011). Logic analysis, is an 'evaluation that allows us to test the plausibility of a program's theory using available scientific knowledge-either scientific evidence or expert knowledge' (Brousselle and Champagne, 2011, p. 70). This allows us to detail some of the finer causal mechanisms by which an intervention may work (Donaldson and Gooler, 2003). Logic analysis can identify assumptions in program design that may not be appropriate in the context of the intervention. In this way, a logic analysis is similar to the more common theory of change model (Brousselle and Champagne, 2011). However unlike a theory of change model - which typically begins at the desired outcomes and works backward to identify and design interventions (Stame, 2004; White, 2009) - logic analysis can be used to assess interventions in the forward direction to assess existing programs and whether actions may lead to desired outcomes.

For this research, we adopt the direct logic analysis, as opposed to the reverse logic analysis of theory of change models. This is because this research was conducted after the design and implementation of the RAN-GRK had already occurred. If the research was about assessing all the potential options for reducing emissions in the LULUCF sector, theory of change models could provide alternative actions. One of the benefits of program theory evaluation is that it can be used to identify or evaluate appropriate performance indicators. A detailed and evidence based logic analysis can ensure that the outputs measured (indicators) are clearly linked to the desired outcomes. Whilst this does not necessarily ensure that the desired outcomes are achieved—as there may be many factors, which affect the link between outputs and outcomes—it can provide a more solid basis to ensure that if targets are achieved, this is reasonable evidence that the desired outcomes will also be achieved. This is particularly important in situations where data are not available to directly measure outcomes, as is the case for emissions reductions. Therefore, in evaluating the impact of the RAN-GRK on reducing emissions in the LULUCF sector, the logic analysis allows us to assess whether and how the actions could plausibly lead to emission reductions, but it also enables us to evaluate the indicators for each action. The results of the logic analysis can help determine whether there is a clear and accurate link between outputs (indicators) and desired outcomes (emission reduction targets).

3.2. Implementation of the framework and data collection

In order to conduct the logic analysis, 28 semi-structured interviews were conducted with key stakeholders at the national level during the period April 2016 – March 2017. Respondents included those involved in the design of the RAN-GRK actions, staff within the Ministry of Environment and Forestry and the Ministry of Agriculture implementing the various actions, and staff with broader responsibilities in climate change, e.g. the Monitoring, Reporting and Verification team in the Ministry of Environment and Forestry. In addition to public servants, respondents were also sought from key research bodies (two) and national NGOs (three). Finally, an additional two phone interviews were conducted with representatives from one district in Sumatra Island as a means to develop some insights into the process at the subnational level.

For respondents involved in the broader formation and review of the RAN-GRK, interviews focused on process, stakeholder engagement, data availability, and perceived challenges and outcomes. For those involved in implementing activities, questions focused on what activities had been implemented, the perceived impact of those activities, any emission reductions and potential challenges or positives found in the process of implementing the RAN-GRK actions. The logic of the activities discussed with interviewees is then assessed by considering the relevant literature. It is also important to stress that our assessment of the quantitative objectives of the actions is based not only on the interviews but also on government documents in order to report officially declared achievements rather than just interviewees' perspectives. Obviously, it would have been ideal to be able to verify the reported achievements, but this was beyond the resources available for this study.

Following the interviews, we developed a list of actual activities implemented and used this to investigate respondents' perspectives about the main way that those activities may have contributed to emission reductions. Using the literature that has examined emission sources in Indonesia – such as on causes of deforestation, forest degradation and peat degradation and fires—we assessed the rationale behind the actions. We also referred to studies that evaluated previous policy interventions designed to reduce deforestation, forest degradation and peat fires. Based on this analysis, the actions were then categorised as those with a direct emission reduction potential, and those that were best considered as supporting actions. That is, actions that set

[7] Table 1 highlights the actions addressed in this paper. They were selected on the basis of availability of access to interviewees and data. The actions assessed by this research account for about 70.7% of the emission reduction targets listed in Table 1.

up conditions for improved forest management, but may not directly lead to emission reductions.

To assess the validity of the indicators used in the RAN-GRK, we drew on the findings from the logic analysis. For each action there are at least two potential indicators. The first is a so-called *project output,* which is the alpha-numerical indicator that measures the achievement of the stated action, for example, establishing 120 forest management units across the county. The second indicator relates to measuring the actual outcome of the action, that is, the potential emission reductions. Given the lack of data about reduction of emissions (including how the indicative emission reduction targets were calculated), the analysis focuses on the project output. In each case, based on the logic model, we could assess whether the outputs were clear and measurable and, secondly, whether they accurately reflect a change in drivers of GHG emissions in the LULUCF sector.

4. Results

Below we present each action studied, we detail the activities implemented, the logic of those interventions described by the respondents, the logic analysis, and the achievements in relation to the objectives and targets.

4.1. Establishing Forest Management Units (FMUs)

Establishing FMUs has been a long-term governance reform program. The forest estate was divided into around 600 FMU areas on the map, which better reflect ecological boundaries rather than traditional jurisdictional boundaries (Interview 3). There are different types of FMUs dependent on the classification of forest within the area: FMUs for conservation (that is, with protected areas), FMUs for timber production, and FMUs for protection (which cover areas that are not deemed suitable for timber production but that do not have special conservation values). Each FMU area is expected to be managed by a local management team. The FMU team is meant to include local officials, company representatives (in case of FMUs in production areas), local communities or other key stakeholders (Interview 3). These teams are expected to take over forest management, administration, such as assessing permit applications, and will remain under the authority of the MoEF (Kim et al., 2016; Mugiono, 2013).

According to respondents, the specific activities that have already been conducted to assist the establishment of FMUs include preparing long term forest management plans, establishing working groups, organising meetings and inviting local government to educate and encourage those subnational actors to form FMUs, training for heads of each FMU, helping the established FMU to develop budgets, and facilitating infrastructure (offices, vehicles etc.).

The logic behind FMUs is that they would provide an institution with more on-site management of the forest resources, which will be better able to monitor and adapt to the relevant local conditions (Kim et al., 2016). Not initially envisaged as emission reduction actions, FMUs are designed to improve forest management by contributing to regional and community income, conflict resolution, encourage community participation (Mugiono, 2013). In terms of their contribution to emissions reductions specifically, respondents explained that establishing FMUs may: i) reduce unplanned deforestation and forest degradation by reducing illegal logging and the illegal trade in timber, and the occurrence of forest fires (Interview 11); and ii) limit the encroachment for destructive activities (Interview 3). FMUs are expected to achieve those outcomes by addressing underlying problems associated with lack of overall planning, lack of localised responses and lack of participation at the local level. In this way, FMUs are seen as establishing the enabling conditions for emissions reductions (Interview 3). Further, FMUs are thought to be more efficient and better able to manage long-term interests of the forest, where the technical, administrative and organisational measures will be based around ideas of sustainability (Interview 11). According to the Third National Communication (MoEF, 2017, Table 5.23) FMUs contribute to reducing deforestation and forest degradation, enhance carbon sinks, and reduce peat decomposition and peat fires. However, it does not specify how those contributions eventuate.

Assessing the logic of this intervention against the literature shows that there is some evidence to support these assumptions. There is evidence that illegal logging causes forest degradation (Burgess et al., 2012; Smith et al., 2003) and increases the risks of fires (Alisjahbana and Busch, 2017; Herawati and Santoso, 2011; van der Werf et al., 2008), both of which, as described above are sources of emissions in this sector. Further, logical analysis shows that there is evidence that lack of overall planning (Casson and Obidzinski, 2002; Palmer, 2001) and lack of localised responses and participation have contributed to illegal logging and forest fires. However, the literature also shows that establishing new localised institutions, is itself insufficient to actually address any of the problems identified above. It is evident from the history of decentralisation and community based natural resource management (in Indonesia and beyond) that even successful local institutions may fail to reduce environmental degradation (Coleman and Fleischman, 2012; Palmer and Engel, 2007; Tacconi, 2007a). This could be because local communities also want to benefit from logging or other activities that lead to forest conversion. Changing institutions does not itself remove the profitability of alternative land uses. Also, new institutions do not necessarily lead to higher participation. Capacity building efforts are often needed to support local groups to better manage the resources (Kim et al., 2016; Santika et al., 2017). It is not clear from the current activities that such support (financial or other) is available.

Further, this analysis highlights that the indicator of success for this action (number of established FMUs) is insufficient to assess the attainment of the target, that is emissions reductions. There are no data, or attempt, at the national level to measure or assess the quality of any FMU team or collate any information on the specific activities. This shows that whilst it is a clear and manageable target, it does not provide an indication of whether there have been any reductions in emissions as a result of establishing these institutions.

Data from interviews indicate that about 347 FMUs for production and 41 FMU for protection were established as of 2014 (Interview 11). However, of the 347 FMUs for production, just 149 had an FMU team. Of the 41 FMU for protection, only 20 had established FMU teams. It should be noted about the FMUs for protection and production that have established management teams that there is no guarantee that they had any management plan or that they had implemented activities that successfully reduce deforestation or forest fires. MoEF (2017) simply reports that 120 FMUs with a total area of about 16.4 M hectares were established. It is worth noting that neither the Biennial Update Report (MoEF, 2015) nor the Third National Communication (MoEF, 2017) report data on emission reductions arising from the implementation of the RAN-GRK in the forestry sector. Therefore, this applies to all the actions considered by this research.

In summary, it appears that the objective of establishing 120 FMUs during the implementation of the RAN-GRK was achieved, but there is no evidence to demonstrate whether FMUs actually reduced emissions.

4.2. Inauguration of forest areas

Inauguration of forest areas refers to the delineation of boundaries with the aim to consolidate the boundaries between the forest estate and the non-forest estate (outer boundary), as well as clarifying the classification functions of forests within the forest estate (that is, production, protection and conservation—inner boundary). The Directorate of Conservation and Stewardship of Forest Area managed this program centrally, but the Forest Area Consolidation Centres based at the subnational level executed it. The specific activities implemented include definition of areas as forest estate (or non-forest area), establishing forest outer boundaries, mapping forests, such as identifying village lands and establishing inner boundaries of different forest classification. This involved working with the local institutions, communities and forest concession holders to delineate boundaries (Interview 18).

Respondents described how the deliniation of forest boundaries would help protect forests from unplanned deforestation. This involves improving the clarity of maps and providing more security to different land users (Interview 18). However, respondents also identified problems implementing this policy. These included resistance of people, lack of cooperation from district governments, and the political economy at the local level, which gave different actors different interests and made conflict resolution difficult (Interview 18). Despite these challenges, it would seem that the output of 25,000 km of boundary was achieved according to MoEF (2017) which reports that 25,577 km of outer boundary were established.

According to the Third National Communication (MoEF, 2017, Table 5.23), this action contributes to reducing deforestation and forest degradation, but it is not stated how those contributions eventuate. The logic model of this action may be that deforestation and forest degradation (emission sources) are caused by the lack of clear and agreed upon legal boundaries. There are several aspects to this. Clear boundaries are important because these classifications determine who has authority over the land (state forest is controlled by the MoEF, areas to be used for agricultural purposes are under subnational authority). The classifications within the forest estate also determine what activities may happen (e.g. mining is allowed within production forest). Clarity of legal boundaries may protect against some types of forest degradation. Therefore, there are potential logical models to support this action.

The literature shows that there is some evidence to support the argument that lack of clear boundaries contributes to deforestation/forest degradation in Indonesia (Sloan, 2014; Wibowo and Giessen, 2015). The lack of clarity in regulations more generally, is also thought to increase risks of deforestation because it is more difficult to determine when illegal activities have occurred, a situation which can be used to the advantage of those who wish to engage in illicit activities (Burgess et al., 2012; ICW, 2009; Smith et al., 2003; Tacconi, 2007b). Providing clarity therefore could reduce this driver of deforestation and/or forest degradation. However, it is important to note that experience has also shown that clairfying a boundary is more complicated than drawing lines on a map (Peluso, 1995; Wibowo and Giessen, 2015). Successfully clarifying boundaries, determining who has authority to make decisions about land use, requires widespread consultation and socialisation. This means that for there to be a logical link between intervention and outcome, the indicators chosen need to demonstrate factors such as meaningful participation and conflict resolution. Further, factors such as available alternative livelihoods are also key to translating clear boundaries to improved environmental outcomes. The indicators chosen for this action are insufficient to demonstrate the impact of its successful delivery. Further, discussions with respondents highlighted that whilst the maps were created, tensions at the community level remain in many cases.

4.3. Management of peatland for sustainable agriculture

This action is focused on research and development of land resources for agricultural land including in peatland. However, the specific management programs to achieve these emission reductions are not clear. The R&D team in the Ministry of Agriculture explained that their focus had been on developing new models of community based sustainable management of peatland (Interviews 24–25). Their research focused on modeling different management strategies and how they could be introduced on degraded peatland. The strategies included actions like water-level management and amelioration with organic fertilizer (which affects soil acidity) as well as using systems of intercropping. This research activity was implemented in four provinces (Jambi and Riau in Sumatra Island, and Central Kalimantan and West Kalimantan). In each province, the research focused on different types of agricultural activities: i) oil palm (Jambi and Riau); ii) rubber (Central Kalimantan); and iii) annual crops such as corn (West Kalimantan). The total area of activity was 20 ha, with about 5 ha in each location.

The people involved in this project were unaware of the RAN-GRK and they did not have any research agenda around reducing emissions. They did acknowledge, however, that the application of these models (if adopted by the district governments) could reduce emissions. The expectation is that with more successful intercrop planting and other activities to improve the soil, it would be possible to keep the peat moist, thereby avoiding emissions by reducing the risk of fires.

Given the lack of detail about this action, it is difficult to assess the logic of the intervention. Interventions to reduce the severity of agriculture's impact on peatland would reduce emissions, however it is unclear the extent to which the research for this action was focusing on practical, large-scale solutions. Nor does this consider potentially more important actions aimed at avoiding agricultural expansion on peatland all together (Koh and Ghazoul, 2010). The Third National Communication (MoEF, 2017) does not present data on the implementation of this action or the other ones related to agriculture. We found no other evidence that the objective – research and development of land resources of 325,000 ha - was achieved.

4.4. Development of agricultural land management in abandoned and degraded land to support plantation, animal raising and horticulture

This action was under the responsibility of the Ministry of Agriculture. The objective was to 'rehabilitate, reclaim and revitalize' 250,000 ha of degraded peatland in agricultural areas. Similar to the previous action, there is very little available information about its design and implementation. The Ministry of Agriculture does not have any directorate focused on peatland, so any available information is piecemeal. The office of planning within the Ministry also had no knowledge of the action or any activities implemented to achieve the RAN-GRK outputs. They could only direct us to the research and development team, whose responses were provided above. It was accepted by the R&D respondents that the actions, the outputs and the emission reduction targets were made in a hurry, without any assessment of feasibility.

There was no reporting either in the Biennial Update Report (Ministry of Environment and Forestry, 2016) about the activities, or whether they had met the targets outlined in the present and the previous actions. According to respondents (Interview 4), the Ministry of Agriculture did not have responsibility for any activities under the LULUCF sector of the RAN-GRK, despite being listed as the responsible Ministry for those actions. Instead, they claimed that in the RAN-GRK, their responsibilities were only those specifically assigned in the *agricultural* sector. This sector had an emissions reduction target of 0.008 $GtCO_{2e}$, which they achieved implementing activities such as an alternative fertilizer program (MoEF, 2015).

4.5. Implementation of forest and land rehabilitation and forest reclamation in prioritized watersheds

The rehabilitation of watershed areas is another long-term objective in Indonesia (Nawir et al., 2007). That is, this program was not designed as an emission reduction action, rather as a reforestation policy that was then added to the RAN-GRK, and it is still ongoing. Whilst there have been many different types of policies and programs to rehabilitate watersheds, much of the activity for this action was coordinated at the subnational level. The national office was involved with identifying critical areas, establishing project targets and organising aspects of the planting programs.

Respondents described a variety of activities involved in this action.

Table 2
Implementation of forest and land rehabilitation and forest reclamation in the prioritized watersheds.

RAN-GRK indicators	Reported output (MoEF 2015)	Reported output MoEF (2017)	Average density of trees planted derived from MoEF (2017)
1. 500,000 ha of forest in prioritized watershed are rehabilitated	429,747 ha	434,284 ha 283,018,338 trees	651
2. Critical areas of 1,954,000 ha in prioritized watersheds are rehabilitated	1,828,471 ha	1,828,472 ha 1,117,613,763 trees	611
3. 6,00 ha of city forest is formed	5122 ha	5122 ha 11,672,530 trees	2278
4. 40,000 ha of mangrove/coastal forest is rehabilitated	31,675 ha	31,675 ha 66,904,433 trees	2112

At the national level, it involved identifying critical areas, first across the whole country using satellite and other data. The target area for rehabilitation was then established through a process of consultation, and removing unsuitable areas, for example those that were already under a concession. The area designated for rehabilitation was the result of this consultation and was revised annually in a process separate from reviews of the RAN-GRK (Interview 20). Once the areas for rehabilitation were identified, the national office also organised the planting program. Planting is conducted either through a tender process, through community organisations or, in remote areas, the Ministry coordinates with the military to have the army do the planting work. Payments for planting are based on the area planted, and there is some provision for checking the survival of trees up to three years after the initial planting (Interview 21). Any long-term management depends on the classification—e.g conservation forest, village forests or production forest—of the planted area.

Respondents argued that reforesting critical watershed would improve the capacity of Indonesia's forests to store carbon (Interview 21). There are several different ways in which this action could reduce Indonesia's emissions. Firstly, reforestation can act as a sink, sequestering carbon from the atmosphere and storing in above and below-ground biomass (Zomer et al., 2008). Secondly, reforestation and rehabilitation could help reduce the risk of forest peat fires and contribute to emission reductions. The former link is the only relationship between this action and emission reductions stated in the Third National Communication (MoEF, 2017).

Forest degradation contributes to emissions (Busch et al., 2015; Murdiyarso et al., 2015; Pendleton et al., 2014; van der Werf et al., 2008) and reforestation can be a carbon sink (Murdiyarso et al., 2015; Pendleton et al., 2014). However, it is not enough to just plant trees. The outcomes are affected by a range of factors such as: i) where the reforestation occurs (previous land uses and soil type) (Paul et al., 2016; Silver et al., 2000); ii) whether the rehabilitated and reforested areas are affected by fires (Choi et al., 2006); iii) species selection and survival rates.

According to its reports, the Ministry was apparently able to achieve the quantitative planting outputs (Table 2). In relation to the outputs reported by MoEF (2017), it should be noted that the number of trees apparently planted are rather surprising given the relatively high densities for items one and two (Table 2) and extremely high densities for the next two items. The survival rates of trees planted in this action was not known by the respondents, nor was it available in government reports. However, research has shown that plant survival rates can be as low as 20% (Boer, 2001). A follow up on this issue also indicates that in some cases inspections had shown that there was no trace of the plantings.[8]

The issues just raised and the literature cited above highlight how the indicator used –hectares planted—is insufficient to demonstrate any real change in the environment, or contribution to carbon sinks. Explicit carbon sequestration indicators are needed.

4.6. Development of social forestry

Developing social forestry has been an objective of the Indonesian government since the 1980s (Barber, 1990; Resosudarmo et al., 2019). Whilst the nature and design of social forestry programs has changed over time (interview 17), the underlying idea is that social forestry could help to reduce poverty as well as to improve forest management. The types of activities involved in this action included preparing the areas to be managed by the community, and facilitating communities in the preparation of an application for 'business license rights management'. The central government authorities also worked with the provincial forestry office, academics and NGOs in a Social Forestry Working Group to accelerate the development of social forestry. This working group facilitated the development of social forestry enterprises, helping communities to identify potential business opportunities, financing and marketing for those businesses as well as implementing broader capacity building for social forestry enterprises.

According to respondents, this action could contribute to emission reductions because each of the social forestry programs - people's plantation forest, village forests, and community forests - require partnerships which ensure planting programs (Interview 17). There were also requirements that 400 trees/ha be planted as part of a community forest title. Respondents argued that establishing areas under social forestry could reduce emissions because social forestry means there will be a greater number of trees in the area as well as higher protection of those trees as communities have direct benefits from protecting them. According to the Third National Communication (MoEF, 2017, Table 5.23) this action contributes to reducing deforestation and forest degradation, and enhances carbon sinks. However, it does not specify how those contributions eventuate.

The underlying theory of this action is that deforestation and forest degradation (and the associated emissions) are caused by the lack of clear legal rights of communities over forest areas. The assumed theoretical link may be as follows: communities with clear rights over their forests are better placed to benefit from them, therefore they have incentives to protect and enhance those resources. The literature indicates that lack of communities' legal rights to forests may contribute to deforestation and forest degradation (Jagger et al., 2014; Kitamura and Clapp, 2013; Larson, 2011) and that allocating rights can reduce deforestation (Barsimantov and Kendall, 2012; Larson et al., 2013; Santika et al., 2017). However, this is may not always be the case (Tacconi, 2007a). For example, evidence from Mexico shows that the impact of community and communal property rights on deforestation depended on factors such as tree species in the forests (Barsimantov and Kendall, 2012), whereas evidence from Brazil showed no relationship between community land rights and deforestation (BenYishay et al., 2017). Therefore, establishing community and social forestry does not necessarily reduce emissions from forests.

[8] Follow up discussion with MoEF official (April 2018).

Table 3
Development of social forestry and community forests.

Indicator output (RAN-GRK)	Output reported by MoEF (2015)	Output reported by MoEF (2017)	Reported in interviews (to June 2016)
National programme to facilitate designation of 2,500,000 ha of Social Forestry/Village forest during 2010–2014	2,560,000 ha have been designated	328,452 ha community forests established 318,024 ha village forests established	773,700 ha
National programme on developing partnership of 250,000 ha of community forests during 2010–2014	292,592 ha have been developed	318,024 ha established	202,084 ha

It is not clear from official reporting (Table 3) the extent to which the objectives of the Action were achieved. The MoEF (2017) report contradicts the MoEF (2015) one in relation to the designation of social forestry areas. Responses from interviews seem to corroborate the results reported in the 2017 document. There is also no clear link or attempt, to measure whether increased rights have led to reduced deforestation or forest degradation. In relation to its contribution to emissions reductions, there is no evidence showing that the implementation of this Action has been effective.

4.7. Forest fire control

Reducing forest fires is a long term challenge in Indonesia, driven in part by climate change concerns, but particularly by concerns for public health and pressure from neighbouring countries that are frequently affected by the haze generated by fires (Tacconi, 2016; Watts et al., 2019). According to respondents, reducing fires is key to addressing Indonesia's emissions from the forestry sector (Interview 12). They think that the number of hotspots recorded through remote sensing analysis is a useful proxy to measure the performance in reducing fires.

The implementation of this action involved fire prevention and suppression groups called *Manggala Agni,* which employ local people and are funded and managed by the MoEF. These groups are present in the most fire prone provinces (Table 4). In 2014, there were around 1758 people working with *Manggala Agni*—divided into 121 teams of about 15 people each. In addition, there are also concerned citizens fire brigades, with over 10,000 registered citizens who have been trained to extinguish fires. The aim is for these groups to put out fires in all forest types—production, protection, conservation—and in non-forest areas.

The targets set under the RAN-GRK was to reduce the number of hotspots recorded in Kalimantan, Sumatra and Sulawesi by 20% compared to the 2005–2009 period. It could seem that Indonesia was able to exceed this target in all provinces (Table 4). However, it is important to note that it is questionable whether the reduction in hotspots was due to the implementation of the RAN-GRK action and whether a reduction in hotspots results in reduced emissions.

Table 4
Average hotspot count over the 2005–2009 and 2010–2014 periods.

Province	Average number of hotspots/year		Decrease (%)
	2005–2009	2010–2014 (RAN-GRK)	
North Sumatra	2078	871	58.08
Riau	10,005	3902	61.00
Riau Islands	94	63	32.98
Jambi	2996	1395	53.44
South Sumatra	7009	3.581	48.91
West Kalimantan	11,104	4335	60.96
Central Kalimantan	10,945	3395	68.98
South Kalimantan	1925	888	53.87
East Kalimantan	2787	1573	43.56
South Sulawesi	586	328	44.03

Source: Interview 12.

The program theory of this action was that fires would occur and the best strategy to reduce their contribution is to better control the burning, catch the fires early and put them out. There was also some effort to educate communities, implying that lack of community knowledge is contributing to starting fires, or failing to react once fires start. The literature suggests that the causes of forest and peat fires are more complex. Key factors that have been shown to increase fire risk include previous degradation—via logging or previous burning, annual weather variations, agricultural expansion, and historical landclearing patterns by companies and communities (e.g. Alisjahbana and Busch, 2017; Herawati and Santoso, 2011; van der Werf et al., 2008).

Therefore, whilst addressing fires is a crucial activity to reduce emissions, the program theory of the RAN-GRK was based on a model that is not entirely supported by the evidence. This program theory does not address the causes of fires as identified in the literature, nor does it attempt to address factors which may increase the severity of fires, such as peat degradation.

The literature also draws into question the appropriateness of the indicator—reducing the number of hotspots—as a means to measure emissions reductions. The number of hotspots is a relatively easily measured indicator, but it fails to demonstrate the details needed to assess whether the intervention has achieved emissions reductions. This is because the emissions from a fire depend on details including the size of the fire and especially whether the fires occur on mineral or peat soil, with the latter resulting in much higher emissions of GHG and fine particulate matter (which has negative impacts on health). This is acknowledged by the government in the Second National Communication, where they argued 'hotspot counts in peatland are not fully proportional to CO_2 emissions, which are governed by further factors such as the depth and area of burning' (Ministry of Environment, 2010, p. xi). This evidence demonstrates the number of hotspots was not an appropriate indicator to assess the performance of this action.

Finally, the count of hotspots decreased during the period of the RAN-GRK (Table 4). This was also noted by the Third National Communication (MoEF, 2017), which reports a decrease in hotspots over the period of 57.9%. However, the fire event that occurred during the 2015 El Nino was the worst since the fires that occurred in 1997–98 (Tacconi, 2016). This indicates that the reduction in hotspots during the period of the RAN-GRK was more likely due to weather patterns than the implementation of the action, given that the fire control activities reported above were also in place in 2015.

5. Discussion and policy implications

The above results (summarized in Table 5) show that there was a direct link (supported by the literature) between the following two actions and the emission source in forest and/or peatland that they were targeting: i) Implementation of forest and land rehabilitation and forest reclamation in the prioritized watersheds, and ii) forest fire control. In each of these actions, the logic model is clear and direct, in the sense, for example, that reforesting watersheds can directly act as emissions sink. This is not to say that the implementation was

Table 5
Summary of achievement of RAN-GRK Actions for forestry and peatland.

No.	Action	Activity/objective and indicator	Success of activity implementation*	Indication of emissions reduction (million tonne of CO_2e) (Target)	Emission reduction target achieved
1	Establishment of Forest Management Units (FMUs)	120 FMUs established	Yes	31.15	NA
4	Inauguration of forest areas	25,000 km of Forest Area Boundary (outer boundary and boundary of forest area function) are established	Yes	123.41	NA
6	Management of peatland for sustainable agriculture	Research and development of land resources of 325,000 ha (including peatland) for agricultural land management development	No	103.98	NA
7	Development of agricultural land management in abandoned and degraded peat land areas to support plantation, livestock and horticulture subsectors	Rehabilitation, reclamation and revitalization of abandoned and degraded peatland in agricultural areas and optimized use of non-food crop lands of 250,000 ha	No	100.75	NA
8	Implementation of a forest and land rehabilitation and forest reclamation in the prioritized watersheds	8.1 500,000 ha of forest in prioritized watershed are rehabilitated	86%	18.35	NA
		8.2 Critical areas of 1,954,000 ha in prioritized watersheds are rehabilitated	94%	71.71	NA
		8.3 6000 ha of city forest is planted	85%	0.22	NA
		8.4 40,000 ha of mangrove/coastal forest is rehabilitated	79%	1.47	NA
9	Development of social forestry	9.1 Facilitated designation of Community/Village Forests management area of 2,500,000 ha	Designated, actual allocation during the period unclear	91.75	NA
		9.2 Facilitated setting up of business partnership in 250,000 ha of people's forest	Yes	9.18	NA
10	Forest fire control	Decreased number of hotspots in Kalimantan, Sumatra and Sulawesi islands by 20% on average from 2005 to 2009, with level of success 67.20%	Almost achieved during the period, but insufficient to prevent fires	21.77	No

* Percentages of achievement are calculated on the basis of implementation reported in MoEF (2015).

successful, the objectives were realistic, or that successful implementation (as measured by the indicators) lead to the achievement of the target, that is, offsetting or reducing emissions.

There is some evidence of a link for three other actions, but the literature shows that the model is more indirect and other factors need to be considered to say that the implementation of that Action could lead to emissions reductions: i) establishment of Forest Management Units (FMUs), ii) inauguration of forest areas, and iii) development of social forestry. For those actions, it is clear that interventions could address some underlying or indirect problems that have been shown to contribute to emissions by the literature, such as the lack of: i) community involvement, ii) clarity of boundaries, iii) financial benefit from maintaining forests; and iv) coordination between key stakeholders. However, it is not clear from the text of the RAN-GRK, nor from the respondents, whether these are the most important underlying problems, and whether the interventions could have or were actually able to achieve any change. The theory of change for each of these interventions highlights many potential factors that influenced whether the interventions could reduce emissions.

Finally, for two actions concerning agriculture in peatland, there was not enough information to assess the logic of the interventions or whether they could be supported by theory of change models. The Ministry of Agriculture had a low emission reduction target of 0.8 $GtCO_{2e}$ from their sectoral plan, but they were also listed as the implementing ministry for several actions under the forest and peatland sector. Despite this, the central planning department of the Ministry of Agriculture did not acknowledge any responsibility for actions in other sectors, nor did they coordinate efforts. The Ministry of Agriculture reported only that they had reached their 0.8 $GtCO_{2e}$ target. This is highly problematic given the very high contribution of peat burning (often driven by agricultural expansion) to national emissions.

The indicators for each of the actions are also of varying usefulness. For the direct links noted above, the targets did provide some indication of a change that could signify emissions reductions. However, in most cases the indicators are insufficient to demonstrate meaningful change. For example, a reduction in the number of hotspots does not provide an indication that the activities implemented have reduced fires. Until more detailed and accurate emissions data are available, these indicators could be useful tools to begin measuring the success of programs to actually reduce emissions. But this will not be the case unless these indicators appropriately reflect the changes in the field.

It can be seen from the logic models discussed earlier that there are many factors needed to ensure that an intervention actually leads to the desired outcome. The indicators chosen, for example establishing 120 FMUs, did not provide a good indication that the actions brought about real change in the forest. The analysis shows that greater detail should have been included to better determine if the implementation of each action actually contributed to reducing activities that cause emissions.

Part of the explanation for the problematic design of the actions is that many of those actions were pre-existing policies, aimed at achieving a variety of different objectives that were just rebadged as climate change actions. There was little evidence that those designing or implementing the actions had considered the climate change implications. Indeed, the amounts of expected reductions of emissions were incomprehensible to the implementers. They were based on the modeling done by Ministry of National Development Planning, but few if any of the respondents had any idea as to how they would achieve this, nor any reporting around the emissions from their projects.

The rather simple but important policy-related finding emerging from this analysis is that to improve policy actions to reduce emissions, the Indonesian government should ensure every policy includes details as to how the action would reduce emissions (Interview 9).

6. Conclusion

Indonesia's ability to meet its international commitments depends on its capacity to reduce emissions from forests and peatland. The RAN-GRK was meant to provide a clear action plan on how the country was going to reduce emissions. However, after the implementation phase from 2010 to 2014, there is little evidence as to whether the actions for forestry and peatland considered here did in fact reduce emissions. The analysis shows there was a disconnect between the actions and their intended outcomes. For most of the actions that we investigated, there was no direct link between implementation and outcome and any indirect link is tenuous. Given the difficulty to address the drivers of deforestation, forest degradation and peat degradation, it is also questionable how realistic many of the actions were. Finally, the indicators selected did not provide an appropriate measure that would allow any statement as to whether the successful implementation of the intervention reduced emissions.

As the Indonesian and other governments continue to develop policies and plans to address emissions to meet international commitments under the NDC process, there are two key lessons to be learnt from this analysis of the implementation of the RAN-GRK. First, a rigorous policy design process that draws on literature to create explicit logic of change models is necessary. A requirement that any action be accompanied by a proposal that outlines the theory of change, the associated assumptions and how they are being dealt with, could go a long way to creating realistic action plans. Second, the theory of change model can be used to better identify indicators that are clear and measurable as well as being appropriate indicators of the changes that are sought.

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