EVALUATING THE IMPACT OF COMMUNITY FORESTRY PRACTICES IN SUMATRA ISLAND, INDONESIA

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Abstract

Community-based forest management is often cited as the solution to better manage forests while providing livelihood and conservation benefits. This study investigates the extent to which community forestry practices in Indonesia managed to meet these expectations and the factors affecting their performances. First, we used propensity score matching to compare forest cover changes of watershed protection forests with and without Community Forests (CF) units in Sumatra, Indonesia. Second, we systematically selected two CF units in Lampung province to understand the factors affecting CF performances. We conducted qualitative assessment of farmers' perspectives on their ability to achieve the dual mandate of CF. We found that the areas managed by CF concessions maintained forest cover more than those not managed by communities. However, biophysical characteristics of CF sites significantly affect the ability of the CF groups to manage their forest and make their living. Although establishing CF helps delineate property rights and reduce social conflicts, the government needs to do more than appropriating land uses. Technical assistances with consideration of distinct biophysical characteristics of the units are necessary for CF units to achieve their goals.

Key Words:

Community forestry, propensity scoring, community-based forest management

1. Introduction

Decentralization has become one of the most ubiquitous policy experiments globally in the last four decades (Bardhan, 2002). World Bank reported that eighty four percent of all countries with population greater than five million (63 out of 75) went through some form of political power transfer to local units of government by 1994 (Dillinger, 1994). In its most basic form, democratic decentralization, i.e. devolution, is transfers of power closer to those who are most affected by the exercise of power (Agrawal & Ostrom, 2001). Decentralization has been framed as a response to failure of centralized states in delivering responsive, efficient, and equitable public services to their constituents (Bardhan, 2002). If local authorities that represent and be accountable to the local population hold discretionary powers over public resources, their decisions would likely lead to more efficient and equitable outcomes than those by central authorities (Ribot, 2004). This benefit of decentralization is also seen as preferable when it comes to the management of common-pool resources such as forests.

In general, management and governance framework of common-pool resources such as forests, can be categorized into two main approaches; access restriction or incentive-making for users to invest in sustainability of their forests for long-term benefits (Ostrom, Burger, Field, Norgaard, & Policansky, 1999). Establishment of protected areas to restrict human activities has shown to be relatively effective in reducing deforestation (Barber, Cochrane, Souza, & Veríssimo, 2012; Chape, Harrison, Spalding, & Lysenko, 2005; Leader-Williams, Harrison, & Green, 1990). FAO reported that protected forest area worldwide has reached 651 million hectares in 2015, with an upward trend of 1.98% annually (FAO, 2015).

Despite this trend, between 1990 and 2015, forest area worldwide has shrunk from 4,1 billion hectares to 3.9 billion hectares (FAO, 2015). The trajectory of forest loss is expected to continue with an annual change of -0.13% (FAO, 2015). It is hard to understate the significance of this negative trend as forests serve an important role in climate change mitigation, biodiversity conservation, as well as global development (Agrawal & Ostrom, 2007; Seymour & Busch, 2016). Deforestation is a major contributor to climate change, while eroding ecosystem resilience to it; at the same time, climate change undermines development and damage forests (Seymour & Busch, 2016). The socio-economic impact of this vicious cycle is pervasive, especially to the poor, where forests play an important role as a vital safety net to help them mitigate the plight or help them out of poverty (Angelsen & Wunder, 2003; Sunderlin, Angelsen, & Wunder, 2004; Sunderlin et al., 2005; Wollenberg, Belcher, Sheil, Dewi, & Moeliono, 2014; Wunder, 2001).

The second approach to govern common-pool resources is incentive making through collective management. Within the context of forest management, this approach can be in the form of community-based forestry. Some recent global assessments have shown that community-based forestry (CBF) are more effective in reducing deforestation than protected areas (Blackman, Corral, Lima, & Asner, 2017; Porter-Bolland et al., 2012), while contributing to local livelihood and poverty alleviation efforts (Sunderlin et al., 2005). Mixed community uses also reduced fire incidences (Nelson & Chomitz, 2011; Suyanto, Pandu Permana, Khususiyah, & Joshi, 2005). It is estimated that local communities manage almost one third of all forests in developing countries, which is twice more than protected areas in these countries (Blackman et al., 2017).

International and national policy agendas are driven by the demands for forest conservation and for advancement of equity and rights of local people. Decentralized forest management offers a way to balance these two demands. It is critical to understand whether CBF can reduce forest loss, and how decentralized forest management in the form of CBF is perceived by local communities and what challenges that they face to conserve forests while making their living

Indonesia is experimenting on a massive devolution of forests rights by significantly increasing the target area of community-managed forest estate from 1.4 million hectares in 2014, up to 12.7 million hectares in 2019 (BAPPENAS, 2014; Indonesia Ministry of Environment & Forestry, 2015b, 2015a) under the umbrella of 'social forestry' (*perhutanan sosial*) program. The program is intended to improve the livelihood of rural communities, while protecting the forests and manage social and cultural dynamics in local forest management (Indonesia Ministry of Environment & Forestry, 2015b, 2016). This contemporary development of Indonesia's forest management presents an important opportunity to examine effectiveness of community forests in achieving its goals of improving rural livelihood while operationalizing sustainable forests management.

This study provides an empirical evidence of community forestry's impact on deforestation rate in watershed protection forests in Sumatra island, with a longer history of CBF exists. Using remote sensing data of annual tree cover loss and propensity score matching to reduce possible confounding effects, we examined if community forestry practices in Sumatra island reduced deforestation rate within watershed protection forests. We also explored communities' perspectives on the challenges and benefits of practicing community forestry in two areas with distinct biophysical characteristics. Two sample community forestry units were selected to represent areas with distinct biophysical characteristics. We conducted series of focus group discussions with members of the communities on the topic of historic land use, the current forest uses, and the benefits and challenges of community forestry.

2. Indonesia land use issue & devolution of management of forest

The latest research on high-resolution global maps of forest cover change between 2000 and 2011 reveals that Indonesia exhibited the largest increase in forest loss in the world (Hansen et al., 2013). Indonesia has lost 15.8 million hectares of forests between 2000-2012, of which, 6 million was primary forest with high carbon and biodiversity values (Margono, Potapov, Turubanova, Stolle, & Hansen, 2014). This massive land cover change can be attributed to illegal logging, lack of management within forest area due to land use conflicts, and lately, rapid expansion of monoculture oil palm plantation in the last decade (Wijaya et al., 2015).

The origins of the current situation can be traced back to the early 1980s, when the government enacted a law on forests land use through Ministry of Forestry Regulation on Forest Boundary Setting Process by Consensus (Tata Guna Hutan Kesepakatan – TGHK) in 1982 (Fay & Sirait, 2000). Through this regulation, the central government designated approximately 74% of Indonesia landmass (around 141 million hectares) as forest estate—centrally managed by Ministry of Forestry. However, due to the lack of data, as well as the top-down nature of the mechanism, this designation was largely enacted through a unilateral decision of the central government rather than a definitive delineation on the ground (Indrarto et al., 2012). Local governments and communities were left out of the policy process altogether. The tenurial rights of the local communities were ignored, hence this early conservation action is considered to be one of the state largest land grabs in Indonesia's history (Fay & Sirait, 2000).

The issue remains unresolved for more than a decade and worsened by the abrupt decentralization policy in 1999 following the toppling of President Soeharto's authoritarian New Order regime (Djogo & Syaf, 2004). The subsequent decentralization of authority over resources management and the creation of local elections substantially changed the power structure of land use in Indonesia. Local leaders began to rent out lands to agribusiness companies and sell natural resources as ways to finance their personal political ambitions (Bram, 2013). Between 2005-2010, illegal logging increases by up to 29% 2 years prior to election, and 42% in the year before election (Burgess, Hansen, Olken, Potapov, & Sieber, 2012).

With the downfall of New Order regime in 1998, the provincial and district governments were demanding greater regional autonomy and control over natural resources that led to the enactment of Law 22 of 1999 on Regional Governance, Law 25 on Fiscal Balancing, and Law 41 of 1999 on Forestry that essentially paved the way for greater control of natural resources by local provincial government (Potter & Badcock, 2001). Securing land tenure for local communities to access forest resources is also regarded as one the main ingredients to improve livelihood of poverty-laden rural communities in Indonesia (W.D. Sunderlin et al., 2004) as well as improving condition of the forests (Maryudi & Krott, 2012). Under forestry law, community forestry is recognized but the actual designation of it were never widely applied (Lawry, Mclain, Swallow, Kelly Biedenweg, & Biedenweg, 2012).

In 2014, the newly elected President Jokowi followed up his campaign promise to reduce disparity of land ownership in Indonesia through redistribution forest estate land with national Social Forestry program and National Program on Agrarian Reform (Sirait, White, & Pradhan, 2016). The government of Indonesia declared an ambitious plan to significantly increase community-managed forest estate from a mere 1.4 million hectares up to 12.7 million hectares by 2019 (BAPPENAS, 2014) under the umbrella of 'social forestry' (*perhutanan sosial*) program. The flagship program is branded as an effort to accelerate poverty alleviation and economic growth in rural areas while maintaining environmental quality of the forest (Directorate General of Social Forestry and Environmental Partnership, 2015; Indonesia Ministry of Environment & Forestry, 2015b). The goal of this program is consistent with the latest data that an estimated number of 1.15 million people that reside within and around forest area in Indonesia claim the state's poverty benefit (Badan Pusat Statistik, 2015). This particular demographic is approximately 14.6% of the total national population that claims poverty benefit (Badan Pusat Statistik, 2015). CBF is seen as one of the poverty alleviation catalyst for rural population (Aji et al., 2014).

The implementation of Social Forestry program is formalized through the enactment of Ministry of Environment & Forestry Regulation No. P.83 of 2016 on Social Forestry. This regulation formally recognizes six schemes of CBF in Indonesia with various degree of management rights and responsibilities; these are (1) community forests (HKm – Hutan Kemasyarakatan), (2) village forests (HD – Hutan Desa), (3) community plantation forests (HTR – Hutan Tanaman Rakyat), (4) customary forests (HA – Hutan Adat), (5) forest partnership (Kemitraan Kehutanan), and (6) 'people's forests' (HR – Hutan Rakyat) .

There have been numerous studies on CBF practices in Indonesia. Studies during the early years of CBF inception in Indonesia were about the process of forest rights' devolution and perspectives on community forestry in Indonesia. For example, Colfer and Resosudarmo (2002) provides rich details on the historical context of Indonesia's centralized forest management and the start of acknowledgement of CBF practices in Indonesia (Colfer & Resosudarmo, 2002). Safitri (2010) examined the socio-legal challenges of securing communities' rights in Indonesia, providing legal arguments and social context of colonial-era influence on Indonesia's modern forest management (Safitri, 2010). Djogo & Syaf (2004) contributed counterproductive outcome of the decentralization process in Indonesia after the fall of the New Order regime (around 1998) to lack of accountability measures when rights to use forest resources was handed out as election bargaining chips of local political leaders to gain support from private sectors (Djogo & Syaf, 2004).

There have been several studies on the implementation of the earliest CBF management in Indonesia in the form of Community Forests (hereafter referred to as CF) concession, especially in Sumberjaya watershed, West Lampung district of Lampung province where CF was first established. Verbist et al (2005) examined the practice of agroforestry system in West Lampung district with one of the first CF schemes in Indonesia. They showed that agroforestry system established through CF provided positive hydrological benefits, in terms of higher discharge to the local dam in the watershed (Verbist et al., 2005). Other studies in the area provided an empirical evidence that agroforestry adoption though CF has managed to reduce fire hazard in forest zone, effectively improving the productivity and biophysical condition of the forests (Suyanto et al., 2005), as well as providing livelihood benefits to the participants of the program (Pender, Suyanto, Kerr, & Kato, 2008). Another study showed that farmers would be willing to follow more restrictive rules if they were given longer contract period, and that they responded very favorably to a hypothetical scenario where they can harvest the timber within their area (Arifin, Swallow, Suyanto, & Coe, 2009).

3. Methods

3. 1 Study area

Sumatra island is chosen as the focus area for this research due to its relatively more established CF practices. The island is located in the western part of Indonesia and is the sixth largest island in the world with an approximate land size of 42.6 million hectare (Whitten, Holmes, & MacKinnon, 2001). The island is also considered as biodiversity hotspot with the highest potential vertebrate species richness compared to other islands in Indonesia (Murray, Grenyer, Wunder, Raes, & Jones, 2015) and home to three species of critically endangered primates (Supriatna, Dwiyahreni, Winarni, Mariati, & Margules, 2017). Between 1990-2012, it is estimated that the island has lost a total of 8 million natural forested land, and suffers the highest rate of forest destruction in the world (Margono et al., 2014; Supriatna et al., 2017). In an effort to curb deforestation and improve local livelihood, the central government piloted several new CF concessions in Sumatera island in 2007.

To ensure that our analysis has sufficient amount of temporal data, we limit our observation to one of the earliest CF that were granted within watershed protection area in the year 2007. This temporal timeframe provides us with nine years of tree cover loss data (2007-2016). All CF permits that were given in the year 2007 are all located within watershed protection forests in Lampung province. The province also has the highest number of CF area in Indonesia with approximately 110,257 hectare of definitive CF area (see Figure 1). This concentration of oldest CF concessions in one province also provides a unique opportunity to reduce potential bias that arises from different governance framework.

3. 2 Quantitative analysis of CF impacts on forest cover

To reduce potential location-dependent bias, we used ‘MatchIt’ package in R (Ho, Imai, King, & Stuart, 2007; King & Stuart, 2011) to conduct the sampling cells matching based on propensity scores. Propensity score is defined as the probability of a control cells being assigned as CF concession. The probability was obtained from a logistic regression model in which the presence or absence of CF (treatment cells) is regressed against control variables. Individual treated cells were then matched to control cells with similar propensity scores (Austin, 2011; D. L.A. Gaveau et al., 2012; David L A Gaveau et al., 2009, 2013; Rosenbaum & Rubin, 1983; Rubin, 1997) to reduce the effect of possible confounding variables in the analysis.

The result of the matching process was then evaluated by comparing differences in propensity scores between control and treated groups and balance statistics before and after the matching process. We employ Kolmogorov-Smirnov test to calculate the difference of propensity scores before and after the matching procedures. Balance statistic is calculated as a measure of percent improvement of median, mean, and maximum value of control and treated groups before and after matching. After the matching process, the response variable (tree cover loss) of matched cells were compared using Wilcoxon rank sum test to detect statistical significance of differences between treated and control cells and calculate the average treatment effect.

3. 2. 1 Sampling method

Independent sampling cells were generated using 500 x 500 meter sampling grid across the observation area (25 hectare sampling cells). Cells that fall completely within CF boundary in watershed protection area are indexed as ‘treated cells’, those that fall completely within watershed protection forest area with no community management are indexed as ‘watershed protection forests control cells’, and cells that fall completely within conservation forests area are indexed as ‘conservation forests control cells’.

With these spatial requirements, the maximum number of treated cells was n=157 plots, control cells within conservation area was n=14,437, and control cells within watershed protection area was n=10,527. For spatial distribution of sampling cells, see Figure 2. For summary statistics on the total area covered by the sampling cells, see Table 1. Map of CF boundaries in Sumatera were obtained from Directorate General of Social Forestry and Environmental Partnership, Indonesia Ministry of Environment and

Forestry with the scale of 1:250.000. Map of legal designation of forest area were obtained from Directorate General of Forest Planning, Indonesia Ministry of Environment and Forestry with the scale of 1:250.000.

3. 2. 2 Response variable

We use tree cover loss as response variable for this research. Tree cover loss is defined as stand-replacement disturbance or the complete removal of tree cover canopy at the Landsat pixel scale (Hansen et al. 2013). For the purpose of this research, the tree cover loss time series is masked to only show loss between 2007-2016 to match the temporal observation of the analysis. This is done through reclassifying the original value of the annual tree cover loss data. Pixel value of 1 to 6 are reclassified to 0 (no-loss), and 7-16 as 1 (loss).

3. 2. 3 Control variables

The variables that were used to calculate propensity scores are slope, elevation, path distance to road, villages, river, and oil palm mills. Selection of these variables is based on previous studies that observed variables that are most likely to determine spatial patterns of deforestation and influence forests accessibility (Ferretti-Gallon & Busch, 2014; David L A Gaveau et al., 2009). Based on the meta analysis conducted by Ferreti-Gallon & Busch (2014), it is found that biophysical variables had clear impact on deforestation. Higher elevation and steeper slopes are consistently associated with lower deforestation rate.

Slope and elevation maps were generated using digital elevation model from National Aeronautics and Space Administration’s Shuttle Radar Topography Mission (NASA SRTM) 1-Arc Second global dataset. The corresponding cells were resampled to 30 meters spatial resolution to match the response variables spatial resolution.

Distance to road, villages, rivers, and oil palm mills for each cell were generated using path distance tool on ArcGIS 10.5.1 that calculates the least accumulative cost distance while accounting for surface distance along with horizontal and vertical cost factors (elevation and slope). Road network, rivers, and villages coordinates were obtained from Indonesia’s Basic Geospatial Information dataset published by Indonesia Geospatial Information Agency. Oil palm mill points were obtained from World Resources Institute’s Global Forest Watch platform.

3. 3 Qualitative analysis on impact of CF

Two CF units were selected as sample units through combination of GIS exercise and multi-criteria selection. We selected CF that are: (1) older than 5 years, (2) part of the same Forest Management Unit that has been recognized by both Ministry of Environment & Forestry and the provincial government, (3) located within watershed protection forest area. We found eight units of CF that met these three criteria within Batutegi Forest Management Unit. Among those that met the three criteria, we selected CF units with different biophysical characteristics. By selecting sample CF units with similar property rights, as well as intra-governance and external support, we can highlight the impact of different biophysical characteristic into the performance of each CF unit.

We then conducted two focus group discussions at each sample CF unit for each gender groups (May-August 2017). Each focus group discussion was limited to 10 participants to maintain a manageable size for a group discussion. Participants were invited to join the focus group discussion through an open invitation announcement by the head of each group

The focus group discussions were designed to understand four things: (1) historical aspect of the units' land use and how CF came into play, (2) current forest uses, (3) benefits of CF from the perspective of community members, and (4) challenges of practicing CF. All interviews and focus group discussions were recorded, transcribed, and coded in Bahasa Indonesia to retain any nuance presents within the interviews and discussions.

We selected two CF units at Tanggamus district in Lampung province that met the three criteria described above and also located in different locations in terms of biophysical characteristics. We seek community consent to participate in the study. The two sample CF units are part of the Batutegi Protection Forest Management Unit (FMU). The first CF unit, Tribuana Community Forest (hereafter referred to as Site A), was licensed in 2007 and located on the northern part of Batutegi FMU. With a size of 1,507 hectare, Site A consists of 500 household members. The second CF unit, Hijau Makmur Community Forest (hereafter referred to as Site B), was licensed in 2009 and located near the center of Batutegi FMU. It is slightly smaller in size with 1,190 hectares and 434 household members. At Site A, we managed to conduct two focus group discussions, with 13 male participants and 6 female participants respectively. At Site B, we had two focus group discussions with 11 male participants and 7 female participants respectively.

Sites A and B present different biophysical features, in terms of elevation, slope and accessibility. Site B is easier to access and closer with population centers, which is about 3-hour drive directly from Bandar Lampung (capital of Lampung province) with relatively good road condition. The site is located at low elevation (415 meters above the sea level), and the landscape is relatively flatter compared to the landscape of Site A. In contrast, Site A has no access road for cars and can be reached by 40 minutes on a trail motorbike after 5-hour drive from the provincial capital of Bandar Lampung. Due to its high elevation at 1,090 meters above the sea level and lack of paved road near the site, it is significantly harder to reach the site with car or regular motorbike. Table 2 presents a summary of the condition of two sample CF units, and Figure 3 presents the location of the sample CF units.

Tanggamus district is located on the southern tip of the province with a size of 4,654.96 square km (Badan Pusat Statistik, 2017b). The district follows the slope of the mountainous Bukit Barisan National Park on the west, and features one of the two large bay of Lampung province, Semaka Bay on the southern side of the district, with a coastline that spans 210 km (Nakagoshi, Supriatna, & Arifin, 2016). It shares border with the West Lampung district and Central Lampung district on the north, West Lampung district on the west, and Pringsewu district on the east. With a population of 580,383 people, Tanggamus district is the second least populated district in Lampung province with only 125 people per square km (Badan Pusat Statistik, 2017a).

Located at the Sekampung watershed area, Batutegi Protection FMU was established in 2010 and is currently responsible to manage 58,174 hectares of watershed protection forest area in Tanggamus district. Topographically, Batutegi FMU is dominated by hilly area with more than 45% of the area classified as steep slope. Batutegi FMU serves critical role to protect Sekampung watershed which consists of three main river systems; Way Sekampung river on the west, Way Sangharus on the Rindingan Mountain, and Way Rilau on the north. The watershed is a catchment area for Batutegi dam that is designed to produce 24 megawatts of electricity and supplies 90,000 hectares of irrigated rice fields on the eastern and central Lampung plains (Kusworo, 2014).

4. Results

4. 1 Impact of CF on tree cover loss

Observation on the spatial distribution of CF area in Lampung province reveals that CF area are the most accessible compared to conservation forests or watershed management protection forests with no community management, with lowest mean of distances to roads and villages (see Table 3).

To control for differences in location-specific biophysical characteristics, we compared the matched treated and control cells from both the conservation area and watershed protection area with no management. We used Matchit package in R to pair cells that have the closest propensity scores. The pairings resulted in 157 matched pairs for both category of control land management.

We tested the distribution of propensity scores before and after matching between CF and conservation area, as well as CF and watershed protection area (see Figure 4). For CF and conservation area, the distribution of propensity score before matching differs significantly (KS-test: D=0.73976, p-value=2.2e-16). Matching reduced the differences significantly (KS-test: D=0.076433, p-value=0.7488). As for CF and watershed protection area, the distribution of propensity score before matching also differ significantly (KS-test: D=0.33112, p-value=3.664e-15), but matching reduced the differences (KS-test: D=0.012739, p-value=1).

After matching procedures were conducted, we observe significant reduction of mean differences in all variables except baseline tree cover (in CF and conservation area comparison) and cost distance to river (in CF and watershed protection area comparison). The matching procedure has managed to improve balancing properties of control variables in both comparison (see Table 4)

We then compared the outcome variables between control and treated cells in matched datasets. We found that CF area exhibit higher percentage of tree cover loss compared to conservation area with 2.31% and 1.78% tree cover loss respectively (p-value = 0.0055, Table 2.6). On the contrary, comparison of percentage of tree cover loss between CF and watershed protection area shows that CF exhibit lower percentage of tree cover loss with 2.31% and 4.81% tree cover loss respectively (p-value=0.01057, Table 5).

The result of Wilcoxon Rank-Sum test of tree cover loss percentage on matched cells for both categories resulted in statistically significant value. Thus, we reject the null hypothesis, and conclude that there are statistically significant differences between the means of control and treated cells in both groups (see Table 5).

4. 2 Impacts of biophysical characteristics on CF performance

Figure 5 present the conceptual framework of key factors influencing the success of CBF (Baynes et al 2015). In our sample sites, biophysical aspects of the sites significantly affect the ability of the community forest group to achieve the stated conservation and economic goals of CF scheme. The ability of the land to support multiple livelihood crops greatly improved farmers' motivation to plant more trees into the landscape, whereas in areas with more limited crops option, planting more canopy trees means reducing their potential economic benefits, thus it is less favorable to follow the government guideline to plant more canopy trees and restoring the condition of the forests. Higher elevation sites with steeper slopes reduce the likelihood of forest degradation, but it also prevents farmer from having more livelihood crop options, thus reducing their motivation in restoring degraded areas.

Lack of technical capacity to process their forest produce, as well as lack of market access and marketing strategy are also preventing CF units from earning higher economic benefits. Currently this role is filled sporadically by local NGO (Konsorsium Kota Agung Utara) that is funded mostly by a bilateral grant under the Tropical Forest Conservation Action (TFCA) program. TFCA is the project implementation of debt-for-nature framework signed between Indonesia and the United States (Prijono, 2017). Despite their best effort to empower CF units in Tanggamus district, they do not have enough funding and staff capacity to support all CF units in the area.

Clear property rights with delineated boundaries that are agreed by all members is key to eliminate social conflicts between farmers, which eventually lead to better intra-community farmers group governance. With better intra governance among members, they are able to coordinate more effectively and take actions against potential offender of CF rules, thus improving the likelihood of CF success.

In terms of government support in the implementation of CF, we found that most farmers believe the government can do more to help them meet the reforestation target. Lack of technical assistance for identifying suitable multipurpose canopy trees at Site A is an example of how government can improve CF implementation. This also raises an important point about improving decentralized forest governance structure. As the forefront of forest management at the field level, Forest Management Units are responsible to assist implementation of CF within their jurisdiction. Batu Tegi Forest Management Unit is completely funded by the provincial government budget, and does not receive any funding from the central government. As of 2017, the annual budget of the FMU is Rp. 285,000,000,- (around USD 19,950) to oversee an area of 58,174 hectare (KPHL Batu Tegi, 2012; Ministry of Environment & Forestry, 2018). This budget is barely enough to pay for their own 35 staffs, let alone developing an impactful and scientifically confident assistance program for CF concessions within their jurisdiction. Thus, supporting the implementation of CF should not be borne by the local government alone. Allocating more resources into FMU as the sole agency that provides day-to-day support for the implementation of CF program means improving the quality of monitoring and evaluation of each CF and increasing the ability for government to identify issues on CF implementation early in the program. These two are keys for the decision makers to evaluate the implementation of CF regularly, adapt, and improve policies to ensure that both the conservation and economic goals can be achieved.

5. Conclusion

Our study shows that community-based forest management in the form of Community Forests concession within watershed protection area possess promising potential to reduce the rate of tree cover loss when compared against watershed protection area with no community management. This promising result supports the idea that generating added economic benefits and improving local community's access to forest resources do not necessarily lead to degradation of forests. We also found that biophysical characteristics of community forest sites significantly affect the ability of the community forest groups to achieve the stated conservation and economic goals of community forestry.

However, risk of forest degradation remains a significant concern when it comes to allocating community forests in highly forested area. Local communities still perceive that community forestry scheme is an opportunity to secure land tenure for their livelihood and putting the goal of forests restoration and conservation as the secondary priority. This means that if the sites cannot provide the expected livelihood benefit, it is likely that the goal to conserve forests can be sacrificed to gain more short-term livelihood benefit.

Improvements in the designation process of community forests and evaluation framework of the national social forestry program can greatly reduce the risk of further forests degradation. Designation of community forestry area should take into account its biophysical characteristics to support multiple land use scenarios that provide ample livelihood benefits for local communities. Ideally, area with low percentage of tree cover that supports multiple livelihood scenarios presents the biggest opportunity to restore forests while providing livelihood benefit with the lowest risk profile for future forest degradation. However, the government supports for technical assistance, such as crop and seed selections, as well as for market access would be essential for them to succeed. This safeguard measures would improve the likelihood of community forests in achieving its goal of improving the livelihood of local communities while protecting and restoring the remaining forests.

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Tables

Table 1: Land use designation in Lampung province & sampling cells

Samplings	Conservation Area	Watershed Protection	Community Forestry
Total area (hectare)	394,811	317,236	8,436
# sampling cells	14,437	10,527	157
Total sampled (hectare)	360,925	263,175	3,925
% sampled from total area	91%	83%	47%

Table 2: Summary of characteristics of sample CF units. Slope and elevation maps were calculated using digital elevation model from NASA Shuttle Radar Topography Mission 1-arc second global dataset (U.S. Geological Survey, 2015). *Cost distance to village were calculated using path distance tool on ArcGIS 10.6 that calculates the least accumulative cost distance while accounting for surface distance along with horizontal and vertical cost factors (elevation and slope). Tree cover in the year 2007 is masked from global annual tree cover loss dataset* (Hansen et al., 2013).*Points of villages were obtained from Indonesia's Basic Geospatial Information dataset published by Indonesia Geospatial Agency* (Geospatial Information Agency, 2016).

Variables		Tribuana (Site A)	Hijau Makmur (Site B)
Licensed		2007	2009
Area (hectare)		1,507	1,190
# of Households		500	434
Male FGD participants		13	11
Female FGD participants		6	7
Elevation (MASL)	Min	918	341
	Mean	1,060	501
	Max	1,238	706
Slope (%)	Min	0	0
	Mean	11.48	12.76
	Max	43	38
% tree cover (2007)	Min	0	0
	Mean	52	82
	Max	100	100
Cost distance to village	Min	2,764	1,042
	Mean	4,269	2,941
	Max	5,518	4,764

Table 3: Summary of spatial distribution of community forests, conservation forests, and watershed protection forests in Lampung province

Variables		**Conservation Area**	**Watershed Protection**	**Community Forestry**
Elevation	Min	-8	-33	245
	Mean	376	625	716
	Max	2,220	2,175	1,570
Slope	Min	0	0	0
	Mean	10	15	14
	Max	79	75	64
Cost distance to mill	Min	44,926	41,277	62,246
	Mean	106,420	91,347	88,368
	Max	168,718	153,394	109,440
Cost distance to road	Min	0	0	0
	Mean	8,480	4,037	3,173
	Max	28,523	15,324	11,010
Cost distance to river	Min	0	0	1,304
	Mean	7,472	8,761	9,072
	Max	23,405	34,297	22,606
Cost distance to village	Min	0	0	0
	Mean	9,374	4,777	3,591
	Max	29,615	16,694	10,509

Table 4: Summary of balance of control variables

A. Summary of balance of control variables for CF and conservation area

		Means Treated	Means Control	SD Control	Mean Diff	eQQ Med	eQQ Mean	eQQ Max
distance	before	0.17	0.01	0.03	0.16	0.12	0.16	0.50
	after	0.17	0.16	0.14	0.02	0.00	0.02	0.15
	% improvement				90%	100%	90%	70%
slope	before	14.33	9.82	7.22	4.51	4.00	4.74	14.59
	after	14.33	14.21	8.05	0.12	2.53	3.00	8.31
	% improvement				97%	37%	37%	43%
elevation	before	670.17	369.68	386.90	300.49	367.28	308.93	599.82
	after	670.17	666.61	438.82	3.56	134.40	174.62	437.66
	% improvement				99%	63%	43%	27%
road	before	3,330.41	8,690.00	4,754.23	-5,359.59	5,500.93	5,397.33	17,631.45
	after	3,330.41	3,433.40	2,245.88	-102.98	352.05	468.50	2,144.01
	% improvement				98%	94%	91%	88%
river	before	8,804.86	7,573.93	4,708.34	1,230.93	1,101.81	1,411.87	3,832.93
	after	8,804.86	8,885.41	5,493.18	-80.55	2,306.48	2,324.60	4,042.39
	% improvement				93%	-109%	-65%	-5%
mill	before	87,648.26	106,476.59	33,248.33	-18,828.33	22,834.30	23,678.80	59,577.31
	after	87,648.26	87,215.19	25,655.04	433.07	14,250.03	14,252.97	27,292.06
	% improvement				98%	38%	40%	54%
village	before	3,692.36	9,589.94	4,902.43	-5,897.58	5,504.80	5,930.98	18,950.94
	after	3,692.36	3,859.07	2,223.65	-166.70	195.68	289.87	1,211.14
	% improvement				97%	96%	95%	94%
tc2007	before	78.02	78.02	26.85	-0.01	8.02	11.06	43.35
	after	78.02	79.93	16.11	-1.92	3.04	3.37	17.74
	% improvement				-37471%	62%	69%	59%

B. Summary of balance of control variables for CF and watershed protection area

		Means Treated	Means Control	SD Control	Mean Diff	eQQ Med	eQQ Mean	eQQ Max
distance	before	0.025	0.0145	0.0119	0.0105	0.0094	0.0102	0.0258
	after	0.025	0.0249	0.0166	0.0001	0	0.0001	0.0064
	% improvement				99%	100%	99%	75%
slope	before	14.3303	15.097	7.2393	-0.7667	2.5247	2.5903	15.571
	after	14.3303	14.489	6.2942	-0.1587	1.1451	1.3939	6.1636
	% improvement				79%	55%	46%	60%
elev	before	670.1702	644.3057	370.4939	25.8645	80.1358	110.7585	571.4414
	after	670.1702	671.2053	356.9752	-1.0351	84.3488	93.1139	387.3333
	% improvement				96%	-5%	16%	32%
road	before	3330.4135	4255.2056	2849.0256	-924.7921	847.0309	949.638	4494.534
	after	3330.4135	3488.7386	2770.5795	-158.3252	262.034	376.5563	3082.321
	% improvement				83%	69%	60%	31%

river	before	8804.8591	8825.0742	5544.4998	-20.2152	1175.9475	1431.2469	11416.2006
	after	8804.8591	8750.5386	5172.4737	54.3205	828.0211	1110.3482	3377.216
	% improvement				-169%	30%	22%	70%
mill	before	87648.2603	91194.4229	18770.657	-3546.1626	3982.0648	6685.1582	44811.8735
	after	87648.2603	86742.468	18112.6416	905.7923	5095.1605	6485.5912	31209.8395
	% improvement				74%	-28%	3%	30%
vill	before	3692.3646	5006.5136	2756.3688	-1314.1491	1174.7963	1335.2152	5445.26
	after	3692.3646	3846.7471	2531.4406	-154.3826	422.7593	515.8248	1900.8711
	% improvement				88%	64%	61%	65%
tc2007	before	78.0169	72.6584	21.9746	5.3585	3.213	6.5098	40.892
	after	78.0169	78.9524	11.8698	-0.9355	1.4506	1.8097	11.5741
	% improvement				83%	55%	72%	72%

Table 5: Outcome variable comparison & test statistics

Comparison		**Control**	**Treated**	**p-value***
CF & conservation area	# Sampling cells	14,437	157	
	Mean unmatched TC change (%)	2.02458	2.31352	
	Mean matched TC change (%)	**1.78360**	**2.31352**	**0.00560**
CF & watershed protection area	# Sampling cells	10,527	157	
	Mean unmatched TC change (%)	3.76452	2.31352	
	Mean matched TC change (%)	**4.80860**	**2.31352**	**0.01057**

Figures

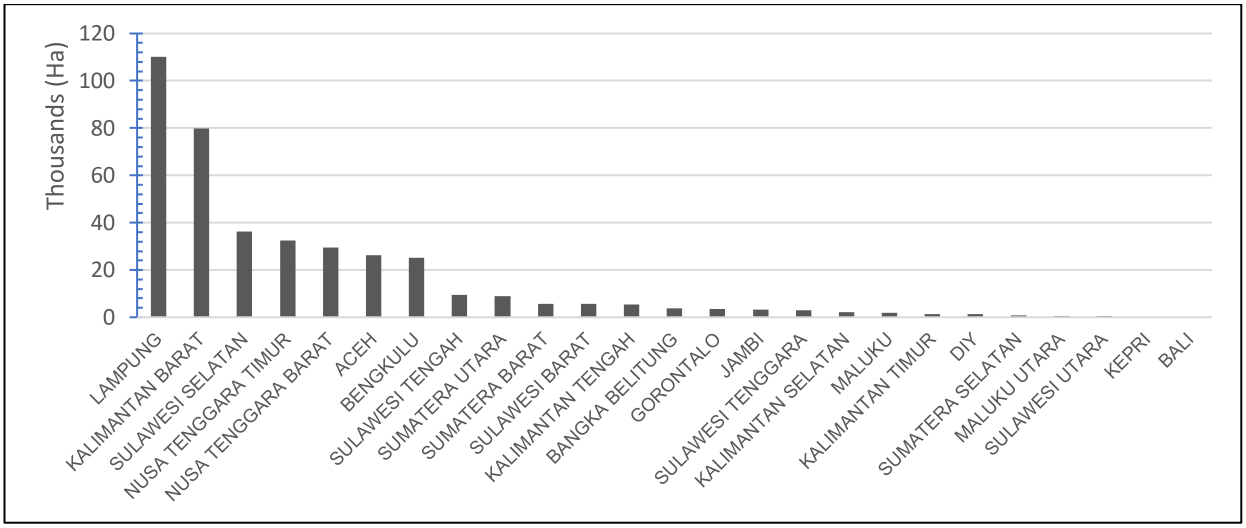

Figure 1: Community forests area by province. (Source: GIS analysis on community forests data, Indonesia Ministry of Environment & Forestry, 2016)

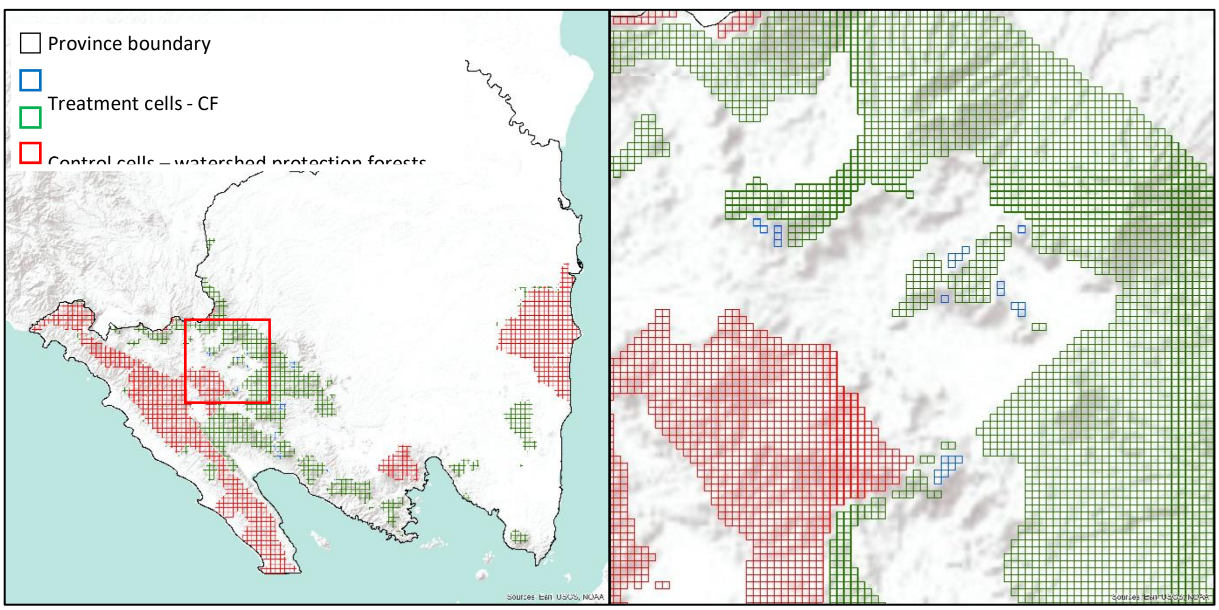

Figure 2: Spatial distribution of sampling cells

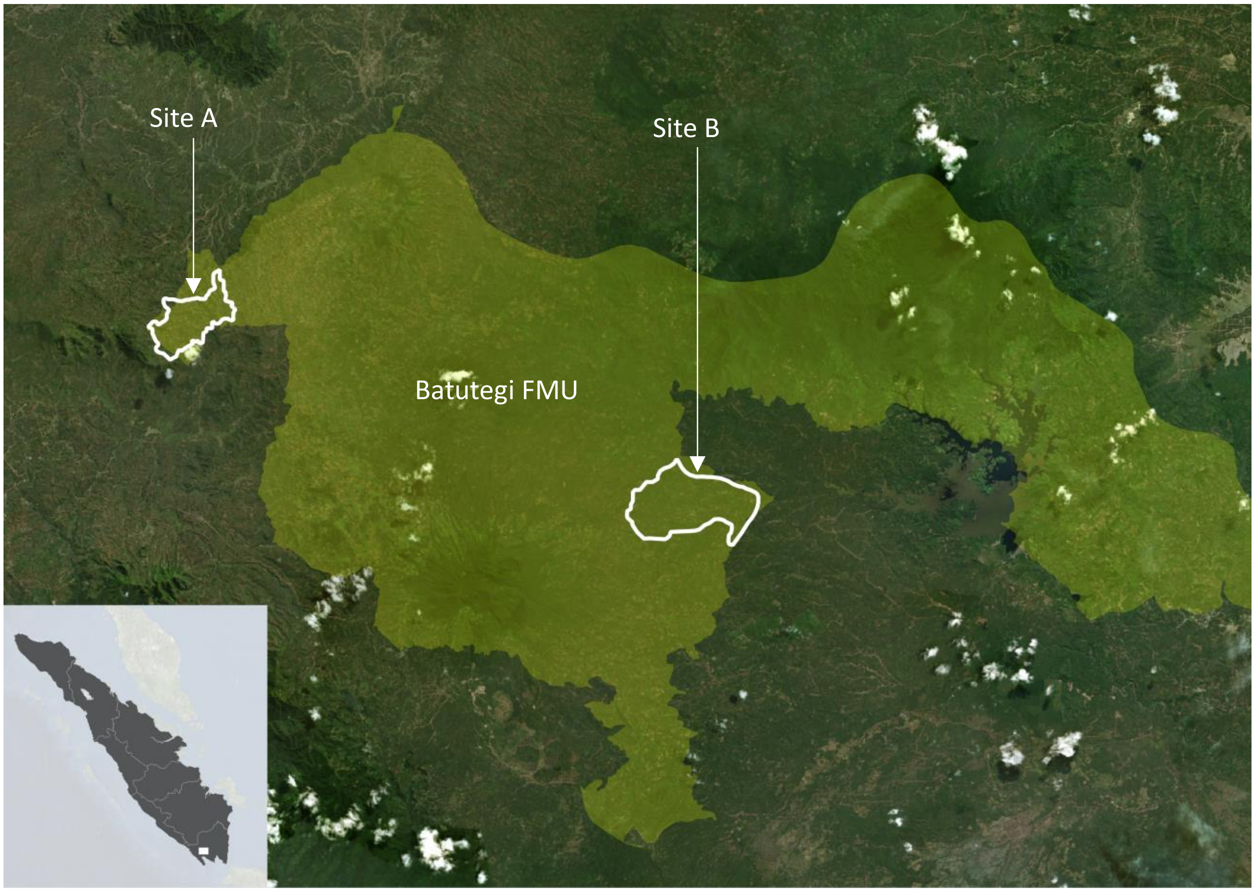

Figure 3: Map of sample CF units.

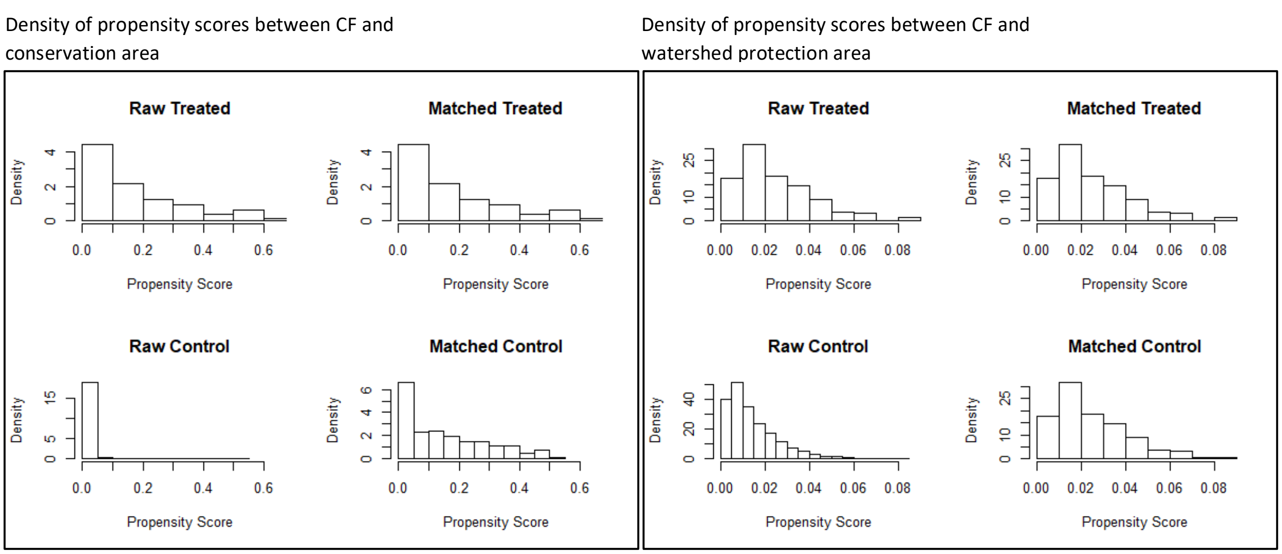

Figure 4: Distribution of propensity score

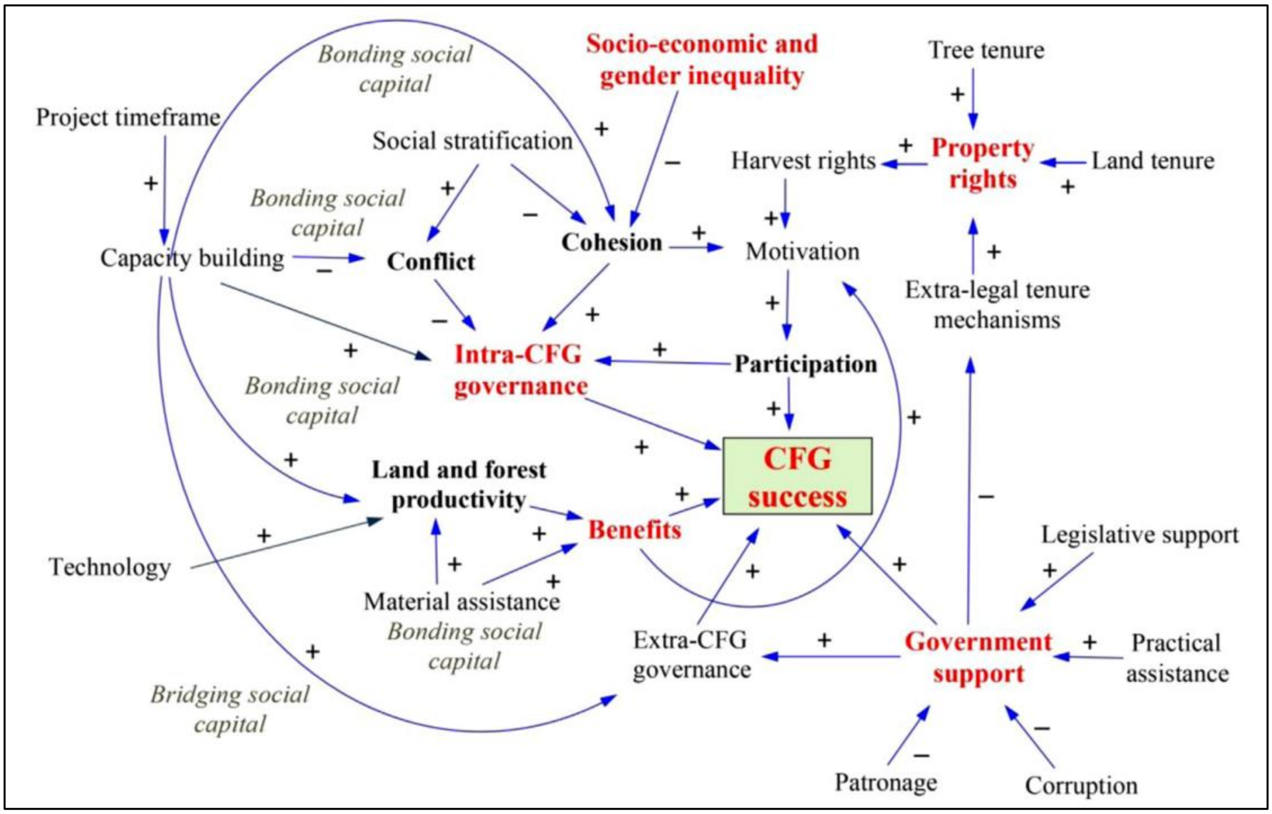

Figure 5: Causal diagram of the relationship between factors influencing the success or failure of community forestry group (Baynes, Herbohn, Smith, Fisher, & Bray, 2015).