An Approach to Achieve Sustainable Development Goals Through Participatory Land and Forest Conservation: A Case Study in South KALIMANTAN Province, Indonesia

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An Approach to Achieve Sustainable Development Goals Through Participatory Land and Forest Conservation: A Case Study in South KALIMANTAN Province, Indonesia

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ABSTRACT

The delivery of sustainable development goals (SDGs) through a participatory land and forest conservation initiative was evaluated in South Kalimantan Province, Indonesia. The initiative focused on the rehabilitation of a 410 ha forest that was managed by local villagers. A forest rehabilitation and management initiative was developed through participatory action, establishing a well-managed rubber plantation that provided new livelihood opportunities. Poverty reduction was promoted, evidenced by a reduction in inequality amongst the local community. Between 2010 and 2018 the Gini coefficient of inequality declined from 34.6% to 31.3%, demonstrating a contribution to SDGs 1 (No Poverty) and 10 (Reduced Inequalities). In addition, forest rehabilitation resulted in improved carbon stock and biodiversity management contributing to SDG15 (Life on Land). This was attributed to successful forest rehabilitation and the reduced incidence of forest fires. Cooperation amongst local villagers categorized as living in poor households was improved, facilitated by capacity building. This focused on rubber plantation management, cooperative action, and firefighting activities. This capacity building contributed to the delivery of SDG 17 (Partnerships for the Goals). Results from a socio-economic survey demonstrated that group activities and cooperation amongst stakeholders were essential to improve both livelihoods and forest management practices.

KEYWORDS

Poverty reduction; carbon stock; social forestry

Introduction

Sustainability Development Goals (SDGs) were agreed prior to the UNFCCC Paris Agreement in 2015, and the UN 2030 agenda for sustainable development focuses on achieving these goals and associated targets. The forestry sector can contribute to synchronistic efforts to meet both SDGs and obligations under the Paris Agreement through actions designed to promote and improve sustainable forest management, and hence enhance local people's livelihoods. SDG 15 (Life on Land) explicitly focuses on sustainable forest management, and other ecosystems (Gregersen, El Lakany, & Blaser, 2017; Swain, 2018). It is generally recognized that sustainable forest management can also promote

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delivery of several socio-economic SDGs dedicated to improving human welfare, such as reduction of poverty and strengthening food security (Swamy, Drazen, Johnson, & Bukoski, 2018). However, effective implementation of actions to deliver SDGs will have substantially varying effects on forests and their uses, involving multiple synergies and trade-offs (Bloomfield et al., 2018; de Jong, Pokorny, Katila, Galloway, & Pacheco, 2018; Pfaff et al., 2018; Timko et al., 2018).

In Indonesia, severe deforestation and forest degradation have occurred. Between 1990 and 2015, forest cover decreased from 118,545 thousand ha (69.0%) in 1990 to 91,010 thousand ha (53.0%) (FAO, 2015). South Kalimantan Province (the focal region of this study) has experienced the most severe deforestation and forest degradation in Indonesia. In this province forest cover had declined to 45.9% in 2013 (Indonesian National Carbon Accounting System, 2018), substantially lower than in other Kalimantan Island provinces (e.g., 73.2% and 82.7% in neighboring East and Central Kalimantan, respectively). Deforestation has been caused by both commercial logging since the 1980s (Fatawi & Mori, 2000) and continuous forest fires (Mori, 2000; Page et al., 2002). Based on REDD+ (Reducing emissions from deforestation and forest degradation including carbon stock enhancement) negotiations, South Kalimantan Province was not targeted as a REDD+ demonstration site (Republic of Indonesia, 2016), because it lacks sufficient available extant forest resources for conservation management purposes. Forest management actions within the province need to focus on forest restoration and carbon enhancement rather than the REDD+ goals of reducing deforestation and forest degradation. Therefore, restoration and rehabilitation programs are required in parallel with activities that reduce both pressures on forest resources and the frequency of forest fires.

In order to reverse the deforestation and forest degradation trends, the Indonesian Government decided to promote the concept of social forestry (SF) (Banjade, Herawati, Liswanti, & Mwangi, 2016). This is defined as a system of forest management activities involving local communities to improve wellbeing and implement sustainable forestry. The Indonesian Government is committed to assigning 12.7 million ha of forest to SF (also referred to as Community Forest, CF) through local community management by 2019 (Maryudi, 2017) and is implementing the approach to accelerate the adoption of sustainable forest management (Lindayati, 2002). Indonesia's Forestry Law 41/1999 includes provisions for local communities to participate in the management of forests throughout the country's forest estate. Under this law, operational procedures for CF (Hutan Kemasyarakatan or HKM in Indonesian) are specified in Forest Regulation 6/2007 and Environmental and Forestry Minister Regulation No. 83/2016. Permits provided under the HKM program (issued for national forest areas designated for 'production' or 'protection' purposes) are valid for 35 years and renewable. The HKM program aims to rehabilitate national forest areas and empower the local community through collective action. The permitting process also sanctions the harvesting and extraction of non-timber forest products (NTFPs) and the establishment of timber businesses in forest production zones. The HKM program relates directly to SDGs, especially with respect to poverty reduction through utilization of forestry products, enhancing participation by local communities, and restoring and managing forest resources (including carbon stock and conservation of biodiversity).

This study focuses on understanding how participatory action may be used to deliver land and forest conservation programs that ultimately contribute to the delivery of SDGs. This approach is particularly important within the forestry sector as governments strive to achieve SDGs, requiring a move away from sectionalism to integrated and coherent policies. A better understanding of forest conservation and management is critical for governments and policymakers to design appropriate policies and interventions that can deliver SDGs. This study focuses on one of the SF target areas in South Kalimantan Province, Indonesia, and investigates how forest conservation and management can be achieved through participatory community action. Forest resources have recognized the importance of providing sustainable livelihoods for poor communities in many developing countries. The focal SF program is based on an integrated approach that directly addresses SDG Goal 15 (Life on Land) and is intended to have positive impacts through the delivery of outcomes related to SDGs 1 (Poverty Reduction), 10 (Reduced Inequalities) and 17 (Partnerships for the Goals).

Study site

The study was conducted in Tebing Siring village (3°41′ N, 114°49′ E, ca. 30 m a.s.l.) in lowlands of Bajuin sub-district, Tanah Laut regency, South Kalimantan Province, Indonesia (Figure 1). The entire regency is also predominantly lowland. The regency has a typical tropical rainforest climate (Af, according to the Köppen classification system), and covers ca. 363,000 ha, including ca. 128,000 ha of forest (about 30% of the total land area) in 2016. The area has been severely degraded. For example, 86,370 ha (68% of the total forest area) of conservation forest (hutan konservasi in Indonesian) had been replaced by alang-alang (*Imperata cylindrica* (L.) P.Beauv.) grassland as a result of severe forest fires. Tebing Siring village (desa in Indonesian) is separated into four sub-villages (dusun in Indonesian) with a total population of 2,668 (879 households) in 2017. The village community comprises two distinct groups of people. About half of one sub-village is inhabited by an immigrant population from Java Island, occupying about 2.0 ha of land in each household, whilst the rest of the community are mostly from the Banjar indigenous group with limited land available for cultivation. The 410 ha study area was essentially managed by the one sub-village of Banjar ethnicity (318 households) who participated in the SF program described below.

The SF program developed from previous ecological restoration and community initiatives. From 2012 to 2018, the Waseda-Bridgestone Initiative for Development of Global Environment (WBRIDGE Initiative) was implemented by Waseda University, Lambung Mangkurat University, and Japan International Forestry Promotion and Cooperation Center (JIFPRO). In parallel, the Indonesian Government implemented an SF program in 2016, targeting an area of 8,860 ha considered suitable for conducting a participatory forest management program. This program involved two local community groups, "Ingin Maju" and "Suka Maju", established in 2011 and 2014, respectively. Participants comprised members of poor households selected (following discussion with Lambung Mangkurat University regarding the study's design) using criteria that included the holding of land assets and home electronics, income level, and home ownership. In 2018, 42 and 48 households participated in the Ingin Maju and Suka Maju groups, respectively (more than in 2012). These groups were supported to manage a newly

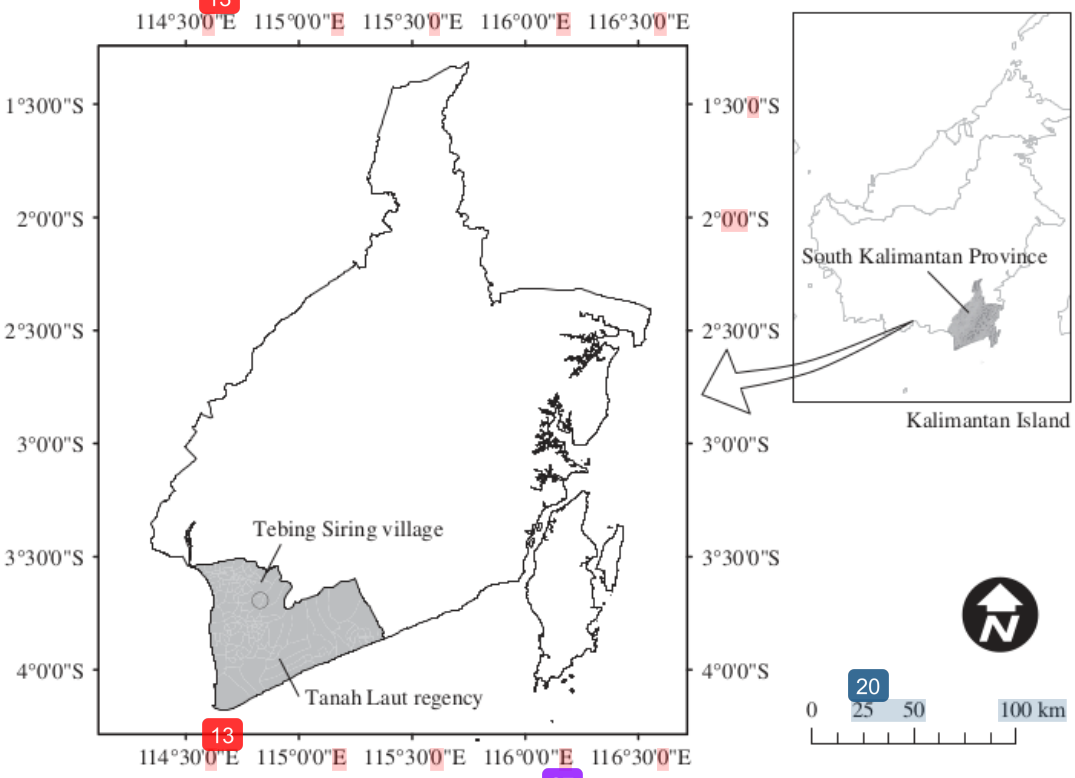

Figure 1. Location of the study site: Tebing Siring village, Bajuin district, Tanah Laut regency, South Kalimantan Province, Indonesia.

established rubber plantation. Also, within the village as a whole, the Indonesian Government initiated a forest ecosystem restoration program that focused on fire prevention and firefighting training. Academic partners in the W-BRIDGE Initiative and the PT Bridgestone Kalimantan Plantation directly supported these community groups for seven years (Figure 2).

Materials and methods

To evaluate progress towards achieving SDGs, we selected four goals that were relevant to this study and the W-BRIDGE Initiative as a whole (including governmental action). These were SDGs 1 (No Poverty), 10 (Reduced Inequalities), 15 (Life on Land), and 17 (Partnerships for the Goals). Progress towards SDG 15 was evaluated by estimating changes in the condition of the forest ecosystem. Progress towards SDGs 1, 10 and 17 was evaluated by questionnaire-based socio-economic surveys in 2010 and 2018 (before and after the W-BRIDGE Initiative) of 40 households (13% of the total participating). Socio-economic data were also collected through informal interviews, with questions regarding income generation and its pattern, economic dependency on the rubber plantations and other work, and effects of the program on the rural people's attitudes, activities and decision-making processes. We identified households that were participants in the W-BRIDGE

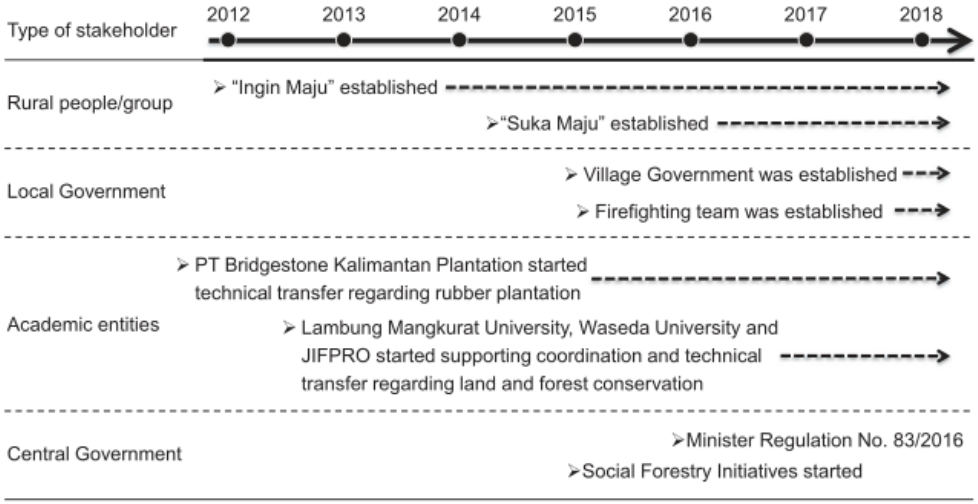

Figure 2. Timeline of forest conservation and stakeholder engagement actions conducted in Tebing Siring village.

Initiative and non-participants, then randomly selected 20 from each group to survey. The interviews were conducted in March 2018.

Satellite image analysis

To evaluate progress towards SDG 15, land cover changes were monitored using remote sensing following implementation of the forest rehabilitation program. Satellite imagery was collected from the study site using SPOT6 (in 2013) and Pleiades (in 2017) high-resolution sensors (optical resolutions are 1.5 m and 0.5 m, respectively). Land cover maps were prepared for both years of 2013 and 2017 by object-based image analysis, following Hiratsuka et al. (2018). We analyzed the spatiotemporal variation of land and forest cover, evaluating the extent of secondary forest (fallow areas following forest fires with closed canopy), shrub (fallow areas following forest fires with open canopy), rubber plantations, oil palm plantations, settlements, and wetland. A ground truth survey was conducted to verify and improve the land and forest cover classification. We then analyzed data on secondary forest, shrub, and plantation (rubber and oil palm) cover. Time intervals between, and sizes of, forest fires were derived from changes in secondary forest and shrub cover, then used as indicators of the success of community-led fire prevention efforts. The development of rubber and oil palm plantations was used as an indicator of land use change leading to opportunities for income generation and improved livelihoods.

Socio-economic survey and data analysis procedures

Questionnaire surveys and semi-structured interviews were conducted to evaluate progress towards SDGs 1, 10, and 17. The questionnaire was designed to obtain quantitative information on: 1) background variables (family size and ethnicity); 2) income structure (on-farm and off-farm income generation activities); 3) capacity to maintain livelihoods; 4)

awareness of village decision-making processes; 5) participation in group activities; and 6) comparison of daily life (e.g., education and health-care opportunities) before 2010 and after 2018. Households were selected using a random stratified sampling approach to ensure that the sample was representative of the village community. A village profile was provided by the head of the village and households were selected with guidance from community leaders. The procedure ensured that the sample contained an appropriate range of households with respect to age, participation and livelihood types. It also ensured that the number of participating and non-participating households were balanced (20 in each group). Each household survey took about 1 h to complete. After completion of the questionnaire survey, semi-structured informal interviews were conducted to obtain supplementary information regarding farming practices and forest use. Households from both the Ingin Maju and Suka Maju groups were included in the survey.

Initially, basic livelihood characteristics and information on the use of forest resources were determined from these data. Then, one-way analysis of variance (ANOVA), multiple regression and principal components analysis (PCA) by the software of IBM SPSS Statistics Ver. 25, were applied to quantitatively characterize community responses. One-way ANOVA was used to explore differences in income generation between 2010 and 2018 of participants and non-participants, respectively, and also differences of own land area in 2010 and 2018 of participants. Multiple regression was used to determine relationships between the dependent variable 'satisfaction in daily life' and independent variables. We confirmed that our data were not highly correlated (<0.7). PCA was used to identify key underlying socio-economic factors and to draw a scatters map of sample households, who participated or not and depend on on-farm or off-farm activities, to extract the key characteristics for proposing an effective capacity building program for villagers' activities (e.g., Yoshikura et al., 2016). The analysis was therefore conducted by 1) evaluating characteristics of respondents that did, or did not, participate in community activities; 2) analyzing variables that influenced satisfaction in daily life; and 3) exploring these data to extract characteristics related to the effectiveness of the capacity building program for villagers.

Results

Forest cover change (progress toward SDG 15, "life on land")

From 2012 to 2018, the W-BRIDGE Initiative supported the local community to establish and manage both rubber tree and cash crop plantations (including upland rice and coffee). These plantations were established within a 52 ha area of degraded land that had been subjected to continuous forest fire events. The capacity building program provided training in planting and forest management (including establishment, weeding, firefighting, etc.), and as a direct result, 47.3 ha of this land was considered well managed in 2017 (Figure 3). From 2015, the area surrounding the plantation (primarily secondary forest and shrub) was also managed by a firefighting team. The extent of secondary forest increased from 115.0 ha in 2013 to 153.2 ha in 2017, whilst shrub cover decreased from 279.7 ha to 179.9 ha in the same period. The area was well managed during the seven years with respect to firefighting activity, even when severe drought and forest fires had occurred throughout Kalimantan island (Chisholm, Wijedasa, & Swinfield, 2016).

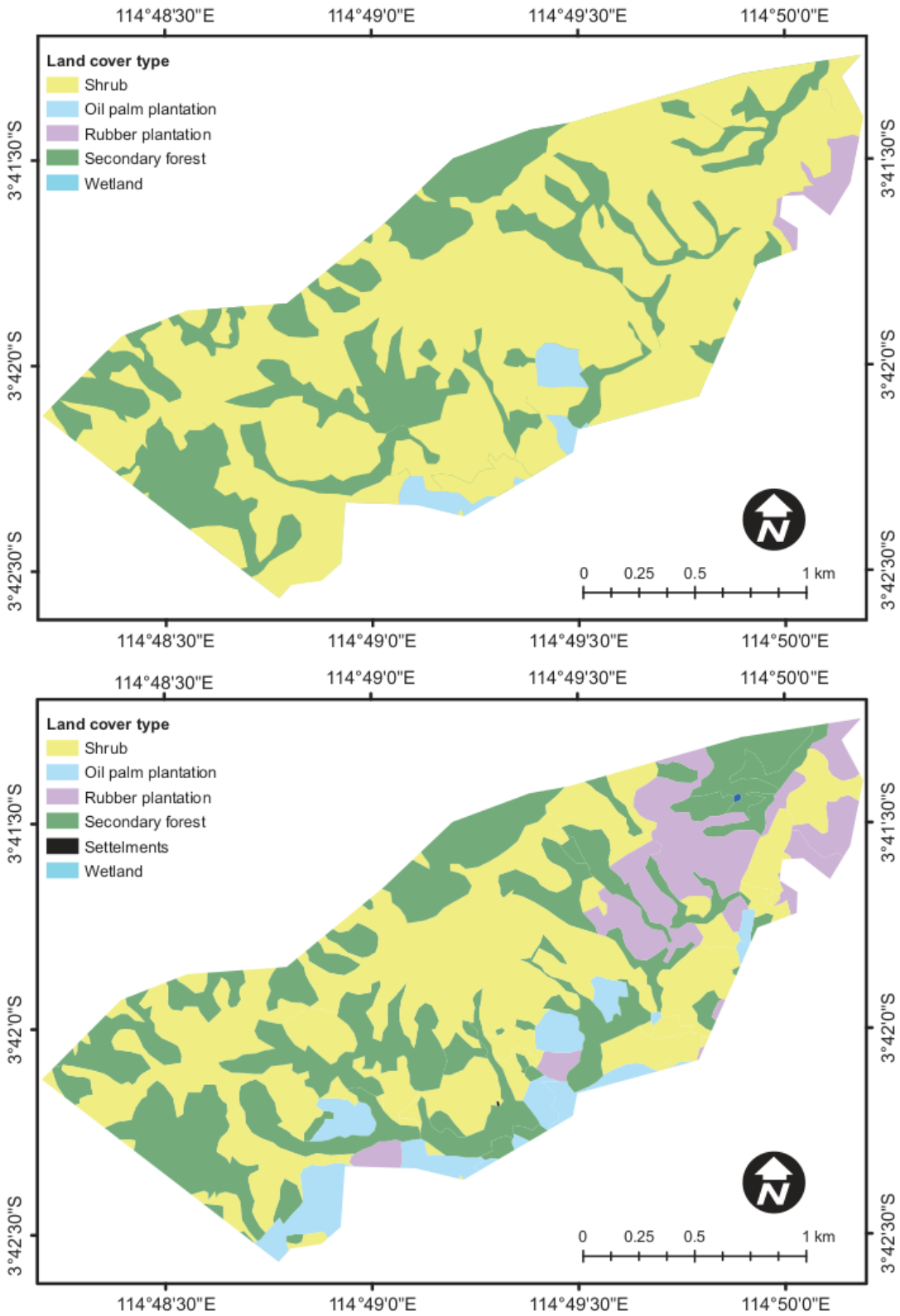

Figure 3. Land cover classification of study area in 2013 (upper diagram) and 2017 (lower diagram). The 2013 and 2017 land cover images were obtained by SPOT6 and Pleiades sensors, respectively.

The establishment of plantations and increase in secondary forest resulted in substantial forest rehabilitation during the study period. Progress to deliver SDG Goal 15 may be demonstrated by an increase in above ground biomass (from 14,330 Mg in 2013 to 16,500 Mg in 2017), an increase of 2,131 Mg during the study period (Figure 4). This increase can be attributed to the landscape-level forest conservation activities conducted by the local community.

In addition, rehabilitation resulted in improvements in wildlife habitats. For example, Higashide et al. (2018) reported that some wild mammals had been recorded (using camera traps) in both newly established secondary forest and the plantations within the study area. This observation further indicates that progress has been made toward SDG 15.

Poverty reduction (progress toward SDG 1, "no poverty")

Results from the socio-economic surveys were used to compare incomes of participant and non-participant households. Between 2010 and 2018 mean total income per non-participant household with standard deviation (S.D.) were from 22,064 (15,041) to 22,249 (14,931) thousand Rp, although this change was not significant ($p = 0.969$, $F = 4.10$). Similarly, mean on-farm income (including rubber production) increased by 23% from 6,584 to 11,685 thousand Rp (S.D. values are 10,734 and 16,357, respectively), but the change was also non-significant ($p = 0.251$, $F = 4.10$). In contrast, mean total income and mean on-farm income per participant household

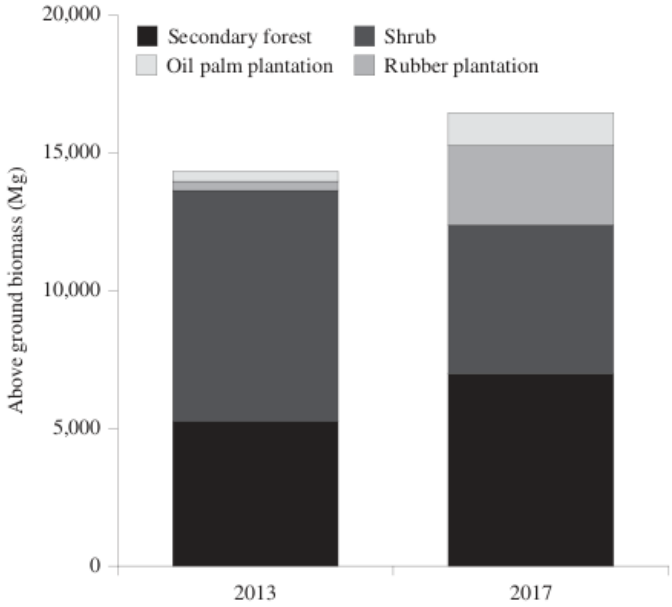

Figure 4. Above ground biomass in the study area recorded in 2013 and 2017.

Note: To estimate above ground biomass we used land areas shown in Figure 3 and the following estimates of above ground biomass per hectare in each land cover type: secondary forest, 50.0 Mg ha^{-1} (Hashimotio, Koji, Tange, & Sasaki, 2000); shrub, 30.0 Mg ha^{-1} (Tanabe & Wagner, 2003); oil palm plantation, 42.3 Mg ha^{-1} (Kotowska, Leuschner, Triadiati, Meriem, & Hertel, 2015); and rubber plantation, 61.1 Mg ha^{-1} (Kotowska et al., 2015). Areas of wetland and settlements were very limited and thus neglected.

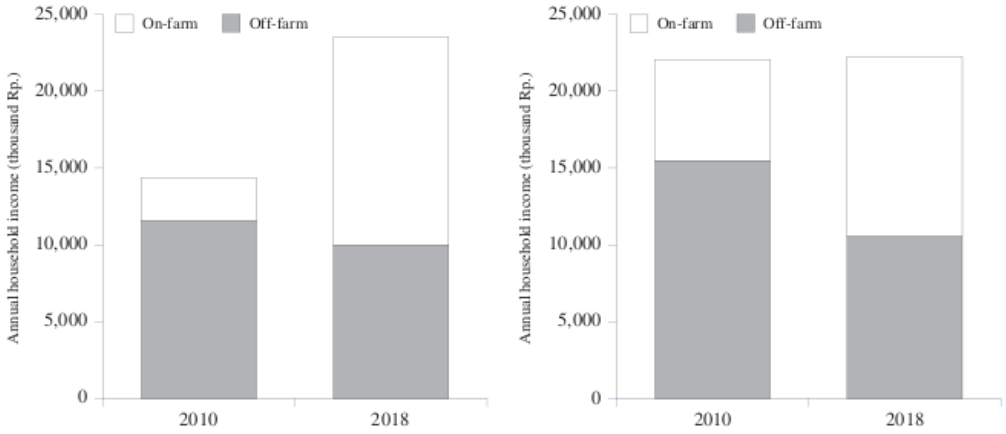

Figure 5. Change in income generation of participants (left) and non-participants (right) in the W-BRIDGE Initiative between 2010 and 2018.

substantially increased, by 64% from 14,345 to 23,523 thousand Rp (S.D. values are 8,024 and 11,539, respectively) ($p < 0.01$, $F = 4.10$) and five-fold from 2,765 to 13,545 thousand Rp (S.D. values are 5,178 and 11,804, respectively) ($p < 0.001$, $F = 4.10$), respectively. The socio-economic survey revealed that members of participant households were dependent on gold mining activities prior to 2012. Following the start of the W-BRIDGE Initiative, capacity building in rubber plantation management resulted in individuals changing career, either joining the rubber company or establishing their own rubber plantations. Overall, mean income generation in Tebing Siring village increased by 26% from 18,205 to 22,886 thousand Rp (S.D. values are 12,524 and 13,187, respectively), and whilst not statistically significant ($p = 0.108$, $F = 3.96$) this resulted in participating households increasing their incomes from 'poor' to 'middle class' levels, thus substantially reducing poverty (SDG 1) and hunger (SDG 2) in the village.

Equality (progress toward SDG 10, "reduced inequalities")

A reduction in the number of poor households reduced inequality and was an expected outcome of the W-BRIDGE Initiative. This expectation was confirmed quantitatively: Gini coefficient of inequality declined from 34.6% in 2010 to 31.3% in 2018; values substantially lower than the national average of 39.5% in 2013 (World Bank, 2018). Results from the socio-economic surveys indicated that this was due to the capacity building that improved both on- and off-farm employability. This capacity building, delivered by the academic partners, focused on training related to both rubber plantation management and group activities. The W-BRIDGE Initiative also resulted in participants from poor households being allocated land for plantations; mean land area ownership increased from 0.28 to 1.23 ha per household ($p < 0.001$, $F = 4.10$).

Results from the semi-structured interviews showed that the new knowledge acquired had changed the daily life of poor households by 1) facilitating stronger societal participation, 2) improving children's education and welfare, 3) reducing participation in illegal mining activities, and 4) creating opportunities to purchase items such as motorbikes and cell phones. Poverty reduction and improvements in daily life also supported the development of stronger social cooperation within the village.

Cooperation (SDG 17 "partnerships for the goals")

The socio-economic survey showed that satisfaction in daily life improved during the study period, increasing (on a five-level Likert scale) from 2.65 to 3.63 between 2010 and 2018. Multiple regression analysis of the 2018 dataset demonstrated that the dependent variable 'satisfaction in daily life' was moderately correlated to independent variables (R^2 = 0.500), with 'frequency of group activity in daily life' ($p < 0.05$) and 'importance of collaboration among villagers' ($p < 0.05$) being key parameters (Table 2). The 2010 dataset revealed no such relationship, with no association evident (R^2 = 0.296), although there were weak indications that one parameter (knowledge) influenced the dependent variable ($p < 0.05$).

The semi-structured interviews revealed that the key factors leading to the successful outcomes of the W-BRIDGE Initiative were: training by PT Bridgestone Kalimantan Plantation that facilitated participant collaboration and information exchange; the local government initiative that established the firefighting team and provided fire extinguishing equipment; and the role of academic partners who regularly functioned as counsellors and mediators, supporting collaboration and the establishment of community groups.

PCA revealed underlying patterns in the socio-economic survey dataset (Table 3). Principal Components 1 and 2 represented the overall satisfaction in daily life and the importance of group activities, respectively (Figure 6). The PCA revealed four key villager groups: A, B, C, and D (Figure 6). Those catabolized as Type A primarily represented participants in the W-BRIDGE Initiative who experienced improved satisfaction in daily life and valued group activities. Those categorized as Type D primarily represented participants who valued group activities but perceived little influence on satisfaction in daily life, whilst those categorized as Type B mainly represented non-participants who had

Table 1. Changes in ownership of land assets for participants and non-participants during the W-BRIDGE Initiative.

				Land asset				Engagement rate			
		Ethnic group		in 2010 (ha)		in 2018 (ha)		On-farm (%)		Off-farm (%)	
Types of villagers	Sample number	Banjar (%)	Java (%)	Mean	S.D.	Mean	S.D.	2010	2018	2010	2018
Participants	20	90%	10%	0.28	0.70	1.23	0.73	19.3	57.6	29.8	52.5
Non-participants	20	85%	15%	0.44	0.81	0.61	0.86	80.7	42.4	70.2	47.5

Table 2. Results of multiple regression analysis with 'satisfaction in daily life' as the dependent variable and independent variables included in the model summarized for 2010 and 2018 (before and after the W-BRIDGE Initiative, respectively).

	2010				2018			
Independent variable	Mean	S.D.	Standardized coefficients	*p* Value	Mean	S.D.	Standardized coefficients	*p* Value
Satisfaction with own land area	2.00	1.18	−0.058	0.725	3.40	1.50	0.274	0.060
Knowledge and/or technique level for daily life	2.05	1.41	0.482	0.015	3.58	1.57	−0.034	0.847
Participation degree in village's land use discussions	1.73	1.43	−0.035	0.879	3.28	1.80	0.183	0.342
Importance of participatory decision-making	3.10	1.50	0.122	0.547	4.28	0.88	−0.492	0.007
Satisfaction with the process of village's decision-making	2.45	1.58	−0.020	0.925	4.08	1.16	0.086	0.640
Frequency of group activity in daily life	1.23	0.80	0.189	0.259	2.73	1.80	0.438	0.018
Importance of collaboration among villagers	2.93	1.66	−0.043	0.828	4.23	1.19	0.324	0.026
Segment	-	-	1.292	0.122	-	-	2.889	0.011

Note: Coefficient of determination (R^2) of multiple regression analysis in 2010 and 2018 are 0.296 and 0.500, respectively.

Table 3. Factor loadings of Principal Components (PCs) 1 and 2 for households in the study area obtained from the Principal Component Analysis (*see* Figure 6).

	Principal component (PC)	
Variables	1	2
Satisfaction with daily file	0.157	0.625
Satisfaction with own land area	0.158	0.497
Knowledge and/or technique level for daily life	0.213	−0.089
Participation degree in village's land use discussions	0.235	−0.210
Importance of participatory decision-making	0.193	−0.470
Satisfaction to the process of village's decision-making	0.230	−0.078
Frequency of group activities among villagers	0.217	0.004
% Variance	49.7	15.6
Accumulated %		65.3

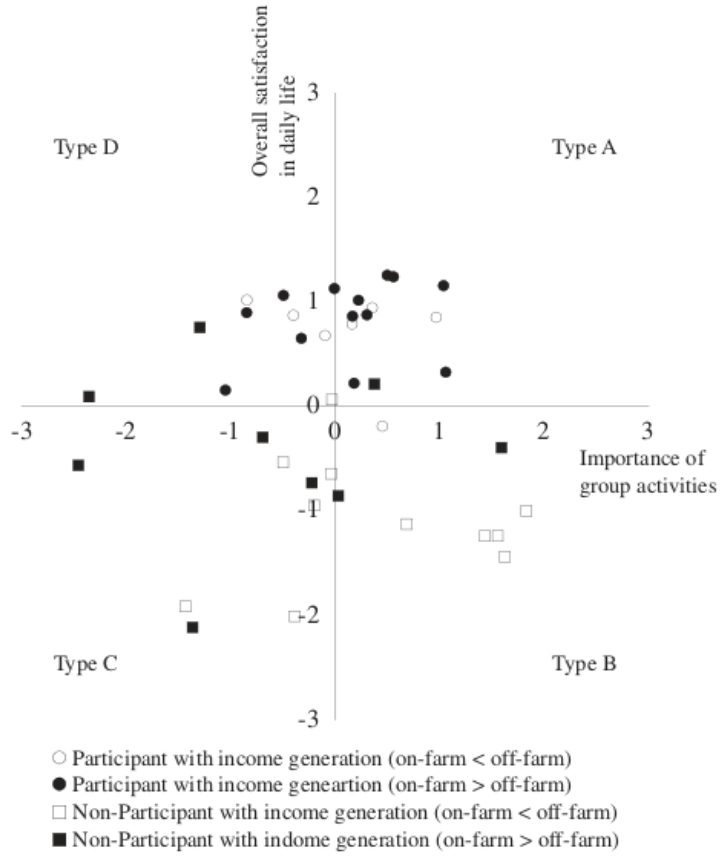

Figure 6. Distribution (factor scores) of households in four groups along two Principal Components (PCs) characterizing socio-economic drivers. PC1 and PC2 indicate the overall satisfaction in daily life (y-axis) and the importance of group activities (x-axis), respectively.

enough income. Also, those categorized as Type C mainly represented non-participants who did not value group or community action. This classification indicates the value of W-BRIDGE Initiative participation and indicates a need to involve community members who did not participate in the future to improve regional stability and reduce poverty.

Discussion

Social Forestry has been recognized as an important tool for forest conservation (De Royer, Van Noordwijk, & Roshetko, 2018; Moeliono, Pham, Bong, Wong, & Brockhaus, 2017), whilst SDGs have provided a valuable holistic framework to integrate consideration of human needs and impacts in such programs. SF, therefore, provides a platform for the development of strategies to achieve sustainable use of forest resources, through timber and NTFPs harvesting. SDGs were agreed upon at the UN General Assembly in 2015 as a framework to be applied at the national level. Hence, it is important to identify and monitor key performance indicators (KPIs) for each SDG nationally, sub-nationally (i.e., provincially) and locally (i.e., at village level). We found that such monitoring was challenging because suitable evaluation methods (including setting KPIs) were not available, at least for the forestry sector. It is expected that this study will be helpful for future assessment of SDGs as a quick survey is possible under such circumstances. Thus, we developed and applied simple community-based evaluation tools that provided information rapidly, and could be applied elsewhere.

Forest conservation projects have been evaluated empirically in terms of managed forest area, carbon stock (Hiratsuka, Iwanaga, Tsuzuki, & Yaginuma, 2014), biodiversity (Yamada, Yoshida, Hosaka, & Okuda, 2016), and economic returns from forest products (Feintrenie, Schwarze, & Levang, 2010). However, it is difficult to assess progress toward socio-economic SDGs without evaluations at the household or individual levels. We applied such an approach and demonstrated progress towards SDGs 1, 10, and 15. We also identified challenges, such as an increase in complaints with regards to the village decision-making processes (Table 2). This disharmony was driven by the desire for rubber plantation profits to be returned directly to individuals rather than the village as a whole. These concerns need to be acknowledged and addressed to enable further progress towards SDGs. We also detected synergistic effects on multiple SDGs, as results of the W-BRIDGE Initiative included not only forest recovery and improvements in ecological health, but also increases in household income and satisfaction in daily life. Towards 2030 targeted by SDGs, it is thought that various discussions will advance as the evaluation of SDGs achievement degree in the future, but it is expected that comprehensive evaluation to Goal 1, 10, 15, and 17 that this research worked will be helpful.

This study focused on Tebing Siring village, a community that is strongly reliant on forest resources for income generation. The W-BRIDGE Initiative achieved forest rehabilitation outcomes that resulted in progress towards delivery of a range of SDGs. This progress was achieved primarily due to the effective engagement of the local community, through participatory action facilitated using a multi-agency approach. A key challenge in developing countries is to identify effective approaches to address the conflict between the economic use of forests and the need for sustainable resource stewardship. Schemes such as the REDD+ program aim to mitigate the use of forest resources by providing economic incentives that value the forest itself for the ecosystem service of carbon stock (Streck, Gomez-Echeverri, Gutman, Loisel, & Werksman, 2009). With consideration of REDD+ which is aiming synergy of socio-economic benefits and forest conservation in the world, approaches that incentivize sustainable forestry programs are likely to become increasingly important for conservation and management of these valuable ecological and economic resources.

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