

Regular Research Article

Reducing Illegal Logging through a Chainsaw Buyback and Entrepreneurship Program at Gunung Palung National Park

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Abstract: Gunung Palung National Park in Indonesian Borneo, home to 2,500 Bornean orangutans (*Pongo pygmaeus ssp. wurmbii*), suffers from severe deforestation that is caused by illegal logging. This article aims to analyze the success of an innovative entrepreneurship program in reducing illegal logging in Gunung Palung National Park. This program combines voluntary chainsaw buybacks with capital investment for former loggers to launch a business of their choice. To analyze the success of this entrepreneurship program, we measured two parameters: (1) transitions of former loggers to sustainable alternative livelihoods and (2) reductions in the number of loggers who log actively inside the park. The average monthly income for participating business partners was 2,923,333 rupiah or \$209 USD for new partners who had participated for less than one year and 3,357,778 rupiah or \$240 for established partners who had participated for more than one year. This income is about the minimum wage for the local area. The failure rate of the program—defined as the partners that returned to logging—was only 6%, or 3 out of 50 partners. Successful forest conservation, however, requires addressing additional factors beyond reducing the access to logging equipment.

Keywords: illegal logging; deforestation; chainsaw buyback program; Gunung Palung National Park; entrepreneurship

1. Introduction

The most significant cause of global deforestation—defined as the reduction in forest canopy cover to 10% or less—is the conversion of forests to non-forest lands devoted to the production of commodities such as palm oil, meat, gold, soy, crop and pastures (Curtis et al., 2018). This process is responsible for 27% of global deforestation from 2001 until 2015. Other significant drivers of deforestation include forestry (26%), swidden agriculture (24%), and wildfire (23%). These global patterns are mirrored on the island of Borneo, where 3.06 Million Ha of the old-growth forest has been converted into palm oil and pulpwood plantations (Gaveau et al., 2019).

Deforestation is often associated with illegal logging—the harvesting of timber or wood from the legally protected forest. In contrast to legal deforestation, which is often conducted by companies with legal permissions to harvest a specific commodity product, illegal logging is usually carried out by low-income local community members (Dudley, 2004; Vasco et al., 2017). Both legal and illegal logging activities are harmful and disruptive to forest conservation in that both cause rapid deforestation and forest degradation. Even legal methods like the Indonesian Selective Cutting System (TPTI) require a longer rotation (cutting down and then growing to re-cut) and often companies neglect re-planting trees within that forest area (Sist et al., 1998). Creating protected forest areas helps to manage and balance the natural biodiversity within forest ecosystems but these areas are separate from those specifically designated for commercial purposes (Bettinger et al., 2017). Illegal logging in protected areas disturbs conservation efforts to maintain forest biodiversity. One protected area experiencing deforestation from illegal logging is Gunung Palung National Park (GPNP), which is located at 1°3' – 1°22' S, 109°54' – 110°28'. The GPNP is one of the largest national parks in Indonesia and home to 2,500 Bornean orangutans (*Pongo pygmaeus ssp. wurmbii*) (Johnson et al., 2005). Deforestation within the GPNP destroys orangutan habitat and is a

major threat to the persistence of this population (Ancrenaz et al., 2016; Curran et al., 2004; Fawzi et al., 2019, 2018; Zamzani et al., 2009).

Reducing illegal logging is an effective practice for slowing deforestation and forest degradation. Global efforts have aimed at decreasing illegal logging since 2002 (Marris, 2010). Illegal logging in Indonesian Borneo does not arise from ignorance or selfishness or a desire to destroy the forest, but for many, it is the only livelihood option in providing their families with income. This factor alone creates immense challenges for decreasing illegal logging carried out by local communities (Vasco et al., 2017). Illegal loggers are community members actively engaged in destroying the forest, but stopping this trade within logging communities is a complex process that involves community and also requires developing a clear understanding of socio-economic processes (Walker, 1987). Economic necessity is the primary cause of illegal logging, with 47% of households around the park relying on logging within the GPNP borders for their income (Hiller et al., 2004). In some villages, logging has become an integral part of the local economy. Therefore, addressing the socio-economic challenge associated with illegal logging is the first step to eliminating illegal logging in this region.

Reducing logging with a socio-economic approach requires finding an answer to the crucial question, "If we don't log a tree, what should we do for a living?" To answer that question, a local NGO Alam Sehat Lestari (ASRI), in partnership with an international NGO Health In Harmony, employed a radical listening meeting with active loggers (Webb et al., 2018). Radical listening is the process of offering space for expressing thoughts and dismantling the usual filters of communication to identify problems and find solutions; in this case, illegal logging (Siry et al., 2016). The logger is the person who engages in the activity of cutting trees down in the forest (Contreras-Hermosilla, 2000). In this article, to be identified as a logger, one must fulfill three criteria: (1) log inside the GPNP, (2) in which the produced wood is a wooden block or plank, and (3) the logging activity is conducted for commercial or personal purposes.

We discovered that the primary reason for logging by local communities was a lack of access to capital and unsustainable jobs, which is in accordance with similar studies in the region (Dohong et al., 2017). A sustainable job refers to a livelihood encompassing three factors, which include the environmental, social, and economic (Knockaert and Maillefert, 2004). Logging activities only satisfy the social and economic factors, whereas the environmental factor is neglected. Sustainable jobs can influence, protect and promote the forest ecosystem growth and halt biodiversity loss, which is goal 15 in the 2030 agenda for sustainable development (United Nations, 2015). This suggests that traditional law enforcement methods, which may put loggers in jail for violations, are ineffective or only temporary solutions to forest conservation efforts. By instead of listening to input from local communities, we suggest that finding alternative livelihoods is a more permanent solution to halting deforestation in GPNP. With this in mind, Alam Sehat Lestari and Health in Harmony developed an innovative chainsaw buyback entrepreneurship program as a solution to local deforestation. The chainsaw buyback program is a cash-swap incentive model in which an active logger can swap their chainsaw for capital to start a new business of their choosing - an alternate livelihood. Here we analyze the success of this entrepreneurship program and evaluate whether or not it has succeeded in reducing logging activity in Gunung Palung National Park.

2. Materials and methods

The Chainsaw Buyback Entrepreneurship Program began on January 17th, 2017, with the intention of reducing the amount of logging activity in GPNP. The program targets active loggers and seasonal loggers who log inside the park's boundaries. Active loggers are those who log trees within the park about once a week. We differentiate this with seasonal loggers who log only occasionally when they need money, usually during the dry season or when there is a high demand for timber. We counted the number of loggers using (1) ground monitoring and site visits by ASRI staff and (2)

reports from forest guardians (local people who work with ASRI for conservation outreach). We collected this information from 35 sub-villages (*Dusun*) whose lands are directly adjacent to Gunung Palung National Park (Figure 1). The focus is on these *Dusuns* because they have easy access to the forest within the park boundaries. Ground monitoring took place three times per year, beginning in 2014 at each *Dusun* to obtain information about their illegal logging activities. The data collected through direct observation of illegal logging activities included information such as logger presence, loading timber, etc., as well as interviews with communities using open questions about who logs in the national park forests. The data is supplemental to regular reports from local forest guardians. Currently there is a community representative in each of the 35-*Dusuns* to help ASRI to communicate with each community. Forest guardians help to obtain information within the community, including the identification of illegal logging activity, reforestation efforts, the use of medical payment with seedlings, etc. These guardians then relay the information back to ASRI.

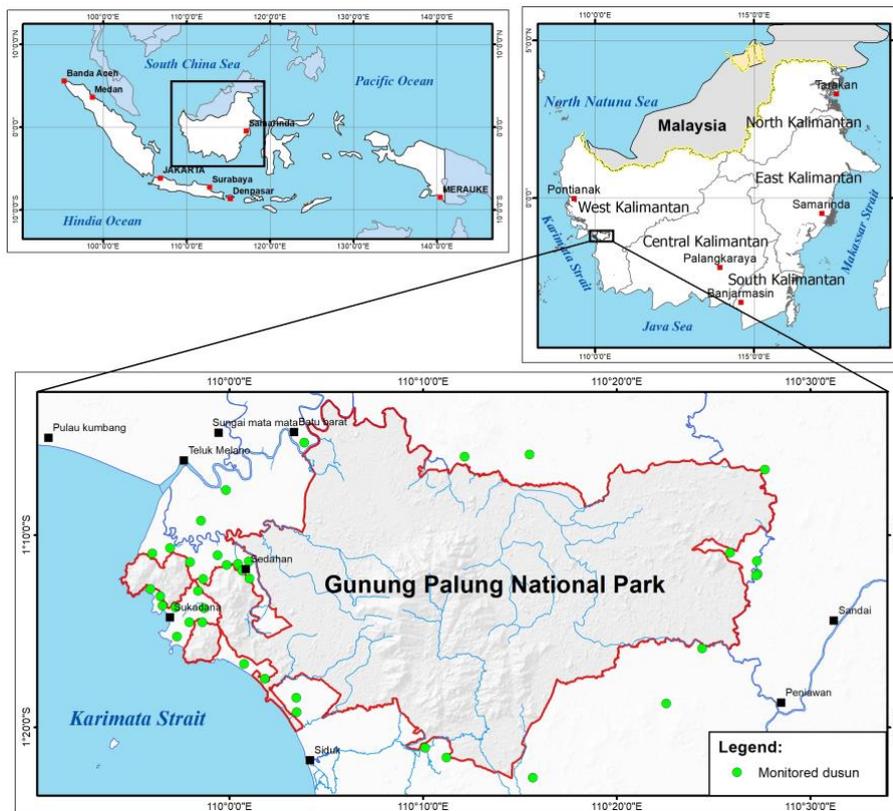


Figure 1. Study area in Gunung Palung National Park [Green dots indicate the 35-monitored *Dusun* that are directly adjacent to the Park]

The chainsaw buyback entrepreneurship program assists loggers in transitioning to alternative careers by establishing their businesses. The first requirement in the program is that the logger has to willingly want to stop their logging activity. Previously, radical listening has found that loggers will not stop their work for a long time, because they cannot find a substitute. Forest guardians are able to communicate information about ASRI’s chainsaw buyback program and often succeed in convincing the logger to willingly stop their logging activities. Through experience, we have found that if the logger stops un-willingly, they tend to revert back to their logging ways once again. Major factors influencing the loggers desire to stop include: the higher risks associated with logging, personal decline in health conditions, safety factors (afraid of getting caught), family, and awareness

of the importance of the environment. Often loggers who want to stop will not do so because they have no other solution to providing an income for their families. Many also do not want to reveal their identity as a logger.

There are four steps to ASRI's chainsaw buyback program. The first step (1) is to recruit an active logger logging within national park boundaries because the focus of the entrepreneurship program is to protect the forest in the GPNP. The active logger should be validated and confirmed as one that logs inside the GPNP because many loggers also work outside of the park's boundaries. To validate and determine that the logger is actively logging within park boundaries and is a positive match for the program, data and information is collected from ground monitoring, forest guardians and GPNP forest rangers. Sometimes, a logger is caught by a forest ranger and is given the option to hand over their chainsaw and join the chainsaw buyback program or be placed in jail. Validating that the person is an active logger within park boundaries is an important step because some people claim they are a logger when in reality they never log. This confirmation makes sure the program is on track and the focus is still on GPNP conservation.

The next step in the chainsaw buyback program (2) is to build a business plan, but this step only begins after the logger is confirmed active within national park boundaries. In this phase, we make sure that their decided business is sustainable and will not fail. In this process, ASRI will buy the chainsaw(s) from participating loggers for 4 million rupiahs (\$286 USD) apiece as a token of appreciation for giving up logging. ASRI then provides an additional 6 million rupiahs (\$429 USD) in start-up capital to help them develop a business of their own choosing. Spouses of loggers can also be included in the process and often use the start-up capital to develop a second business. Including spouses of loggers is considered to be able to 1) increase the chance of financial success for the couple, 2) help ensure enthusiasm and accountability among participants and 3) empower women. The next step in the buyback process is the signing of a contract with ASRI (3). When the business plan is done, the loggers must sign the contract for legal proof that they stopped logging and will pay back the start-up capital provided by ASRI without any restricted time frame. ASRI, the GPNP office, and the local government also sign this contract. The GPNP office and local governments role are to monitor whether the partner reverts back to logging. The final step in the buyback process is to make sure that the funds are spent towards materials related to the signed agreement of their business plan (4). The total of ten million rupiahs is not given in cash but is directly spent according to the business plan by ASRI. For example, if a participant wanted to start a chicken broiler business, ASRI would use the funds to buy small chickens, food, and the materials for creating cages. The resulting business is then jointly owned by ASRI and the logger under a profit-sharing model until the start-up capital is repaid, at which point the loggers become the sole owners. ASRI assists the loggers in developing business plans and provides other technical assistance to ensure that the business is thriving and sustainable.

To analyze the success of this entrepreneurship program in reducing illegal logging, we measured two parameters: (1) successful transitions to sustainable alternative livelihoods, and (2) the number of active loggers inside the GPNP. To measure transitions to sustainable alternative livelihoods, we collected information from participating loggers using structured questionnaires that asked about their income before and after joining the entrepreneurship program. Forty-six partners (N = 46) responded to the questionnaires between 1 January 2019 and 28 February 2019. These responses represent 92% (46 out of 50) of the total partners through August 1st 2019. The questionnaire asks specifically about their socio-economic condition (marital status, number of children, education, housing, and monthly income from logging activity), health problems related to logging and the benefits of stopping logging activity. The question is an open-ended question to explore information about logging activities. The data were analyzed using descriptive statistics.

3. Results

3.1 Sustainable alternative livelihoods

By August 1st, 2019, 50 loggers had joined this program. Because the program includes loggers and their spouses, each potentially starting their own business, those 50 couples have launched a total of 90 businesses with 17 different variations. The most common types of businesses are groceries, shops, chicken broilers, fishing, fuel retail kiosks, vegetable farming, fish farming, barbershops, motorcycle/car washes, and restaurants (Figure 2). A third of those 90 businesses have failed, resulting in a success rate of 66.7%. Among couples with at least one failed business, it was usually the spouse's business that failed, rather than the logger's. This might have happened because participants often consider the logger's business to be the primary one and the spouse's as secondary. More money and effort are therefore spent on the logger's business, increasing its chance of success relative to the spouse's. Among loggers whose businesses went bankrupt, many of them decided to work for a palm oil company. Others returned to logging in protected areas beyond the national park.

The average income for each business partner is clustered by how long they have participated in the program. Partners involved for less than one year had an average monthly income of 2,923,333 rupiah or \$209 (Table 1). The average monthly income increased to 3,357,778 rupiah or \$240 for partners who had participated for more than one year. These incomes are ~1.5 times the minimum wage in the region in 2019 (North Kayong Regency) and are comparable to the average income from logging (~3,560,000 ±2,050,000 rupiah, or \$254 ±146). Logging income is highly variable, however, the maximum monthly income can be as high as 11 million rupiah (\$785), and during some periods loggers can earn over three times the regional minimum wages (Hiller et al. 2004). This potential for high earnings from logging may explain why 3 out of 50 program participants returned to logging. They returned to logging within the first year after starting their business due to a lack of experience and necessity to generate income.

Table 1. Socioeconomic characteristics of chainsaw buyback entrepreneurship program participants.

Variable	Respondent characteristics	Proportion (%)
Number of samples (N)	46	
Married	Yes	100
	No	0
Children	Average = 2	
Own house	Yes	100
Education	Attend primary school, not graduated	58.7
	Primary school	32.6
	Junior high school	8.7
	Senior high school	0.0
Monthly income from logging	Min	: 1,500,000
	Max	: 11,000,000
	Average	: 3,563,043
	SD	: 2,051,125
Monthly income from entrepreneurship	Partner < 1 year	: 2,923,333
	Partner > 1 year	: 3,357,778
Number of owned chainsaws	Average = 2	
The age of first working as a logger	Average = 21 years	

Technical assistance was an essential part of the entrepreneurship program because only ~33%

of participants had finished primary school and only 9% had finished junior high school. Loggers near Gunung Palung National Park usually started logging at 21 years old. The absence of formal education most likely creates difficulties in financial management.

The top benefits of stopping logging reported in the questionnaire were being healthier and that they could spend more time with their family (Figure 2). Some of the partners also address the benefit of a better social life because they spend their time at home after they stopped logging. Previously, when working as a logger, they had several health problems related to logging activity. Logging activity requires heavy work and a time commitment for extended periods of time in the forest. Low back pain is the most common health problem resulting from logging activity. This could happen because lower back pain itself is associated with several risk factors, such as cumulative workload (carrying heavy loads of wood), repetition, vibration from chainsaw, duration of working hours, and several unusual body positioning. Loggers usually work at least 8 hours per day, and they use a chainsaw weighing at least around 20 kg and when it is turned on, there will be extra vibration from the machine that can cause extra load to their body. Vibration from a chainsaw can cause muscle contraction that leads to disturbance in blood flow, deposition of lactic acid, and causes pain. Carrying heavy loads and frequent bending are also factors that are related to low back pain (Burdorf and Sorock, 1997; Coenen et al., 2013). These health problems associated with logging may be a major driver for transitioning to alternative careers. Improved health was the primary non-income benefit reported by participants in our program, with over 80% of respondents describing feeling healthier after transitioning away from logging.

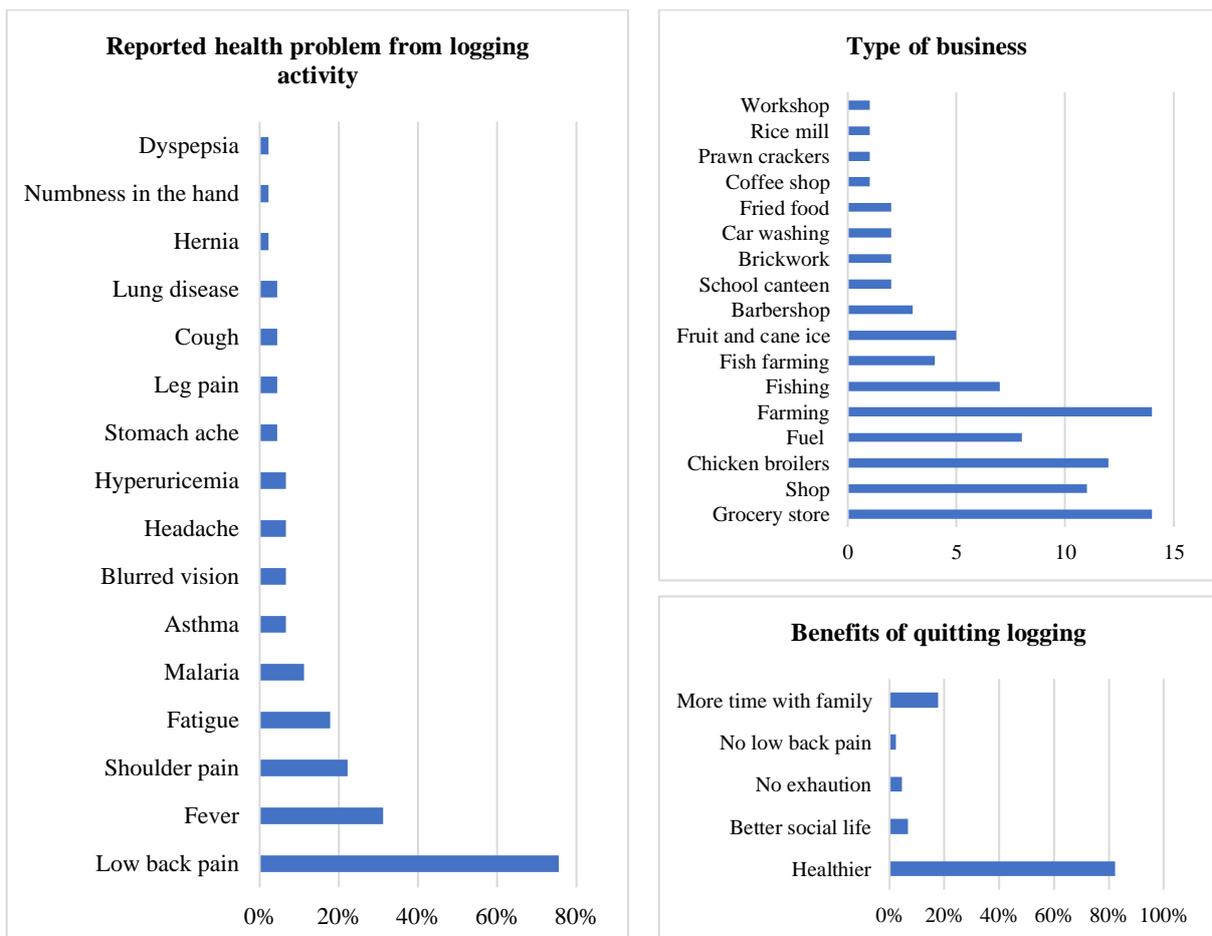


Figure 2. Reported health problems from logging activity, types of business after joining the program, and benefits from transitioning away from logging.

3.2 Has the number of loggers decreased?

The number of people logging inside the GPNP, determined by ground monitoring and site visits, has remained relatively stable since 2014. The dip in the number of loggers in the third period of 2015 was probably due to an especially dry season associated with an El Niño event. Dry periods cause decreased river volume, making it harder to transport timber. The number of loggers reached its peak in late 2017 and early 2018, probably due to high timber demand and an especially wet season that allowed for easy timber transport.

We began the chainsaw buyback entrepreneurship program in the first period of 2017, but we have seen no change in the number of loggers logging in GPNP. With 50 active loggers transitioning to alternative livelihoods, theoretically, the number of loggers should have decreased from ~70 to ~20, but instead, the number remains ~60. Two reasons could explain this lack of an observed decrease. (1) Our ground monitoring and site visits underestimated the number of loggers inside the national park. Illegal logging activity has penalties because it is breaking the law, so some loggers might hide their identity. According to previous research in *Dusuns* surrounding GPNP, logger estimates were retrieved using community surveys rather than direct monitoring and estimated at a total of ~150 loggers in 2017 (Webb, 2018). Similarly, data collected from forest guardians in each *Dusun* also reported more loggers (Table 2). In this case, many of the extra loggers are seasonal loggers that only cut timber during certain seasons or periods of high demand. Many of these seasonal loggers are farmers that respond to climate and market pressures and take up logging when it is particularly profitable or when farming is less productive. (2) Loggers that used to work outside the park boundaries may have moved into the park as previous loggers transitioned to alternative livelihoods. Our ground monitoring data count only loggers active within the park boundaries, but survey data (Webb, 2018) and data from forest guardians indicate many additional loggers working in nearby areas. The national park is an attractive resource for loggers, as it contains an abundance of marketable timber and easy river access for transport. Therefore, many loggers may have shifted into the park to take the place of former loggers.

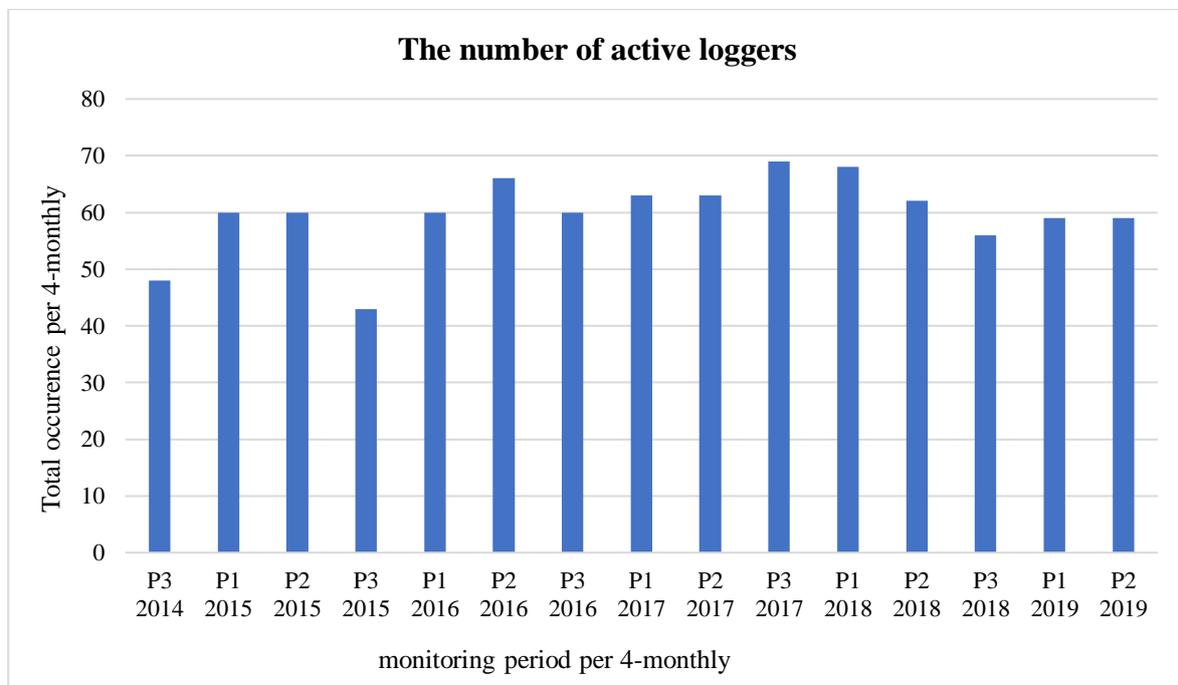


Figure 3. The number of people logging inside Gunung Palung National Park, determined by ground monitoring and site visits.

Table 2. The number of people logging inside Gunung Palung National Park per year, determined by local Forest Guardians.

Year	Active	Less active	Log just outside the park
2018	42	64	No data
2019	60	50	49

4. Discussion

The number of loggers in the GPNP remains high. Accurately estimating the number of loggers is difficult because different methods provide different results, and many loggers are seasonal workers only occasionally logging within park boundaries. This becomes an obstacle when trying to reduce deforestation in this region. In this multi-level perspective analysis, our innovative chainsaw buyback entrepreneurship has helped 50 logging couples in GPNP achieve alternative livelihoods. This social transition can happen within and between the logging groups as well. A program partner can influence their friend(s) to stop their logging activity and join this entrepreneurship program. While this is influential, the most important part is to build and maintain an effective working partnership between ASRI and the communities to create revolutionary change (Gersick, 2019). The entrepreneurship program not only reduced logging activity in GPNP, but it also creates empowerment opportunities among the partners. The final objective of this project is to provide sustainable jobs that can create a socio-economic balance and protect the environment at the same time. This chainsaw buyback program is applicable to other areas that need forest preservation. This program can be mixed with social forestry management that aims to alleviate poverty and improve forest condition (Moeliono et al., 2017). We can make some modifications, such as changing the chainsaw swap-cash method with converting swidden agriculture in protected forest areas into agroforestry based on forest restoration.

Eliminating logging in the park requires both rigorous monitoring and conservation initiatives that address logging at the landscape scale. The chainsaw buyback entrepreneurship program only tackles one factor (access of equipment) out of five factors that are related to illegal logging in Gunung Palung National Park (Hiller et al. 2004). The other four factors are (1) access to the forest, which is still widely open, (2) access to labor, (3) funding from timber brokers, and (4) the market for timber. To reduce the number of loggers to zero, we need to resolve these remaining issues. These factors only can be solved in the landscape – regime levels, such as political influence and by building the will to support efforts to reduce illegal logging, not only from the GPNP office but also from the local and national government (Tacconi, 2012). Without support from the government, a logger's transformation to a sustainable job will only see effects on a micro-scale and will not decrease the number of loggers in GPNP.

One thing that we can learn is that several obstacles hinder the success of the chainsaw buyback entrepreneurship program. The main problem is how to get funding to support the program. Each logging couple requires ~10 million rupiah, and possibly more to improve the chances of success for both spouses businesses. Although ~60% of the funds for each couple are meant to be returned through cost-sharing, repayment is unpredictable and contingent on the success of the business. Another challenge is increasing the diversity of potential businesses for participants. Finally, education is a challenge, as most of the partners have limited education or struggle with literacy, and therefore require additional training or technical assistance.

The environmental benefits from the entrepreneurship program are that it can save old-growth trees from logging activity. Most illegal logging is selective logging, in which loggers harvest individual trees with a diameter > 50 cm (Matangaran et al., 2019). This kind of logging causes forest degradation rather than complete deforestation. If this degradation continues, it will contribute to

negative environmental impacts and wildlife declines (Jamhuri et al., 2018). The chainsaw buyback entrepreneurship program aims to reduce this type of selective logging. Each logger in the national park can cut ~300 trees per year. Even at a modest scale of recruiting 50 loggers a year, the program could save >15,000 trees per year. This would have a significant impact, as even small gains in forest area or quality in GPNP can provide immediate conservation benefits (Helms et al., 2018, 2017; Pohnan et al., 2015).

In the case of illegal logging activity, we recommend using ground monitoring to obtain actual information. This method is used to understand more fully the process of illegal logging activity in protected forests. Another tool that we can use is a satellite-based system, which is proven to be successful in monitoring deforestation (Popkin, 2016). Satellite-based systems, however, have some limitations, such as cloud cover, temporal resolution and the inability to detect forest degradation due to coarse spatial resolution (Mitchell et al., 2017). Decreasing the number of illegal loggers is still challenging because many loggers do not want to stop their lucrative ventures. The market still needs timber and logging provides fast cash. It is not an easy task to tackle illegal logging. The entrepreneurship program only slows the rate of degradation in this region because it reduces the number of loggers.

5. Conclusions

The chainsaw buyback entrepreneurship program has helped many loggers in Gunung Palung National Park transition to alternative livelihoods. The average incomes from the entrepreneurship program are similar to their previous logging incomes after just one year of participating. The downfall is that the chainsaw buyback program only addresses one factor related to logging. Eliminating logging in the national park requires further interventions, for example reducing access to the timber market logging capital as well as other more comprehensive governmental assistance.

Author Contributions:

NIF, JAH, & AMI contributed to study design, data interpretation, and wrote the manuscript; AN & AG contributed to data collection, analysis, and interpretation; NF supervised the program and reviewed the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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