The resilience of the agricultural system in the midst of the climate change issue in West Kalimantan

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Abstract. Population growth and land management are severe issues in Indonesia as a developing country. This condition leads to the food security problem and creates a high demand for land to become an agricultural area. Meanwhile, Indonesia is known for having two-thirds of the terrestrial area as forest area and at the same time, the availability of the agricultural area is limited. These opposite issues are creating a phenomenon in forest conversion to become an agricultural area. Due to this situation the agricultural sector is considered as the sector responds for “deforestation-leading-to-climate change” in Indonesia as happened in Labian Village, West Kalimantan. The objective of this study is to analyze the impact of an involvement of the forest-dependent-community of Labian Village in the investment program of forest and climate change to combat the deforestation-leading-to-climate change issues through the activities of sustainable agriculture. Based on an explorative study from the five-year project, it is known that sustainable agriculture can be done back-to-back with the mission to avoid encroachment to the forest area. By implementing the participatory land-use planning as a tool of sustainable land management, the community now can maximize the utility from their land and generate sufficient welfare.

1. Introduction
As a developing country, Indonesia has a rapid population growth. The total of Indonesia’s population is reached more than 267 million people in 2020 being corresponding to 135 people per km² [1]. In 2015 there is 12.5% of Indonesian citizens were classified as the member of the community which dependent on forest (forest-dependent-community) [2]. Forest-dependent-community (FDCs) include forest residents who depend on forest resources as their main source of food and livelihoods; people who reside near forests but have mainly agricultural livelihoods and use forests to supplement their consumption and income-generating activities; and rural people whose main income comes from labor supplied to forest based commercial activities [3]. The increase of population required additional services to be fulfilled, such as food, housing, and hospitals [4, 5].
In the meantime, Indonesia is an archipelago country which has a terrestrial land for approximately 1,910,931.32 km² [6], whereas 68% of these areas are classified as forest area [7]. The remaining percentage of terrestrial areas were allocated for the non-forestry sector, such as agriculture, factory, housing, and other uses. Therefore, there was major contestation in the non-forest areas. But, due to low economic impact and rapid population growth, there was plenty of agricultural areas is converted into other land use to accommodate the increased needs, such as housing.

In West Kalimantan, Indonesia the indigenous communities who are classified as forest-dependent-community are still practicing the shifting cultivation to fulfill their needs. Shifting cultivation is defined as an agricultural system by rotational agriculture with a fallow period of cultivation [8]. Classical shifting cultivation with the slash and burn method by Dayak People in West Kalimantan is aimed to clear the cropland, control weeds, and increase the soil fertility. Most Dayaks in West Kalimantan and Malaysia practice a system of shifting cultivation as the only "rational" answer to efforts to maintain life on infertile land [9].

The increase in food demand due to the increase of population and conversion of an agricultural area into other land use creates severe problem related to the availability of cultivation areas to produce food. It is known that the most feasible solution to tackle the shortage of an agricultural area is by converting the forest areas. Particularly, in West Kalimantan the conversion of forest areas means the practice of shifting the cultivation system there. The forest conversion is still going rapidly since most forest-dependent-community are perceiving that the forest product has low value compared to the other product, such as agricultural products. The low or high value of some products is determined based on the people’s or consumer’s willingness to pay in which equal to the degree of the consumer’s expected utility from the paid products [10]. In most cases, the conversion is intended to create additional value from the forest areas. By converting the forest areas into agricultural areas, the forest-dependent-community could get a higher benefit from it. Despite the utilization of forest products, the forest-dependent-community is treating it as a supplement to their daily consumption and not a major input to their livelihood [3]. Furthermore, the agriculture and forestry sectors, including deforestation and forest degradation processes associated with these sectors, are major contributors to global greenhouse gas (GHG) emissions, accounting for approximately half of low-income countries’ total GHG emission budgets [11]. This condition raises a stakeholder’s assumption that the agricultural activities are the cause of deforestation, therefore hampering the existence of classical agricultural systems in Indonesia as FDC’s sources of livelihood.

In response to this condition, a forestry program called “Forest and Climate Change Program – Financial Cooperation (FORCLIME FC)” is introduced to contribute to the Indonesian policy on climate change. The program aims to reduce the emission from deforestation and degradation, increase forest cover and natural resource conservation, and increase the social welfare by at least 80% compared to degree before the implementation of FORCLIME FC. The FORCLIME FC is implemented through the investment program happened in the level of demonstration activity in the village of forest-dependent-community-based on the concept of sustainable livelihood approach. The investment program has three main strategies, there are: 1) Financial support, 2) Strengthening capacity building by facilitation, and 3) Mentoring.

One of the areas intervened by the investment program of FORCLIME FC was Labian Village, Kapuas Hulu District, West Kalimantan Province in which the investment program was started in 2015. The questions from the implemented investment activities are:

1. How does the investment program successfully reduce deforestation from the expansion of an agricultural activity by the forest-dependent-community?
2. What is the role of the community to avoid encroachment to the forest area?
3. What is the state of the art of agricultural activities to climate change issue?
The objective of the study generated from the questions above is to analyze the impact of an involvement of the forest-dependent-community of Labian Village on the investment process by FORCLIME FC to combat the deforestation-leading-to-climate change issues through the activities of sustainable agriculture.

2. Materials and methods
The study was conducted in Labian Village, Kapuas Hulu District, West Kalimantan. There were 787 villagers consist of 77% of Dayak Taman and 23% of Dayak Iban in 2017. The total area of Labian Village was 48.24 km² and 85% of the areas were flat. The location is present in figure 1.

![Figure 1. Location of Labian Village.](image-url)

The data of this study was collected using the non-structural in-depth interview with the 15 staffs of FORCLIME FC, 10 villagers of Labian Village, and information collected from the activity reports of FORCLIME FC. The research was conducted in both qualitative and quantitative. The qualitative analysis has been used through the exploratory study using narrative approaches. Engel and Schutt [12] mentioned that exploratory research enquires into the circumstances in a community, how people get along in their setting, what meanings they give to their actions, and what problems relied on their actions and they are concerns about. Exploratory research was conducted to determine the nature of the problem, and it was not intended to provide conclusive evidence, but helps readers to have a better understanding of the problem. The framework analysis was based on the situation-structure-performance (SSP) paradigm by Allan Schmid as reviewed by Berg [13]. SSP is perceived sufficient to describe the fact of the study since Berg [13] explained that performance according to Allan Schmid was a description or measure of how net
benefits are distributed (i.e., who gets what) and serves as the dependent variable throughout much of his analysis.

Besides, the quantitative analysis was conducted by calculating the degree of land-use change in Labian Village based on land cover change analysis derived from Indonesia’s Ministry of Environment and Forestry (MoEF) casu quo Directorate General of Forestry and Environmental Planning (DG PKTL) through National Forest Monitoring System (NFMS). This analysis was using 23 class of land cover data classification based on the regulation of DG PKTL of the MoEF No. P.1/VII-IPSDH/2015 concerning about Land Cover Monitoring.

3. Results and discussion

3.1. Situation

Based on the feasibility study report of FORCLIME FC year 2014 in Labian Village, most of the villagers were performing shifting cultivation. Shifting cultivation is the tradition of an indigenous community to get food especially rice in a dry land through slash-and-burn activities according to the timeframe of slash-burn-cultivate-harvest. These periods shall take place within 1 year only by following the seasonal changes, there are slash-and-burn during dry season and cultivate-harvest during the rainy season. Therefore, the villagers have already developed a calendar system called with the seasonal calendar as a reference for them to determine the approximate time of shifting cultivation and other activities, such as Dayak’s indigenous ceremony (in local language: Gawai Dayak). Though, the implementation of any program initiated by FORCLIME FC shall also follow this seasonal calendar.

According to the field visit (8-10 December 2018) it is known that each household could only manage 1 hectare annually, so that if they held a minimum 5 hectares of land the shifting cultivation was taking place for 5 years. Confessed by an interviewed household (9 December 2018 Personal Communication) that most of the household in Labian Village held a shifting cultivation area for average 5-10 hectares and distributed in many places within the village area or fragmented, instead of situated in one continuous landscape. Therefore, the household was abandoning the areas that already managed during the shifting cultivation period for another 4 years and they will come back to this area after they managed all areas belong to them or in the 5th years. It has been mentioned [15] that the shifting cultivation is a traditional wisdom as a form of land use managed by the indigenous community with the system of rotation and fallow (temporary resting of land) which most of them aim to have a subsistence living. Temporary resting of land is understood to allow the land to recover themselves in terms of soil fertility due to an intensive agricultural activity. Most of cases in the past that during the fallow period these areas were turning into the secondary forest, if and only if, the fallow was happening in for long time or in decades.

Taking a note from Labian Village in which their areas are covered by forest (secondary and primary) for 33.5% from the total land cover, most of these areas were subject to the shifting cultivation sometime in the future. Hence, experts and activists have perceived the shifting cultivation as a driven factor to deforestation [16]. Despite natural vegetation or forest is at a higher risk than other land cover types and a quarter is under threat from the expansion of agriculture [17], but it is dilemmatic since shifting cultivation is a tradition in most of Dayak in Borneo as the only "rational" answer to maintaining their livelihood from a natural infertile land [8]. Therefore, FORCLIME FC was challenged to divert the Labian Villager’s dependency from the shifting cultivation in the forest and creating another livelihood opportunity to substitute this kind of indigenous way of life. However, to do so, they had another challenge for the program could be implemented in this village, there was trust.

Trust was a big issue for the FORCLIME FC during the initial implementation of their program. It is since the villagers commented that the program by FORCLIME FC would be like another program that make the villager were only an object, instead of the subject of the program. By taking a role as an object
of the program, the villagers considered that there was no continuity of the program since they had no self-belonging to any carried-out program. Besides, they were asking the FORCLIME FC to get more knowledge, to be respected, compassionated, and amazement that they never had before (Leader of Villager’s Group of Utik-Utik Sub Village of Labian Village, 8 December 2018 Personal Communication). Therefore, before the villagers were ensured that could get what they expected, there was no trust in the program of FORCLIME FC. The situation was well understood and FORCLIME FC was coming with a structural breakthrough.

3.2. Structure

The FORCLIME FC was established through the cooperation between the MoEF of the Republic of Indonesia and the BMZ of the Federal Republic of Germany. There was source of fund from these entities and treated as a grant to be distributed or expensed to tackle the deforestation and land degradation who are led to climate change issues in Indonesia. One of the programs initiated by the FORCLIME FC was distributing the grant to the entities at the grass-root level or villagers since there was a consideration based on their feasibility study that the villagers took an important role in deforestation and land degradation processes.

The distribution of the grant was using the investment mechanism. It means that FORCLIME FC was investing the grant to the village. The investment fund invested in the village should be supported by the institution that well-managed, representing the intention of villagers, and supporting the successfulness of the objective of the program. Therefore, the FORCLIME FC made the village as a management unit of the program on the grass-root level, creating a local champion, and bottom-up approach.

The village as management unit. It is important for the investment program could be sustained. The sustainability of the program was only be happening if they got its legitimation from the village authorities. Lesson learned mentioned by the villagers (9 December 2018 Personal Communication) that most of the other program would be extinct once the program is finished. It is since the program was not in line with the legitimate village development program. Any non-legitimate program carried-out by the other parties would be considered as an obstacle and an additional burdened task to the authorities (Authority of Labian Village, August 2018 Personal Communication). On the other hand, the FORCLIME FC was considering the village as a management unit since they have components of the sustainable livelihood approach (SLA) that could support the successfulness of the investment program. The components of SLA are Social Capital, Natural Capital, Human Capital, Physical Capital/Infrastructure, and Financial [18]. Among these 5 components, the first 4 components were existed in the Labian Village, so that the presence of the investment program of FORCLIME FC was fulfilling the lack of the 5th component.

Local champion. The local villager is a call sign for the people who resident in the village in which the investment program of FORCLIME FC was implemented. The local villagers were considered strategic to engine the investment program since they were the only person who well-known the characteristic of village’s culture, well-knowledge on any form of social interaction within the village, and well-identify regarding the problems that could be hampering the implementation of the investment program. However, not all local villagers could be the engine of the program. The FORCLIME FC has a criterion for local villagers could engine the program, there were: must be from young-energetic-generation, well-educated, somehow respected by the other villagers due to their social status, and promoted by village and sub-district authorities. Local villagers who met these criteria was assigned as leader of the village group, village facilitator, and field mentor. Local villagers who are assigned for these tasks are called with local champion to motivate their role. It was important since the local champion and their knowledge are prospective to continue the investment of FORCLIME FC whenever the project is terminated, and no further support is giving.
Bottom-up approach. FORCLIME FC was investing the money to the program organized by the villagers in a group so that the program is called an investment program. The program is consisting of various activities proposed by the villagers assisted by the local champion. The assistance took place to ensure that the program relies on the needs of villagers, directing the activities to comply with the corridor of an emission reduction, and the activities could divert the dependency of the villagers from the shifting cultivation in the forest. The list of activities to be incorporated into the program were identified in a participatory manner, communicated to the authorities, and proposed to the FORCLIME FC. Therefore, the authorities gave their legitimation to the activities in the program and incorporate them into the village development program. Meanwhile, the FORCLIME FC was dispatching the investment fund based on the financial calculation proposal of the activities.

Through those three actions of FORCLIME FC, they gained trust and acceptance from the Labian’s villagers since 2015. As mentioned by Weiss [19] that trust leads to approachability and open communications. Furthermore, once the investment fund was dispatched, it was received and managed through the villager’s group-based-mechanism organized by the local villagers in Labian Village as the main actor.

On any occasions during the field visit, the Labian’s villagers (8-10 December 2018, Personal Communication) mentioned that they managed the investment fund under the value of the environment. The value of the environment cannot be just a matter of what there is, but also consist of the opportunities it offers to people [18]. By setting up the opportunity for the villagers to manage the investment in their areas, it is equal to developing the villager’s capacity. This approach could also arouse the presence of a natural resource management on the grass-root level through a local institution. It is since the villagers were having a self-belonging to the investment in their areas and tend to get sustainable benefits from it. Besides, in placing trust in the villagers might be reducing the rate of deforestation and its future destructive potentiality. Meanwhile, the process of investment mechanism of FORCLIME FC is presented in the figure 2:

**Figure 2. Investment Program of FORCLIME FC.**

In 2015 the implementation of FORCLIME FC in the Labian Village is started by accelerating the participatory land-use planning (PLUP). It is important to ensure the villagers-based-management-areas
that further ensure the aspects of space or land availability and certainty of land rights between village member and stakeholders. During the process of PLUP, the communication between village member, village government, and local champion were happening dynamically to indicate the potential of regional conflict and, at the same time, its solution. The processed of PLUP is presented in Figure 3.

![Figure 3. Flow process of PLUP.](image)

Afterward, the process of PLUP ended up by assigning investment activities to the allocated areas within the Labian Village, there was villager’s nursery development, planting with agroforestry schemes, plant maintenance, villagers-based forest patrols, NTFP management, fast investment in the form of demonstration plots with horticulture products, sylvofishery, and sylvopastural. Participatory land-use planning put the horizon of sustainable land management through a landscape approach because the villagers will get the information accurately by mapping their area directly. Modern approaches to land-use planning not only determine appropriate land-use types but also provide decision-makers with sustainable land resource management scenarios that improve productivity and sustainability [20].

### 3.3. Performance

FORCLIME FC has been investing some resources in Labian Village since 2015 or almost 5 years. On the other hand, the investment is carried out by villagers in the form of a group. Based on the result of PLUP, most activities proposed by the villagers were related to the agricultural activities, so that FORCLIME FC initiated a smart agricultural practice in achieving the sustainable agriculture towards their vision on emission reduction. Climate-resilient/smart agricultural practices potentially sustain food production in the harsh environment thereby ensuring maximum farm generated income, profitability, nutritional and health benefits, reduced GHGs emission and agricultural pollution [21].

FORCLIME FC initiated a smart agricultural practice in Labian Village in the form of demonstration plots with horticulture products. Since the demonstration plot with horticulture products was managed through villager’s group-mechanism, so that there were indigenous-bonded-regulation and local wisdom in managing the natural resources. These are an important matter since the group initiative was coming up due to a similar understanding of the community situation regarding the financial availability to fulfill the daily needs. Therefore, the community perceived that by gathering into a group could generate possible better income from productive land-based-activity. The lesson learned from the demonstration plot of Utik-Utik Sub Village of Labian Village was the villagers could generate additional income by cultivating horticultural products in a limited area. The income was a major complement to the income they earned from the shifting cultivation in the forest.

The member of the group has taught how to organize a small organization. It is seen from the role distributed among them. According to the interview (9 December 2018 Personal Communication,) that
there was role distribution in managing the selection of crops, the timing of seeding and harvesting, and product marketing. Especially for the crop selection and product marketing, they have set up one role as a market intelligence to ensure the product in the market in which plenty in terms of number or what product is flooding the market. Besides, this function is also to spy the crops planted by other villages, so that they could arrange the planted crops to not like the other villages. By this intelligence activity they can maintain high revenue from their agricultural work. Afterall, more interestingly was the role distribution initiated by the women in the group, instead of the group leader. It is since in Dayak people, women have an important role in ruling the household and take a major part in working in the field as similar to men.

The member of the group was also taught that the value gained from the demonstration plot was much more similar to what they earned from the shifting cultivation. Even, on any occasion, from what they earn, they could finance any necessary basic needs, there are health services, education, and leisure. Since then, their perspective of shifting cultivation is changed. Nowadays, they perceive that shifting cultivation is no longer feasible as daily livelihoods. It is since to do shifting cultivation; they need huge capital and labor-intensive. On the other hand, the demonstration plot as a form of permanent cultivation is less labor-intensive, less capital, and less risky.

Due to the investment program of FORCLIME FC, there were major changes in term of knowledge and economic welfare. On the knowledge aspect, despite managing an organization in well-manner by role distribution, it is known that the community in Labian Village was implementing the concept of revolving fund. It is since the investment fund invested by the FORCLIME FC was utilized to fund the other activities outside the program. The accounted activities were producing kettle fertilizer, production of banana chips where the bananas itself were cultivated from the demonstration plot, production of homemade honey, and micro-scale groceries. These are a part of business diversification in appropriate to the principle of, “don’t put the egg in one basket”. It was calculated from the initial investment fund invested by the FORCLIME FC that nowadays the Labian’s villagers who ran the demonstration plot had already expanded the value of their assets into 5 times from the initial investment period, there was 20 million rupiahs.

Furthermore, in term of knowledge, as well, the community has set up such a system called with 9 to 10 distribution. It means that despite there are 9 members in the group, but the profit will be divided into 10 part in pro-rate. The 10th part of the profit is intended as a group credit balance to be accumulated to be used to expanding their business. In this aspect, the community’s group is implementing the principle of credit balance and dividend distribution to the member as a shareholder. According to the confession of Labian Villagers (9 December 2010 Personal Communication) who are a member of the group of the agricultural demonstration plot, nowadays, they could earn 1 million rupiah up to 3 million rupiahs per month as dividend from their activities. It is better than before the period of an investment program where they were had not have any additional income but only from the result of shifting cultivation to finance their livelihood and basic needs, such as child school and medical fees.

These improved knowledges had put a new horizon from the forest-dependent-community that encroaching the forest areas was no longer feasible as the way of daily livelihood. Therefore, the vision to decrease the deforestation level has been achieved. Miller [10] mentioned that people would tend to choose the product which created more benefit with less capital or effort, than a similar stage of benefit but with higher capital/effort. It is equal to the understanding of the concept of an opportunity cost in the microeconomics’ literature.

The decreased level of deforestation can be shown from the land cover change in Labian Village through time-series data of 2011 to 2018. The land cover may be simply defined as anything that is on the ground, so that it can be observed using remote-sensing tools. The observed specific spatial attributes are vegetation, carbon stock, nutrient storage, and forms a habitat for plants and animals. Thus, grasslands,
trees, forests, deserts, cropped fields, and buildings are depending on the scale of observation. These are all recognizable elements of land cover [22]. The time-series data of land cover change in Labian Village is presented in Table 1.

| Land Cover          | Area (ha) | | | | | | |
|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Shrub               | 4.63      | 4.63      | 4.63      | 4.63      | 4.63      | 4.63      | 4.63      | 4.63      |
| Swamp Shrub         | 172.64    | 172.64    | 172.64    | 172.64    | 172.64    | 172.64    | 172.64    | 172.64    |
| Secondary Dry Land  | 67.46     | 67.46     | 67.46     | 67.46     | 67.46     | 67.46     | 67.46     | 67.46     |
| Settlement          | 1,573.30  | 1,573.30  | 1,573.30  | 1,573.30  | 1,551.06  | 1,551.06  | 1,551.06  | 1,551.06  |
| Agriculture         | 2,977.45  | 2,977.45  | 2,977.45  | 2,977.45  | 2,984.82  | 2,984.82  | 2,984.82  | 2,984.82  |
| Bare Land           | -         | -         | -         | -         | 14.87     | 14.87     | 14.87     | 14.87     |

Source: http://geoportal.menlhk.go.id/arcgis/rest/services/KLHK [23]

According to the data in Figure 4, there were 7 identified class of land cover that was existing in the Labian Village, there were shrub, swamp shrub, secondary dry land forest, secondary peat swamp forest, settlement, agriculture, and bare land. The data shows that there was no land cover change between 2011 to 2014. However, in 2015 to 2018 there was an area changes in secondary peat swamp forest for 14.8 hectares. According to the remote-sensing analysis the changes were happening due to the expansion of an agricultural area. It was a tradeoff from what is expected due to the implementation of the investment program of FORCLIME FC.

The trade-off happened since during the initial program in 2015, there was a limited number of villagers who are involved as a group member under the investment program of FORCLIME FC. The limited number was due to the low trust from the communities to engage in the program. By the time being the trust was significantly increased, expanded among the communities, and gained by the FORCLIME FC. Especially, whenever various benefits had been obtained by the group who ran the demonstration plot. The remaining villagers were starting to propose their group to get an investment and their knowledge is expanded to follow the first community group who considered successful.

Meanwhile, the agricultural areas that were created by an expansion to the forest areas now seem to be abandoned. It is since the data in Figure 4 is showing the increasing number of bare land and it is in line with the expansion number of an agricultural areas before be mentioned. Nonetheless, the knowledge of most villagers now is developed. Particularly their understanding on shifting cultivation is no more feasible compared to permanent cultivation. Apparently, after 2015 there was no more additional expansion activity in the forest areas in Labian Village.

4. Conclusions
Agricultural activities are indeed threatening the forest areas and could lead to the deforestation. However, it could be possible only, and if only, the forest-dependent-community as a subject of the agricultural activities has no choices on their livelihoods. The conversion of forest areas to become an agricultural area
is inevitably if the community is re perceiving the value from agricultural products are higher than forest products. By expanding the knowledge of forest-dependent-community on the permanent agricultural system could create higher benefit than shifting cultivation system, the community has no driven factor to expand the agricultural areas to the forest areas. Therefore, deforestation could be avoided towards achieving the vision of emission reduction within the REDD+ framework. The permanent agricultural system in Labian Village is showing its resilience among the climate change issues and it could support community livelihood to generate their maximum utility. Eventually, this study shows that by building the knowledge of the forest-dependent-community with a trust-based-rapprochement and an appropriate system of program could support the resilience of an agricultural system amid climate change issues in which often putting agricultural activities as a root cause of deforestation and forest degradation.

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