Is agro-ecotourism approach a potential to support climate change mitigation?

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Abstract. Indonesia is one of the biggest contributors to greenhouse emission globally. The trigger of such contributions can be traced to Land Use, Land Use Change, and Forestry (LULUCF). The problem of deforestation is complex, involving social, economic and political sectors. On the other hand, a holistic approach has not been widely discussed and implemented. This paper attempts to review and aims at providing potential answer on how to manage the forest and its relations with people in order to combat forest destruction caused by people. We believed that managing such relationship is the key to maintain the sustainability of the forest while keeping its roles and sustainability. Literature review was employed to develop a problem framework, and to develop alternatives in bridging the relationships between forest and local community. Collecting relevant literatures using keywords such as “forest and climate change mitigation”, “agroforestry and climate change”, “ecotourism and climate change”, and “agroforestry and ecotourism”. 96 articles were found. Further, through matching the content and the research goals of the articles, 13 articles were selected for further content analysis. We proposed agro-ecotourism as the alternative answer that can be pursued to balance the relationship between forest and people, especially in putting forest as an important partner rather than an exploitable asset. Hence, agro-ecotourism may help to increase the awareness among local community on the critical roles of the forest in the long term to fight against climate changes.

1. Introduction

Climate change is a global phenomenon that has been becoming a global concern today. The impact is not only felt locally but also globally, even across sectors and strata of society [1]. These impacts include decreased water quality and quantity [2], changes in habitat and species extinction [3,4], health problems [5,6], droughts that affect agricultural productivity [7,8], rising sea levels that endanger the existence of coastal areas and islands [9,10] includes an increase in the intensity of the occurrence of extreme natural disasters [11,12]. The phenomenon is fundamentally related to the condition, which is termed "The Great Acceleration." Reference [13] state that the term "Great Acceleration aims to capture the holistic, comprehensive and interlinked nature of the post-1950 changes simultaneously sweeping across the socio-economic and biophysical spheres of the Earth System, encompassing far more than climate change". Specifically, this is manifested by an increase in the use
of fuels (fossil & non-fossil) from both production and consumption, which contribute to an increase in greenhouse gas (GHG) concentrations in the atmosphere [12]. In addition, the Land Use, Land Use Change, and Forestry (LULUCF) sectors including deforestation and forest degradation, especially in the tropics region also causes the increasing GHG concentrations in the atmosphere [14], [15], [16], [17], [18].

Reference [19] state that the contribution of the sector reaches 10% of total global emissions. Specifically, forests in Indonesia and Brazil are the most significant contributors to emissions through deforestation, this happens due to the potential carbon storage that reaches 35% of the total carbon in the world's tropical forests [20]. In the period 1950-1997, Indonesia lost 37% of forest cover [21]. The decrease in the area of forest cover takes place with a relatively high and fluctuating speed [22]. Facing similar problem as other developing countries in tropical regions, deforestation in Indonesia is significant problem that demands attention as well as it prompts specific approach to solve.

Many factors underlie and drive deforestation in Indonesia. Some authors mention that these factors include expansion of plantation/agricultural land, illegal logging, population pressures and government policies [21]; [22]; [23]; [24]. These various factors imply that deforestation in Indonesia is a result of the complexity of the problems associated with socio-economic aspects, including the policy process [25]. In line with this, [26 in general divide the causes of deforestation on two main components, namely direct and underlying causes which consist of several aspects such as natural causes, human activities, and governance weaknesses, broader socio-economic and political causes.

Reference [27] emphasizes that “Deforestation results from complex socioeconomic processes, and in many situations, it is impossible to isolate a single cause. Therefore, a comprehensive and holistic effort is needed to minimize and even solve the problem of deforestation in Indonesia, which is an essential part of climate change mitigation [28]. The approach used so far is considered to be partial and not optimal in involving the community for forest management, including minimizing deforestation. Community involvement in forest management and avoided deforestation is considered to have significant results [29].

Indonesia has committed to reduce emissions from the forest sector with reforestation, carbon conservation, and forest fire mitigation [30]. But, the decision maker is too slow in mitigation practice because the forest fire from time to time becomes more difficult to solve. Reducing emissions is and will remain a great challenge for Indonesia, if the problems of illegal logging have not been addressed properly. This is caused by many of the forest area that prohibit to cleared due to deforestation [30].

Technically, this approach is carried out by planting wood plants together with other plants (plantation or agricultural commodities) and or livestock farming [32]. Technically, agroforestry land management practices include variations such as home gardens, intercropping, live fences, parklands, riparian buffers, shaded perennial crop systems, shelterbelts, silvopasture, improved fallows, rotational woodlots, tree plantations on arable land and shifting cultivation [32]. This approach aims to optimize the role and function of land to obtain a variety of benefits [32]; [31] including supporting climate mitigation and adaptation [33].

On the other hand, Ecotourism has been recognized to give benefits economically, socially and culturally as well as environmentally. Ecotourism is a method to introduce and promote natural beauty and cultural attraction. The development of ecotourism requires tripartite cooperation, community, government and private sector. In order to develop ecotourism, we needed community, government, and private sector contribution. Relying only one active party will not sustain the ecotourism development [34].

We propose Agro Eco-tourism as a method in developing a forest to become tourism destination and for agroforestry. We hope the combination of agroforestry and ecotourism, in addition to providing education to the community about forests conservation, socio-economic benefits, also creating climate change mitigation. This paper aims to provide potential answers to how to manage the forest and its relations with people in order to combat the forest destruction caused by people. In answering this
question, this study examines the literature related to agroforestry, and ecotourism, then proposing a new approach to combat the climate change.

2. Methods
The method used in this research is content analysis and literature study. The authors have collected relevant literatures to acquire an understanding about existing methods and strategies generally employed to mitigate climate change. First, authors utilized scientific publication to be able to draw a better understanding about climate change mitigations. Articles were collected from various journals related to agro-ecotourism and climate change mitigation. Using Science Direct Database, including research articles only, Keywords used were “forest and climate change mitigation”, “agroforestry and climate change”, “ecotourism and mitigation”, and “agroforestry and ecotourism”. Details of the number of the articles are available on Table 1. All articles were published in the periods of 2003-2019. After filtering these set of articles, by excluding the duplicate which appears more than once during search, the authors found 96 articles. By matching the research goals and the articles’ content, 13 articles were further analyzed.

Table 1. Database for literature review

| No | Keywords                                   | Number of article found |
|----|--------------------------------------------|-------------------------|
| 1. | “forest and climate change mitigation”     | 88                      |
| 2. | “agroforestry and climate change”          | 5                       |
| 3. | “Ecotourism and mitigation”                | 1                       |
| 4. | “agroforestry and ecotourism”              | 4                       |

3. Result and Discussion
Based on the literature search, using certain keywords “forest and climate change mitigation”, “agroforestry and climate change”, “ecotourism and mitigation”, and “agroforestry and ecotourism”, three categories we found in the preliminary results. The categories were climate change mitigation, agroforestry and climate change mitigation, dan ecotourism. The existing studies discussed on how agroforestry or ecotourism benefits climate change mitigation separately. Out of the articles collected, the authors have not found a single article which combined and discussed both methods together in climate change mitigation.

3.1. Climate change mitigation
One big challenge for climate change mitigation is to slow down the speed of deforestation or forest degradation. Currently these problems contribute to 15% of global greenhouse gas emission. One of the program, Reducing Emission from Deforestation and Forest Degradation, (REDD), also sustainable forest management and sink enhancement (REDD +) have been promoted as suitable programs to support the efforts for forest conservation and to increase the carbon stock activities as well as the development of alternative energy resources
Several mitigation activities that were found and offered in the existing research literature in the mitigation of climate change are as follow:

- Renewable energy, energy efficiency [35]; [36]; [37]; [38]
- Reducing deforestation and forest degradation [22]
- Replanting, restoration, reforestation, and plantation practice [39]; [40]
- implementation carbon sequestration projects [41]; [42]
- developing alternative energy resources [43]
- sustainable peatlands management [44]
- eco-friendly vehicles [36]; [44]
- reducing GHG emissions [45]
- ecotourism development [46]; [47]
The authors focus the discussion in this paper on the agroforestry and eco-tourism as methods for climate change mitigation that may, and mostly, require the involvement of local community living surrounding the forest to implement and to develop either agroforestry or ecotourism.

3.2. Agroforestry and climate change mitigation
Mitigation is defined as a series of human intervention activities to prevent long-term climate damage through reducing anthropogenic emissions and increase greenhouse gas uptake [50]. The activities may be implemented in several sectors, such as 1. Forestry & agriculture, 2. Energy, 3. Waste, 4. Transportation, 5. Industry, and 6. Infrastructure / buildings [51]. Climate change mitigation is not only related to the efforts to reduce emissions and to increase the absorption of greenhouse gases alone, but also related to several additional benefits such as economic development, environmental management, agricultural development, and improvement of the quality of life of the community, including improving welfare [52].

Agroforestry has an essential role in climate change mitigation because it involve safeguarding the stability of greenhouse gas concentrations in the atmosphere, improving the functioning of ecosystems, increasing resistance to extreme climates through the enrichment of soil fertility & retention, and soil carbon sequestration [50], [53],[54], [55], [56]. Specifically, [32] state that agroforestry mitigation potential is 27 ± 14 t CO$_2$ e / ha / y. Furthermore, agroforestry can increase the stock of carbon biomass in trees ranging from 46-51% [57].

Agroforestry plays a significant role in increasing soil carbon uptake through increasing the number of hair roots, rhizodeposition, and litter accumulation [58], [59], [60]. Furthermore, this land management system has a variety of additional roles such as the fulfillment of household needs, job creation, and social equality, providers of animal feed, firewood, and medicinal plants [61]. Thus, it can be said that agroforestry is relevant to climate change mitigation. Even climate change mitigation can be achieved significantly by combining a complex set of actions between the agriculture and forestry sectors (agroforestry) [50].

One limitation of agroforestry is the local community may perceive the method as impairing the level of crops productivity. Hence the local community has the tendency to go against the agroforestry method. Furthermore, as local community have limited knowledge to select proper commodities suitable to the soil condition, this limited knowledge also limit the ability to generate more income from conventional farming. Hence, a more reason to be reluctant to accept agroforestry method.

3.3. Ecotourism
Ecotourism is an approach based on 5 elements, which are natural, sustainable ecologically, educative, benefit for community, and creation of tourist satisfaction. Alternative for the development of ecotourism was to involve community with 3 dimensions concept : economic, social and political dimensions. To be successful, ecotourism development must include soil and water conservation consideration [62]. Ecotourism is actively accepted as a method to improve environment consciousness, management, and conservation [47]. Ecotourism can protect large amounts of forest over the long term [46]. Ecotourism can be a major income generator and support local economies [46], and it will impact to forest sustainability. A country like Indonesia, through natural diversity and local cultural ecotourism can attract many visitors from all over the world. In current moment, Indonesia offers at least 160 ecotourism sites all over Indonesia. The developments of those sites are mostly involving the cooperation among local community, government and private sectors. Although many sites of Eco-tourism show significant contribution to the economic welfare of local community, however there are cases in which the natural environment as the main asset of eco-tourism were severely harmed by the high number of visitors attracted to visit the ecotourism sites. The regulation to limit the number of visitor allowed to visit the sites on one particular time is a hinder to the economic interest of the local community, And this point is the weakness of the ecotourism development. To discourage visitors from
harming the natural environment, limiting the number of visitors is the only way to conserve the forest, and in the same time, limiting the income earned by the local community.

3.4. Agro Ecotourism

Some text As agroforestry and ecotourism has their own weaknesses, a new approach is proposed in this paper. We propose Agro Eco-tourism as a method in developing a forest to become tourism destination, and in the same time allows the local farmers benefitted from the forest through agroforestry. This approach offers a better scheme economically for the local communities, in a way that while the farmers has to accept smaller income from practice of agroforestry in the short run, however in the long run the local communities may be able to receive more benefit economically through ecotourism. Also by practicing agroforestry, in the long run, local community will have a better and higher quality of natural environment. We propose that balancing the short term and long term economic benefit, with a proper approach to the local community, the new method will be adequately accepted and will be adopted in the long run.

We believed that climate change mitigation is a complex problem, and requires a comprehensive solution. It involves not only how to increase the land coverage, also how to ensure the community living surrounding the forest, that the local communities will have economic and natural benefit by living in harmony with the forest. Agro ecotourism may have the answer to solve both natural and economic challenges. By involving the community, government and private sectors, the possibility to improve the quality of the forest through increasing the number of trees to cover the forest, and in the long run improving the livelihood of the local farmers seems possible.

4. Conclusion

After the compilation of the literatures about agroforestry and eco-tourism, it can be concluded that there was a diversity of methodologies in approaching climate change mitigation. This paper focused on agroforestry and ecotourism review methods, as the method that involved local communities in its implementation. Literatures have supported the notion that agroforestry could increase the stock of carbon biomass and soil carbon, although agroforestry had weakness in convincing the local farmers to adopt the method for the seemingly declining income from crops. On the other hand, developing ecotourism has its own weakness since it limits the possibility to have higher number of visitors. Combining the two, agro ecotourism is proposed as a new approach that balances the less attractive agroforestry method with the long term benefit for the local community.

5. Recommendation

The concept of Agro-Ecotourism requires more studies in the future, and experimentation in implementing the method and involving local community in its operationalization. Future thought can be directed to further developing the concept of agro ecotourism. Also, future research may want to show a real calculation, benefits and cost of implementing agro ecotourism. Through the real calculation, it will be easier for the local community to understand, to calculate calculating their benefit in the long, unforeseen future. and to adopt the method

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