Modern Environmental Science and Engineering (ISSN 2333-2581)
August 2021, Volume 7, No. 8, pp. 829-836
Doi: 10.15341/mese(2333-2581)/08.07.2021/005
Academic Star Publishing Company, 2021
www.academicstar.us

Efficiency and Potential Evaluation of REDD + Actions: Case Study From Muong Gion Commune, Quynh Nhai District, Son La Province, Vietnam

Wataru Yamamoto[1], Van Tuan Vu[2], Van Hung Pham[3], and Yumiyama Daisuke[4]

1. IDES, Japan

2. Forest Science Centre of North Western Vietnam, Vietnam

3. SNRM Project Son La, Vietnam

4. Kokusai Kogyo Company, Japan

Abstract: The aim of REDD+ is to contribute to climate change mitigation by slowing forest loss and degradation and to increase forest carbon stock through the conservation, management and expansion of forest. Multisector approaches (considering the multiple functions of forests with livelihood enhancement) are taken with the participation of local communities and smallholders in the developing environment where the governance on land use has limitation. The objective of the paper is to evaluate the potential and efficiencies on forest carbon stock and livelihood enhancement of the REDD+ actions supported by SNRM project in Muong Gion commune, Quynh Nhai district, Son La province. The benefit of livelihood in the household and carbon stock increased/saved by each REDD+ action was quantified by comparing the project cost used for beneficiaries and estimated benefit of carbon stock and livelihood enhancement. The result showed that Assisted Natural Regeneration (ANR) undertaken by low-cost manners is the most efficient having a large potential for carbon stock enhancement followed by dissemination of Improved Cooking Stove (ICS). Agroforestry, fruit/forage contour cultivation on slope, demonstrated the largest livelihood enhancement efficiency with high potential. The low cost ANR with a result-based mechanism combined with other livelihood benefits, as well as dissemination of ICS and agroforestry overcoming the barriers (techniques, cost, labor and grazing damage) are recommended in order to establish a basis for sustainable natural resource management for multi-functional benefits. It is recommended to disseminate the project result in other locations and to reach the INDC target.

Key words: participatory natural resource management, provincial REDD+ Action Plan (PRAP), assisted natural regeneration, improved cooking stove, agroforestry

1. Introduction

The aim of REDD+ (Reducing Emission from Deforestation and Forest Degradation) is to contribute to climate change mitigation by slowing forest loss and degradation and increasing forest carbon stock through the conservation, management and forest expansion. According to the Intended Nationally Determined Contribution (INDS), Vietnam will promote sustainable forest management, programs/projects related REDD+ and PFES (Payment for Forest Ecosystem Services) in order to reach the forest cover goal 45% by 2030 [1].

REDD+ actions are highly country-specific and evolve with practice. Integrated landscape approaches, including all sectors and land-uses, effective engagement of indigenous peoples and local communities, and forest actions based on sustainable forest management (SFM) are considered to be the basic framework for the REDD+ implementation [2].

Corresponding author: Wataru Yamamoto, Ph.D., research areas: natural resource management and rural development. E-mail: wyamamoto99@hotmail.com.

However, the validity of REDD+ actions regarding carbon stock and livelihood enhancements are hardly studied.

The objective of the paper is to evaluate the potential and efficiencies of the REDD+ actions supported by SNRM project on forest carbon stock and livelihood enhancement in Muong Gion Commune, Son La Province. The paper highlights the results of the project based on four years implementation in collaboration with provincial, district and commune authorities, village authorities, and beneficiaries.

2. REDD+ Action in Participatory Forest Resource Management Projects

In a community-based participatory forest resource management project aiming at REDD+, four types of project inputs are required: 1) the cost borne and technical support by project, 2) contributions from beneficiaries in forms of labor, lands and other available materials, 3) contribution from organized community for the project purpose, and 4) collaboration with state agencies and other stakeholders (Fig. 1). The expected project outcomes are: 1) carbon stock increase/saved, 2) livelihood enhancement and 3) enhancement of other ecosystem services (co-benefit in REDD+). Communities were organized to participated in the project as a group to undertake project activities and the villagers participated in the project activities individually for their benefit with own investment (mainly labor and lands).

3. Material and Methods

3.1 Sustainable Natural Resource Management Project

3.1.1 Overview

SNRM project is a technical cooperation project funded by Japan International Cooperation Agency (JICA) in collaboration with the Ministry of Agriculture and Rural Development (MARD), the Ministry of Natural Resources and Environment (MONRE), and Northwest provinces implemented during 2016-2020. The SNRM project aims to develop capacity of the institutions concerned on the preparation of Provincial REDD+ Action Plan (PRAP) through the implementation of Commune level REDD+ pilot activities. REDD+ pilot Activities were undertaken at selected 13 target villages at Muong Gion commune of Quynh Nhai district in Son La Province.

SNRM supported village level forest management and livelihood development through establishing Village Management Boards for Forest Management and Livelihood Development (VMBFMLD), formulating village forest patrolling team, forest regulations for village forests, and village funds for village activities. The project worked with facilitators from various government organizations including District Department of Agriculture and Rural Development (DARD)/sub Forest Protection Department (FPD), Extension center, and Commune People's Committee (CPC). The project supported mainly materials and trainings and beneficiaries contributed labor, lands and certain percentage of project support as their contribution to Village fund.

3.1.2 REDD+ Actions in SNRM

SNRM project supported to carry out three types of REDD+ Actions: three forest management activities (forest protection, pine plantation and assisted natural regeneration), two energy saving activities (improved cooking stove and biogas) and seven livelihood development activities (Table 1). Pine plantation and ANR increase carbon stock while ICS and biogas plant reduce emission by saving energy produced by fuelwood. Three livestock development activities (fruit cultivation at home garden, agroforestry: fruit/forage contour cultivation on slope, cardamom cultivation in natural forests) mainly enhance livelihoods but store limited carbon, while the others (vegetable, fodder grass cultivation, mushroom production, and compost/organic fertilizer production) simply enhance livelihoods directly through sales.

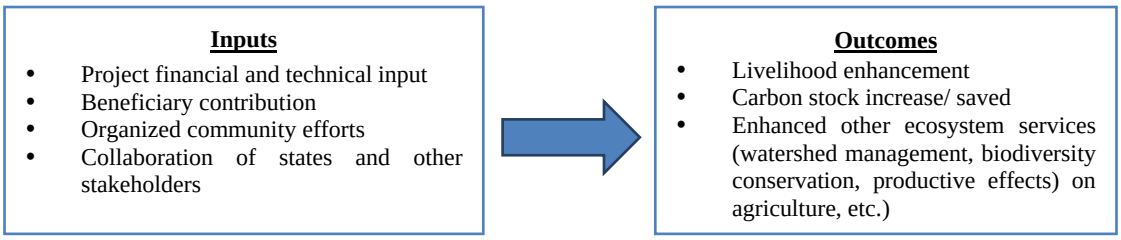

Fig. 1 Project input and outcome in SNRM.

Table 1 REDD+ actions conducted by the SNRM project [6].

Activity type	Scale	Description
Forest management activities		
Forest protection	12 villages 159 members 5,027 ha	Setup Village Management Boards for Forest Management and Livelihood Development (VMBFMLD), Village Fund (VF), Forest Patrolling Team (VFPT) to monitor village forest area in cooperation with commune forest ranger(s) Provision of Forest patrol route map
Pine plantation	4 villages 94.85 ha	Plantation of *Pinus masoniana* Provision of Seedlings, training to villagers and Checking and Monitoring
Assisted Natural Regeneration (ANR)	10 villages 295.4ha	Designing ANR, Provision of Seedling for gap planting, Installing sign board and boundary pole, Training, and Checking and Monitoring
Energy saving activities		
Improved stove distribution	13 villages 579HH	Supporting design, molding to produce improved stove at villages, Training, supporting materials
Biogas plant installation	1 village 2 HH	Supporting 50% cost of material Training and Study tour.
Livelihood development activities		
Vegetable cultivation	12 villages 451 HH	Training on vegetable cultivation techniques, Supporting seeds for 2 seasons
Agroforestry: Fruit/forage Contour cultivation on slope	11 villages 72 HH	Design survey, Technical training, Supporting seedling/seeds 15 models with fruit trees (peach, plum, longan, mango, litchi, Docynia indica, etc.) + Ghine grass + Maize/soybean/peanut were planted on contour line
Cardamom plantation in natural dense forests	1 village, 1 HH	Sa Nhan (Amomum longigulare) plantation under natural dense forest canopy
Mushroom production	1 village, 7 HH	Technical training, providing material and equipment and marketing support

3.2 Site

The pilot site was selected by three criteria: 1) size of existing forest area, 2) deforestation area between 2010 and 2015 (based on National Forest Inventory & Survey data), and 3) accessibility to carry out project activities. Muong Gion commune was selected as a pilot commune because of large forest loss between 2010 and 2015 (2nd in Son La) and relatively accessible to carry out project activities.

Muong Gion commune is located at north-western part of Son La province with a total natural area of 18,710.3 ha, of which forest land is 16,065 ha (accounting for 86% of the total natural land area), the PFES area is 7,003.38 ha (44% of forest land). It has more than 90% of the land on a steep slope; it is difficult for agriculture production. Although the population is increasing, soil is getting to be more degraded, leading to a decline of both available lands and agricultural productivity. Muong Gion Commune has upstream forests of the Da River, increasing soil erosion and leaching will affect the life of hydropower dams.

Villagers in Muong Gion commune are mostly subsistence farmers who produce most of food at home. 90% of their annual income comes from livestock [3]. Fruits produced in home garden are mostly for home consumption. In recent years, there have been some job

seeking and employment in big cities like Son La, Hanoi.

3.3 Calculation of Effects on Carbon Stock and Livelihoods

The benefit of livelihood in the household and carbon stock in the forest by each REDD+ action was quantified by comparing the project cost used for beneficiaries and estimated benefit of carbon stock and livelihood enhancement. Livelihood enhancement was estimated by farmer interviews while carbon stock enhancement was estimated based on existing literatures. The CO_2 absorption capacity of 5 years old pine plantation was used for pine plantation [4] while that of natural forests was used for ANR [5] based on the fact that greater than 90% of biomass comes from trees and the assumption that most tree growth was disturbed before the action. In case there are several different activities were carried out in the same model (e.g., agroforestry activities), a reasonable successful example was used for comparison. The cost benefit ratios were calculated for each REDD+ action by the following formula.

Cost benefit ratios (Carbon stock and livelihood enhancement benefit per year) = Benefit of REDD+ Action (either Carbon stock benefit (CO_2 ton/ha/year or Livelihood enhancement benefit VND/HH/year)/Project cost (VND/ha or VND/HH).

Forest protection, fruit tree cultivation, compost production, fodder grass cultivation were removed from the analysis due to the following reasons: no direct quantifiable carbon stock saved (forest protection), no direct livelihood effect (compost and fodder), technical focus approcuh (fruit tree cultivation).

Due to the participatory approach of the project, the beneficiaries provided substantial labor for all the actions; these values were analyzed in the discussion. Since the study aims to obtain approximate result of cost benefit analysis of three years, the inflation rates of Vietnam during the project period (2017-2020), approximately 3%/year was ignored.

4. Results: Cost and Carbon/Livelihood Benefits of REDD+ Actions

Project cost and effects of carbon stock increase/saved and Livelihood enhancement are presented in Tables 2 and 3. The cost effect ratios between project costs and effects on carbon stock showed that ANR demonstrated the highest efficiency followed by ICS (Fig. 2). Biogas showed the lowest. Regarding effects on livelihoods, agroforestry: fruit/forage contour production on slope showed the highest cost effect ratio followed by vegetable cultivation (Fig. 3). Cardamom plantation and mushroom production had low efficiency.

Table 2 Summary of cost and effects on carbon stock of REDD+ actions.

REDD+ Actions	Project Cost (VND)	Input from HHs	Livelihood enhancement (VND/HH/year)
Forest management activities			
Pine afforestation (AR)	4,295,500/ha	Labor, land	18.81/ha
Assisted natural regeneration (ANR)	750,000/ha	Labor, land	34.86/ha
Livelihood development activities			
Improved cooking stove dissemination	160,000/HH	Labor materials	1.468/HH
Biogas installation	5,000,000/HH	Labor, land materials	2.936/HH

Remarks:

- Pine plantation: Project Cost: Design VND 1,100,000/ha, seedling VND 3,195,500/ha. Training: 594 participants [6]. Beneficiary contribution: Labor 131.3 man-day/ha for 4 first year/ha (x 206,000 VND/man-day =27,045,740 VND/ha) and land. Carbon stock increase estimated in 5th year: 18.81 CO_2 ton/ha/year [4]. PFES VND 396,400/ha after 5 years.
- Assisted Natural Regeneration: Project Cost: regeneration design VND 750,000/ha, Training 678 participants [6]. Beneficiary contribution: Labor 29.78 man-day for 3 first year/ha (x 206,000 VND/man-day = 6,134,680 VND/ha) and land. Carbon stock

increase estimated: 34.86 CO_2 ton/ha/year (after 3 years) [5]. PFES VND 396,400/ha after 3 years.

- Improved cooking stove: Saving 40% of firewood consumption (interviews of 60 villagers), 2,000 kg/HH/year (cooking and alcohol making) [7]. Carbon stock saved estimated: 800 kg/HH = 4.4 CO_2 ton/year/HH.
- Biogas plant installation. Project support VND 5.000.000/HH and HH paid 10.000.000. Saving 80% of firewood consumption (interviews of two villagers), 2,000kg/HH/year (cooking and alcohol making) [7]. Carbon stock saved estimated: 1600kg/HH = 8.8 CO_2 ton/year/HH.

Table 3 Summary of cost and effects on livelihood enhancement of REDD+ actions.

REDD+ Actions	Project Cost (VND/HH)	Input from HHs	Livelihood enhancement (VND/HH)
Vegetable cultivation	132,710	Labor, fertilizer land	900.000
Agroforestry Fruit/forage contour production on slope	2,623,344	Labor, fertilizer land	30,000,000
Cardamom plantation in natural forest	1,868,000	Labor, land	2,250,000
Mushroom production	1,640,000	Labor, place	2,500,000

Remarks:

- Vegetable cultivation: Livelihood enhancement from farm interviews (average of 40 HHs) [8].
- Agroforestry: Fruit/forage production on slope: Longan and mango model (200 trees/ha 5 m×10 m horizontal and vertical intervals, 0.2 ha/household, 50% each). Livelihood enhancement: example of one successful villager estimated at 5th year based on the condition of 3rd year [3]. Carbon stock increase CO_2 estimated: ≒4 ton/ha (after 3 years).
- Cardamom production: Livelihood enhancement. Farmer interview. example of one HH [8].
- Mushroom production. SNRM project supported VND 1,640,000/HH for mushroom production model and its income is VND 2,500.000/HH. Based on farm interview. Average of 7 HHs [8].

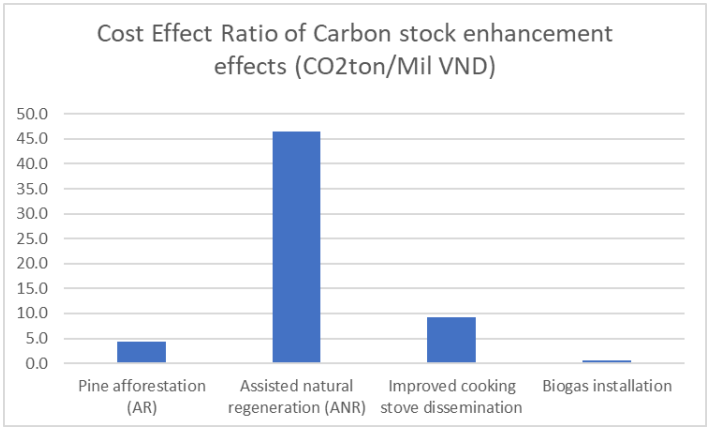

Fig. 2 Cost effect ratio of effects on carbon stock.

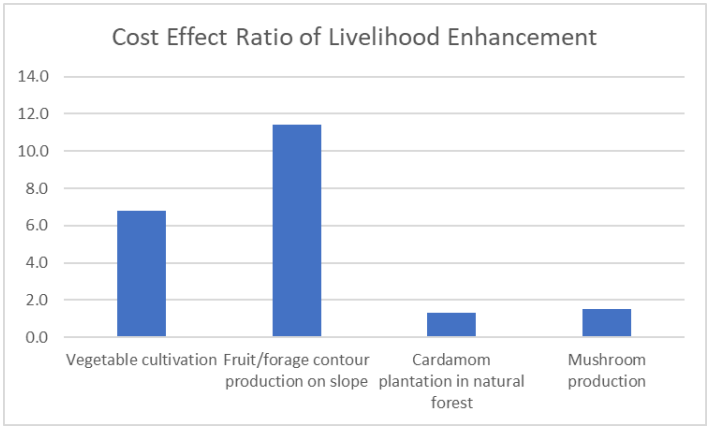

Fig. 3 Cost effect ratio of effects on livelihood enhancement.

5. Discussion

5.1 Participatory Natural Resource Management With Contribution of Beneficiaries for Strengthening Community Engagement

In SNRM, REDD+ actions were implemented with the provision of materials and capacity building activities. The beneficiaries contributed labor, land, and local available materials. In order to ensure the sustainability, beneficiaries contributed some parts of the cost to village fund (fruit tree, improved cooking stove, biogas plant) which is used for village level management activities by VBMFMLD.

Participatory approach by organizing village management boards, forest regulation and village fund have guided the villages together towards the same direction as the project. Livelihood development combined with forest management with village organization was a good option to control forest degradation drivers (grazing, fire, etc.) creating social pressure and make forest protection stronger (VFPT, VF, etc.).

5.2 Comparison of Effect on Carbon Stock Increase/Carbon Saving

The result of cost effect ratio showed that ANR (46.5) had the largest efficiency on carbon stock followed by ICS (9.2). It should be noted that the cost of ANR of SNRM is much lower than that of FPDP (Forest Protection and Development Program, the largest government program) since the project did not pay for the labor (labor cost is 6,134,680 VND/ha, making Cost Effect ratio much lower 5.1), suggesting that the low cost implementation of ANR dramatically improved the efficiency which may not be possible without other arrangements including livelihood supports through village organization. In general, costly land-based activities including AR and ANR are not for carbon but for other purposes such as AR for timber production and ANR for erosion reduction. SNRM demonstrated that the low cost ANR with other incentive can be one option for emission reduction.

5.3 Carbon Saving Potential of Improved Cooking Stoves

Dissemination of ICS was disseminated with low cost in SNRM (VND 180,000/ICS) using molds based on the design with villagers considering different preference of each tribe and produced by villagers [9]. According to the interviews with 60 villagers, 98.2% of households are satisfied with the stove and it is showing the expansion to other villages. The interview with villagers showed ICS saves approximately 40% of firewood. Since it is used 579HH, the carbon saving potential is large. Interval of firewood collection by beneficiaries became longer (from 7 days to 10 days' interval). Larger size ICSs for alcohol distillation and cooking cattle feed were also made by five households. However, there are several points to be improved: ICS design for each tribe and utilization and quality control of materials. Active research and extension activities are expected based on the result of the project

5.4 Potential of Afforestation and Assisted Natural Regeneration

Comparison of biomass increase between AR and ANR, ANR is much more efficient, lower cost with higher carbon stock increase (34.9 and 18.8 CO2ton/ha/year of carbon stock increase by ANR at three years and AR at five years, respectively). In fact, the availability of PFES (expecting to be paid in three years for ANR and five years for AR) encouraged the beneficiaries to work in the field since SNRM did not pay the labor. The additional provision of rice from FPDP to beneficiaries helps to continue such arrangement. In SNRM, ANR was attempted for 295 ha and 129 ha has already qualified for PFES payment in three years (44%) [10]. SNRM demonstrated that such result-based benefit distribution functioned well, and it would help maintain the forest (rather than

paying their labor work in the first years). Strategical location of ANR for erosion control is a right option.

It is important to make open forest convert to dense forest. AR is expected to produce a pine timbers at 15 years or longer. It should be emphasized here that AR is for timber and if timber is not properly produced by AR (difficult to protect the site against grazing/forest fire for harvest), the investment is not feasible for the activity. According to a villager, from the pine planted by the former government 661 program, resin was tapped after 10 years and timber was harvested and sold at 12 years with a very price.

Investment for AR and ANR should be combined with proper protection mechanism as undertaken in SNRM (Village management boards, forest regulations with village fund) to make AR and ANR successful. Available PFES supported to strengthens the mechanism [10].

5.5 Potential of Biogas Installation

The biogas plant installed in the Xa village with the cost VND 15 million (SNRM project supported VND 5 million and household contributed VND 10 million). The biogas plant can save about 80% of firewood; however, the expansion to more villagers was difficult due to the high cost of one unit. Also scaling down the pig production was observed due to the demand decline.

5.6 Comparison of Livelihood Enhancement Effects

Although it is difficult to compare the livelihood enhancement effect by REDD+ activities due to the variability of the beneficiaries, agroforestry: fruit/forage contour cultivation on slope showed is the most efficient followed by vegetable cultivation. Fruit/forage contour cultivation on slope has a large potential with the available slope lands (90% of the land of Muong Gion commune on a slope), but the that of vegetable cultivation is limited due to the land availability (it produces a winter crop on paddy after the rice). Investment of both money and labor as well as appropriate technique and protection against grazing are needed for fruit cultivation. Agroforestry implementation through village mechanism helps disseminate technology and protection against animals. Although carbon stock enhancement is limited ($4CO_2$ ton/ha), the pants on forage hedgerow slow the speed of stream flow when intensive rainfall occurs; therefore, a new type of PFES for erosion control reduced cultivation can be considered. It would help dissemination of fruit/forage cultivation on slope in the first few years.

Muong Gion is natural habitat of amomum (mainly *Amomun xanthioides*) scatter planted in some villages with low economic value. Cardamom cultivation has a large potential but since it is a new activity, the cost was rather high and the market is rather small, therefore, the price may decline dramatically if many villagers start producing it since the expansion is relatively easy. Having processing facility and transport to major cities need to be considered in order to use the potential.

Mushroom production needs large investment for smaller market with intensive competition. It showed limited success since the villagers did not continue due to the market decline.

6. Conclusions

Recognizing the multiple functions of forests sustaining livelihoods of local populations and ecosystem services, twelve types of REDD+ pilot activities were implemented in SNRM project by multisector approaches with the participation of local communities and smallholders.

The efficiency and potential on carbon stock and livelihood enhancement were compared among the REDD+ activities based on the four-year project result. The study demonstrated that the Assisted Naturel Regeneration undertaken by low cost manner is the most efficient with high potential for carbon stock enhancement followed by dissemination of Improved Cooking Stove whereas fruit/forage contour cultivation on slope demonstrated the largest livelihood

enhancement effect with high potential. The low cost, result-based implementation combined with other livelihood benefits for afforestation and ANR, as well as dissemination of ICS and agroforestry overcoming the barriers (techniques, cost, labor and grazing damage) are recommended.

Acknowledgements

We thank SNRM Son La Provincial Project Management Unit (DARD, FPD), DPC and District FPD of Quynh Nhai District, CPC of Muong Gion Commune, and FPDF Son La for the collaboration for project implementation and the provision of information, as well as JICA and Kokosai Kogyo Company (KKC) to give us an opportunity to implement the project and to present the paper.

References

[1] INDC (Intended Nationally Determined Contribution), 2015, available online at: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Viet%20Nam%20First/VIETNAM'S%20INDC.pdf.

[2] FAO, REDD+ implementation: REDD+ reducing emissions from deforestation and forest degradation, 2020, available online at: http://www.fao.org/redd/areas-of-work/redd-implementation/en/.

[3] W. Yamamoto, V. T. Vu, V. H. Pham, D. T. Vu and D. Yumiyama, On farm demonstration of agroforestry model: Fruit and forage contour cultivation on slope in Muong Gion Commune, Son La Province, Vietnam, SNRM, JICA, 2020, available online at: https://daln.gov.vn/en/ac129a2011/snrm-redd-pilot-success-story-no-1.htm.

[4] D. Q. Ngo, Research results on CO_2 absorption capacity of some major plantations in Vietnam, Vietnam Forest Science Institute, 2006.

[5] Q. B. Tran and V. T. Nguyen, Research results: on CO2 absorption capacity of natural forest in Muong La district, Son La province, Vietnam Forestry University, 2013.

[6] V. H. Pham, T. V. Vu and D. T. Vu, Assessment Report: Pilot Activity sub-component in Son La Province, SNRM, JICA, 2019.

[7] T. K. L. Tran, N. Doland and J. B. Kathryn, Firewood extraction and use in rural Vietnam: a household model for three communes in Ha Tinh Province, *Agroforestry Systems* 91 (2016) (4).

[8] V. H. Pham, Narrative Report on the 4th Round Monitoring and Evaluation of REDD+ Pilot Activities of SNRM Project In Son La Province, SNRM, 2020.

[9] W. Yamamoto, V. H. Pham and V. T. Vu, SNRM REDD+ Pilot: Success Story: Participatory Dissemination of Improved Cooking Stoves in Muong Gion Commune, Quynh Nhai District, Son La Province, Vietnam, SNRM, JICA, 2020.

[10] W. Yamamoto, V. T. Vu, V. H. Pham, D. T. Vu and C. Naito, Enhancing Impacts of Payment for Forest Environmental Services on Forest Management: Experience of SNRM REDD+ Pilot Implementation in Muong Gion Commune, Son La Province, Vietnam, 2019, *Proceedings From International Conference: Linkage of Higher Education, Research and International Integration of Sustainable Forest Management and Bioeconomy*, Vietnam National University of Forestry, Hanoi, 2019.