JAPAN INTERNATIONAL COOPERATION AGENCY

SUSTAINABLE NATURAL RESOURCE MANAGEMENT PROJECT

LIVELIHOOD IMPROVEMENT ASSOCIATED WITH BENEFIT SHARING MECHANISM IN COLLABORATIVE MANAGEMENT PLATFORM

This evaluation report has been made as a part of the Sustainable Natural Resource Management Project (SNRM), Component 3 funded by the Japan International Cooperation Agency (JICA) and executed by the Ministry of Agriculture and Rural Development of Viet Nam.

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ABREVIATATION

BSM	Benefit sharing mechanism
CM	Collaborative management
CMA	Collaborative management Agreement
CPC	Commune people committee
DARD	Department of agriculture and rural development
DONRE	Department of Natural resource and environment
DOIT	Department of Industry and Trade
DPC	District people committee
JICA	Japan International Cooperation Agency
EFLO	Environmental friendly livelihood option
LBBR	Langbiang Biosphere Reserve
SNRM	Sustainable natural resource management
NLC	Nguyen Long Joint stock company (Mushroom company)
PFES	Payment for Forest Environment Services
NTFP	Non-Timber Forest Products

1. Background

1.1 Introduction of SNRM- component 3

The Sustainable Natural Resource Management Project (SNRM) funded by Japan International Cooperation Agency (JICA) has been implemented in Vietnam since November 2015. The overall objective of the project is to enhance the capacity for sustainable natural resource management in Vietnam.

The Project of Sustainable Natural Resource Management- Component 3 (Biodiversity conservation; hereinafter referred to as "the Project") aims to establish an integrated and collaborative ecosystem management system for sustainable conservation and management of the Lang Biang World Biosphere Reserve (LB-BR) in Lam Dong province with 3 main outputs are:

(1) An institutional framework necessary for management and operations (integrated and collaborative ecosystem management framework) of LB-BR is established;
(2) The Collaborative Management Agreement (CMA) with the Benefit Sharing Mechanisms (BSMs) is upgraded as a tool for conservation of forest ecosystems in the core and buffer zones of the proposed LBBR;
(3) The results of forest ecosystem and biodiversity monitoring are used for the management of the core and buffer zones of the proposed LBBR.

The basic idea of the BSM in the above (2) CMA is to provide benefits to community redidents in exchange for their contributions to the forest conservation through activities based on CMA. The Environmentally Friendly Livelihood Options (EFLO) is to improve the livelihood of local people in an environmentally friendly manner as well as to reduce the negative impact on natural resources and environment as an important part of BSM) in the CMA. Considering the above objectives, EFLO approach is to; 1) integrate and collaborate with relevant stakeholders to support local people, 2) develop sustainable livelihood models in an appropriate manner with capacity of the target villages to increase people's income, and 3) minimize negative impacts on environment through the development of EFLO models using appropriate techniques.

The target of the EFLO is the ethnic minority HHs in the villages whose livelihood improvement expectedly contribute to the conservation of the LB-BR as mentioned above.

1.2 Current situation in 7 target villages with focus on the ethnic minority people

1.2.1 Seven target villages and their issues

The target villages (Bon Dung 1, B'No B, Da Tro, Da Ra Hoa, Da Bla, Klong Lanh and Dung K'Si) are located in the core and buffer zones of the LB-BR recognized by the UNESCO in 2015, as well as in important watershed areas where sustainable conservation / development is strongly required. Whereas, deforestation and forest degradation have been taking place and furthermore agro-chemicals have been abusingly used for vegetable and flower farmings in the area including the target villages, causing negative impacts on their conservation including water quality. Those are

impotant issues in the sustainabl conservation/ development of the LB-BR and the important watershed area.

Another issue is poverty among the local people in the villages. There were 1,253 households (HHs) with 5,539 members, among which 196 HHs are Kinh and 1,057 HHs are K'Ho ethnic minority accounting for 84.4% of all HHs (the Lac Duong DPC statistics in 2015). According to "the Socio-Economic (Financial) Survey in the target villages (hereinafter referred to as the Survey)" by the Project, HHs with incomes below 2 million (or nearly 100 USD) / month, which is officially classified as poor, accounted for 29,6% in the total HHs of the villages as shown in the table 1 below. The rate of the poor HHs is highest in Da Chais commune and the lowest in Lac Duong town. Up to 87% of the Kinh HHs are in the medium or better-off groups, while nearly 50% of the minority HHs belong to poor and near poor groups. Poverty issues often leads to negative impacts on the conservation of natural resources. Due to the poverty coffee fields are often obliged to be sold to Kinh people, resulting in the conversion of forests/ forestlands into alternative coffee fields by the minority HHs, which, together with land speculation by Kinh people, is a driver of deforestations/ degradations of forests in the district including the villages.

Table 1. Distribution of HHs in the target villages by the value of average income

Town/ Comune	Below 2 M	2~4.2 M	4.2~8.3 M.	8.3~16.7M	16.7~30M	30M~
Lac Duong	13.7 %	24.5%	32.9%	19.2%	5.8%	3.8%
Da Nhim	36.4%	37.3%	19.2%	6.3%	0.9%	-
Da Chais	38.7%	38.8%	15.1%	6.2%	1.1%	-

Note; M; Million VND/Month/ HH Source; Socio-Economic (Financial) Survey in the target villages

1.2.2 Major livelihood activities in the target villages

As shown in the table 2 below, the livelihoods of the local people in the villages are featured that almost of all local people cultivate coffee as the most important livelihood and that PFES is an important income source, especially to poor HHs. And attention should be paid to the fact that poor HHs are heavily dependent on forest resources. Thus, the improvement of the livelihood of the minority HHs is very important to conserve the LB-BR.

Table 2. Major livelihood activities in the target villages (%)

Town / Comune	Coffee farming	Husbandry	Hired labor	NTFP colection	PFES contract
Lac Duong	77.0	25.4	78.7	34.7	20.4
Da Nhim	91.7	15.2	54.0	34.6	77.2
Da Chais	97.7	15.9	54.3	68.6	84.9
Average	88.4	19.7	62.2	43.0	60.5

Source; Socio-Economic (Financial) Survey in the target villages

Table 3. Income of households categorized by major livelihoods in the target villages

(million VND/year/HH)

Town/ Comune	Coffee farming	Vegetable farming	PFES contract	Salary & hired labor
Lac Duong	28.6	142.0	9.46	44.5
Da Nhim	21.8	95.0	8.89	16.6-
Da Chais	13.7		15.2	20.9

Source; Socio-Economic (Financial) Survey in the target villages

Among major livelihoods, the coffee farming currently generates profits of 5.8 million VND/ year / HH on average despite of its importance to most of the local people as livelihood, whereas, the vegetable farming there brings 66.8 million VND/ year/ HH which is much higher in profits than that of the coffee farming. Furthermore, coffee farming at Da Chais commne is not profitable with loss of 0.6 million VND/ year/ HH. Thus, current coffee farming is not so profitable compared to other farmings, especially for the minority HHs. Difficulties of the coffee farming of the minotiry HHs are that its low productivity with 1/3~1/2 amount of coffee beans produced compare to Kinh HHs, high coffee production cost caused by fertilizer cost accounting for around 40% of the total production cost, and the exploitation over everything including sales of coffee beans of debted HHs by local shops lending money with very high interst rate. On the other hand, the vegetable or flower farming is much more profitable than coffee. However, issue with those farmings are that lots of agro-chemicals are used, negatively affecting environment and that they require conisderable investment and certain level of techniques which are not, assumedly, affordable to most of the minority HHs for the time being at least.

2. Direction of EFLO development for the minoity HHs in the target villages

2.1 Development of EFLO strategies

With reference to the EFLO, taking into account the result of the Survey, that is; many villagers' livelihoods depend heavily on coffee production and therefore, their income can only be obtained during harvesting months (Nov, Dec,and Jan), resulting increasing their financial dependence on local shops, it was decided that the basic policy of the EFLO was to improve the profitability of the coffee farming and to diversify crops of the agricultural production. In particular, it was decided that crops and necessary techniques for their introduction should be selected based on the selection criteria such as environmental friendliness, the utilization of local resources, small financial burden, and technical accessibility, considering the location of farmland within the LB-BR and farmers' financial situation.

Besides, it should be noted that forest owners cannot provide continuous technical support for livelihood improvement because they do not have direct responsibility and human/ financial resources for developing and disseminating agriculture techniques. Therefore, in order to realize continuous benefit provision to CMA participants even after the project termination, the following were adopted as EFLO implementation strategies: (1) Technique transfer to key farmers

who agreed to share it with CMA participants, (2) Utilization of existing programs/ budgets of the provincial government organizations such as DARD, DONRE and DPC for collaborative support to their livelihoods, and (3) Technical transfer, collaborative production, and product sales in collaboration with private companies related to coffee and mushrooms.

After agreeing with forest owners on the EFLO strategies, an implementation/budget plan was prepared based on the strategies, which consist of coffee farming improvement activities, coffee production support activities with use of local resources, identification of profitable crops with their trial productions and of private companies willing to collaborate with, as well as promotion activities of agricultural products.

2.2 Identification of EFLO models appropriate to the minority HHs

In order to identify potential crops and concrete measures for contributing to improving livelihoods in the target area, following three activities 1) research survey (soil survey), 2) problem extraction through village meetings and 3) business sector trend survey were conducted. Of particular note was the "impact on productivity due to the disappearance of organic matter" and "proposal for maintaining/ raising productivity by adding organic matter" obtained from the survey, used as judgment materials when deciding the improvement activities. Besides, the selection of potential crops was tried to narrow down according to the actual job through the following process.

Table 4. Process of selection of potential crops

Extraction of issues	Survey into models	Survey target	Key farmer-based training and demonstration
Improvement of the processing and sales of coffee beans	1. Direct sales (Starbucks certification program) 2.Processing and value-added improvement	1.ACOM's sustainable production of coffee 2.UCC/La Viet Coffee, Married coffee company	1. Direct sales through certification programs 2. Coffee Beans (Cherry) harvesting and processing
Improvement of profitability through soil conservation of coffee fields and reduction of its	1.Appropriate use of livestock manure through cowshed improvement 2. Soil conservation by using local organic matters and mixed planting	1.Organic fertilizer making through livestock manure practiced by key farmers 2.Organic fertilizer making with using coffee pulp 3. Practice of	1. Making and fertilizing organic fertilizers through the improved cowshed 2. Production and fertilization of organic compos by using coffee pulp

production costs		Coffee/Banana mixed planting	3. Coffee & Banana mixed planting
Diversification of crop production Mushrooms, persimmons, medicinal herb	1.Contracted mushroom production 2. Medicinal herb mixing	1. Institute of Science and Technology, Lam Dong DOST and, Nguyen Long company, 2.BNBNPMB herb production model	1. Cultivation of shiitake, shimeji and cloud ear mushroom 2. Herb and seedling cultivation test

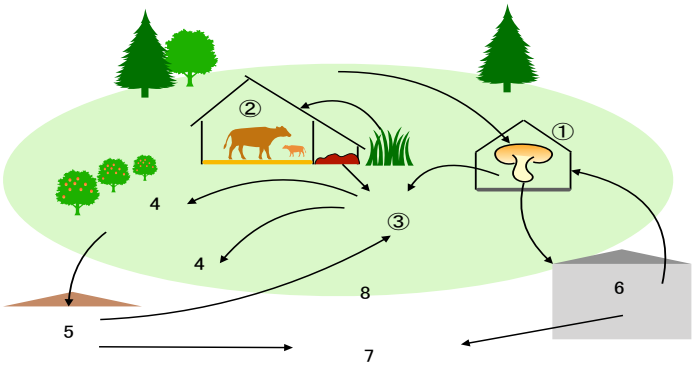
Based on the results of the above trainings and demonstrations with Key farmers, the following two types were selected as EFLO models, considering sustainability from view points of 1) public services by local governments, 2) continuous cooperation between private businesses and villagers, and 3) villagers' interest (willingness to invest). Besides, even when identifying crops, the higher selection criteria were whether or not implementations of crop productions (administrative services, private sector cooperation) work.

i. Cowshed improvement, cow dung and composting of local organic matters, fertilization, reduction of grazing in forests, pasture cultivation, and banana mixed planting in coffee fields. Implementation method: Cooperation with DPC / CPC, DARD and DONRE.
ii. Production and direct sales of agricultural products (mushrooms, persimmons, coffee) using production methods with minimum environmentally negative impacts. Implementation method: Collaboration with private companies such as ACOM, UCC, Nguyen Long (NL), Sang Sinh, LAS, etc.

Then, it was decided that EFLO development was focused on developing/ establishing the following two models, considering the perspective of the LB-BR conservation, sustainable agricultural development, and consistency with related policies of the provincial organizations concerned.

i. Profitability improvement of coffee farming through raising fertility of soils, productivity of coffee plantation and reducing coffee production costs: Cowshed improvement and compost production using cow dung (application of the Poverty Reduction Program) improving cowshed and securing raw materials for compost (application of the Poverty Reduction Program) coffee pulp and local agricultural by-products (application of DoNRE budget).
ii. Development of highly profitable Shiitake production model and establishment of its value chain (application of DPC budget).

The relevant diagram on these two EFLO models is shown below.



①	Shiitake production model
②	Cowshed improvement model, grass cultivation for cow, use of its manure for compost
③	Compost production (raw materials: waste fungus bed, cow manure, coffee pulp)
4	Application of compost to coffee garden/farmlands for increased fertility
5	Coffee processing company: Sale of coffee pulp produced in the coffee refining process
6	Shiitake company; Shiitake media production/sale, packing of shiitake collected from famers
7	Sales of shiitake with the LB-BR logo to the place of consumption
8	Tourism and environment education in the LB-BR including BNBNP

As shown in the above, livestock farming is the foundation of the subsistence agriculture, and cow dung, a by-product, can be used as a compost and a method of obtaining cash. Coffee pulp is promising as local raw material. Furthermore, the used mushroom media from shiitake mushroom cultivation is also a useful material with the same value as cow dung. In other words, by creating the organic matter circulation within the region, a scenario is established that improve the sustainability of agricultural production and restrict cash expenditure which is an initial assumption of this project.

3. Development of EFLO models

Development of EFLO models aim to address local issues such as creating additional livelihoods and/ or reducing negative impacts on environment/ natural resources. Development of each EFLO model is considered/ planned based on (1) availability/ potential of demands on a crop(s), (2) capacity of target villagers in terms of producing the crop(s) with affordable cost and techniques and (3) possibility of collaboration/ integration of the model development with programs/ budgets of the relevant stakeholders such as DPC, CPC, DARD, DONRE and private companies to maximize available financial/ human resources of the stakeholders concerned for materializing

the model. The development of the model with programs/ budgets of the relevant stakeholders in the above (3) is conducted through the CMP, in which stakeholders discuss and agree on the collaboration to implement their committed responsibilities for model development to solve /mitigate issues. (For detail of the CMP, please see Evaluation report on the CMP)

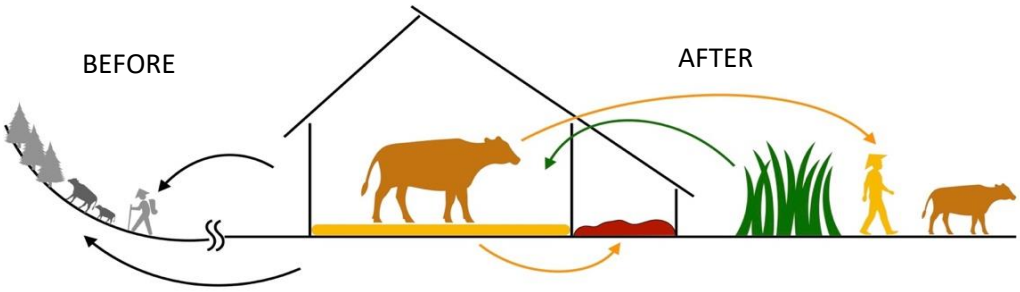
The EFLO model in this report consists of 2 parts, firstly profitable coffee production by applying compost made of local organic matter, including cow manure available with the proper design of cowshed/ grass planting and secondly profitable shiitake mushroom production. The implementation and results are described below:

3.1 Cowshed improvement model

3.1.1 Background & Objectives

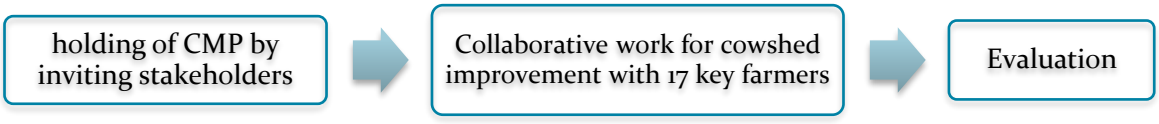
In the target villages cattle is important livestock for HHs including poor ones. On the other hand, it was pointed out that the free grazing of cattle causes negative impacts on the environment. Specific examples include water pollution and invasion into crop fields, destroying crops.

In response to the above local issue, the project coordinated with the LB-BR MB and stakeholders such as DONRE, Lac Duong DPC, Agricultural center, CPCs, and villagers in the target villages to hold a CMP in May 2019 for the goal of reducing free grazing and environmental pollution as well as of improving livelihoods through using manure as shown below.



3.1.2 Cowshed improvement trial in 2018

The cowshed improvement trial in 2018 was organized through the workflow shown below:



(1) Result of the CMP

In the CMP, issues taking place in the target villages and possible solutions with roles and responsibilities of the stakeholders were discussed and agreed upon as below:

Table 5. Roles and Responsility of the stakeholders based on the Agreement of the CMP

Stakeholders	Main activities / Resposibilities	
17 farmers agreed to:	▪ Have lands to build a cattle shed (15m2) and to grow grass (100m2) in legally owned land ▪ Buy construction materials except for those materials provided by the project and relevant stakeholders ▪ Prepare feed and beding materials	▪ Do not violate Forestry Law ▪ Keep at least 3 cattles ▪ Follow technical guidance ▪ Share knowledge and experience with other farmers in the village
SNRM Component 3 committed to:	▪ Organize study tours for famers /officers concerned to adavanced areas ▪ Provide building materials (cement, sand, stone, bricks and corrugated iron) ▪ Support district agriculture centers to guide and to monitor the farmers in the process of making cowshed improvement ▪ Support funding for the above activities which is equivalent of 150 million VND	
DONRE agreed to:	▪ Support materials (rice husks, rice bran, yeast) to make a biological bed for cattle shed which is equivalent of 11 million VND.	
Agricultural Division of DPC agreed to:	▪ Provide grass seedling for the farmers which is equivalent of 15 million VND ▪ Support organize training ▪ Participate in monitoring/ evaluating the model for replication in the district.	
Agricultural Center in the district agreed to:	▪ Design the cowshed, and supervise the construction of the cowshed ▪ Prepare technical guideline on husbandry techniques ▪ Guide to making a biological bed ▪ Support vaccination and disinfecting shed ▪ Participate in monitoring and evaluation.	
CPCs concerned agreed to:	▪ Supervise the construction of cowshed; ▪ Coordinate whole process of activities involving the famers with the SNRM project	

(2) Results of the collaborative works based on the CMP agreement

Seventeen key farmers learned on cow raising in an eco-friendly and economicaly effective manner through participating in the traning & study tour to advanced local models of cattlesheds improvement combined with compost application as follows;

(2-1) Grass planting

Before the support, 17 famers did not have the habit of growing grass to raise cows, through the study tour and the training, 12 out of 17 farmers planted grass with a total area of 10,600 m2 on talus, along streams or along the garden boundary, depending on the topography of each farmer, to feed their cows in captivity. Although the rest of farmers (5 farmers) did not grow grass, they could often collect enough grass along streams to feed their cows. Regarding grass planting, 4 out of 12 famers failed growing grass because they did not follow the planting technique/ and grass fields were destroyed by cows. As establishment of grass fields for feeding cows is important for successful cowshed improvement, the model activity should be continuously supported/ monitored, and farmers should actively participate in the model even after the project termination.

(2-2) Cowshed improvement through capacity enhancement

Between July 2018 and August 2019, 17 supported farmers increased the number of cows, from 81 cows (5 cows per farmer on average) to 113 cows (7 cows per household on average).

Before the supporting, the total area of the cowshed of 17 farmers was 140m2, of which 7 out of farmers did not have cowsheds, the remaining 10 farmers had small cowsheds with only 12-16 m2, without floor and cesspool. The project and District Agriculture Center organized a training course on cattleshed improvement combined with bio-bed and on breeding techniques, and provided materials necessary for the cowshed improvement. Thus, the farmers increased the total cowshed to 680 m2. Depending on the number of cows that the farmers constructed cattleshed with different sizes as follows: 20 m2 to raise 3-5 cows; 30 m2 to raise 6 - 10 cows; 42 m2 to raise 11-17 cows.

(2-3) Growth of cows in improved cowsheds

Cows raised in the cowshed grow better. According to the survey data, before the cowshed model was introduced, the cow grew slowly (14 / 17 farmers) or on medium (3 / 17 farmers) after the model was applied the cow grew from medium (4 / 17 farmers) to fast (13/ 17 farmers). Cows become less sick and they are given better disease control because they are easier to vaccinate in the cowshed than in free-grazing conditions.

(2-4) Manure collection

In addition to the benefits of the cowshed such as better growth of cows with less sickness and prevention of crop damages and environmental pollutions, the manure collection becomes an another important benefit in terms of organic compost making for profitable farming of crops including coffee and for replacing chemical fertilizer to reduce negative impacts on environment.

The amount of manure to be collected is proportional to the number of cows, cow size and duration of captivity. In fact, it was found out that only a few farmers had 1 m3 manure per month before introduction of the cowshed improvement, which was increased to 3 m3/month in average. The amount of manure collected on a monthly basis is quite variable. There are 3 households in Da Nhim commune building the cowshed but they still do free grazing so they cannot collect any manure. Some households raise 15 cows including 9 calves with 6 hours/day of free grazing time, they collected 7m3 manure/month. On average, the monthly amount of manure collected is 0.48m3 / head, but if the cow is captured 100% of the time and fully supplementing rice husks and grass, the total amount of manure collected is 1m3 / head as in Pang Ting Bram household. Grazing time also affects the amount of manure because the cow's habit is to excrete the manure early in the morning and in the evening, so if the cow releases the cowshed after 8 am and come back to the shed about 4 pm, the farmer will get the highest amount of manure.

3.1.3 Cowshed improvement trial in 2019

After seeing successful results of the cowshed improvement model in 2018, Da Chais CPC which was to conduct the cow support program for poor and near-poor farmers in 2019, contacted and proposed to the SNRM project to conduct another cowshed improvement model for 28 farmers in the 2 target villages within the commune. Fully understanding that this could be a good opportunity to change awareness of villagers and to replicate the model for sustainable conduct of the models in poor ethnic minority communities, the project organized a meeting with the Da Chais CPC, District agricultural center and 28 farmers to clarify the roles and responsibilities of each stakeholder.

Cowshed improvement trial in 2019 was organized through the workflow shown below:

As for the trial in 2019, the target group was farmers including poor ones who registered for the cow provision support by DPC/CPC with use of the Poverty Reduction Program. This trial was aimed to evaluate its applicability to poor farmers.

(1) Result of the meeting in 2019

As the previous CMP meeting, stakeholders agreed on the support with each responsibility and budget allocation as follows:

Table 6. Roles and responsibilities of the stakeholders based on result of the CMP

Stakeholders	Implementation / Resposibilities
Fermers agreed to:	▪ Keeping cows, or registered with cowshed by DPC/CPC in 2019 ▪ Do not violate Forestry Law ▪ Follow technical guidance ▪ Share knowledge and experience with other farmers in the village

SNRM Component 3 committed to:	▪ Organize study tours to advanced models in the target villages ▪ Provide the building materials (cement, sand, stone, bricks and corrugated iron, and bedding material) ▪ Guide and monitor the farmers in the process of making cowshed improvement in collaboration with district agriculture centers
Da Chais CPC / DPC agreed to;	▪ Provide cows to farmers registered in accordance with the Poverty Reduction Program ▪ Conduct training ▪ Participate in monitoring and evaluating models for replication in the district.
Agricultural Center of Lac Duong District agreed to:	▪ Design the cowshed, and supervise the construction of the cowshed ▪ Prepare technical guideline on husbandry techniques ▪ Guide to making a biological bed ▪ Provide vaccination and disinfecting shed ▪ Participate in monitoring and evaluation.

(2) Results of the collaborative works based on the meeting result

Twenty eight farmers participated in the cowshed improvement model in which above supports committed by the stakeholders were collaboratively conducted, thus, having completed 28 cowshed improvements with biobeds though delayed. Because of late finance and disbursement of the buget for the cow provision to the farmers on the part of the CPC in 2018, the construction work of the cowsheds was commenced late with overlapping to the coffee harvest season, which further delayed the construction of the cowsheds. As a result, cows provided by the CPC grew slowly in the first year due to the outdoor grazing under cold weather. Although some farmers' awareness remained almost unchanged, cow raising was gradually shifted from freegrazing to captivity. However, farmers participating in the model were mostly poor farmers with mostly poor qualifications / awareness, they were very passive and relying on subsidies. Thus, achievements of the second cowshed improvement model were limited such as free grazing practiced by some farmers. In general, it takes time to realize new way of the cow raising from the traditional method, thus awareness-raising programs, training, and especially monitoring and evaluation for timely interventions by the CPC officers and the extention workers are required.

3.1.4 Outcomes on the cowshed improvement in 2018-2019

(1) Free grazing time

According to a survey conducted in March 2020, grazing time of 44 out of 47 farmers participating in the activity was reduced after the cowshed improvement including the grass planting.

(2) Manure collection

If the bedding materials are put into cowshed properly, 1 m3/head/month of the cow manure is collected.

Case of farmer A:

During the implementation process, the best farmer is Mr. A in Lac Duong town who is well aware of the benefits of cow raising, thus bravely investing in building a cowshed with area of 240 m2 and more cows are going to be introduced with the expectation of selling cow manure to farmers in the town and of making compost for application to his coffee farm. Currently, the famer collects an average of 1m3 manure/cow/month and sells at 800,000 VND / m3, which has brought a stable income for the farmer.

Case of farmer B:

Some wealthier farmers in the district such as Mr. B followed the model of a captive cow with almost no support of the project. After joining study tour organized by the project to an advanced model of the cowshed improvement in Don Duong district, he realized the effectiveness/efficiency of the model, thus he invested his own money to build a cowshed and bought materials for making bio-bed. Currently, the farmer raised 10 cows with compost made by collected manure to fertilize 3 hectares of his farms of artichoke, green pepper, beans and coffee.

(3) Economical efficiency

- The average cost of the cowshed improvement with bio-bed installation is 13,798,000 VND / farmer.
- With the improved cowshed, famers can collect manure to sell or fertilize crops. The selling price of 1m3 manure is 800,000 VND in the district, then the monthly income might be 2,220,000 VND/month by growing 3 cattles, thus, making it possible to repay the loan related to cowshed improvement.

(4) Environmental aspects

- It surely minimize environmental pollution including the source of water supply.
- An improved cowshed does not smell badly because of the bio-bed.

3.1.5 Remaining issues

i. Because of low comprehension/ awareness and of insufficiently committed inputs by some of poor farmers, they still stick to traditional free grazing.
ii. Biobeds is required in the cowshed to collect manure, for which rice husk is currently used as the meterial. However, the issue is high prices of the rice husk due to the transpotation cost from remote areas. Therefore, used mushroom media, which is becoming more and more available at reasonable prices through the development of shiitake mushroom production EFLO model in 3.2 below should be used as alternative bedding materials.
iii. The captive cow needs grass planting. The issue is availability of suitable lands for grass lanting which keep moisture in even dry searson. Some of the participants in the cowshed improvement model apparently lack suitable lands for planting.

Through the above CMP it was agreed upon among its particpants that the the cowshed improvement trials should be evaluated in terms of indicators below.

1. Manure utilization rate is assumed related to pollution and cost reduction for farming.

2. Labor work for grazing is assumed related to labor efficiency of farmers.

3. Invasion to crop field during grazing is assumed related to economy and stability of the community.

4. Grass growing is assumed related to reducing grazing time and manure collection.

3.2 Compost making

3.2.1 Background & Objectives

As for the coffee cultivation in the target area, most farmers heavily rely on chemical fertilizers, which is easily obtained and transferred to the remote coffee field by motorbikes. The research survey (soil survey) mentioned at 2.2 in the target villages revealed that organic matter content in soil and pH decreased, causing impaired nutrient absorption in the coffee production. And considering that the fertilization (purchased chemical fertilizers) accounted for around 40% of the total coffee production cost, compost making with locally available organic maters such as manure and its application to coffee fields can certainly reduce coffee production cost, leading to higer profitability of the coffee farming. Thus, the project provided composting technique using locally available raw materials to improve organic matter contents of the soil and soil fertility.

The goal is to produce useful compost with locally available sources such as cow dung, coffee husks, fresh coffee pulp, and used mushroom media. The expected outcome is that composting techiques are disseminated among farmers in the target villages with raised awareness on self-made compost value and the application of compost to fields of crops, especially to coffee farming.

3.2.2 Implementation

As in cases of other EFLO models, the project discussed and cooperated closely with the stakeholders on the dissemination of the compost making to clearly define their roles and responsibilities as follows:

Table 7. Roles and responsibilities of the stakeholders

Stakeholders	Implementation / Responsibilities
Farmers agreed to:	▪ Attend all training courses, mixing practices, study tours ▪ Apply the compost to coffee farming and record their results ▪ Share experiences and knowledge with other farmers
SNRM Component 3 should:	▪ Develop criteria for selecting farmers and coordinating plans for implementation among relevant parties ▪ Organize study tours to advanced mofeld at Tram Hanh, Cau Dat - Da Lat city in coopreation with stakeholders ▪ Support for technical training ▪ Provide materials for compost making ▪ Monitoring and evaluation on the compost making activities.
Agriculture Division of the District agreed to:	▪ Participate in study tours, and monitoring and evaluation of the model for possible replication in the district.
Environmental Protection Division- DONRE agreed to:	▪ Co-organize trainings and then replicate/ expand the activities out of the target area including Ta Nung commune.
Farmer Association of communes and town agreed to:	▪ Select a list of farmers to participate in training and study tours ▪ Replicate the model in target area
Coffee company agreed to:	▪ provide fresh coffee pulp and transfer to the composting field prepared by villagers.

The compost making activities were conducted in accordance with the agreed responsibilities of the stkeholders.The project organized training courses on it for 115 farmers (PFES patrol team members)producing coffee in the target area. The project also invited forest rangers and the International Center for Tropical Highland Ecosystems Research (ICTHER) of the BNBNPMB to learn about the techniques and benefits of compost.

After the compost training with use of fresh coffee pulp and coffee husk, each participating farmer obtained 300kg of the compost produced through the training to apply for fields of coffee and other crops. ICTHER of the BNBNPMB learned the technique and test it for growing indigenous species in its nursery. Environmental Protection Division of DONRE also learned the composting technique and organized additional trainings for the farmers and officials of Ta Nung, Cau Dat, and some communes in Lam Ha and Don Duong districts where environmental issues related to the coffee cherry processing were taking places.

3.2.3 Results and outcomes based on opinion/impression of farmers

(1) Information collection on participating farmers' opinion/impression

(44 farmers among the participated farmers in March 2020)

Q1. Is the composting method easy and applicable for you? (Yes = 86.6 %)

Q2. Do you continue producing compost after the training? (Yes = 93.3%)

Q3. Have you reduced your fertilization cost by applying compost? (Positive= 76.6%)

Q4. Have you improved your coffee by applying the compost? (Positive=93.3%)

(2) Technical aspect

- Easy to apply because of simple techniques
- Provide enough nutrients and macro- micronutrients to soils for helping plants grow well
- Improve soil, increase soil pH.

(3) Economic aspect

The cost of making compost from cow dung and coffee husks is as follows:
20 tons of coffee husk (5 trucks) = 1,200,000 VND
2 m3 cow dung = 1,600,000 VND
Bran, husk, yeast = 950,000 VND
Total = 3,750,000 VND / 6 tons
Production cost: 3,750,000 VND / 6 tons = **675,000 VND/ton** (excluding labor cost)
Market price of compost and manure:
Chemical NPK fertilizer: 7-9 million VND / ton
Song Gianh organic fertilizer: 4 million VND / ton
Cow dung: 1.6 million VND / ton

(4) Environmental aspect

Minimization of environmental pollutions caused by waste from coffee husk and cow dung from free grazing has been made. Some households have been collecting 3-4 bags manure per day in the forest and/or along the road, which is sufficient to compost household scale.

(5) Ability to replicate the model

The participants in the target villages understood the benefits of compost making, therefore, they bought the materials to make compost by themselves. With the arrangement of the project, 11 farmers in Da Nhim commune and Lac Duong town contracted with a private coffee processing factory to continuously buy its coffee husk for compost making at the end 2019.

3.2.4 Summary

Composting technique is a farmer's technique of converting relatively inexpensive local organic matter into valuable materials. The technique is very important especially in areas such as the LB-BR where high standards of environmental protection are required.

Here are the factors that contributed to the success of the EFLO models in the target villages.

Factor 1: The effectiveness of compost was verified through demonstrations by key farmers, which is aimed to make it visible to villagers.

From the beginning of the project, the project conducted demonstrations of the compost making with use of cow dung, rice bran or charcoal and its application at coffee fields of key farmers in collaboration with Lac Duong City and Da Nim Commune. As a result, the difference between the neighboring coffee gardens became clear from the second year, and many villagers visited the gardens and noticed that coffee garden applied with the compost looked much lively even in the dry season compared to surrounding gardens. This understanding on the difference has become an incentive for the spread of the coffee pulp compost and is expected to increase cow manure collection from now on.

Factor 2: Use of locally available and economically affordable materials and simple/ easy production techniques is important for the successful EFLO models.

Use of locally available and economically affordable materials such as cow dung, coffee pulp, waste mushroom beds, rice bran, and charcoal which are familiar to villagers and of simple and easy-to- use technique are ingredients for the success of EFLO model.

Factor 3: Materials that pose a risk of environmental pollution, which enable to easily/ widedly obtain supports from government organizations, are suggested to be used for livelihood improvement.

A large amount of coffee pulp was stored in the open air, causing an ammonia odor, and its leachate flows into rivers, causing pollution. Cattle dung also causes pollution by exposing it to rain, and mushroom beds also become a source of mold and flies that are harmful to the mushroom cultivation if it is not properly fermented. If materials actually or potentially causing polution are utilized for livelihood improvement of local people, the activities can be easily/

widely supported by government organizations responsible for the prevention of pollutions and for community developments as shown in the above compost making.

The solutions of the above issues are none other than small-scale decentralized composting. As long as the solutions are confirmed to be economically feasible and techinically applicable, it is expected that the villagers continue to practice them for their livelihood improvement, which also contribute to the solution or the mitigation of the local issues.

Whenever local issues take place in the LB-BR, causing negative impacts on conservation/ development, the LB-BRMB should organize CMPs to find / implement solutions on the issues in collaborative manner among stakeholders including forest owners, DPC/CPC in each district, provincial departments such as DONRE and DARD and villagers concerned, taking into accounts the above factors and evaluations.

3.3 Shiitake mushroom production model

Shiitake mushroom production is a diversified livelihood in the target villages, and the project supported following activities based on collaborative management methods including the CMP.

3.3.1 First trial in 2018

(1) Objectives

- Create opportunities for farmers in the target villages to participate in shiitake mushroom production as a diversified livelihood model to increase their income with eco-friendly farming.
- Evaluate the feasibility and applicability of shiitake mushroom production by the farmers before its expansion.

(2) Implementation method

- Recognizing “Shiitale mushroom” as an important product for farmers in the target villages in terms not only of economical aspects but also of environmental aspects, the project in collaboration with stakeholders including a company producing mushroom media, namely Nguyen Long Company (NLC) technically supported 2 key farmers in Da Nhim commune to make the first trial production who made investment by themselves for the construction of mushroom production facilities (hereinafter referred to as the facility).
- The trial production period was from May 2018 until Sep 2018. 2 key farmers and NLC confirmed profitability and applicability of the shiitake production, as a result, they decided to continue the production and to invite addtioanl farmers to join the production.

(3) First collaborative works with roles/ responsibilities of stakeholders

Project

- Develop an action plan on shiitale trial production

- Conduct study tours in collaboration with stakeholders including CPC for exchanging and sharing experience
- Provide funding for training and buying mushroom media for the trials

NLC

- Design the mushroom facility and equipments for the production
- Provide technical guidance to the farmers on basic skills for shiitake mushroom
- production
- Provide 3,000 mushroom media to the farmers for the 1st batch of production to try basic
- skills learned
- Purchase produced mushroom at the contracted price

Da Nhim CPC

- Support the farmers in terms of communication with the NLC
- Participate in study tours to learn about the mushroom production

Key farmers

- Invest in the construction of the facility and in purchasing related equipments necessary for the mushroom production
- Conduct mushroom cultivation in accordance with the NLC's technical guidance
- Keep records on the cultivation throughout the production period
- Share experiences with new commers (other farmers) in the target villages by requests of CPC and the project

(4) Results of the trial

The results of the trial production are evaluated in terms of economic efficiency as follows:

Table 8. Economic efficiency of the shiitake production

Period of cultication	Total production	Sales	Expence /Crop
3.5 months	810 kg/ 3000 pc media	56,700,000 VND	35,000,000
* 3 crops anually		* price: 70000 VND/kg	*30,000,000 for media

The initial cost of building the facility (50 m2) and of purchasing equipments was 40 million VND in total and the mushroom media costed 30,000,000 VND for 3,000 media. After 3 months of the trial, each media produced 0.27 kg shiitake and sold at 70,000 VND/kg. Expenses includes 5,000,000 VND as depreciation cost for the facilities within 8 crops.

Estimated anual profits of the trial shiitake production and profit of other production in the region

Table 9. Profits of crop productions

Crop	Expense	Sales	Profit / month	Notes
Shiitake	105,000,000*	170,100,000	9,175,000	3 crops / year / 50m2,
Coffee	22.500.000	35.000.000	1,041,667	Crop/12 months / 7500m2
Vegetables	21,000,000	45,000,000	2,000,000	Crop/ 2 months / 1000 m2

* 30,000,000 for mushroom media + 5,000,000 for depreciation of the facilities per crop

Through the comparison table above, it can be seen that the mushroom model is more profitable and the area required for production is much smaller than in other crops. And stable price according to the contract is attractive to farmers who have been suffering from unstable/ low prices of the coffee. Therefore, after 3 months of the trial production, many local farmers started registeration to wait for the mushroom media, including:

- In Da Bla village: 10 farmers willing to join the contract, of which 5 farmers can start the production without any financial support.
- In Da Ra Hoa village: 3 farmers willing to join the contract, of which 1 farmer can start the production without any financial support.

3.3.2 Collaborative works for expansion of the shiitake production model in 2019 based on the result of CMP with stakeholders

(1) Objectives of holding CMP

After seeing successful results of the mushroom production model in 2018, the number of farmers participated in the model at around the target villages was increased to 18 farmers with 25 facilities by May 2019. The Secretariat of the LB-BR MB and local authorities proposed to apply/expand the model to ethnic minority communities within the LB-BR.

However, issues for further expansion of the model and the mushroom sales promotion were identified as follows:

- Unstable production amount caused by inappropriate production
- Inappropreate treatment of used mushroom media
- Insufficient investment capital to participate in the contract production
- Unstable supply of the mushroom to market which was caused by ustable production
- Limitted equipments and trainings for the production and the post-harvest
- No VietGAP certificates on the mushroom production in the target villages
- Unclear contract description causing issues between conracted farmers and NLC

(2) CMP organization

In order to expand the model by solving these issues, with support of the project the LB-BRMB organized a CMP in May 2019 under the title of “Mushroom development as an environmentally friendly crop of the LB-BR” which was attended by stakeholders including DONRE, DPC, CPCs, private companies and farmers willing to join the mushroom production model.

As a result of discussions on the expansion of the model with attention paid to the above issues, the expansion was agreed upon among the stakeholders with their responsibilities as follows.

- Training on basic production skills by private companies for newly contracted farmers
- Technical support in terms of humidity/temperature control and quality improvement of harvested mushroom
- Application for Certification on VietGAP
- Establishment of a supply chain with promotion activities of the shiitake mushroom in HCMC.

Roles and responsibilities of the stkeholders agreed upon. All stakeholders confirmed their respective responsibilities shown below which were proposed by themselves:

Table 10. Roles and responsibilities of collaboration among stakeholders based on the CMP

Stakeholders	Implementation / Resposibilities	
Farmers agreed to:	▪ Keep responsible for investment to build mushroom production tools / facility and to buy mushroom media ▪ Follow the company's technical guidance and the contract	▪ Not violate Forestry Law ▪ Share knowledge and experience for other farmers in the villages
NLC agreed to:	▪ Collaborate with stakeholders to select eligible farmers for the contract ▪ Provide technical guidance on production and post-harvest ▪ Commit to purchase mushroom produced/ harvested by contracted farmers following the contract between them	
SNRM project Component 3 committed to:	▪ Provide funding for study tours and trainings ▪ Support equipments to control quality and hygiene and ▪ improve labor productivity of farmers in the target villages ▪ Assist sales promotion of shiitake mushroom ▪ Support registeration of VietGap certificate for farmers	
DoNRE agreed to:	▪ Support households out of the target villages of the SNRM project with mushroom media ▪ Provide funding for study tours and training	
Agricultural Division of DPC agreed to:	▪ Support equipments to control quality and hygiene, improve labor productivity, and mushroom media for farmers ▪ Assist sales promotion of shiitake mushroom	
CPC / town PC agreed to:	▪ Monitor the conditions of farmers participating in mushroom cultivation and to monitor the model with the participation of SNRM project, company, and Agriculture division of district.	
DARD agreed to:	▪ Apply the New Rural Programs to support the shiitake mushroom production model in the district ▪ Support the establishment of the mushroom supply chain	

(3) Result of collaborative works on expansion of the mushroom production

The collaborative works brought positive results as follows.

(3-1) Support on production related techniques

- Technical support on setting appropriate mushroom production environment and improving harvest method for higher quality.
- 39 famers in and out of the target villages were supported with harvest related equipments such as trolleys/ plastic boxes, labor protection equipments and monitoring equipments.
- Through humidity/ temperature monitoring, farmers learned appropriate mushroom production environment (humidity/ temperature), which affect the total yield of the mushroom.
- The project demonstrated to key farmers how humidifier improve the mushroom production environment. Most of the famers bought humidifiers and sprincklers to improve the environment by applying them.
- In order to improve harvest method, technical guidance on harvest methods was made to the farmers with provision of necessary tools. All farmers harvested A class through direct packing in accordance with the guidance which was purchased by NLC at the highest unit price of 100,000 VND/kg.

(3-2) Training for newly contracted farmers

- Farmers participated in the model were supported with materials and tools. Especailly 5 farmers in Dung K No commune improved production skills.
- A study tour for sharing experiences was conducted, resulting in deeper understanding of the farmers on the importance of maintaining humidity and temperature during the mushroom cultivation.

(3-3) VietGAP certification to Farmers

- With support of the project, VietGap certificates were officially issued to 17 farmers growing shiitakes in Da Nhim commune, and NLC started selling the shiitake produced by the farmers with the certificate.

(3-4) Establishment of the supply chain and Promotion activities in HCMC

- With support of Lam Dong province, NLC participated in AEON trade fair in HCMC to strengthen market connection for the mushroom sales as well as to introduce /promote the value of the LB-BR.
- Spply chain of the mushroom to HCMC was established by private companies with support of DARD/ DPC, through which shiitake has been brought in users in HCMC.
- Cold chain was established in collaboration with partners, making it possible to deliver high quality shiitake.

3.3.3 Outcomes on the shiitake mushroom production model

(1) Economical feasibility

- Investment cost is saved by applying idea on salf-made facilities.

- Avarage construction cost of a-50 m2- mushroom production facility with equipments is 48million VND.
- In case of 8 crops depreciation period, the depreceiation cost is 6 milion VND.
- Estimating that average yield 250g/ media with 3,000 media/ facility and average sales price 60,000 VND/kg, then, revenue is 45,000,000 VND. Thus, farmers can ensure their profit 9,000,000 VND. However, it became clear that yields and quality of mushroom varies depending on whether media are well cultivated or not. In addition, even though average yields per mushroom media are from 250g to 300g or more, profitability is varied because the purchase price is set according to the quality of mushroom purchased.
- Provincial organizations concerned provided support to local farmers in building mushroom facility and shelves to reduce initial investment costs whereas the farmers started share know-how among themselves for the cost reduction.
- Generally speaking 4000 to 5000 pieces of media are arranged in a 50m^2-mushroom facility. Although it is possible to increase the yield in the facility with 5000 pieces, a quality deterioration due to oxygen deficiency was observed. If the equipment is not available for the ventilation appropriate to the facility, about 3000 pieces per facility are appropriate.

(2) Technical applicability

- Checking quality of media provided is required with its replacement in the beginning if necessary, and skills for adding water into mushroom media regulary.
- Efforts to keep appropriate temperature and humidity are required. As temperature rises, humidity decreases during daytime. Thus, humidification is required. It is also important to keep the density of the mushroom bed appropriate from the viewpoint of ventilation.
- The yield depends on the main environmental factors related to the quality and yield of mushrooms such as temperature, humidity, ventilation, hygienic in mushroom production facility. An example of key farmer keeping conditions properly is described bellow:

Example of one of farmers participated in the mushroom production:

- Maintains humidity of 85-90% by regularly spraying mist with15-minute intervals.
- Medias at the bottom line are more than 15 cm away from the floor and keeps hygiene
- A mushroom production facility of 50m2 with 3200-4000 mushroom medias, which can maintain appropriate ventilation and oxygen concentration.

By applying the proper condition management above, the farmer obtained sales of 160 Mil. VND from 10,000 mushroom media and profits of 100 Mil.VND in 3 mushroom production facilities. It shows that the mushroom production is feasible and applicable for the region including the target villages although farmers need maintain and update their production skills.

[Advantages]

- The shiitake mushroom production is profitable than other cash crop productions such as coffee and vegetables

- It requires a limited agricultural land, thus causing little pressure on forests. It is not affected by weather conditions such as rain and wind, which can be practiced by using domestic labor.
- Shiitake mushroom is an eco-friendly agricultural product by using local materials including recycled organic matter for sustainable agriculture, without using chemical pesticides affecting surrounding environment.

[Risks]

- Every stage of the mushroom production has a risk as follows.
- Insufficient quality (matuaredness) of mushroom media sold to the contracted farmers.
- Properness of the construction on the mushroom production facility in accordance with the recommended design
- Appropriate cultivation care by the famers including humidity/ temperature control in accordance with the guidance
- Appropriate havest of the mushrooms which keep their quality
- Market of the mushroom, which fluctuate depending on demand and supply
- Ustalble social infulastructure such as electricity cut in the region, which caused quality issue on mushroom media in 2019.

3.3.4 Recommendations on shiitake production

It is strongly recommended that the stakeholders including provincial organizations should continuously support shiitake mushroom as an ecofriendly local product representing the LB-BR**,** even after the project termination, considering the following.

(1) Strengthened support for the production of the shiitake as an ecofriendly product in the LB-BR

- After 2 years of its development, shiitake mushroom was developed as a key product of the district.
- DPC conducted supporting the shiitake production as a part of local product development by funding trainings for capacity enhancement of villagers and lending land for the NLC's new factory because of its characteristics as a local product as follows:
  - Matching with local climate and local human resources of the LB-BR
  - Non-checmial eco-friendly product with high potential in terms of maket development
- In 2019, Lam Dong PPC approved Shiitake mushroom as One Commune One Product (OCOP) proposed by Lac Duong DPC following the OCOP policy of MARD. Thus, the DPC is in the position to follow the dicision to support Shiitake development with related stakeholders.

(2) Market development of shiitake

LB-BR logo created with the support of the project, which was officially approved by the Department of Property Right as a trademark is currently used toghther with Shiitake product

destribution for the defferenciation of the product from other products and for sharing the LB-BR information to retailers and consumers as potential supporters of shiitake production as well as the LB-BR.

(3) Contribution to the development of sustainable agriculture model

Shiitake mushroom production could play key roles to contribute to the development of sustainable agriculture models because ①it is a profitable livelihood option ②it requires a tiny area for its production, which provide almost no pressure for forest conversion in the LB-BR ③ it does not use pesticides, and ④used mushroom media becomes useful organic matter for cattle raising and compost production, which is utilized for various agricultural production including sustainble coffee production in the region.

4. Evaluation on the EFLO

4.1 Summary of the EFLO activities

The EFLO was implemented in the following way as mentioned in the above 2.1. Its basic policy was to improve the profitability of the coffee farming and to diversify crops of the agricultural production based on the analysis into livelihood situation of the target villages with selection criteria on crops and necessary techniques for their introduction such as environmental friendliness, the utilization of local resources, small financial burden, and technical accessibility, considering the location of farmland within the LB-BR and farmers' financial situation.

And EFLO implementation strategies on (1) Technique transfer to key farmers who agreed to share it with CMA participants, (2) Utilization of existing programs/ budgets of the provincial government organizations such as DARD, DONRE and DPC for collaborative support to their livelihoods, and (3) Technical transfer, collaborative production, and product sales in collaboration with private companies related to coffee and mushrooms were adopted for the sustainable conduct of the EFLO, considering that forest owners as leading players of the CMA cannot provide continuous technical support for livelihood improvement because they do not have direct duty and human/ financial resources for developing and disseminating agriculture techniques.

4.2 Evaluation on the EFLO

EFLO is evaluated based on the 4 perspectives below.

Table 11. 4 Perspectives for the evaluation on the EFLO

Perspective	Description
Effectiveness	Mainly measures the extent to which a program or a project attains its objectives
Impact	Examines positive and negative changes as a result of the project. This includes direct and indirect effects and expected and unexpected effects.
Efficiency	Measures the outputs in relation to the inputs to determine whether the project uses resources effectively to achieve the desired results.

Sustainability	Measures whether the benefits of the project are likely to continue after the closure of the project.

4.2.1 Effectiveness

As explained previously, the objective of the EFLO is to provide benefits to villagers participating in the improved PFES patrol in the CM forests for strengthening of forest conservation in the LB-BR as the BSM of the CMA. The project developed EFLO models appropriate to the target villages through which villagers can raise their livelihood with available resources including financial one and affordable techniques at the same time to solve local issues such as pollutions in accordance with the selection criteria on crops and necessary techniques such as environmental friendliness, the utilization of local resources, small financial burden, and technical accessibility as mention above 4.1. Furthermore, the EFLO models were formulated based on the implementation startegies such as collaboration with provincial organizations and private companies in terms of support of techniques, budget/ program and sales as mentioned above 4.1.

Considering that the objectives of SNRM project Component 3 is to develop a collaborative management system for sustainable conservation/ management of the LB-BR with output 2 that CMA/ BSM is upgraded as a tool for the conservation of the LB-BR, the EFLO has proved itself as very effective tool. Thus. Effectiveness of the EFLO is judged as very high.

4.2.2 Efficiency

EFLO model developments were made in the following manner. Firstly, survey into livelihood in the target villages was made including identification of issues such as coffee farming which is major livelihood with low profitability. Secondly, based on possible scenario causing low profitability, scientific survey into soils of coffee fields was conducted. Thirdly in accordance with the survey result, small-scale activities on compost making with use of available organic matters were made and demonstrate for other villagers by key farmers. Forthly, only after the good results were confirmed, the activities were expanded with many villagers who were convinced of the benefits of the compost making and its pllication. Thus, EFLO activities were made on step by step basis, in other words, very efficient manner.

The EFLO was conducted based on the implementation strategies such as Utilization of existing programs/ budgets of the provincial government organizations such as DARD, DONRE and DPC for collaborative support to their livelihoods, and Technical transfer, collaborative production, and product sales in collaboration with private companies. Actually, 2 models of EFLO were conducted in a collaborative manner among stakeholders such as provincial organizations, private companies and villagers based on the result of CMP and all of the participants in the CMP provided financial and technical contribution to the model development including the villagers who made financial and labor contribution.

Thus, efficiency of the EFLO is judged as very high.

4.2.3 Impact

The EFLO model on Cowshed improvement was established, based on the 2nd CMP which collaborative works among the stakeholders were conducted, which aimed to ①livelihood improvement of the villagers through manure collection for compost making/ application to reduce coffee production cost and to raise fertility of coffee fields toward profitable coffee farming ②reducing pollution caused by cow manure etc.. Having seen the good results of the EFLO model, CPC and villagers there requested to replicate the model with them. Fully understanding the importance of the EFLO model for its solving local issues, the DPC (the most important stakeholder) decided and implemented the 2nd cowshed improvement activities with the stakeholders.

The importance of the EFLO as an effective / efficient tool has widely been being recognized among the stakeholders participated in the collaborative works for the EFLO model development. However, the development is limited, therefore, the impact of the EFLO remains in a cetain level at this moment although its is considered that the impact is growing bigger and bigger. Thus, the current impact of the EFLO is judged as middle.

4.2.4 Sustainability

The EFLO model development is aimed to address local issues taking place in the CMA implementation such as creating additional livelihoods and/ or reducing negative impacts on environment/ natural resources.

The importance of the EFLO in terms of solving local issues has been being become widely recognized among the provincial organizations involved in the EFLO development. And the EFLO development is conducted through collaborative works among the stakeholders including provincial organizations and private companies with use of their programs/budgets and techniques in accordance with the implementation strategies. Therefore, implementers, budgets and techniques necessary for the development/implemetation of the EFLO model is secured.

And EFLO models are conducted to develop and disseminate eco-friendly crops and methods for livelihood improvement with minimized negative impacts on the environment which are appropriate to environmentally sensitive areas such as national parks and the LB-BR. It is assumed that the LB-BRMB and its board members' organizations such as DARD, DoNRE and DPC will be increasingly under pressure to develop chemical-free EFLO models in the LB-BR and important watershed areas, considering that the flower cultivation which is the most popular agriculture item is practiced with use of lots of agro-chemicals, posing serious risk of the contamination on soils and water in the above mentioned watershed areas. Thus, the sustainability of the EFLO is judged as high.

5. Lessons learned from the development of the EFLO models

Lessons learned from EFLO activities within the collaborative management framework are drawn here to help the LB-BRMB and the public/ private sector organizations develop more effective EFLOs to support local people with similar challenges. Here, cowshed improvement, compost

production, and shiitake cultivation are recognized as a circular agriculture support, and lessons of the series of activities are described aiming at contributing to the incentives for improving the livelihoods of the villagers involved in forest conservation.

(1) Involvement of farmers with self-support is important for good results

In many cases, villagers are ones to be supported, and it is common for villagers to receive supports from the government organizations. However, in this project, the active participation of the villagers was requested, who are the main actors in terms of recognizing issues and how to solve/ improve them. As a result, support activities went smoothly and well with farmers of self-support spirits, while the activities did not work well with farmers of little self-support spirits. For example, the 1st cowshed improvement trial produced good results in which key farmers with aboudant self-support spirits were actively involved, and in the 2nd trial in Da Chais, poor farmers, who wanted to receive a cow, was supported with the cowshed improvement, and the achievements were limited because the most of participating farmers were accustomed to receive supports, in other words, with little self-support spirits.

(2) Demenstration of a model with key farmers is very useful for its dissemnation

In order to extend techniques developed to increased number of villagers, it is important to show its effectiveness or feasibility through the eastablishment at various places of the demonstration models using techniques in collaboration with key farmers.

(3) Conduct of economic evaluation on a model is good for its dissemination

In order to confirm the effectiveness of shiitake cultivation, the project conducted a demonstration experiment in collaboration with a private company to confirm its profitability and applicability of the mushroom production using mushroom media prepared by the company. At that time, nine villagers from Da Nim Commune were invited to the private company to learn about cultivation methods. As a result, two villagers voluntarily agreed to cultivate the mushroom as well as to construct one mushroom facility for each, and three months later, the results were evaluated with stakeholders. After the profitability of the mushroom production became clear to villagers, the mushroom cultivation based on the contract with the company was gradually expanded in accordance with the capacity development of the farmers and the company.

(4) Consensus building among stakeholders in advance is indispensable for good results

EFLO activities were conducted based on consensus building through stakeholders' forum called the CMP before implementation of collaborative works in order to secure understanding on its objectives, issues, methods of solution on the issues, and roles and responsibilities of each stakeholders. And if CMP was organized on the second Cowshed improvement at Da Chai mentioned above, it is considered that its result could have been much better.

6. Conclusions and recoomendations

(1) EFLO (Shiitake mushroom production and Production and application of compost using locally available organic matters) models appropriate to environmentally sensitive areas including Biosphere Reserves, national parks and important watersheds were developed and laid the foundation to expand the model with increased villagers in the LB-BR. Thus, the EFLO is a very effective BSM tool for replication after the project termination.

(2) CMP plays a crutially important role in developing the EFLO models in terms of the organization of collaborations among stakeholders including villagers with their roles and responsibilities to secure budgets/ techniques required and to raise awareness etc. for materialization of EFLO models.

(3) Production and application of compost using organic matters increased cost efficiency in coffee farming, which is an effective way of gradually solving the issue on low profitability of the coffee farming, the most important livelihood in the district.

(4) Shiitake mushroom production model is a very profitable model with a tiny land (50m2) required, thus contributing not only to livelihood improvement but also to forest conservation. Thus, shiitake mushroom is appropriate crop in the LB-BR.

(5) The supply chain of the shiitake mushroom including the cold chain was built up between the group of the production villagers and users in HCMC such as restaurants and supermarkets. The supply chain stabilizes demands and prices of the shiitake mushroom, whereas the cold chain keeps its quality.

(6) The shiitake production model is designed to be easily conducted for higher productivity/ profitability by minority villagers through the introduction of affordable and easy-to-use equipment.

(7) Human resources of the LB-BRMB secretariat which is very important in terms of developing and implementing CMP/ EFLO in addition to operation of LB-BR related activities such as the management plan implementation. Nevertheless, an only staff of the BNBNPMB is placed, who is concurrently working as a secretariat of the LB-BRMB. In addition, the staff of the secretariat does not have knowledge/ know-how on agriculture but have forest related knowledge/ know-how. Thereofore, it is strongly recommended that a person with knowledge and experiences on the agriculture should be employed as an additional staff of the LB-BRMB secretariat with support of the PPC.

APPENDIX

Appendix 1: Technical guidline for Shiitake Mushroom

1. The key technical points of shiitake production through the project

1.1 Facility Design

- Environment analysis with indicators affecting mushroom to find better location for farmers.

  □ Sunlight: should be low, and shading area is requested to minimize its facility cost.

  □ Humidity: should be high and stable, and additional facility as humidifier should be designed.

  □ Ventilation: should be enough to get fresh air inside of the mushroom house.

- Adjustment of basic design of mushroom house according to the environment data

  □ Shading: according to sunlight, shading materials should be arranged in case of no-shade

  □ Facilities as humidifier should be adjusted to get suitable humidity for mushroom.

  □ Nets and facilities for improving the ventilation should be installed to get enough fresh air.

*House and iron made facilities can be made by produces with instruction by the company.

1.2 Production skills

1.2.1: Quality check of mushroom media in beginning phase

No.	Tasks	Descriptions	Requirements
1	Receiving mushroom medias	- Check and finalize the number of medias delivered at the company. - Confirm the number of plastic boxes borrowed to transport and the delivery deadline - Sign and receive the delivery note and payment receipt. - Handling and loading the embryos lightly, avoid breaking the medias.	- Make sure to check that the received medias are sufficient and are not contaminated with mold. - Check and report back to the company if there is any problem with the embryos within 3 days after receiving them. - Return the full amount of plastic containers borrowed

	Illustration pictures		
2	Media arrangement	- Arranging 13-14 medias each row - Arranging head of the media outward	- Do not put more media in a row than reccommended.
	Illustration pictures		
3	Withdrawing the cotton cork and plastic collar (after 3 days receiving the medias)	- Conduct the withdrawal of the cotton cork and plastic collar of the media	- Gathering the cotton corks for treatment. - Returning the plastic collars to the company
	Illustration pictures		
4	Tearing of the bags (after 7-10 days of	- When the mouth of the bag appears brown, tear slowly the outer bag, to show out the brown part, and pull the torn	- Do not tear off completely the bag. - Do not put the medias touching one another.

	withdrawing corks and collars).	bag down to bottom and keep it in place. - Arrange the embryos in the shape of herringbone: 1 bag inward followed by 1 outward and continue to increase ventilation. - Cut off early sprouting mushrooms that are deformed due to the influence of the bag	- Do not let the media broken, or damaged the surface.
	Illustration pictures		

1.2.2 Management during harvest period

No.	Tasks	Descriptions	Requirements
5	Hygien	- Perform cleaning and spraying the floor.	- Ensuring cleanliness, do not wet the embryos and mushroom
6	Watering	- Water outside the house 3-4 times a day, 2 hours apart, each time watering about 2-3 minutes. (If it's a rainy day, does not need watering) - The temperature in the mushroom house must not exceed 25^0C	- Absolutely not watering directly inside the mushroom house, if it is found that watering in the house, it will be considered a breach of the contract and the contract will be suspended indefinitely.
7	Harvest (after 5-7 days)	- Monitor and perform pruning for embryos that grow too many mushroom, do not let more than 15 mushroom buds appear on each media at the same time.	- Must use scissors to cut, do not pluck by hands. - Do not let mushrooms grow too small or too large. - Cleaning after harvesting at the end of the day. - Record of daily yield.

8	Categorizing, packaging	- For high-grade mushrooms (grade A), pick directly to package. - For common product lines (grades B and C), harvest directly into the basket, then conduct sorting and packaging all at once according to quality requirements. - For grade-D products i.e. too blooming mushroom, they will be gathered to the company for preliminary processing and preservation.	- Meet the requirements for the size and quality of food safety hygiene - Keep product packaging clean, not dirty, torn or wet.

1.2.3

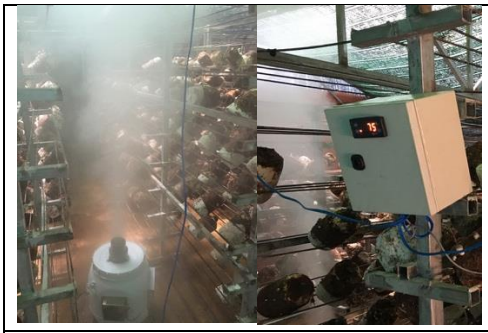
No.	Tasks	Descriptions	Requirements
9	Soaking the medias	- About 20 days after harvest, arrange medias in plastic containers for soaking. - Medias are submerged in water for 8 hours. - After 8 hours drain the water, put medias on the shelf and wait for the harvest.	- Clean water source for single use. - The embryos must not exceed 18 items per plastic container. - Ensure that the medias are immersed
	Illustration pictures		
10	Seasonal finish	- Cleaning up old medias and falling sawdust. - Fix the mushroom house, scrub/clean the shelves. - sprinkle lime powder in and around the house, 20kg of lime. - Pull up the canvas around the house for airy - Leave the mushroom house for 10 days, keep the door closed	- Ensure clean and well ventilated - New season starts after at least 10 days.

	Illustration pictures		

1.3. Environmental condition adjustment and monitoring

Environmental condition should be properly adjusted, and good result can be compared by monitoring data sharing for active lerning

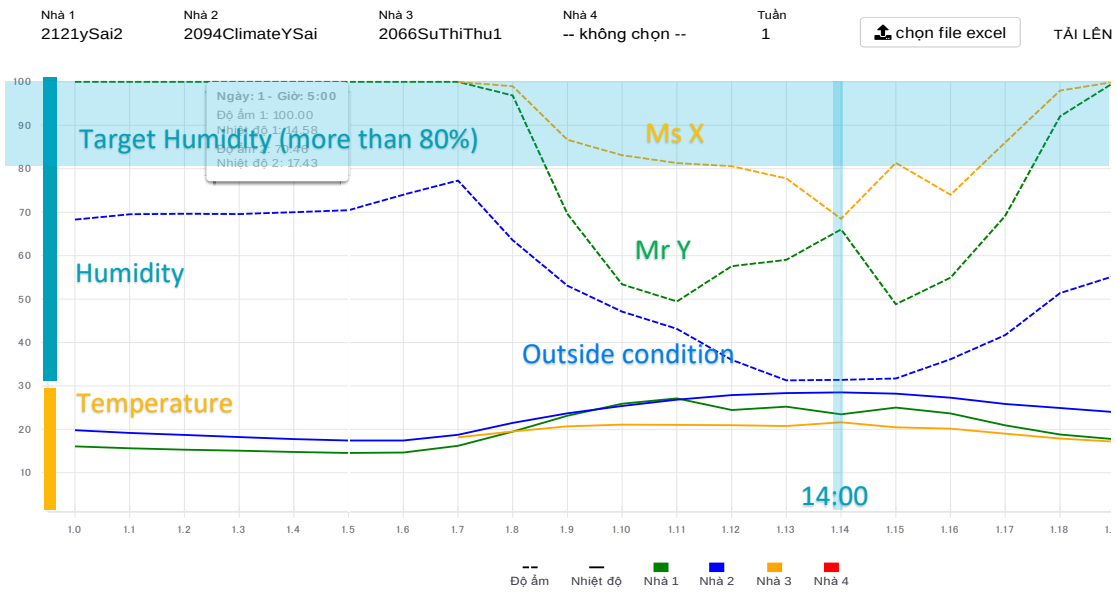
□ Humidifier application and monitoring by Mimosatek devices

	
Humidifier application: Its regulator works to adjust humidity automatically.	Mimosatek monitoring device: Sensor devices regularly send monitoring data to the gate way in the region to upload data to the mimosa sever.

□ Data sharing on Web

Farmers and NLC share these monitoring data on Web.

(Monitoring data in the mimosa sever should be processed into data sheet to be shared on web manually at this moment even through Mimosatek is developoing new application for data sharing)



[Humidity] H1: Ms X (orange) ▪ Adjusted properly H2: Mr Y (Green) ▪ Lower than appropriate level H3: Outside (Blue) ▪ Low level	[Temperature] T1: Ms X (orange) ▪ Adjusted properly T2: Mr Y (Green) ▪ Higher than appropriate level T3: Outside (Blue) ▪ High level, not appropriate level

2. Management guide of mushroom production and supply chain

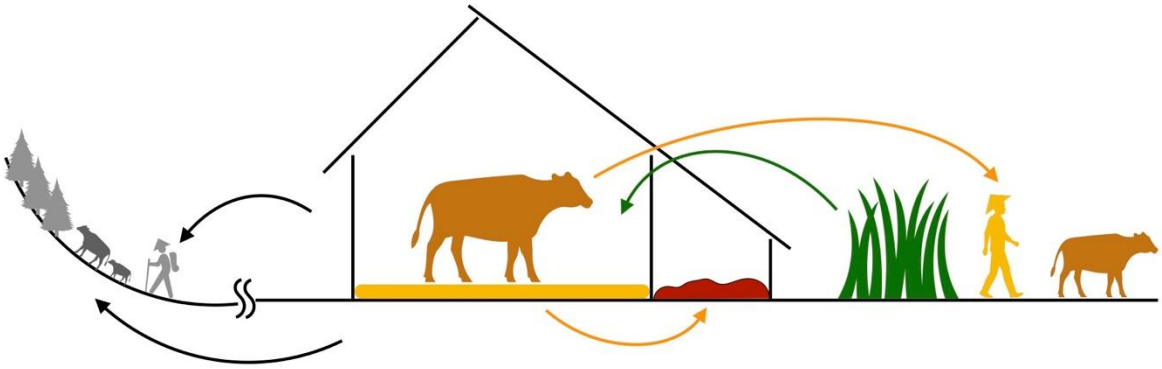
No.	Technical stages	Illustration pictures	Notes
1	Preparation of materials: - Grinding rubber branches - Humidifying - Mixing	 	- Ensuring stable quality and right types of input materials – Adding water achiving 70% - Supplementation of good quality rice bran 10% + 10% corn bran / basic material dry weight With such material composition, fresh shitake mushroom products are 100% organic and high quality

2	Bagging: Inputing the substrate and making the cork		- Bagging by machinery or by hand; - each bag contains about 1kg of materials (moistened) - Cotton cork, plastic collar
3	Autoclave		The time lasted in 8 hours at 98oC
4	Culture of the embryos		- Conducted in a clean culture room, equipped with room sterilization equipment, ozone generators, ultraviolet lamps, air-conditioners, dehumidifiers, etc. - Required to transplant all bags within 8 hours, 20-30g/ bag
5	Nuturing the medias		- Embryos are put into plastic baskets with the quantity of 12 bags / basket - Incubate them in room temperature of 20 ± 2oC; equipped with a ventilating fan, air conditioning - Incubation time: 60 days
6	Browning		- Put embryos in browning room; temperature 25 ± 2oC, humidity> 80%, diffuse light - Take away the corks and remove the collars of the embryos in 1 week. - Remove the bag completely when it is completely browned - Total browning time lasts in 20-25 days
7	Shocking		- Brown embryos are shocked in clean water for 8-10 hours; water flows continuously

8	Fruition		- Post-shock embryos were placed on shelves in the house to produce mushroom with temperature conditions <27oC, light 300-500 lux, maintaining the air humidity> 85% by mist spraying system outside the mushroom house. Notice: Do not water the mushroom directly during harvest. No other chemicals or stimulants are used in the cultivation of this local Shitake variety.
9	Harvest		- Mushrooms are collected in the afternoon every day to minimize the time from the farm to the consumer - Use scissors to cut the stalks close to the bag of embryos. - Daily cleaning of the mushroom house after harvesting - After picking, the mushrooms are kept in a well-ventilated place until packing.
10	Transportation		- Mushrooms are transported by refrigerated trucks with temperatures from 5 - 12 oC to Ho Chi Minh City within 8-10 hours, and delivered to customers in the early morning of the next day.

Appendix 2: Methods of cattle shed improvement

This is a semi-captive method in combination with additional feed at the barn. With this method, cows are grazed part-time so they have less damage to crops, minimize environmental pollution, have advantages in vaccination, disease management and collecting manure.



Transition of cattle keeping after shed improvement

	Before	After
1. Manure utilization	Manure cannot be collected properly because of limited time to stay inside sheds.	Manure can be collected properly in shed with space for keeping manure under the roof.
2. Time of grazing	More than 6-8 hours /day should be required for person in charge to get enough grass for cattle	Less than 4 hours /day should be required and cattle do not have to get in the forest.
3. Impact to cultivers on fields	Cattles sometimes get into corn fields of other farmers during grazing and it affects a lot for the community.	By minimizing grazing time and distance, risk for fields should be improved.
4. Feed / grass	Without planting grass near to the shed, grazing time cannot be reduced.	By planting grass, cattles can be stay in sheds.

Steps for cattle shed improvement

1. Location of cowshed

- Cowshed must be built on high, easy to drain, not flooded when it rains.
- It is far from the house about 20-30 m to ensure sanitation of the housing area, prevent bad smell as well as to avoid odors and flies that affect human health.
- Select the suitable direction to avoid breaking rain, wind flow. It needs to cool in summer and warm in winter.

2. Build cowshed improvement:

Cattle shed should be cement coated, ensure flat floor, well-drained water. Appropriate cattle shed height, corrugated iron roofs, plank walls, troughs for grass and water troughs separate. Construct dirty drainage ditches and manure pits behind the shed so that dirty water and feces do not soak into the ground or seep into groundwater to take advantage of all leftover manure and grass into the manure pit to increase the volume of feces, increase income for farmers but still ensure veterinary hygiene.

Manger

Manure keeping space

3. Bio-bed making

Spread the husk and probiotics evenly. When you see the wet floor due to excessive amounts of manure, spread more rice husk and yeast or rake-off all of old manure and husk into manure pits and then spread new rice husk and yeast into the cowshed floor.

4. Grass growing

Grass should be planted along the banks of streams and on the talus or farm boundary to save area of cultivation and to avoid soil erosion

Gr

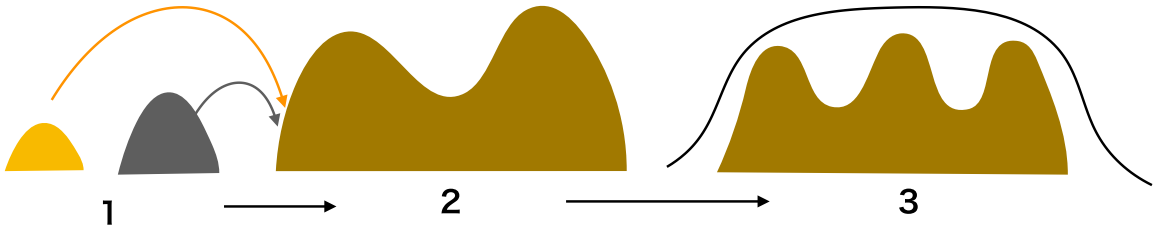
Appendix 3: Techniques for compost making

1. Introduction

Compost utilizing local organic matter is effective in regions where nutrients in the soil may be lost due to high temperature and high rainfall. A survey of LBBR near a national park has pointed out that the input of soil organic matter is essential for sustainable agricultural production.

As one method applicable in the region, we introduce the bokashi compost in which charcoal and rice bran are added to cow dung, waste fungus bed, and coffee pulp that are locally available.

2. Process of bokashi compost with fermented rice bran & Charcoal



	Process & check points	Materials : amount for 1m3 compost
1.1	[Rice bran fermentation] - Depending on the temperature conditions, adjust the amount of yeast accordingly, when the temperature is low, increase the amount of yeast to ensure effective fermentation (according to the ratio of yeast/bran is 1-1.5%). Mash small yeast then mix well with rice bran with about 50 liters of water how the moisture content in fermented rice bran is about 35-45% (high moisture content will slow down the fermentation). After mixing, put them in a bag or cover with a canvas and keep in a cool place. After 2-3 days, open and mix again to ensure even fermentation in the pile. In the process of mixing, it is necessary to stir well to avoid lumps. Rice bran after being fermented for 3-5 days, is mixed with other waste agriculture products to make compost.	- Rice bran: 20 kg - Yeast for rice wine: 100g - Water: 5L
1.2	[Charcoal making] - Plug the aluminum chimney down and about 10-15cm above the ground, spread 50kg of rice husk around the tube and use shredded paper or small firewood to ignite the material under the chimney. After seeing pale white smoke along with the chimney, gather the rice husk in the burning place to cover it. When you see black on the surface, stir and when completely carbonized use water to put out the fire.	- Rice husk : 100kg / 5 bags - Saw dust - Dried crash timbers - Chimney

	- Purpose: To absorb toxins of bacteria, harmful gases, deodorizing, to improve nutrient storage capacity and stimulate microbiological activity	
2 -3	[Mixing the ingredients] - Mix coffee husk (or other agricultural residues such as grass), cow dung, rice husk, rice husk charcoal with fermented rice bran. During the mixing process, pour water how the humidity reaches 50-55%. - After mixing, composting height of 0.8-1m and covering by canvas to avoid rain and sun. Mix composting every 10 days/time, check if the humidity is below 50-55%, we need to add more water. During composting, the temperature is 55-60^{0}C. When the compost pile has rotted and the temperature inside compost is equal to the ambient temperature, that is the end of the composting (about 1.5 - 2 months)	- Cow manure :750kg =15 bags - Wasted Mushroom media :500kg - Coffee pulp : 3m3 - + fermented rice bran & charcoal

			
Grind yeast	Mix the bran and yeast	Mix more water, stir well	Incubate in bags, store in a cool, dry place
			
Plug the vertical chimney	Burning rice husk	Watering to put out fires completely	Finished rice husk charcoal

		
Compost pile height 0.8 -1m	Cover with canvas to prevent rain	After every 10 days, stir and check moisture content of composting

3. Effects of compost

- Improve the soil environment, increase soil fertility and macro- microelements, protect soil environment.
- Balancing nutrients, increasing soil porosity and absorption capacity for plants.
- Slow-decomposition of organic fertilizer should reduce erosion to provide nutrients during plant growth.
- Helping plants grow fast and sustainable.