



**Japan International Cooperation Agency (JICA)
Sustainable Natural Resource Management Project (SNRM)**

On farm demonstration of agroforestry model:

Fruit and forage contour cultivation on slope in Muong Gion

Commune, Quynh Nhai district, Son La Province, Vietnam



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List of Abbreviations

AFLI	Agroforestry Guideline for Sloping Lands
AG	Agroforestry
CPC	Commune People's Committee
DPC	District People's Committee
FPD	Forest Protection Department
HH	Household
JICA	Japan International Cooperation Agency
KAP	Knowledge Attitude Practice
MARD	Ministry of Agriculture and Development
PRAP	Provincial REDD+ Action Plan
REDD+	Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
SALT	Sloping Agricultural Land Technology
SNRM	Sustainable Natural Resource Management Project
VAFS	Vietnam Academy of Forest Science
VF	Village Fund
VFPT	Village Forest Patrolling Team
VMBFMLD	Village Management Boards for Forest Management and Livelihood Development
VND	Vietnamese Dong

Summary

In order to generate sustainable income through fruit production converting from shifting cultivation and to reduce soil loss while producing forage, agroforestry models of fruit forage contour cultivation were introduced on slope in Muong Gion Commune, Quynh Nhai district, Son La province. Mango, Son Tra (*Docynia indica*), Lychee, Longan, and Plum were planted on contour alternately in vertical line (5m x 8.5m interval) with annual crops (corn, cassava and peanut) in between. Guinea grass (*Panicum maximum*) was cultivated as contour hedgerows (two lines) along the fruit trees (70 HHs, 19.94 ha). Technical training for compost making and grafting were also conducted.

Longan, mango and Son Tra showed good results (>96% survival with good growth) and expected to initiate fruit production generating income of 30-72,000 VND/tree in 2020. It is expected to generate 33 million VND/year/HH (94% of average agricultural income/HH) from mango/longan model (235 trees/ha 50% each, 0.2ha/HH) and 60 million VND (200%) from grafted Son Tra model (294 trees/ha, 0.8ha/HH) in the 5th year, 2022. Forage harvest was estimated as 11,290 kg, with 7 harvests/year, an average of 868 kg/HH /year, which accounts for 7.7% of forage demand (mostly for buffalo) in the household.

The performance was the worst at remote sites a little away from home due to insufficient care taking, cattle grazing and poultry especially in the early stages. Some households have low forage demand and removed the hedge. Lack of harvest caused seed sowing creating difficulty in crop cultivation at some households. Forage growth need to be controlled properly. Probably collective action by group helps.

Compared with other schemes, SNRM showed much better performance. It is because SNRM approach was comprehensive (detailed technical design for each village/HH, quality (grafted) seedlings, detailed technical training), participatory (species selection, agreement), handholding (monitoring with tech feedbacks), and arranged with local institutions and authorities. Review and evaluation of the result and incorporating them in other programs / projects in the province is recommended.

1. Background

Muong Gion commune 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 land per capita as well as agriculture production per hectare. Muong Gion commune is located in the Da river watershed of Son La hydropower dam. Increasing soil erosion makes the life of dam shorter. The farming system of local people are not diversified. The products produced from sloping cultivation has low value, failing to meet the essential needs of indigenous peoples and markets.



Figure 1: Typical landscape of Muong Gion Commune (paddy on slope and shifting cultivation)

Agroforestry is a productive land use system having deliberate association of woody perennials with annual crops. With a proper design, it can reduce soil erosion while increasing and maintaining per unit production over the time. Plants on hedgerow slow the speed of stream flow when intensive rainfall occurs.

Since 2015, Son La province has conducted a series of surveys, projects, workshops, field trips, and model visits to find the best way to convert shifting cultivation on slope to other production systems¹. In Muong Gion Commune, farms are engaged in livestock production as main income

¹ Conclusion No. 121-TB / TU, May 31, 2015 of the Standing Committee of the Provincial Party Committee on the policy of planting fruit trees on sloping land until 2020

Resolution No. 28/2017 / NQ-HDND dated March 15, 2017 of the Provincial People's Council regulating support to renovate mixed gardens and fruit trees in the province

Resolution No. 37 and Resolution No. 80 of the Provincial People's Council on the approval of the project on developing fruit trees in the province until 2020

source and low productive annual crop cultivation on the degraded slope. Fruits are hardly produced for sales. On farm trials were carried out by Agroforestry for Livelihoods of Smallholders Farmers in Northwest Vietnam (AFLI) project². However, it was a limited scale and actual impact on farm economy and farmer's acceptance were unknown.

Sustainable Natural Resource Management Project (SNRM) funded by JICA aims to support effective utilization of slope through the production of fruit and forage on slope with various grafted fruit trees, contributing to reducing soil erosion and protecting the watersheds of the Da river. In the Provincial REDD+ Action Plan (PRAP) of Son La, the enhancement of the agricultural livelihoods for local people is one action of solution package to control the conversion of forests to upland fields. Based on the natural, socio-economic, and households' conditions, fruit and forage contour cultivation models are demonstrated in 9 villages with the total area of 19.94 ha.

2. Farming system of Muong Gion Commune

The villagers participated in the demonstration model has approximately 5 persons in their family with 3 persons under working age (Table 1). Villagers are subsistence farmers who produce most of food at home. They produce varieties of products and 90% of their annual income comes from livestock (Table 2). Fruits produced in home garden are only for home consumption. They

Table 1: Family composition, land use and livestock status of Agroforestry model participants, Muong Gion Commune

	Categories	Unit	Amount
I	Family member		
	Family members	No./HH	5.17
	Work force	No.	3.05
	Hired labor	Month	0
II	Land		
	1 Agricultural land	Ha/HH	0.53
	2 Grazing lands	% of HH	35.29
	3 Fish pond	m ² /HH	547
	Fish ponds	% of HH	70.6
	4 Forest area	Ha/HH	1.75
	PFES land area	Ha/HH	0.87
PFES	VND	467,823	
III	Livestock		
	Buffalo	No./HH	2.5
	Cow	No./HH	1.83
	Goat	No./HH	1.5
	Pig	No./HH	1.1
	Poultry	No./HH	17

Source: Pham Van Hung., Vu Van Tuan, Yamamoto W., Yumiyama D. Report 2nd monitoring and evaluation on agroforestry model. SNRM. 2020. Interviews from 17 households.

Resolution No. 76/2018 / NQ-HDND dated April 4, 2018 of the Provincial People's Council on policies to support the development of production, processing and consumption of safe agricultural products and foods in the province in the period of 2018-2021

² Agroforestry models were set up at Mai Son, Van Ho, and Thuan Chau districts by AFLI project.

are hardly engaged in another work as labor outside the house.

Each household has approximately a half hectare of agricultural lands including paddy. They keep several kinds of livestock including buffalo, cattle, goat, fish, pig, and chicken for their consumption and sales. Only 35% of households has grazing land. The major form of animal husbandry is semi-grazing, grazing in forest land or community grazing area in the daytime and supplementally stalled at night or during bad weather. Ruminants (buffalo, cattle and goat) are fed with Guinea and Elephant grass as well as natural grass and pig is fed by cooked corn and cassava. On average 1.7 ha of forest is allocated to each household and receive PFES for a half of their forest. General characteristics of participants are presented in Table 2. Average household income of participants was estimated as 35.4 million VND/year.

Table 2: Annual income of participants

	Type	Unit	Quantity sold	Amount (1000 VND)	%
1	Livestock			541,900	90.0
	Buffalo	Animal	11	233,000	38.7
	Cattle	Animal	11	108,000	17.9
	Goat	Animal	18	25,600	4.3
	Pig	Kg	850	69,500	11.5
	Poultry	Kg	665	69,800	11.6
	Fish	Kg	450	36,000	6.0
2	Annual crops			60,200	10.0
	Rice	Kg	2,200	24,200	4.0
	Maize	Kg	10,600	29,680	4.9
	Peanut	Kg	150	3,000	0.5
	Soybean	Kg	25	500	0.1
	Black beans	Kg	120	2,400	0.4
	Coffee	Kg	70	420	0.1
3	Fruit trees			0	0.0
	Total (1+2+3)			602,100	100.0
	Total (1+2+3) per household			35,418	

Source: Pham Van Hung., Vu Van Tuan. , Yamamoto W., Yumiyama D. Report 2nd monitoring and evaluation on agroforestry model. SNRM. 2020. Interviews from 17 households.



Figure 2: Fruit forage contour model planted in Cut Village (8m x 5m spacing for mango and longan alternately vertically and two-line cultivation of forage along the fruit)

3. Agroforestry model

Productivity, sustainability and adaptability are the main criteria for designing agroforestry system³. The design incorporated by SNRM has three main points.

- Reduction of soil erosion by contour hedgerow of grass and woody perennials as sloping agricultural land technology (SALT)⁴
- Increase of financial output in the long run by replacing annual crop with fruit cultivation
- Production of forage on the hedgerow for reducing pressure of livestock on forest



Figure 4: Training of contour planting using

In order to satisfy the adaptation criteria, participants were consulted, inspected and trained with regard to the land condition and financial requirement to operate the system. The model was designed for each participant differently based on their interests and capacity. Only the committed farmers in front of village authority and CPC with written agreement were accepted. The project provided seedlings and technical training. Only well selected grafted seedlings with good variety were supplied. Technical backups were taken from the experience of VAFS and AFLI project⁵. Eight fruit trees are used with good

perspective of income generation (Table 3).

Table 3: Expected fruit Production of selected species in the first years

	1st year (kg)	2nd year (kg)	3rd year (kg)	4th year (kg)	5th year (kg)	Price (vnd/kg) (in Market in 2019)
Fruit type	<i>Planting</i>	<i>No flower on trees</i>	<i>A few flowers on some trees</i>	<i>More flowers for fruits</i>	<i>More flowers for fruiting</i>	
Late ripened longan	0	0	2 to 4	10 to 12	22 to 25	25,000

³ Raintree J.B. 1983. Guidelines for Agroforestry Diagnosis and Design. Working Paper No. 6. International Council for Research in Agroforestry.

⁴ Asian Rural Life Development Foundation. 1997. Sloping Agricultural Land Technology (SALT)

⁵ VAFS: Vietnam Academy of Forest Science. AFLI. Agroforestry Guideline for Sloping Lands in Northwest Vietnam.

Lychee	0	0	0	3 to 5	7 to 10	25,000
Tam Hoa Plum	0	0	1 to 2	4 to 6	14 to 18	15,000
Hau Plum	0	0	1 to 2	5 to 7	15 to 20	15,000
Taiwanese Mango	0	0	3 to 5	12 to 15	35 to 40	20,000
Docynia indica	0	0	0	4 to 6	14 to 18	15,000
Grafted Docynia indica	0	0	1 to 3	5 to 8	15 to 20	15,000
Grafted lychee	0	0	0	5 to 7	10 to 15	25,000

Source: Farmer interviews. AFLI project. Vu Van Tuan. Evaluation and comparison of the growth and development of Son Tra varieties (seedlings, cuttings, grafted) at Chieng Bom Silvicultural Experimental Station. Northwest Forestry Science Center. Tay Bac University.

Table 4: SNRM Fruit and forage cultivation model

No.	Village	HH No.	Model area (ha)	Model/HH (ha)	Planted species
In 2017		31	12.86	0.41	
1	Huôi Tèo	4	2.58	0.86	Son Tra + Ghinea grass + Corn
			0.48	0.48	Grafting existing plants (Peach, orange, and Son Tra); Son Tra + Ghinea grass + Corn
2	Xanh	1	1.63	1.63	Late-ripened longan + Black plum + Ghinea + Corn
3	Bo	1	0.12	0.12	Grafted longan+ Ghinea grass
			0.67	0.67	Late-ripened longan + Pomelo + soybean
4	Xa	7	1.13	0.16	Late-ripened longan + Taiwan mango + plum + casava
5	Gion	1	0.56	0.56	Planting Ghinea grass along the field banks
			0.36	0.36	Trám đen + Taiwan Mango + Ghinea grass + Banana + Soy bean
6	Co Lúu	1	0.52	0.52	Grafted existing lychee*; Planting Thieu lychee + Late ripened longan + Ghinea grass + Cassava
			0.46	0.46	Plant Guinea grass around the pond
7	Cut	8	2.09	0.30	Long-ripened longan + Taiwan mango + Ghinea + Corn
			0.21	0.21	Trám đen + Ghinea grass + Corn
8	Cha Co	8	2.05	2.05	Lychee + Taiwan Mango + Late ripened longan + Ghinea grass+ Corn
In 2018		39	7.08	0.18	
1	Tong Bua	2	0.78	0.39	Tam hoa plum + Coffee
		37	6.3	0.17	Tam hoa plum
Total		70	19.94	0.28	
*Integration with the district's agricultural extension program					
Son Tra (Docynia indica), Trám đen (Canarium tramdeum)					

Source: Pham Van Hung, Vu Van Tuan. , Yamamoto W., Yumiyama D. Report 2nd monitoring and evaluation on agroforestry model. SNRM. 2020.

4. SNRM Implementation Process

4.1 Project introduction and planning

SNRM organized project planning workshops at each village to explain the objectives and activities of the project. SNRM supported to form Village Management Boards of Forest Management and Livelihood Development (VMBFMLD) with regulation of village forest management. All activities were undertaken through them. Technical staff of district ranger station, district extension station, and commune participated in the project as facilitators. SNRM supported seedlings and technical trainings to participants. 70 households in 9 villages registered to participate in fruit and forage contour cultivation.

4.2 Review potential land, fund for operation

After the village meetings, the project officers reviewed potential land and financial capacity of participants for this activity the proposed lands were measured with GPS.

4.3 Technical design



Figure 3: Village meeting for technical

SNRM organized village meetings for design fruit and forage contour cultivation models at each village by consultants who have expertise and experience in implementing agroforestry models in the Northwest provinces. In the meetings, the effects of contour cultivation on production and environment was explained to villagers and species to be planted were discussed.

In February 2017, fruit forage contour cultivation models were designed for 39 households in 8 target villages (Huoi Teo, Xanh, Bo, Xa, Gion, Co Liu, Cut and Cha Co)⁶ (Table 4). The models incorporated villagers' desire and technical requirement.

4.4 Signing agreement

SNRM project, the participants, the representative of Muong Gion CPC made agreement (roles and responsibilities of each party) for the activities.

⁶ Ha Van Tiep, Nguyen Van Hung, Lo Thi Kieu, Hoang Quoc Thanh. February 2017. Technical Design on Agroforestry in Muong Gion Commune, Quynh Nhai district, Son La province.

4.5 Technical training and Study tour to villagers

SNRM organized 13 introductory courses on fruit and forage contour production for all the villagers including those who do not participated in the model. Content includes: Techniques for soil preparation fertilizing, use of an A frame for contour planting, planting fruit trees/grass, preparing rootstocks to transplant and improve fruit trees. 591 persons including 138 female students, accounting for 23% participated in the training.

SNRM project organized a study tour to visit agroforestry models supported by AFLI project in Co Noi commune and Hat Lot commune, Mai Son district, Son La province. 26 villagers (25 males and 1 female) participated the tour.

4.6 Technical inspection of seeds and seedlings

In March 2017, SNRM made signed contracts with reputable seed suppliers in Son La. Before purchasing, seedlings were periodically inspected by project staff to ensure the origin, quality assurance, qualified gardening standards based on regulations by MARD⁷. The seedlings were provided by Son La Center for Plant, Livestock and Aquatic Breeds (under the Department of Agriculture and Rural Development of Son La province) and Center for Scientific Research and Transfer technology (Tay Bac University).

The project has provided a total of 9,296 seedlings of grafted Mango, grafted late litchi, grafted Plum, grafted Son Tra, Grapefruit, grafted Tram Den and Coffee and 6,149 kg grass seed cuttings Guinea, to 8 villages.

4.7 Village addition for expanding models

In 2017, Xa village planted pine in their lands which was next to agricultural lands of Tong Bua village. Originally Tong Bua village was not a target village of SNRM since it is a resettlement village of Son La Hydro Power Dam which does not have any forest. Since there was a risk of grazing in the plantation site, the project decided to add Tong Bua village as an example of fruit cultivation model. The agricultural land allocated to Tong Bua village was far from the village.

Participants and plants were decided through village workshops organized by SNRM. Two households planted Coffee with annual crops and others (37 households. The land was collectively owned and distributed to each household based on the number of family in the household⁸) planted plums in July 2018.

⁷ MARD. 2001. Decision on standards of fruit seedling 106 and 108.

⁸ The land is located on slope and was divided into portions of each person. Each person takes 1.5meter wide of land to horizontally towards to the top of the hill. For example, if the family has 5 members, the family has 7.5m wide lands from the bottom to the top of hill. Ha Van Tiep, et. Al. The technical guidelines for establishment of agroforestry model grafted plum + coffee, and mono-cultural grafted plum plantation in Tong Bua village, Muong Gion commune, Quynh Nhai district. 2018. SNRM.

4.8 Monitoring

Project staff regularly monitor and supervise to have timely support for people to participate in the model: techniques of planting, caring, pest control, etc. Organized monitoring and evaluation was carried out in March 2019 and March 2020⁹.

5. Project Output and Outcome

5.1 Survival rate and situation of growth

a) *Survival rate*

After nearly 3 years of the implementation, fruit and forage cultivation on slope models have certain successes. The survival rates were high for Son Tra (both grafted and non-grafted), longan and mango (97-100%), while medium (74-80%) for Lychee and plum, and low (54-62%) for Tam Hoa Plum and coffee.

b) *Situation of growth and development:*

- Son Tra (grafted and non-grafted) showed good growth, no pests, plants with over 2m height, and most of them having flowers. They can be harvested in September 2020.
- Lychee and plum: Average growth, some plants are destroyed by pests, and insects.
- Tam Hoa plum: slow growth and development (reasons: newly planted in 2018, a place far away from home, with poor caretaking and protection; limited fertilizer cultivation, lack of irrigation water and being destroyed by cattle).
- Coffee: developed fairly evenly, but some plants have disease (blackened leaves). Households sprayed chemical 3 times. This disease will be reduced when the rainy season comes.

5.2 Fruit Harvest

Fruit trees from grafted seedlings mostly flower after 1 to 2 years of planting. Except for Lychee, they will bear fruits from 2020 after 3 years of planting.

As of March 2020, (except for Tam Hoa plums planted in 2018), fruit trees planted in 2017 have flowers, will bear fruits (mango trees bear young fruits), and will be harvested in months. Based on the observation of flowering branches, or small fruits, the total estimated income is about VND 36.3 million. The income generated from each tree estimated was higher for Late-ripened longan (72,000 VND/tree), Taiwan Mango (68,000 VND/tree), and grafted Son Tra (30,000 VND/tree) (Table 5). Other fruits are too young to figure out at 3 years old.

⁹ SNRM. 2019. Case Study: Combined Agricultural Models. Pham Van Hung, Vu Van Tuan. Yamamoto W. Yumiya D. Feb. 2020. 2nd Monitoring And Evaluation On Agroforestry Model. SNRM.

Table 5: Survival rate, growth and expected harvest of fruit trees

Fruit tree	Farms No.	Trees No. planted	Survival rate (%)	Growth	Expected harvest 2020	
				Good: 3 - Poor: 1	Quantity (kg)	Sales per tree (VND)
Late ripened longan	9	256	98	2.4	860	72,419
Lychee	3	38	74	1.3	0	0
Tam Hoa Plums	4	255	54	1.8	40	3,284
Hau Plum	5	56	89	2.4	20	0
Taiwan Mango	8	169	96	2.4	755	68,711
Son Tra	3	557	99	3.0	120	3,249
Grafted Son Tra	1	20	100	3.0	40	30,000
Grafted lychee	1	15	80	3.0	0	0
Coffee	2	1,800	61	2.5	600	2,727

Source: Pham Van Hung, Vu Van Tuan , Yamamoto W., Yumiyama D. Report 2nd monitoring and evaluation on agroforestry model. SNRM. 2020. Interviews from 17 households.

5.3 Forage Harvesting

Forage harvest was estimated that the total forage yield is 11,290 kg, with a frequency of 7 harvests / year (usually from May to November), an average of 868 kg/household /year. A half of the forage was used for buffalo (Table 6).

Table 6: Forage Utilization by animal type

No.	Type	Forage utilization (kg)	%
1	Buffalo	5,530	49.0
2	Cattle	2,600	23.0
3	Goat	1,710	15.1
4	Fish	650	5.8
5	Others (shring with others)	800	7.1
	Total	11,290	100.0

Source: Pham Van Hung, Vu Van Tuan, Yamamoto W., Yumiyama D. Report 2nd monitoring and evaluation on agroforestry model. SNRM. 2020. Interviews from 17 households.

5.4 Intercropping crops

Maize, cassava, peanuts, soybeans, and coffee were planted as intercrops¹⁰). Maize has the largest area: 1.94 ha (accounting for 45.2%), then coffee: 1.56ha (36.4%), cassava 0.73 ha (17.0%), the rest are peanuts and soybeans: 0.06ha (1.5%).

5.5 Profit from intercrop

The amount of profit after paying for the cost including seeds, cuttings, seedlings for planting, NPK/organic fertilizer, pesticides, lime powder, etc. was estimated as approximately 58 million VND in total with 22 households, 26 million VND/HH/year (Table 7). On average the total number of working days per households in the models was 387 man days.

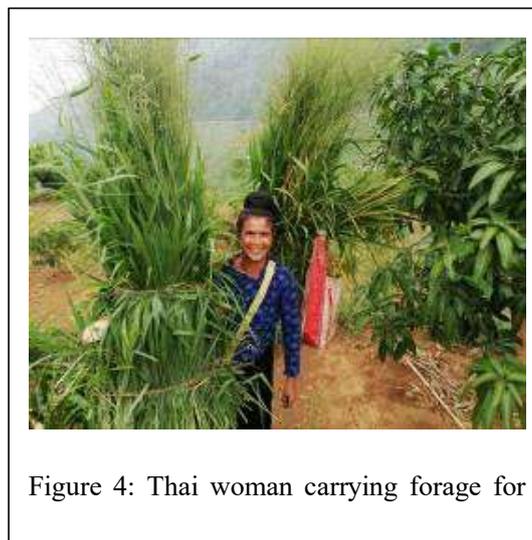


Figure 4: Thai woman carrying forage for

5.6 Response of CPC/DPC

The district, commune, and villagers are interested and eager to learn and apply in other areas; this is also an opportunity to raise the awareness about agroforestry, the benefit of permanent plants, and income and contribute to supporting better forest protection. Many delegations visited and studied the models in Cut, Co Liu and Huoi Teo villages.

Table 7: Production and sales of annual crop and coffee

No.	Inter crop	Number of households	Area (ha)	Investment					Harvest					
				Seed (VND)	Fertilizer (VND)	Plant protection drugs (VND)	Total (VND)	Per ha (VND)	Quantity (kg)	Consumption (kg)	Sales (kg)	Price per kg (VND)	Sales (VND)	Sales/ha (VND)
1	Corn	8	1.94	4,190,000	14,402,500	1,577,000	27,946,500	6,514,336	12,100	4,900	7,200	2,800	33,880,000	17,463,918
2	Casava	6	0.73	857,000					12,200	12,200	0	1,700	20,740,000	28,410,959
3	Peanut	3	0.05	300,000					165	50	115	20,000	3,300,000	66,000,000
4	Soybean	1	0.01	20,000					10	10	0	20,000	200,000	20,000,000
5	Coffee	4	1.56	6,600,000					70	0	70	6,000	420,000	269,231
	Total	22	4.29	11,967,000	14,402,500	1,577,000	27,946,500	6,514,336	24,545	17,160	7,385		58,540,000	

Source: Pham Van Hung, Vu Van Tuan, Yamamoto W., Yumiyama D. Report 2nd monitoring and evaluation on agroforestry model. SNRM. 2020. Interviews from 17 households.

6 Lesson Learned

Perspective of good income generation from fruits in a few years

¹⁰ In 2017 some villagers planted coffee instead of annual crop in their model by themselves. Coffee is a part of model in 2018 at Tom Bua village.

The project demonstrated on farm contour fruit and forage cultivation on slope. All the participants interviewed responded that the model should be continued and expanded with the guidelines and orientations of local authorities (villages and communes). There is a huge potential to develop lands on slope in a similar way. Many villagers initiated similar models at their homes after visiting the model supported by SNRM. Even though it is only three years after planting, it brings some income to the households.

Good income will be generated from Mango, Longan and Son Tra and it is expected to increase three times in 4th year and 10 times in 5th year. Based on the growth model of the fruit trees, in 5th year (two year from now), it will produce significant income for the participants: potentially reaching 30 million VND/year/HH, 87% of annual cash income of the household from the Longan and Mango model (200 trees/ha 5m x 10m horizontal and vertical intervals, 0.2 ha/HH, 50% each) in Cut village, and 60 million VND (169% of annual income/HH) from the grafted Son Tra model (250 trees/ha 4m x 10m interval, 0.8 ha/HH) located on higher elevation sites in Huoi Teo village.

Challenge at sites away from home

However, although survival rates were not much affected except for coffee and plum, the actual growth of trees were varied. The performance was the worst at sites away from home (Cha Co and Tong Bua villages). It is considerable that care taking was not sufficient and cattle and poultry destroyed the site especially in the early stages. The reasons not to be able to take care the model may be due to financial and social reasons.

Financial constraint and government support

The large investment in the first year and no income from fruits in the first 2 years affected the decision of participants. Although the villagers signed the agreement with SNRM and CPC, some villagers did not fully follow technical steps due to land conditions, lack of labor, and investment capacity, leading to the poor performances. Financial support to individual or group of households as seen in Yen Bai may improve the situation¹¹ but the lack of labor probably remains as constraints.

Grazing control

Grazing is probably the largest issue for developing a good agroforestry model on slope. The source of animals can be either inside the village, another village in the commune or another commune. Implementation of agroforestry at several households in cluster encourages villagers to

¹¹ Yen Bai provincial government issued Resolution No. 15/2015/NQ-HDND, and Decision No. 27/2015/QD-UBND for Tram Tau and Mu Cang Chai districts. Financial support to individual or group of households planting Son Tra and (6 M VND/ha) contour cultivation of maize on slope with grasses to reduce soil erosion (1 M VND/ha).

work better as a group for caretaking, protection, harvest and consumption of products. In order to use the social defense to protect natural resources, SNRM supported to organize VMBFMLD and to formulate village forest management regulations which impose fines to illegal grazing. However, it is likely that in some case villagers cannot claim the damage by grazing due to social pressure. CPC can play a larger role in grazing control. CPC should support such village to ensure the regulation can properly function. Against the animals from another village, CPC should facilitate intervillage communication. For example, Tong Bua villagers who is engaged in contour fruit cultivation helped the protection of pine plantation of Xa village. For the ones from other commune, CPC needs to communicate with the other CPC (Table 8).

Table 8: Possible action for agroforestry development by institutional level

Institution level	Possible action for agroforestry development
DPC/ District Extension Service	<ul style="list-style-type: none"> • Financial support to good agroforestry model • Provide tech assistance to identify models, develop demo farms with handholding support, conduct good M&E with feedback mechanism
CPC	<ul style="list-style-type: none"> • Grazing control to impose village regulation, inter village/ inter-commune communication • Support forming VMBFMLD
Village	<ul style="list-style-type: none"> • Setting up VMBFMLD to control grazing • Setting up demo farms for success story • Farmer to farmer training on farm • Setting up intra village grazing control mechanism through VMBFMLD

Challenge in forage supply

Forage hedgerow supplies feeds for cattle and buffalo, and prevents soil erosion contributing to water resources for the Da river basin. 868kg forage was harvested in total by seven times at 13 farms on average estimated to be 7.7% of animal needs of the household. It is significant amount of forage for the household. Since intensive labor is required for fruit and crop cultivation, villagers often work at the sites. It was easier for villagers to collect the forage at agroforestry sites than randomly collecting in the field.

However, the forage demands depend on the number of buffalo and cattle; it is not advisable to have forage hedgerow for the villagers that do not have enough animals. Some villagers do not have neither buffaloes nor cattle and shared the forage with other villagers. For non-cattle raising households, contour forage hedge can be designed and replaced by other crops such as medicinal

plants (citronella) and fruit (Pineapple) to generate income for the households, and to meet demand of soil erosion prevention.

Natural spread of grass seeds affected the cultivation of other crops. Grass needs to be harvested before seeding in order to avoid it. It was found that the selection of grass varieties was not appropriate in higher elevation. In Huoi Teo village located upper parts of Muong Gion, Guinea grass grows slowly; elephant grass was more suitable.

Arrangement of technical assistance

Compared with other effort made by government (e.g. Quynh Nhai District Agricultural Extension Center, in Gion village, Co Liu villages), the performance of SNRM models was much better. SNRM support was more comprehensive (supporting survey, technical design for each village/household, quality (grafted) and inspection of seedling, technical training, handholding assistance with regular monitoring and evaluation), participatory (species/variety selection consultation, agreement with villagers), handholding (regular monitoring by SNRM staff and facilitators), arranged with local institution (facilitator from extension service, tech design by VAFS, training by Tay Bac University), and connected with local authority (involvement of village authority and CPC)¹².

Main crops (fruit trees) and intercropped plants (grasses, short-term crops) must be carefully selected. It is necessary to control the origin and quality of seedlings before planting.

Regular monitoring and communication by SNRM staff for awareness raising encouraged villagers to perform well. Monitoring and feedback mechanisms are formed by villagers through VMBFRLD, village leaders, and collaborators.

Integrating with other activities of SNRM (e.g. composting, grafting of fruit trees) helped better implementation of the model¹³. Some villagers mastered grafting technique and use the technique to their plants in their gardens. Incorporation with another agroforestry model of Quynh Nhai district extension (a sustainable mango intensive model in Co Liu village) helped enhance the effectiveness and sustainability of the model.

Forming a team of facilitators from technical staff of district ranger station, district extension station, and commune and village officials greatly helped the capacity building for local partners. They fully participated in technical training and visiting activities, and grasped technical knowledge. This system is very effective and their experience should be well utilized.

¹² Fruit and forage cultivation implemented by Quynh Nhai District Agricultural Extension Center selected only one species of grass (Loong Muc), one fruit in each village (mango in Co Liu and grafted avocado in Gion village).

¹³ For instance, at Huoi Teo village, a villager planted non grafted Son Tra trees replacing damaged grafted one by grazing by themselves and grafted sapling with other grafted saplings.

7 Conclusions and Recommendations

SNRM project has developed agroforestry models of fruit and forage contour cultivation on slope in nine villages of Muong Gion commune in Son La province.

Contour fruit and forage cultivation not only contributes to crop diversification, increases product value per area, but also contributes to the reduction of production risks, and soil erosion prevention. It is an important activity for reduction of emission from deforestation and forest degradation and contributes to the protection of catchment of the Da River basin.

There is a great potential for applying the models in Son La province in general and in Muong Gion commune in particular, where villagers are currently largely cultivating monoculture crops on slope.

The project results should be handed over to local partners for further study, incorporating the model in the overall development strategy of agriculture and forest sector.

Specific recommendations based on the results are:

- Review and evaluate the SNRM fruit forage contour cultivation models and incorporate them in other programs / projects in the province
- Sensitize extension workers on selection of suitable crops and their practices of each locality
- Provide financial support to villagers to undertake fruit forage contour cultivation on slope
- Establish model farms of fruit forage contour cultivation as extension services of the village
- CPC to create communication mechanism for inter village/commune for grazing control
- Set up Village Management Board in each village to control grazing in the village
- Establish interest groups in the village to share technical and market information and support each other
- Support producing high quality seedlings with proper standards
- Promote fruit forage contour cultivation with compost making, and grafting techniques to improve fruit production