AGRICULTURAL METHODS AS COPING MECHANISMS TO FOOD STORAGE FOR VIETNAMESE MINORITIES IN MOUNTAINOUS REGIONS

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1. Introduction

Foods security is perceived the most important in agricultural countries such as Vietnam. Since Vietnam embarked on a successful economic reform which helped developed agricultural production, sustainable living earning, food security, and people's standard of living have improved while poverty has been reduced nation-wide. Vietnam transformed itself from country dependent on food imports to becoming the second largest exporter of rice in the world. However, possibilities of achieving sustainable living wages and food security vary by location and they are limited in some areas. For instance, populations in rural or remote areas, or comprised of large groups of minorities are still living in poverty and continue to struggle for survival.

At present, availability of agricultural land is diminishing due to population growth and deforestation. Recent policies have focused on improving two significant problems: (1) environment and (2) foods security. There have been numerous projects initiated for mountainous regions in Viet Nam, but minimal research have been conducted about food security, which continues to remain a challenge.

It is important to understand the current situation of sustainable living and food security by examining risk and facilitating factors. The aim of this paper will be to explore coping mechanisms to food shortage in agricultural production. Suitable plants and animalseco-friendly solutions are proposed to improve sustainable living capacity based on local conditions, and to mitigate negative impacts of natural disasters – awkward sentence.

2. Current situation of agricutural production in studied communities

2.1. Crop production

In studied communities, land for rice paddy cultivation are not much, almost production activities are based on swidden agriculture. Cultivation skills are still primitive, resulting in low productivity. Morever in these areas, they are facing serious potential risks of land wash and erosion. Cultivation systems among studied communities are quite the same, they include main parts as follows:

- **Rice Paddies**

There are rice paddies in all three communities. However, the areas are not so large, and only make up a small percentage of each household's agricultural land but play a very important role in ensuring the family's food security. At the time of the study, the average area of a rice paddy per person is 402m^2, with the largest located in the Lu Village, Bac Can (533m^2) and the smallest in the Ke Mui Village, Nghe An

(178m^2). Approximately 65% of the rice paddies in studied communities have enough water to cultivate two harvests of rice per year. These areas are not the same among households in each community. For instance, in the Chien Village in Hoa Binh, the population density ranges from 200m^2/person to 530m^2/person. The average wet rice cultivation area per person in studied communities has been on the decline compared to past years due to water shortage and increase in the birth rate (see Table 1).

Table 1: **Wet rice production in studied places**

Comparision factors	Dzao Minority (Lu Village)	Muong Minority (Chien Village)	Tho Minority (Ke Mui Village)
• Average/household (m^2) • Average/person (m^2)	2,666 533	2,376 494	938 178
• Cultivation area of two wet rice crops	5	67 %	51 %
• Wet rice percentage meet food demand of the community	50%	65%	40%
• The ways to deal with the shortage of rice	- Sell other agricultural products. - Explote forestry products.	- Sell other agricultural products. - Work for somebody - Borrow	- Sell other agricultural products. - Afforest - Work for somebody

The rate of the households who do not have any land to cultivate wet rice, vary between communities. In the Ke Mui Village, Nghe An is the highest (30%), while in Lu Village, Bac Can was much less (7%). In the Chien Village in Hoa Binh, almost every household cultivates wet rice. Based on differences between various communities, it is clear that we can not rely on wet rice to deal with the problems of food security.

Table 2: **Food security status in surveyed communities**

	Tho		**Muong**		Dzao	
	n	%	n	%	n	%
Shortage	6	10.0	14	20.9	41	71.9
1-2 months	8	13.3	51	76.1	7	12.3
3-6 months	23	38.3	2	3.0	8	14.0
7-12 months	23	38.3	0	0.0	1	1.8
Total	60	100.0	67	100.0	57	100.0

Source: Figures surveyed in 2005

There also is differing rates of food shortages and levels among households. For instance, the rate for Tho Minority in Nghe An is 90%, compared to 79% for Muong Minority in Hoa Binh. The rate of hunger in the Dao Community in Bac Can s lower than the previous two communities because the Dao people earn their living in valleys stretched out along streams. This allows them to access more areas for cultivating wet rice, as well as benefiting from nearby forests rich with natural resources. There are various reasons why almost all the households face hunger for several months. They include: (i) lack of land for cultivation, especially for rice paddies; (ii) newly formed households; (iii) misfortunes in production, such as droughts, floods, etc.; or (iv) big events during the year like funerals and marriages.

In order to address the dilemma of food shortage, in agricultural production, it is impotant to consider food variety. For instance, in the Chien village in Hoa Binh, the seria of rice paddy variety which is paid more attention, in summer crop is Dai Bac 8; in winter crop - Nep Ban. These two varieties have been used in a large scale in past years. Thus, this raises the question why is there are so many hybrid varieties of rice with high productivity which are adaptable in different ecological environments within the country, but yet communities such as the Muong Community in the Chien Village still continue to use local varieties that have a loweroutput while facing food insecurity? By studying these communities, we learn that the rice variety in Dai Bac 8 was initially introduced in the Village in the early 1990s. Several years later, the inhabitants have discovered that this variety is highly compatible with their ecological conditions and their crops had a higher likelihood of surviving in cold temperatures and to fight against pestilent insects. The downside is that the productivity is not so high in comparision with hybird varieties that are used in other localities like in Tap Giao, Q5, Khang Dan, etc.,however, the local ride is of high quality and has a promising high economic value. The difference in its productivity compared to hybrid varieties is from 180 to 300 kg/sao, while the difference in price is from 3,500 VND 5,000/kg.

The farmers have their own ways to sustain the local variety. According to some informants, an offer was put forth to the District of Tan Lac to transplant Q5 variety on a large scale with the financial support of a Japanese development organization (JVC) in early 2004, but the inhabitants rejected this plan. There were only some households in support of this offer becuase their harvest was seriously destroyed by leaf-rolled pestilent insects while those who had transplanted Dai Bac 8 still archived their usual productivity.

To reduce the risk caused by natural disasters and negative impacts of markets, the inhabitants have also diversified rice varieties for different crops. In studied communities, the inhabitants use their indigenous knowledge as a mechanism to stabilize their living in agricultural production.

Table 3: **Paddy rice varieties transplanted by Muong Community (Chien Village in Hoa Binh)**

No.	Variety name	Crops	Cultivated places	Average productivity (quintal/ha)
1	**- Spring crop :** 100% area is cultivated with the Dai Bac 8. This variety is sustainable to the cold weather, and its plants are only 40-50cm. This is an ordinary rice variety, has tasty seeds, better productivity, and suitable with the climate and weather in Tan Lac area. This variety comes from Nong Luong Commune, Mai Chau, Hoa Binh since 1991-1992. The rice grows in 120 days.	- Cultivate in winter crop (from winter to spring). - Sow rice on November 20th, transplant at the end of January and beginning of February, and harvest in June.	- Insufficiently watered fields. -Sowing and transplanting density: 117 kg of the variety/ ha.	-Better households (having enough fertilizer): 35-40 quintal/ha. -Poor households (not having enough fertilizer): 25-28 quintal/ha.
2	**- Summer crop :** Moutainous Village Rice (local glutinous rice). The rice is 65-70 cm, its seeds are big, white, glutinous, and sweet-smelling as normal, and suitable with land fields in Nam Son, The rice grows in 115 days.	-Sow rice on April 20th, transplant at the end of June and beginning of July.	-Watered or muddy fields; accounted for 80% of cultivated area and cultivated by 100% of the households. -owing and transplanting density: 88 kg of the variety/ha.	-Better households: 30 quintal/ha. -Poor households: 20-25 quintal/ha.
3	-Glutinous rice C: comes from Bac Son (in 2003); its plants are short, not glutinous or sweet-smelling, and grows in 85-90 days.	-Sow rice in 20-25 days (sow rice from May 20th-25th, and transplant in the beginning of June); harvest after transplanting 90- 95 days.	-Cultivate in shallowed, sanded and watered land fields. Cultivated area is about 10%, and 50-60% of the households transplant. -Sowing and transplanting density: 110 kg of the variety/ha.	-Better households: average 20 quintal/ha. -Poor households: 10-12 quintal/ha.
4	-Nhi uru 838: grows in 110-115 days, 55-60 cm high.	The same as Glutinous rice C	-Shallowed, sanded and watered land. There are only 5 households stransplant on a small scale. -Sowing and transplanting density: 100 kg of the variety/ha.	-Recentaly began cultivation so data not available for productivity but may be estimated at 30 quintal/ha.

5	-Khang dan: grows in 90-95 days.	The same as Glutinous rice C	-Shallowed, sanded and watered land, 5% of the households transplant on the area of 01%. -Sowing and transplanting density: 110-120 kg of the variety/ha.	Better housholds: 30 quintal/ha. Worse households: 20-25 quintal/ha.
6	-Nep Camglutinous rice (local variety)	The same as glutinous rice of Moutainous Villages	-Cultivate in deep and muddy lands. There are 50% of the households transplant on a small scale, and used mainly for medicalpurposes. -Sowing and transplanting density: 80 kg of the variety/ ha.	Low productivity: 15-20 quintal/ha.

Source: Figures surveyed in 2006

Furthermore, it was discovered that some other experiences need to be considered when deciding methods to employ in land cultivation. The inhabitants said that if they were to cultivate on deforested lands, water flow would wash away both soil and planted trees. That is the reason why watersheds in studied communities are well-protected. Also in the Chien Village in Hoa Binh, some households found out on their own how to fertilize maize effectively after many attempts. Initially, the fertilizer for maize was being washed away because the sloping of the land. The inhabitants realized a way to surmount this problem was to anticipate when there will be rain, and then before it starts, dig holes of about 7-10 cm deep , and then add in fertilizer into them. This way, when it rains, water will permeate from above, and fertilize the entire land.

This study demonstrated that there are differing experiences in rice paddy production. Existing limitations in its cultivation are as follows:- Sowing density is too high (150kg/ha, 3-4 times in comparision with other places)

- Low productivity: 3.0-3.5 ton/ha/crop

- Fertilizer is too little (100 kg NPK/ha) while organic fertilizer is not used much (excluding the case of Chien Village in Hoa Binh, organic fertilizer is used more due to support by the JVC project which helped people compost and green manure in recent years).

- There are increasing number of pestilent insects in recent years.

- Lands are tattered: for instance, Chien Village in Hoa Binh, each household has on average 40 plots of lands at different locations.

- Swidden agriculture

This is the largest land type of agricultural households in studied communities, and plays an important role in securing food for the inhabitants. The average area of moutainous fields per household is large, but cultivation in this type of land is risky due to unpredictable weather changes. To deal with the difficulties, the inhabitatants

mostly do extensive farming and diversify forms of crop rotation with various types of plants.

Figures in table 1 and table 4 show that in the communities that have more paddy rice areas, they also have more moutainous field areas accordingly. Among the three studied communities, Lu village in Bac Can is the worst in term of it relations with outside world (but the average of its agricultural land per person is the largest); plants in their moutainous fields are quite diversified though mostly belong to food plants of group 1. For the Chien Village in Hoa Binh and Ke Mui Village in Nghe An, the average of its agricultural land per person is smaller, their location make it easier to be in contact with the outside world, and their plants in moutainous fields mostly are used for commercial crops such as hybrid corn and sugar-cane.

Table 4: **Production of moutainous fields in studied places**

Comparison factors	Lu village	Chien hamle	Ke Mui village
-Average/person (m^2)	2216	643	293
-Main planting trees	Upland rice, local corn, hybrid corn, and ginger.	Local corn and hybrid corn.	Hybrid corn and sugar-cane.

Source: *Figures surveyed in 2005*

Table 5: **Plants in moutainous fields of Chien Village in Hoa Binh**

Sequence of cropping pattern	Planted variety in the spring crop
1	Local corn
2	VN 10, 9698, bioseed
3	Cassava
4	Hybrid corn + Cassava
5	Local corn + Cassava
6	Corn + Peanut
7	Corn + Dried field bean + China squash
8	Corn + Mustard greens
9	Mustard greens
11	Local corn + Batata
12	Hybrid corn + Batata

Source*: Figures surveyed in 2006*

Swidden agriculture is different among communities, but in general, there are three ways people cultivated:

- Self-supply cultivation: This way is usually applied in communities that are far from the center, have less chance to approach the markets and bad transportation like Lu Village in Bac Can. In these areas, there is a high diversity of plants, especially food plants which are essential to satisfy self-supply demands of abitants.

- Semi-self-supply cultivation: This is the main method for cultivation in all three studied communities where it is not very far from the centers; small markets are formed through services of small dealers. Cropping system are quite diversified. Apart from traditional trees, there have been some commercial trees like bean, hybrid corn, etc.

- Marketoriented production: This type of production is mostly applied in communities near centers like Ke Mui Village in Nghe An, where people find it easier to incorporate new development techniques and invest in intensive cultivation such as sugar-cane planting.

Generally in these studied communities, there is a great variety and diversity of the local food and foodstuff plants. In addition to their high quality, they are also advantageous due to the ability to combat pestilent-insects and adapt to changing weather conditions. Plants such as corn, bean, and rice are suitable with to the culinary culture of ethnic minorities in moutainous areas. Many local plants can be cultivated with productivity equivalent to hybrid plants, but are being replaced by new ones. Though local plants are disappearing, they have been surveyed, collected to be reserved, classified, evaluated, and revigorated for cultivation in the areas. It is possible that preeminent properties of new plants can bea possible solution for hunger elimination and poverty reduction in moutainous areas. In recent years, new plants (especially corn) have gradually replaced local plants, making the cultivation system become more monotonous. This monotony is one cause to the decline of stability in the cultivation system. It is a reason for epidemic booms, which then may lead to unpredictable disasters. There have been many expensive lessons that these mountainous residents have to pay when living in this type of terrain. Alongside with new plants are chemical fertilizers and insecticides that could be destructive for one's living environment.

Favourable conditions, dificulties, and challenges for cultivation

Favourable conditions

1. The local plant diversification is suitable with economic and social conditions, as well as customs and practices of each community.

2. Poor households usually plant more local than hybrid corn, while economically better-off households tend to plant more hybrid corn.

3. In studied communities, the inhabitants have a lot of cultivation experiences, especially in cultivating different plants in one area.

4. Many local plants are able to adapt to the soil and climate conditions of the

localities, and it is possible to say that is a rich source of valuable plant genes.

5. Much experience is gained in sowing, planting, and cultivating in severe conditions within moutainous areas, and have been passed down for many generations. In particular, cultivation of plants require water and substance in differences from the soil. In moutainous fields, people tend to cultivate plants of several variety: banana in the upper areas, corn and cassava in lower areas, and plants in the bean family in the lowest lying areas. This kind of simultaneous cultivation can limit the vaporization of water so that the plants are able to absorb more water, and ultimately create a synergistic support system among themselves (such as corn and plants of the bean family).

Difficulties

1. Hybrid corn are usually affected by termites and woodeaters.

2. The expense is quite high when investing in plants with high productivity.

3. Local plants are degenerating because only certain varieties are selected and revigorated; many household want to cultivate local rice, but do not have its seeds.

4. Many households do not have enough land to use for cultivation, their land may be fields are exhausted, and the weather may

land to use for cultivation, their land may be fields are exhausted, and the weather may be too extreme at times. These limitations serve as obstacles to eliminating hunger and reducing poverty, and thus, serve as barriers in achieving food security in studied communities.

2.2. Animal husbandry

In general, breeding is considered to have great potential in moutainous areas, especially for cattle-breeding.In the communities, however, economic returns from breeding is still low despite many advantages found in this research. Animals who are bred are merely used for the purposes of local consumption. Main domestic animals in all three communities are buffaloes, oxen, and pigs.

- *Cows*

Cows are the highest valued domestic animal, and have been steadily increasing in quantity over the years. For example, the herds of cows in the Chien Village in Hoa Binh province have increased from 100 in 2003 to 113 one year later. Approximately 60% of researched households has raised and has been raising cows. The number of cow-raising households in localities is expected to increase because cows are considered a valuable assetand of great importance for supplying traction and fertillizer.

Table 6: **Current situation of raising cows by ethnic groups**

	Tho		Muong		Dzao		Total	
	N	%	n	%	n	%	n	%
Less then 3 cows	59	98.3	59	88.1	56	98.2	174	94.6
4-5 cows	0	0	8	11.9	0	0	8	4.3
More than 6 cows	1	1.7	0	0	1	1.8	2	1.1
Total	60	100.0	67	100.0	57	100.0	184	100.0

Source: Survey in 2005

Almost all cows raised by the households are local cows due to the following reasons:

- Capability of suffering from austere conditions and of low nutrition needs. The cows, which are easy to pasture, rarely damage farm produce and other crop plants.
- Cows can reproduce more easily than water buffaloes. For instance, an 18- month or 24– month old cow can be bred, and after 3 years, the cow can give birth to its first offspringsfarrow.
- Low risk level in cow raising .
- Cows are more resistent to disease, and rarely catch ticks when pasturizing.
- When raising cows in local grassy areas, households do not have to pay the cost for feeding them. They, however, can sell the cows since they are worth a lot. For example, a bull is sold at 3-5 miilion VND, while a cow is valued at at 6-8 million VND. This money in turn is then used towards building homes, as well as equipment and furniture purchases. There is a stable demand for cows on the market, which continues to promote cow raising .
- Cows could be used for labor to help plow fields and serve in other agricultural activities. Cow raising supplies a secondary source as cow pat.

However, there are some difficulties in the development of raising cows: The initial invesment capital for breeding animals is high, so that poor households cannot afford it.

-It takes nearly 3 years for first set of off springs, and 15 months for every subsequent set of off springs.

- *Water Buffaloes*

In the studied communities, the number of herds of buffaloes are generally stable. The result of this research revealed that households do not like raising buffaloes because of their low capabilities to reproduce. However, there still were some following advantages:

- Capability of suffering for austere conditions and low nutrition needs. The buffaloes, which are easy to pasture, only pasture in forests and rarely damage farm produce and other crop plants.
- The buffalo seldom susceptible to diseases. Buffalo breeding is reliable with a low level of risk.
- Food sources for buffalo is grass, so the breeding is suitable for the poor who only need to access areas of grassy land.
- It is easy to sell a buffalo for a considerable amount of money, such as a selling price of 4 – 5 million VND per buffalo.

Buffaloes offer good traction, especially for plowing wet fields. In addition, buffaloes supply a large amount of fertilizer.

Table 7: **Current situation of raising buffaloes by ethnic groups**

	Tho		Muong		Dzao		Total	
	N	%	n	%	n	%	n	%
Less than 3 buffaloes	57	95.0	67	100.0	44	77.2	168	91.3
4-5 buffaloes	2	3.3	0	0	12	21.1	14	7.6
More than 6 buffaloes	1	1.7	0	0	1	1.8	2	1.1
Total	60	100.0	67	100.0	57	100.0	184	100.0

Source: Survey in 2005

Buffalo raising in studied communities still has several disadvantages, especially since the number of buffaloes have not increase over the years:

- Due to the low reproductive capability of buffaloes, buffalo breeding does not have high economic returns, so this would not be a good strategy in eliminating hunger and reducing poverty in the area. Buffaloes usually rut latently, so it is difficult to recognize. It is easy only for male buffaloes to identify females buffaloes who is in rut. These disadvantages can be easily overcome. For example, When buffaloes are pastured in small numbersin scattered areas, which is the current situation in the communities, these disadvantages are apparent. Therefore, breeding is very low. Almost all interviewed households do not like to breed buffaloes because of low reproductive capabilities and number of offsprings.

- *Pigs*

The number of herds of pigs in studied communities is stable, with neligible increase or decrease over years and is dependent on annual epidemics. Over 80% of surveyed households raised or previously have raised pigs, but the current proportion of households is about 40%. The difference of 40% of households who currently do not raise pigs was attribute to their herds perishing due to disease and decided to not breed them any more or do not have the capital to do so.

Table 8: **Current situation of raising pigs by ethnic groups**

	Tho		Muong		Dzao		Total	
	N	%	n	%	n	%	n	%
Less than 3 pigs	56	93.3	57	85.1	52	91.2	165	89.7
4-5 pigs	3	5.0	6	9.0	4	7.0	13	7.1
More than 6 pigs	1	1.7	4	6.0	1	1.8	6	3.3
Total	60	100.0	67	100.0	57	100.0	184	100.0

Source: Survey in 2006

Pig raising in studied communities has several following advantages:

- Little initial investment capital in pig breeding is required so it is easier for the poor to participate.

- The food sources are available, which include rice bran, corn, and cassava.

- Pigs are butchered for worship and rites of ethnic groups, and supplied for daily food for the people. Furthermore, pig breeding provides income from the sale of pork.

On the other hand, pig breeding has some disadvantages:

- Low productivity in breeding, with little amount of money earned in selling one

pig at about 500 – 600 thousand VND per one flesh pig.

- During the periods between crop harvests, pigs compete with people for food, such as cassava and corn.

- Pigs are easily proned to death from diseases, thus contributing to low breeding rate.

- *Poultry raising*

The objectives of poultry raising in households in studied communities are mainly for worship, rites, and consumption. The stocks of raising fowl and duck are locally-grown. Almost all surveyed households raised or have raised poultry, but many households have decided to stop because all of their poultry flocks have died due to disease. The advantages of raising poultry are as follows :

- Little initial investment capital in poultry breeding is required for the poor to participate.

- The poultry is easy to pasture, and have access to available food sources such as rice bran, corn, and cassava.

- Poultry breeding supplies food for the people.

However, this type of breeding also have some challenges:

- The productivity of local poultry is low, so therefore, raising poultry has low ' economical benefits.

- Many fowls die from disease, and further contributes to having a low economic value.

Difficulties in animal husbandry development

Cattle

- People are not aware of processing preseved raw food for the dry season.

- It is difficult to set aside a certain area for growing grass, because local people need more lands to cultivate food plants.

- Cattle are pastured freely, therefore, performance on pasture usage is low. Grassy areas, where cattle are pastured continuously, will become exhausted because they do not have enough time to regenerate and grow, which changes the landscape of pasturing toan unusable area. Meanwhile, the far grass-lands with few pasturing cattles only have old grass and thus, produce a lower quality for beef consumption.

- Many households do not fence in the cattle, and so the cattle are subjected to unsanitary conditions during the wet season. Many calves and buffalo calves die due to poor hygienic living environments.

- In several breeding households, people have little'awareness about available vaccination for their herds of cattle. They are afraid that the vaccine will transmit the disease to the cattle.

- Veterinarian staff in the communes are few in quantity and do not have extensive training.

- The educational level of the people in the area is low, leading to difficulties in techonological advancements in cattle breeding.

- Capital for investment in breeding is inadequate. Many households dare not to borrow from banks because they fear that their monthly income is not enough to pay for the interest on the loans.

Pig and Poultry

- Because of free pasturing, pigs and poultry are particularly vulnerable to disease.

- Primary food for pigs and poultry is available agricultural by-product, and thus, the poor quality of food and their low productivity can lead to low economic returns from breeding.

- Many herds of pig and flocks of poultry have died because they are not given any vaccination.

- In general, the educational level of the people in the area is very low, and they lack money to invest in breeding (e.g., fences or cages, industrially produced food, veterinary medicine, etc.). Thus, in the short-term, there are major limitations to overcome for

- achieving high-productivity in breeding pig and fowl stocks.

3. Market integration with food security in studied communities

Together with the process of market integration, there are several changes in agricultural production in these studied communities. Many earn-living methods, which can guarantee a better life for people, has been conducted in communities such as growing plants for cash income. The ratio of agricultural products in the market has noticeably increased. This trend reflected people's effort to use land resources more effectively in order to increase their income and achieve food security.

Table 9: **Capability for maket approaching at Chien Village in Hoa Binh province**

No.	Criteria	Quantity
1	Number of shops in the village	3
2	Number of household with persons involved in business activities	10
3	Number of dealers trading in the village	8 (5 Kinh; 3 Muong)
4	Approach to private financial source	0
5	Ratio of agricultural products sold to the market	70%
6	Ratio of domestic animals sold to the market	90%

Source: Information collected from disscussion with farmers, 2006

In general, food insecurity is an issue that is diminishing in studied communities. Farmers, whose lives are based on traditional cultivation methods in the fields, currently are growing comnodity plants, such as hybrid corn, peanut, ginger, and sugar-cane. A large amount of their agricultural products is sold to the market, and the earnings are then used to purchase food and goods for their families. Some kinds of plants, such as hybrid corn and LVN10, also are widely grown by people. In recent times, some communities such as Tho ethnic group in Nghe An, have cultivated sugar-cane. Some plants, such as hybrid corn and peanut, were grown in the swidden to

replace traditional crops like local corn, cassava, and upland rice, for the purpose of earning higher profits. Many communities of ethnic groups have learned cultivation techniques and acquired planting experiences from Kinh people. People with high quality and relatively large areas of land for cultivation, large amount of funds, and relatively high level of knowlegde will be more successful in agricultural production. Industrial crops arenot inherently traditional in nature, as in the case of cultivation of some Tho ethnic households in Nghe An. Even so, in poor communities of ethnic groups, they ar faced with difficulties in integrating themselves into the market. Result of this research demonstrates that there are widening gap in incomes between household groups. Area for wet rice are kept at relatively stable levels, while areas for upland rice, local corn, cassava, and other traditional plants used in household have been significantly reduced. With market integration and population growth, land resource is becoming more valuable.

4. Solutions to deal with food shortage in studied communities

4.1. Solutions to severe weather

- Variety and changing time for cultivation depends on rain patterns during the year.

- Increase in number of crops during the rainy season such as in Ban Lu, Bac Kan. There is use of a short-time seed with 2.5 or 3 months for one round of harvest.

- Interpolating and overlapping cultivation to make the best of humidity during the rainy season and to prevent erosion. Corn was inter-crop cultivated with wheat, bean, banana, and papaya. Inter-crop cultivation with large areas of leaf coverage can reduce water evaporation and growth of weeds.

- Growing many kinds of crops to reduce risk caused by the weather and market sales. Each kind of crop has a different growth schedule and pattern. For instance, at some periods when there is no rain, one kind of plant may be in the critical stage of growth, while other crops are ready for harvesting. Every household has a minimum of five plants.

- Forests have more rain available for the soil and prevent erosion. Also, forests can shield itself from the breeze of winds, therefore, reducing water evaporation. In the regions where the forest area is large, water is better regulated throughout the year, soil better maintains its moisture, and water resources are more available for cultivation of agricultural plants.

4.2. Issues in agricultural production of studied areas

- *Food secured by using local and hybrid varieties*

Difficulties in guaranteeing food security:

- Decline in forest area.

- Population growth.

- Local knowlege being outpaced by rate of enviromental changes.

- Dependence on nature.

Therefore, production of food per capita is low and is being threatened to further declince due to food scarcity.

To deal with the risk of food scarcity, local plant varieties are given priority, although promotion continues for cultivating plants with potential higher productivity. Local varieties may be more advantageous than finding a replacement.

Table 10 : ***Comparison between local and improving varieties***

Local variety	*Hybrid variety*
- There is a long time for selection, so it is more time efficient to use ones adaptable to local conditions. - Suitable with habitat - Fewer requirements for investment in intensive farming. - Low productivity.	- Easily affected by environmental changes. - More complicated requirements in techniques employed. - More requirements for investment in intensive farming. - High productivity.

- Local varieties continue to decline.

- Those varieties have changed, so that cultivation technique is not suitable anymore.

- Lack of supporting services for cultivation of those varieties, or policies for promoting and supporting improving varieties.

-The uphold and cultivation of those varieties in reasonable areas have much importance in the guarantee of food security not only for locally but also for preservation of gen resource for plants.

- *Capability of the people for investment and achieving progress in agricultural techniques*

All households interviewed did not use or hardly used fertilizers for their local plants. The reason is simple - there was no money to buy fertilizer. Improving varieties are grown in soil with irrigation. Almost all well-off and middle-class households in rural areas did not fertilize their plants as required for intensive farming for these types of varieties.

Enlargement of cultivation area for improving varieties may be affected by two prerequisite conditions: (i) area with irrigration and (ii) capability of investment of households. In studied areas, both of two prerequisite conditions are limited. Expansion of areas with irrigation depends on level of investment from the government, and capability to ensure water supply.

Results from 85% interviewed households indicated that knowledge and experience for cultivation of new seeds are very low. Most of households are not fluent in the process of intensive farming, and cannot financially afford to carry out the required technical procedures. Therefore, this report proposes that current cultivation methods should be studied and improved through following actions: continue to use reasonable ratio for types of local plants and domestic animals; use available resources in households like muck and green manure; and effectively use available area and knowledge. People are not able to advance their cultivation skills since many did not receive any ’technical agricultural training in order to continue to grow local plant seeds in a changing environment, while new seeds of plant with quite humble area in comparasion to total cultivation area are overly emphasized. People mentioned several times about the

effect of promoting method for agriculture that is "hold the hand, point to the task" – this method is necessary because of the low level of households' awareness. Models of improving cultivation should be given more attention, especially more than traditional ones. The success of these models will gradually help to change people's awareness of a nature-dependent lifestyle that has been ingrained in the culture for a long time.

5. Comments and proposals to develop agriculture

5.1. Planting

Continuing to plant local food crops, such as corn, cassava, and bean, with the following notices to achieve high productivity and to be in accordance with level of cultivation technique and investing capability of local inhabitants:

- *Selection and purification of local varieties*: It is necessary to inquire in detail about varieties of food crops planted in local areas, determine the seeds which can be widened, instruct people to select and purify local varieties, store those seeds, construct a system for supplying seeds to communities through determination of key households in planting, selecting, and revigorating. The government should offer support through policies in preservation and development of local seeds.

- *Determine reasonable season for cultivation*: People must define what is considered a reasonable season, because local seeds are usually planted at the beginning of the rainy season leading to greater impact of seasonal to their growth and productivity. A "reasonable season" is one where there is stable productivity over many years, rather than one that experiences fluctuations.

Rice

- *It is necessary to focus on sowing:* Avoid sowing at many times, which is higher for the situation with pestilent insects and difficulties in water management.

- *Reducing the quantity of seeds to be sowed:* A high quantity of seeds, which is the current situation (120kg/ha in the Chien Village in Hoa Binh province), is wasteful. The field with thick density of sowing rice can lead to higher risk of damage by pestilent insects and smaller rice grain, so rice productivity could decrease. The adequate quantity for sowing should be one-third of its current amount.

- *Higher use of fertillizer*: With light mechanical composition of the land and unflat terrain, if fertilizer is manured gathering and scattering, people must use a large amount of fertilizer. Because effects of fertillizer is low so an adundant amount of fertilizer must be used for the adequate productivity. Therefore, people should separate fertilizer for manuring several times. The best solution would be to put fertilizer into the soil near the roots of the plants. This method, which uses pressed tablets of fertilizer, is applied only once within the entire season. It is deemed acceptable with cultivation habits of ethnic groups, quite saving, and easy to employ. This method has been applied and highly accepted in many regions of ethinic minorities.

- *Recommendation to use green manal muck and compost:* Even with a large

number of oxen and a plentiful source of cow pat, people did not take up the habit of using muck. It is necessary to have advocacy efforts, mobilization, and education about using organic fertilizer in intensive cultivation of rice. Currently, in the Chien Village in Hoa Binh province, activities of above mentioned issues are being sponsored by JVC, and has been received well by local residents.

- *Study water conservation for irrigation:* Rice is a plant that has requires much water for cultivation, so water conservation will have significant impact in expansion of areas for irrigation. The method used is to saturate irrigation to maintain humidity when growing rice until the rice plants are splitting to inear.

Maize

- *Arrangement of right season*: Arrangement of right season has significant meaning in guaranteeing food security because corn is a major crop.

- *Deeply manuring together with supper water absorbed fertilizer l:* To sustain humidity, people need to apply the method of deeply manuring, and combining fertilizer with water hyper-absorbed materials to prevent drought between two rainy seasons.

- *Using both inorganic and organic fertilizers:* Because the land was cultivated for many years without any method to maintain fertility of the soil, the result is exhausted lands with negligible nutrients in the soil. People cannot help manuring if high productivity of corn is required. Manuring with chemical fertilizers over sloping land with light mechanical compositon during the period where water evaporation is larger than amount of gained from rain, so the effect of fertilizers is very low and requires high costs. This is not financially feasible for many poorresidents. To overcome this situation, inhabitants can use tablets of inorganic and organic fertilizers studied and produced by the Hanoi Agricultural University No. 1. This product is made from local materials, such as muck and green manure, which are available in localities.

- *Selection and purification local maize varieties*: It is neccessary to conduct a study to determine local corn seeds which have development potential for selection and revigoration.

- *Using inter-cropping and rotational crop*: Studies and promotion of local knowledge in interpolating cultivation between corn and bean plants are needed, so that inhabitants can achieve higher value per one area unit of land, while at the same time with maintaining the fertility of the landthroughout the season.

- *Growth of sugar cane as a short-term industrial plant:* For this plant, localities should plan to extend cultivation area gradually and in a reasonabe time. This plant should only be grown in lands that have irrigation.

- *Development of short-term as well as long-term industrial plants:* Solutions to reduce both risks due to natural disasters and the market, can be diversifying different kinds of plants, setting up a fund to support people who have misfortunes, and especially, upgrading and advancing knowlegde and skills in the market for ethnic groups.

Several techniques to be considered.

1. Regulating humidity

This measure plays an important role in achieving high and stable productivity during extreme weather conditions. Methods could be increasing the amount of water on the land at the beginning and the end of rainy seasons, and reducing the amount of water lost by evaporation, reducing flow of water on the top soil, and increasing the capability of water absorption. All of above mention methods have an effect on humidity. Methods are as follows:

- Deep plowing at the beginning and the end of rainy seasons in order to bring more amount of water, while at the same time soften the land so there is more dispersion of water.
- Minimizing actions occuring on the land during the period from July to September where there is a lot of rain, in order to limit the progression of erosion.
- Covering many ways such as using the remnants of plants and interpolating cultivation.

2. Soil protection technique

- Intercropping and high density planting.
- Increasing the fertility of the land by planting green-manure plant and manuring organic fertillizer. Some green-manure plants recommended in trial studies are *Flemingia congesta* and dried field bean. *Flemingia congesta* is good for the land and can be used as food for cattle. Dried Field bean with big amount of green substance, and can make land soft and dispersing, the plants supply significant organic protein. Leaves from Dried Field bean plants could be used as food for the cattle.

3. Fertilizer

In order to reduce input costs for fertilizers, inhabitants can use the following methods:

- Community-based raising management, so that production and increase source of manure can be better developed.
- Producing compost; for instance, activities in the Chien Village in Hoa Binh province, has been mobilized to change inhabitants' awareness and training on ways to produce compost effectively. Using saving manuring methods, which is a method for manuring tablets of fertilizer, and also know as fertilizer deep placement (FDP)

4. Other possible techniques as solutions

- Cultivating following the same-level lines: it means that plowing andcultivating are conducted parallel to the hillside. Its methods can contribute to reducing flow-whasing and erosion because of the water.
- Making mountainous field.
- Planting green-manure plant.
- Making reservoir to restrict water.

5.2. Raising Animals

5.2.1. Breeding animal

Development of flesh ox breeding is suitable to conditions in studied communities with low nutrition in local areas. Poor households with little capital can raise local grass oxen, but household with more wealthcan afford to raise hybrid Sind oxen. Hybrid Sind oxen may gradually become major seed .

Encouraging inhabitants to raise pigs and fowls for the supply of household activities because these two domesticated animals are suitable with local conditions and require

lower quality diet. Regulation for veterinary activities in the communities should be conduct in order to prevent epidemics, protect the hygiene of the environment, and add more source for manure for agricultural plants.

5.2.2. Food for ruminate cattle

Planning for pasturing area; in turn, pasturing can eventually restore areas and cutting hay for storage for the dry season.

5.2.3. Preventing and eliminating epidemics

- Constructing cages or fences to ensure about hygienic conditions for the animals, preventing environmental pollution, and protecting the health for both inhabitants and cattle.

- Boosting mobilization, and increase vaccination rates for cattle and poultry in localities.

- Creating conditions for local veterinary staff to attend short-time training courses on veterinary issues, such as primary and intermediary courses so that they can better control epidemics. In each village, a veterinary medicine cabinet should be constructed, and the cabinet should be managed and used by local veterinary staff.

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Summer rice plant in Chien village, Hoa Binh province

Photo*: Source of the Project funded by the Rockefeller Foundation*