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**Production and processing of canna vermicelli in
Hung Yen province toward sustainable development**

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Abstracts:

Located in the Red River Delta region, Hung Yen province has 923000 ha of total land area, of which agricultural land area occupied 60.67%. The agricultural land area per labor is 0.1 ha. However, it has been annually decreasing due to the development of industrial zone, construction of urban zone, expansion of road... For these reasons, the sustainable development for production and processing of agricultural products plays a very important role in job creation for farmers who loosed their own agricultural land, avoidance of quantity and quality loosing of raw agricultural products and increase in economic efficiency of agricultural production and processing.

The production and processing of canna are traditional jobs of rural households in Hung Yen. They not only have been creating jobs for rural households but also increasing in their income. Beside the social and economic benefit created by these activities, the processing activity has caused many negative consequences. It led to environmental pollution due to its waste, overuse of chemical substances. Desiccated of vermicelli in bad condition resulted in the unsafe food. Therefore, this study is conducted to deeply investigate both positive effects and negative consequences created by production and processing of canna vermicelli in term of economic, social and environmental aspects. This study concentrates on the farm households; discuss advantages and disadvantages of production inputs, processing techniques and output market of their products from arrowroot to vermicelli; and find out solutions for the sustainable development for production and processing of vermicelli.

Keys words: Production, canna, processing of arrowroot, sustainable development

1. INTRODUCTION

It is estimated that the *Canna Edulis ker* (dong rieng) planted area of all countries in the world is about 200,000 – 300,000 ha, of which Africa occupied the largest cultivated area and its yield is about 30 tons per ha ^[3]. In Vietnam, the *Canna* originated from Peru has been planted by French colonialists since 1896.

In order to meet the demand for flour and vermicelli of processors, the canna cultivated area has been expanded since 1986 ^[3]. In 1993, the *canna* cultivated area in Vietnam was about 30,000 ha. In some provinces such as Hung Yen, Hanoi, Hue, Dong Nai, etc the canna has been cultivated for producing flour and vermicelli.

At the 10th Congress, Communist Party of Vietnam had defined that it was essential to “stimulate the development of agricultural enterprise, especially processing of agricultural, forestry and aquaculture products” ^[2]. The production and processing of *canna* flour and vermicelli are traditional jobs of rural households in Hung Yen province. These traditional jobs not only help the local people handle with the employment issue, but also help them increase their income. Beside the social and economic benefits created by these activities, the *canna* flour processing activities have caused many negative consequences to environment; especially the residuals from this processing are released directly to the environment which led to environment polluted. In addition, the overuse of chemical substances and the unclean conditions in processing *canna* vermicelli, etc has threatened consumers by an unsafe food.

Therefore, "*Production and processing of canna vermicelli in Hung Yen province towards sustainable development*" is a suitable direction in accordance with the rural

development policy of the Party and State of Vietnam during the international integration era.

2. STUDY AREA AND METHODOLOGY

2.1 Study area

Hung Yen Province locates in the heart of the Red River Delta - the key economic zone of the Northern area and the key triangle economic zone Hanoi - Hai Phong - Quang Ninh. Hung Yen is considered as the eastern gate of Hanoi capital. The study area in this province including:

- + Tu Dan commune, Khoai Chau district. This is one of the largest communes that has many favorite conditions and has a long tradition in cultivating *canna* for flour processing.

- + Lai Trach hamlet, Yen Phu commune, Yen My district - a trade village of processing *canna* vermicelli for more than 60 years. In march 2004, Lai trach village was officially recognized as a trade village of *canna* vermicelli.

2.2 Methodology

* *Data collection:*

- Primary data of the study were collected by:

- + Semi-structure interview carried out among households of producing and processing the agricultural products in Khoai Chau and Yen My districts, Hung Yen province. In Tu Dan, we surveyed 48 households (HHs) over 719 HHs of production, processing and collecting of *canna* and flour. In Lai Trach, we surveyed 17 HHs over 18

processing vermicelli HHs. In addition, we investigated 4 HHs of wholesalers and retailers of vermicelli in Hai Phong, Quang Ninh, Hung Yen.

- + Discussion with experts and local authorities.
- + Focus group discussion: two groups in two communes, each group include 7 to 8 farmers.
- Secondary data were collected from the annual provincial reports of agricultural production; the related books; other scientific materials and the websites of related prestigious organizations.

* *Data Analysis*

The data analysis method in this study consists of:

- + Descriptive statistics used to describe the production and processing from *canna* to vermicelli.
- + Comparative statistics used to compare the economic value between the *Canna* plants and other competitive plants; and to compare the efficiency of stakeholders from producing to processing *canna*.
- + Cost - effective analysis method used to analyze the economic, social and environment efficiency from production to processing of vermicelli.

* *Indices of economic, social and environmental used in the study:* GINI index; fight against poverty; protection and health improvement; sustainable land management; rural development and sustainable agriculture; control of toxic chemicals; role and status of women in development; strengthening the role of farmers; transfers of technology; beneficiary participation^[1].

3. RESULTS AND DISCUSSION

3.1. Production and processing of *canna* vermicelli in survey areas

3.1.1 Production and processing of *canna* flour in Tu Dan commune

Table 1. Production and processing of *canna* in Tu Dan commune

Criteria	Unit	2008	2009	2010	Comparison (%)		
					09/08	10/09	Aver. (08-10)
1. No HHs cultivating <i>canna</i>	HH	1095	719	479	65.66	66.62	66.14
2. <i>Canna</i> cultivated area	Ha	279.4	193	91.43	69.08	47.37	57.20
3. Quantity of <i>Canna</i> production	Tons	15087	10229	4662	67.80	45.58	55.59
4. No of HH processing flour	HH	109	82	60	75.23	73.17	74.19
5. Quantity of <i>Canna</i> processing	Tons	20367	13289	6433	65.25	48.41	56.20

Source: Tu Dan People Committee, Khoai Chau, Hung Yen, 2011^[6]

In general, numbers of *Canna* cultivated households, *canna* cultivated areas and the quantities of *canna* production have been decreased remarkably yearly. They had been replaced by banana and other crops.

3.1.2. Processing of *canna* vermicelli in Lai Trach Commune

Lai Trach vermicelli trade village has been existed for nearly 60 years. In 1955, there were about 120 households who grew *canna*, processed flour and processed vermicelli with the average productivity of each household of 20 kg vermicelli per day. In 2010, there were 19 processing vermicelli households. By applying the semi-technology in processing vermicelli, the productivity in these HHs reaches 1000 kg to 1200 kg per

day and they can provide to the market around 1800 tons of vermicelli, achieved revenue of 39,600 million VND. This contributed significantly to the total local gross output^[7].

3.2. Production and processing of *canna* vermicelli of surveyed households

High average age of household headers (over 50 years old) is one of the major obstacles in applying the modern technologies in processing the *canna* flour and *canna* vermicelli. Most of household headers are male (accounted for 63%).

3.2.1 Economic, social and environmental efficiency of *Canna* production.

* *Economic efficiency:*

According to the *canna* growers, banana is one of the most competitive trees to *cannas*. Thus, to evaluate the economic, social and environment efficiency, banana is chosen to compare with *canna*.

Table 2: Comparisons between the *Canna* and Banana (average per ha)

Criteria	Unit	<i>Canna</i> (1)	Banana (2)	(2)/(1) (%)
I. Intermediate Cost (IC)	1000VND	30426.42	36499.39	119.96
II. Family labors	Working day	45	302.33	671.85
II. Gross output (GO)	1000VND	51924.87	104281.77	200.83
III. Value added (VA)	1000VND	21498.45	67782.38	315.29
IV. Mixed Income (MI)	1000VND	21498.45	67782.38	315.29
V. Profit (Pr)	1000VND	16998.45	37549.11	220.90
VI. Variation coefficient of MI	%	22.58	41.64	

Source: Survey, 2009

Mixed income of banana production was 3.15 times higher than that of *canna*. This is the main reason why growing area of *canna* reduced significantly over time. However, the variation coefficient of mixed-income indicators of banana was 41.64% while that of *canna* was only 22.58%. It means that the representative level of banana growing group is lower than that of *canna*. It also implies that the risk of growing banana is higher than growing *canna*.

** Social and environmental assessment in canna production*

Canna production creates less employment for family labors (45 working days per ha) than banana production (302 working days). However, intercropped production of *canna*, corn, peanuts or peas has more positive impact on improving the fertility of soil than banana mono production

Canna production uses more organic fertilizer (burnt ash) and requires less chemical fertilizer and pesticide, which contributes greatly to maintain sustainable of soil as well as to ensure safety inputs for flour processing stage. In contrast, banana production used larger amount of pesticide, especially nourishing fertilizer for leave with unclear origins. This situation resulted in potential threats for banana growers, consumers and living environment, as well.

Canna is an easy growing tree. It is also easy to adapt to external conditions and has high resistance to diseases. Profit of *canna* production and processing is 2 to 3 times higher than rice production ^[3]. And it can survive in some harsh condition that banana cannot.

In summary, production of canna can generate income for households, maintain and develop conventional agriculture, and satisfy sustainable development.

3.2.2 Economic, social and environmental efficiency of canna vermicelli processing

** Technology of flour processing*

Table 3: Phrases of flour processing

Phrase	Work	Technology	Waste
Phrase 1	Washing root	Manual	Waste water and solid waste
Phrase 2	Milling	Machine	
Phrase 3	Stirring 1 st	Machine + Manual	
Phrase 4	Filtering 1 st	Manual	Waste water and organic waste
Phrase 5	Stirring 2 nd	Machine + Manual	
Phrase 6	Filtering 2 nd	Manual	Waste water and organic waste
Phrase 7	Package	Manual	

Source: PRA 2010

Nowadays, the farmers used machines and new techniques in some phrases of processing (especially the phrase 1, 3 and 5). This contributed to increase processing scale. The processing capacity is about 4 tons of canna per times.

In 2009, the average discharge amount of flour processing in Tu Dan commune was 74.7 thousand m³ liquid waste which came directly to canals and

3864.7 tons solid waste, mainly organic matters (root skim, soil) disposed to the environment without any treatment.

** Technology of vermicelli processing*

In vermicelli processing, the application of machines and techniques in some phrases (phrase 5 and 7) creates condition to increase outputs per processing times from 1 to 1.2 tons of vermicelli in case of using 10 to 12 employed working days. However, the usage of whitening chemicals in processing vermicelli may lead to potential threats for both vermicelli processors and consumers.

Table 4: Phrases of vermicelli processing

Phrase	Work	Technology	Waste
Phrase 1	Wash flour	Machine + Manual	Waste water, solid waste
Phrase 2	Filer, whiten flour	Machine + Manual	Waste water
Phrase 3	Rewash flour	Machine + Manual	Waste water
Phrase 4	Flour	Machine + Manual	Heating and evaporation water
Phrase 5	Flour	Machine	Heating and evaporation water
Phrase 6	Dry vermicelli 1st	Machine + Manual	Heating and evaporation water
Phrase 7	Cutting	Machine	Solid waste
Phrase 8	Dry vermicelli 2nd	Manual	Water evaporation

Source: PRA 2010

In 2009, vermicelli production in Lai Trach village, Yen Phu commune created a rather large amount of waste, around 28.3 thousand m³ liquid waste and evaporation water with contaminated whitening chemicals into the environment through canals; and about 70 tons solid waste disposed to the environment without treatment.

* *Economic efficiency*

Table 5: Results and economic efficiency of flour and vermicelli processing

Items	Unit	Processing of flour (1)	Processing of vermicelli (2)	(2)/(1) (%)
I. CPTG (IC)	1000VND	65105.76	108506.38	166.66
II. Family labor	Working days	35.78	41.37	118.85
III. Production revenues	1000VND	87467.04	138924.10	158.83
V. Value Added (VA)	1000VND	22361.28	30417.73	136.03
VI. Mixed income (MI)	1000VND	20535.37	27751.10	135.14
VII. Profit	1000VND	16706.74	23200.89	138.87

Source: Survey data in 2009

Processing of flour creates high income for households. On the average, mixed income per ha of a flour processing household was 20.5 million VND and their net income after deducting family labor cost was 16.7 million dong. The mixed income and net income from processing vermicelli was higher than flour processing at 1.35 and 1.39 times, respectively. Both flour and vermicelli processing bring high income for processing households.

** Social and environmental efficiency in processing*

All processing households used their own houses, yards and gardens for doing their business. Each household own only 0.05 to 0.1ha. However, this area cannot enough for their working. On the average, each vermicelli processing household had to rent 0.15 ha for drying vermicelli. The cost for renting land is also very high at the average price 49.18 million VND per ha per year. Most of households wish to get supports from local government for having enough land for their production.

Flour and vermicelli also generates employment for local people. On the average, it generates 104.16 working days in flour processing and 147.4 working days (both family and employed labor) in vermicelli processing for 1ha canna production. It also helps to attract a great number of labors from neighboring areas, increases their income; contributes to stabilize population; and reduces immigration from rural to urban area for finding work.

However, there is a converse role of male and female headers between two groups: production and processing *canna* flour; and *canna* vermicelli production. In the group of production and processing canna flour, the male headers accounted for only 47.73% while in the other group, the male headers occupied 95.24%. In vermicelli processing, the participation of women in some phrase is higher than in canna flour processing because of requirements on skilled labor for making vermicelli threads, laying and drying vermicelli. Over labor age women can also involve in vermicelli tying work.

Beside great economic and social benefits, there has been increasing evidence of threats to the living environment of canna processing villages due to the poor knowledge of processing households in using additives and drying products in unsanitary places.

From the group discussion of vermicelli processing households, 30% of households dried vermicelli near inter district and commune roads, 10% dried vermicelli near animal husbandry area. All of processing households used additives for whitening flour without any standard guide. According to Ho (2002), chemicals used in whitening flour include NaHSO_3 0.3% và KMnO_4 0.1% [4]. However, households used much higher amount, up to 25- 50% of NaHSO_3 and KMnO_4 . They even used poisonous chemicals such as H_2SO_4 , coloring chemicals with non-original identification, unclear trademarks. Of which, about 10- 20% of un-original flour imported from China through illegal trading which was very difficult for quality control.

Although processing activities created employment for many people, 100% workers were not provided health protection facilities and could not access to health insurance. The working environment and conditions of vermicelli workers remains potentials for risks.

In brief, Canna flour and vermicelli processing as well as other food and foodstuff processing in Vietnam have many negative impacts to the living environment of processing workers and surrounding communities.

Box 1: Pollution of the living environment

Mr Nguyen Van Hung, a resident of Lai Trach village: “water sources in the village are increasing seriously influenced due to waste water from vermicelli production and cattle rising. Waste water is not treated; canals are small and not regularly repaired leading to stagnant waste water, and waste water flood into village roads with bad smelling. This situation imposed negative impact on the health of local people.”

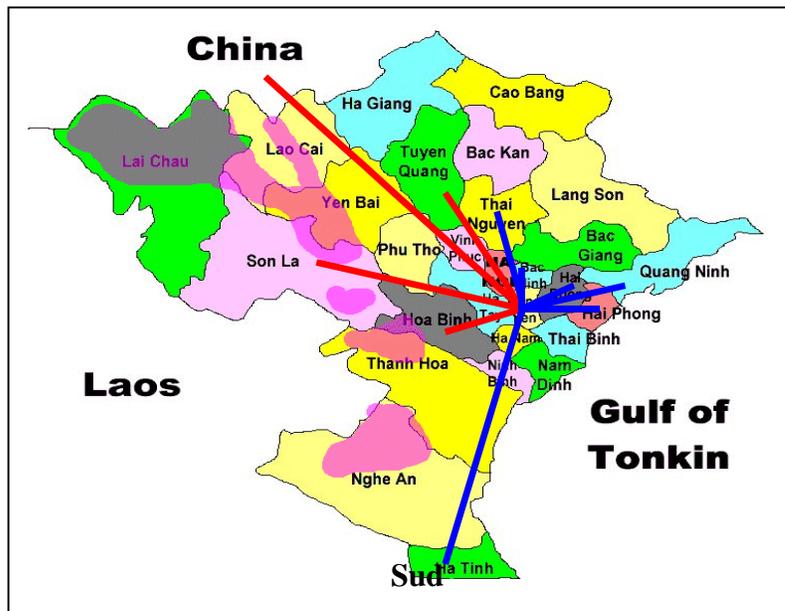
3.2.3 Value chain of vermicelli in Hung Yen

* *Economic efficiency*

Production, processing and marketing of canna vermicelli is a chain with the participation of many actors. The value chain approach focuses on financial cost and shows economic benefit, roles of each actor in the value chain of canna vermicelli.

In 2009, the main sources of canna flour came from Tu Dan commune, accounted for about 70% and other 30% came from Son La, Tuyen Quang, Hoa Binh and China.

The market for outputs spreading out to many provinces from the North to the South. However, the products were mainly sold in the Northern provinces such as Hung Yen, Thai Nguyen, Hai Phong, Hai Duong, Quang Ninh, Bac Ninh and Hanoi, etc.



Map 1: Product flow of vermicelli of Lai Trach village

- Legend
- Markets for canna flour products of Lai Trach village
 - Markets for canna vermicelli products of Lai Trach village

There are 6 actors in the value chain of vermicelli in Lai Trach village from canna producers to final consumers, of which 4 actors are agriculture based (arrowroot producer, flour processor, flour collector, vermicelli processors) and two other actors are small scale private traders (wholesalers, retailers in provinces).

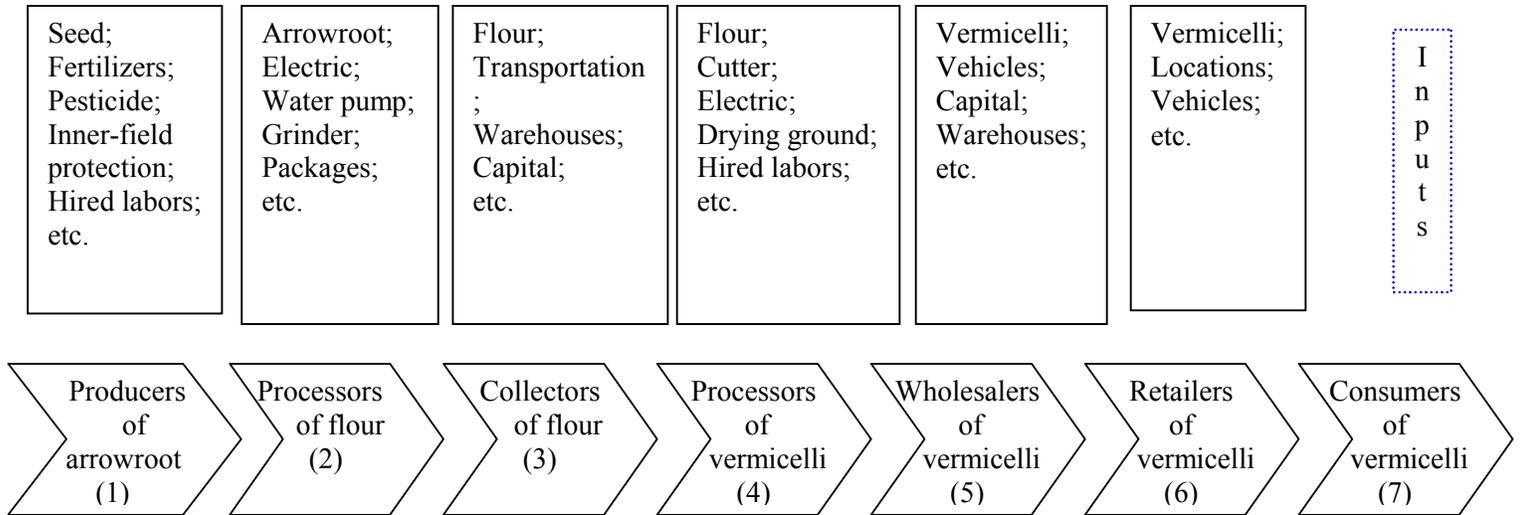


Diagram 1: Value chain of vermicelli in Hung Yen

Table 6: Outputs and selling price of vermicelli value chain in Hung Yen

Agents	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outputs (tons/ha)	55.56	10.36	10.36	7.84	7.84	7.84	7.84
Selling price (millionVND/tons)	0.77	6.66	6.97	17.76	20.02	20.73	

Note: Flow of equivalent products by a ha of canna production

** Distribution channels of vermicelli*

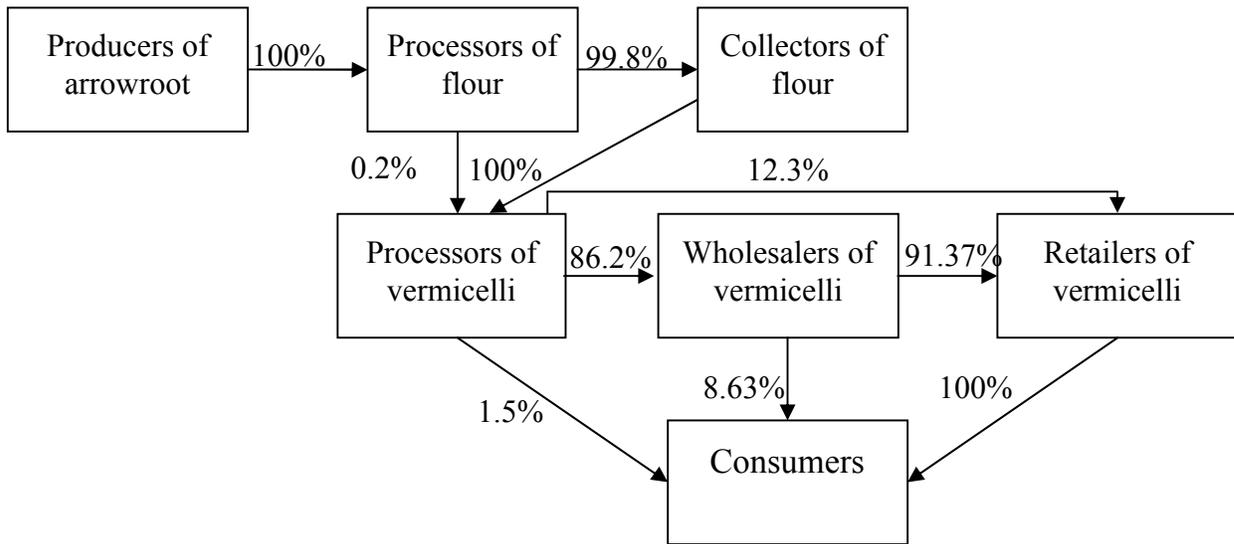


Diagram 2: Distribution channels of canna vermicelli in Hung Yen

Vermicelli in Lai Trach is sold in many provinces. Without any trademark, its can only provide in informal and open air market. It could not approach to formal markets such as supermarkets, restaurants.

A comparison of Vermicelli’s characteristics from Lai Trach (Hung Yen) to those of neighboring areas has revealed the competitive potentials of Lai Trach’s products on markets.

Processing and consumption of these products has brought incomes and opportunities for households to participate in the markets. Farmers’ roles, their market accessibilities, and their living standard have been improved. However, awareness of processing households about markets is limited. Although vermicelli of Lạị Trạch trade village has not been branded yet, it is still popularly accepted and highly appreciated by consumers.

Table 7: Characteristics of Hung Yen’s vermicelli to those of neighbor provinces

Indicators	Hung Yen	Thai Binh	Ha Tay
1. Rate of grit remained in product	1	3	2
2. Product level of toughness	1	2	3
3. High price	2	3	1
4. Product design	2	3	1
5. Product level of thinness	2	3	1
6. Rate of canna flour of products	1	2	3
7. Color of products	White, light yellow	Wooden, black	Various (lemon, red brown,..)
8. Product brand	Not yet	Not yet	Yes
9. Linkages to retail markets	Markets	Markets	Markets,supermarkets

Note: 1 is the best, 3 is the worst

Source: PRA surveys in 2010

Box 2: Registration of collective product brands

Mr. Phung - a Secretary of Lai Trach, said: “For years, district leaders at all levels have encouraged the trade village to apply a brand registration for Lai Trach’s vermicelli. Nevertheless, when presenting this proposal to a meeting of processing households, it was disapproved since there was a wonder of paying high taxes by having a brand. At the moment, there are some businessmen from Hanoi bought products of Lai Trach and re-sell them to supermarkets after packaging and labeling brands name”.

* *Division of economic benefits by chain operators*

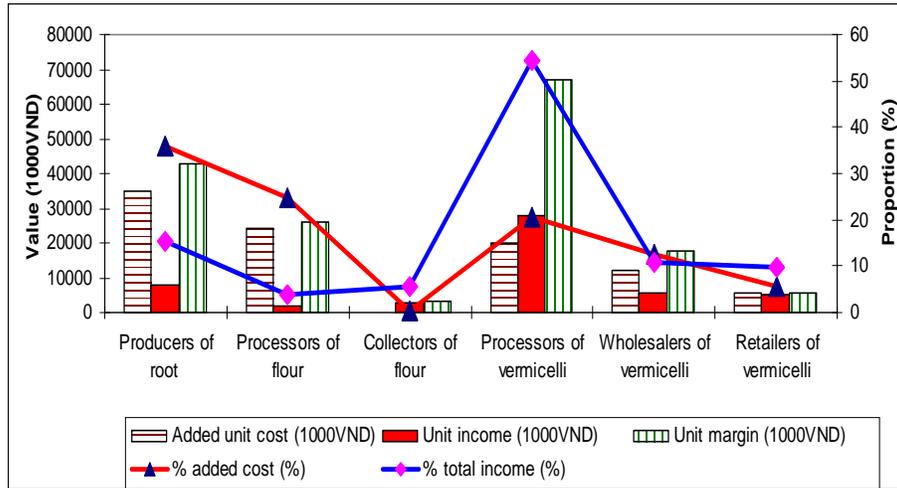


Figure 1: Distribution of cost, income and margin among agents

The benefit distribution of operators in the chain is considerably different and unequal. The group of cultivation household invests 35.85% total added-cost but gained only 26.34% total income; while the group of vermicelli processing household spends 20.67% total added-cost but gained 54.57% total income of the whole chain.

All income sources of 2 main groups (flour production and processing, and vermicelli processing) are presented in the following figure:

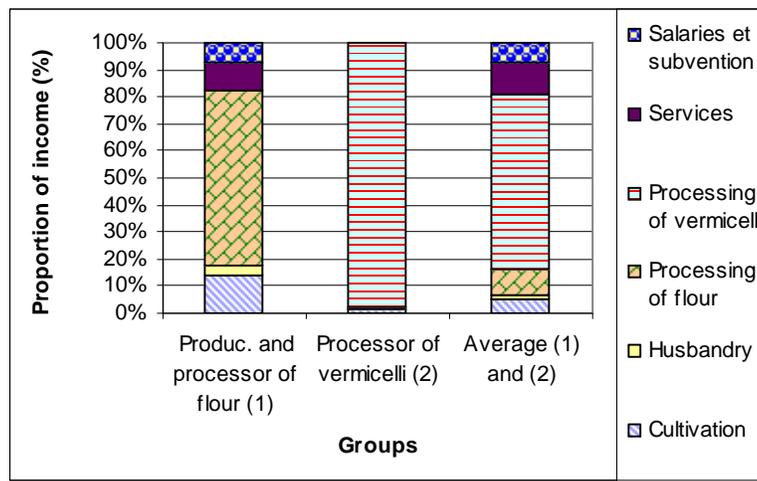


Figure 2: Proportion of income by groups

For the group of flour production and processing, mixed-incomes from flour processing took 34.67% of the total household income. Incomes of arrowroot cultivation took 44.35% of total income from cultivation phrase (approximate 9.5% of the total household income in 2009) meanwhile bananas only took 21.77% of incomes from cultivation. Hence, arrowroot has played as a main crop of households. Cultivating arrowroot does not require much work (45 working days per ha during 10 months) and processes of arrowroot just concentrate on 2 - 3 last months of the year (each household focuses on processing 15 times/year). Therefore, a large numbers of off-season labor from these households go to urban areas to run small businesses or work as hired labor. Incomes from wages, allowances took the highest proportion (37.9%) in the total household income. However, this immigration from rural to urban area to seek jobs has caused many disorders in the local region. Several social troubles (i.e. drug addiction) have emerged in the locality in recent years.

Incomes from vermicelli processing in the group of vermicelli processing occupied 97.31% of the total household income. It implies that vermicelli processes has played an important role to the production pattern of this group. In spite of running agricultural production, incomes from cultivation of these households account for a very little proportion (1.5%) in the total household income.

** Social effect aspect*

Index of GINI and Lorenz curve indicated that average income of 2 surveyed groups is high gap (GINI index was 0.583). 64.62% of household with their incomes belonged to group 20% of lowest income in total surveyed households. 4.62 % of

household with their incomes belonged to group 20% of highest income in total surveyed households.

The average income per household of group with 20% highest income was 2.89 times higher as compared to that of group with 20 % lowest income.

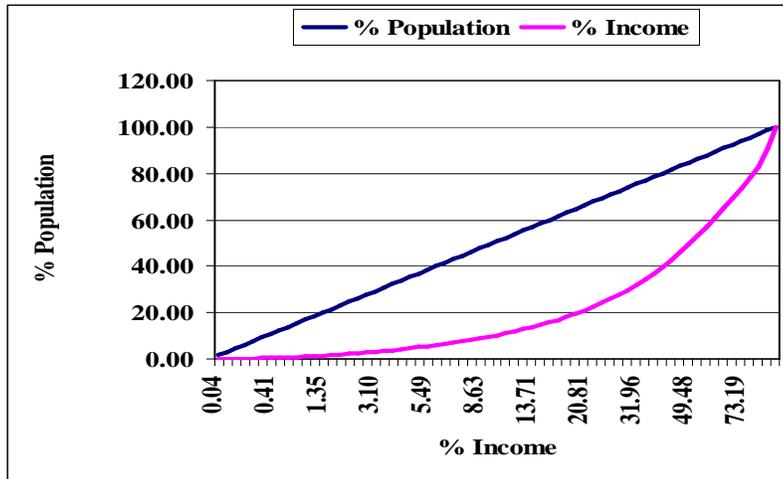


Figure 3: Lorenz curve

3.3. Some solutions toward sustainable production

Canna production should reach a stable trend.

The awareness of processing household should be improved. They must strictly follow the safety standard of using substances during processing process. Further, using the drying system in good condition is very necessary for their vermicelli process.

Economic punishment solution should be imposed for processing households to reduce waste discharging to the environment. Moreover, the local system of waste treatment also should be built soon.

It is very important for local authorities to disseminate and enhance awareness of household in protection and development of brand product of villages.

4. CONCLUSIONS

Production and processing of canna vermicelli in Hung Yen province toward sustainable development is very necessary.

Canan production created a stable income and faced with a lower risk than banana production. However, income from banana production was higher than that of banana production. For this reason, the farm households have been reduced their canan land area. A large numbers of off-season labor from these households go to urban areas to run small businesses or work as hired labor. This immigration from rural to urban area to seek jobs has caused many disorders in the local region.

Flour production and vermicelli processing have been created a jobs and stable income for local farmers and neighboring labors. It is significant contributed for stability of their life.

Laitrach's vermicelli has been gradually increased in consumed quantity in market, especially in the Red River Delta region. However, this product has not been access to consumers in supermarkets, restaurants due to lack of trade label of product.

Health protection of processing labors, consumers and the standard of food safety has been ignored by local authority and other related offices.

Untreated waste from processing has caused a seriously polluted the environment.

The large income gap exists between group of canan production, flour production and group of vermicelli processing.

In order to reach the objective of sustainable in cana production, processing and selling products, the close cooperation of all related officers in Hung Yen is very necessary and urgent.

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