

AN INVESTIGATION OF LOCAL COMMUNITY EXPERIENCES ON THE IMPACTS OF EDIBLE CANNA CULTIVATION AND PRODUCTION IN CAO BANG PROVINCE

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Abstract. Vietnam is well-known for its agricultural production, a backbone of the country's economy since *Doi Moi* in 1986 and even after the pandemic. Many areas have witnessed the positive impacts of poverty reduction and livelihood boosted by expanding the food crops areas nationwide. This study focuses on edible canna, one of the most preferred crops to local people in many provinces in the Northern Midlands and Mountainous region due to its suitable natural resources. While this highly productive crop has led to socio-economic improvement, it also entails to myriad of impacts on local. By applying the qualitative research method through 20 semi-structured in-depth interviews and field observations conducted in early September 2023, this paper analyzed the spectrum of impacts through the lens of local people in Nguyen Hue commune, Hoa An district, Cao Bang province. We show that apart from the widely known optimistic effects, the challenges of edible canna cultivation and production have emerged. Key questions addressed include: How does the local community maintain the earnings from edible canna production? How has the local community fared amidst the current situation as results show that branding and environmental issues have affected severely to the future of this crop? This paper contributes to debates on matter production of edible canna given the concern that this plant has its life cycle.

Keywords: Edible canna, Northern Midlands and Mountainous region, impacts, local community.

1. Introduction

Food crops, one of six crops, are one of the most important nutrition sources and are garnered for daily consumption [1]. The development of food crops has solved the problem of food security worldwide in the context of an increasing global population [2, 3]. In addition, food crops are a source of cash for many poor farmers and a means to poverty reduction and alleviation [4-6]. Nevertheless, the production also poses significant threats to the environment. Agriculture and food production are responsible for more than 25% of total global greenhouse gas (GHG) emissions into the atmosphere. Groundwater resources are being rapidly depleted and polluted by fertilizers and pesticides.

Received September 21, 2023. Revised October 14, 2023. Accepted November 15, 2023.

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Biodiversity has been deeply eroded due to these practices. Deforestation, primarily for agriculture, generates a significant portion of global greenhouse gas emissions and causes habitat destruction, species loss, and biodiversity erosion [7, 8].

According to the classification of the Food and Agriculture Organisation of the United Nations (FAO), food crops are divided into two main groups, grain food crops (collectively called cereals) and root food crops. In Vietnam, food production is concentrated mainly in two regions including the Red River Delta and the Mekong Delta. These two regions alone account for 63.5% of the country's food production structure [9]. In recent days, besides grains, many potential crops have been included by localities in the region's food crop structure in the Northern and Midlands Mountainous region due to its elevated terrain and diverse climate types. Notably, edible canna is one of the root food crops that has been chosen to grow since the 1990s as a means to diversify livelihood and increase income in many places.

Before starting the empirical part, it is worthwhile to highlight the relevant research on edible canna. This issue has occurred in some research in which the authors analyzed the application of edible canna to ensure food security, livelihood diversification, and economic development contribution [10-12]. The first challenge of growing edible canna is to ensure its quality over an extended period [13-17]. On the other hand, research has shown that edible canna cultivation and production, of course, also face other hardships such as environmental pollution [18] and branding [19, 20].

The Northern Midlands and Mountainous region are made of 14 provinces across 116,898 km² (about 35% of the country). The total population is approximately 14.7 million (about 15.2% of the country) [9] with more than 30 ethnic groups including Thai, Dao, Tay, Nung, H'mong, and Kho Mu, to name a few. Each group possesses its own cultural and farming practices. Since the early 2000s, this region has achieved significant socio-economic achievements. Nevertheless, it still endures the country's poorest and most disadvantaged regions in terms of per capita income as well as poverty rates. The average monthly income by region of the Northern Midlands and Mountainous is 2.8 million VND (117 USD), while the Red River Delta and Southeast regions range from 5 to 6 million VND (208-250 USD) per month [9]. In addition, the top ten provinces and cities with the highest poverty rates in Vietnam mostly situated in this region, including Dien Bien (34.5%), Son La (28.6%), Lai Chau (27.9%), Ha Giang (25%), Cao Bang (24.5%), Bac Kan (20.65%), Lao Cai (14.8%), and Yen Bai (14%) [9]. This announcement has showcased a recurrent issue in this region.

Cao Bang, a province with a rapid development of edible canna cultivation and production is chosen as a case study. The authors recognize the need for more empirical research on the impacts of this food crop. This is a complex issue driven by many factors. From the perspective of sustainable poverty reduction, the number of research on this topic has mostly focused on the technical aspect rather than its economic impacts and challenges. Limited research implies a need to have more support schemes and empirical studies, particularly concerning ethnic groups and the cultivation of edible canna.

The next section provides a brief overview of the research methodology, the results, and implications are discussed. The discussion part also provides appropriate suggestions. Finally, the conclusion sums up the findings.

2. Content

2.1. Methodology and research area

2.1.1. Methods

This study utilizes the qualitative approach by applying the qualitative semi-structured in-depth interviews. This is a method of interacting with individuals and paying close attention to their tales in a relaxed environment. Volunteers were found through purposeful snowball sampling. At first, prospective participants were contacted based on the heads of the villages' suggestions. These are where subsequent participants are drawn from. The authors visited the study site and conducted fieldwork in September 2023.

The authors randomly selected 20 households living in three villages in Nguyen Hue commune, whose family economy depends on edible canna and other crops. Of the 20 interviewees, it is estimated that more than 80 percent are Nung. The interviews were conducted mostly in the standard Vietnamese Kinh language. This study employs a qualitative thematic approach to data analysis. The majority of interviewees are men, and most of them are at the age between 50 and 65 years old. The authors interviewed the participants before the harvest season when farmers had free time to stay at home.

2.1.2. Research area

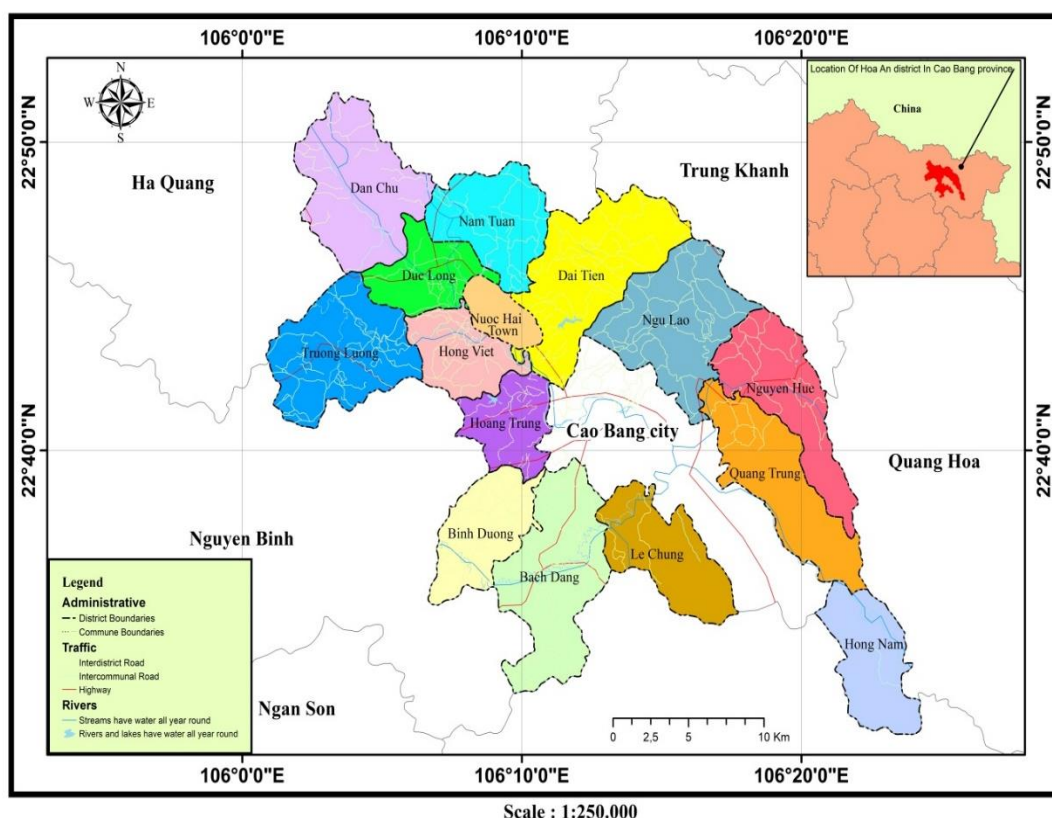


Figure 1. Administrative map of Hoa An district, Cao Bang province

This section provides general information about Nguyen Hue commune where the edible canna cultivation and production takes place. Nguyen Hue commune is located in the southeast of Hoa An district, Cao Bang province, 31 km away from the district center,

covering an area of 4.343 hectares. As of December 31, 2021, Nguyen Hue Commune has a population of 3.964 people with 936 households. According to the People's Committee of Nguyen Hue commune, there are 6 ethnic groups living together, including Tay (about 44 percent), Nung (about 48 percent), and other ethnic groups such as Kinh, Mong, Dao, and Muong.

Nguyen Hue commune has a total agricultural land area is 673.38 hectares which accounts for 15 percent of the total area. The terrain is strongly divided by small streams, high hills and mountains, steep slopes, challenging weather conditions, heavy floods in the rainy season, and winter droughts. About one-third of land is suffering from drought, which greatly affects agricultural production. Against this backdrop, Nguyen Hue commune has gradually introduced edible canna into the local crop structure to improve food security and livelihood diversification. Currently, the commune has 90.07 hectares of edible canna growing area (13.37% of the agricultural land area) with 402 growing households (42.2% of total commune households), of which 217 households produce canna vermicelli (54% of households growing edible canna). In recent years, thanks to the development of science and technology, consumer marketing has become more widespread. Therefore, the canna vermicelli consumption market has gradually expanded to many provinces and cities across the country.

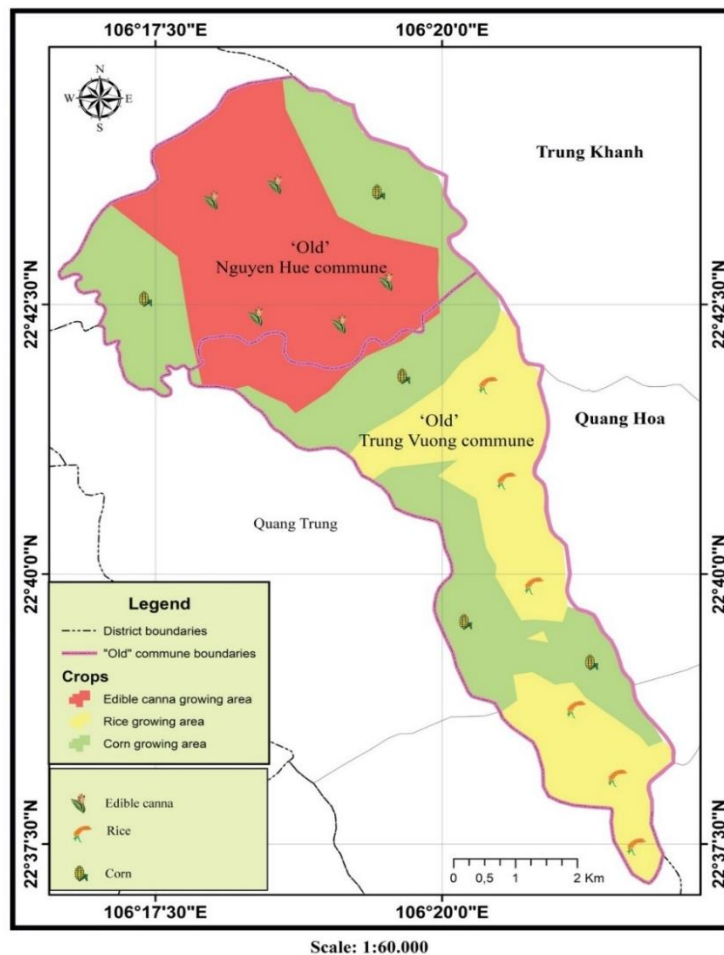


Figure 2. Map of food crops distribution in Nguyen Hue commune

Secondary data informed the rearrangement between Nguyen Hue commune and Trung Vuong commune in 2020 entailed a new Nguyen Hue commune at the moment. This expansion was by Resolution No. 864/NQ-UBTVQH14 dated January 10, 2020, issued by the National Assembly Standing Committee on the arrangement of administrative units at district and commune levels in Cao Bang province. Figure 2 demonstrates the food crops distribution in Nguyen Hue commune. The area occupies approximately two-thirds of the ‘old’ Nguyen Hue commune.

In this newly established Nguyen Hue commune, the ‘income’ boundary between the ‘old’ Nguyen Hue and the ‘old’ Trung Vuong commune remains the same. This fact reveals that a large share of income in the old Nguyen Hue commune originates from edible canna. The local households concurred that rice and corn cultivation have not improved the income and living standard of the growers in the Trung Vuong area. Although the local government has continuously tried to encourage its people to alter the crop structure, two reasons are found to hinder the decision. First, the arable land in the ‘old’ Trung Vuong is not as good for growing edible canna as in the ‘old’ Nguyen Hue. Secondly, lack of experience obstructs farmers from planting and make canna vermicelli. During the fieldwork, the researchers noticed a ‘crop’ boundary between Nguyen Hue and Trung Vuong.

2.2. Results and Discussion

2.2.1. Results

2.2.1.1. History Of Edible Canna Cultivation and Production

According to results obtained from the field trip, edible canna was used to grow on a small-scale area by the local people in the 1990s until the early 2000s in the former Nguyen Hue commune. The important factor causing edible canna productivity to decrease over the years was the tendency to the bearing capacity of the soil after almost 10 years, affecting the sustainability of ready-made planting in the future. Moreover, the price of the canna vermicelli was largely determined by the markets, leading to the lack of interest from local people in the Nguyen Hue commune. Consequently, this plant was out of food crop structure and people switched to rice and corn cultivation to ensure a living. Figure 3 illustrates the timeline of edible canna cultivation in Nguyen Hue commune, Hoa An district, Cao Bang province since the last decade of the 20th century.

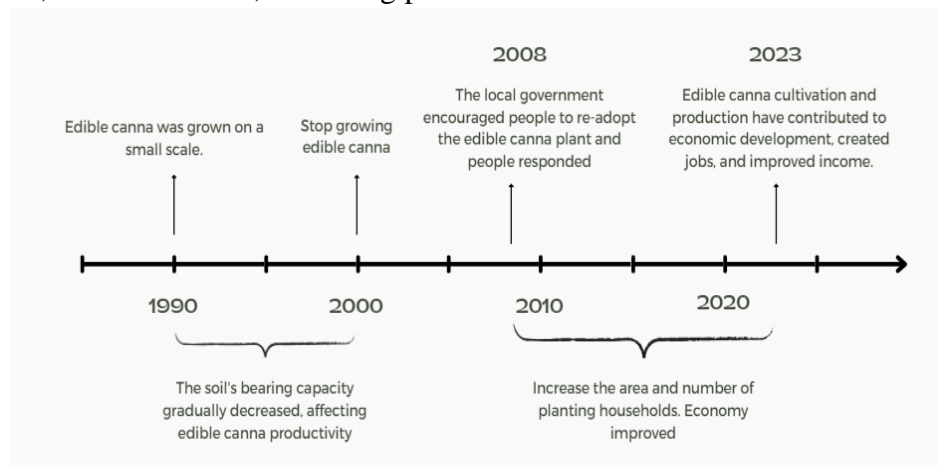


Figure 3. Timeline of edible canna development in Nguyen Hue commune

It was not until 2008 when the local government, once again, encouraged its people to re-apply a so-called new edible canna variety. The local government also provided financial support, introducing new techniques as well as machine supplies to make canna vermicelli. Households have re-joined with all their passion. Surprisingly, the cultivation area of edible canna has expanded sharply and spread to many neighboring districts such as Trung Khanh, Quang Hoa, and similarly, in Cao Bang province. Table 1 provides a detailed edible canna expansion since 2012 until now.

Table 1. The expansion of edible canna area in Nguyen Hue commune (2012-2023)

Year	2012	2017	2020	2021	2022	2023
Area (hectares)	22	37	67.8	82	88	90.07

In 2021, the People's Committee of Nguyen Hue commune developed plan No. 26/KH-UBND on developing edible canna plants for the period 2021-2025 to increase the area and increase income for households participating in edible canna growing.

2.2.1.2. Economic Impacts

As mentioned in the literature review, edible canna cultivation and production has brought various economic benefits. This section presents the positive impacts on local people in three hamlets in Nguyen Hue commune. Table 2 presents the general information of participants in terms of cultivation area, productivity, investment cost, and monthly income:

Table 2. General information of participants regarding food crops in three hamlets

Participants	Village	Cultivated land area (m ²)	Productivity	Price (VND/kg)	Investment costs (mil.VND)	Monthly income (mil.VND)
<i>Edible canna cultivation and canna vermicelli production</i>						
Participant 1	An Lai	Over 2.000	10 tons of rhizome	60,000	50 – 60	27
Participant 2	An Lai	5.000	20 tons of rhizome	60,000	> 30	> 20
Participant 3	An Lai	4.000	3 tons wet of starch	60,000	> 30	> 10
Participant 4	An Lai	3.000	10 tons of rhizome	60,000	30	> 20
Participant 5	Na Danh	Over 1.000	8 tons of rhizome	75,000	> 20	30
Participant 6	Na Danh	3.000	3 tons of wet starch	60,000	30	23
Participant 7	Na Danh	4.000	14 tons of rhizome	60,000	30	> 10
Participant 8	Na Danh	Over 4.000	4 tons of wet starch	60,000	30	20
Participant 9	Na Danh	1.500	1,2 tons of wet starch	60,000	> 20	> 10

Participant 10	Canh Bien	5.000	25 tons of rhizome	60,000	25	> 30
Participant 11	Canh Bien	Over 3.000	12 tons of rhizome	60,000	30	> 20
Participant 12	Canh Bien	1.500	7 tons of rhizome	60,000	> 20	10 – 15
<i>Edible canna cultivation and starch production</i>						
Participant 13	Na Danh	3.000	> 2 tons of dry starch	30,000	5	7
Participant 14	Canh Bien	5.000	> 3 tons of dry starch	30,000	7	7 – 8
Participant 15	Canh Bien	2.000	2 tons of dry starch	30,000	5	6 – 7
Rice and corn plant						
Participant 16	An Lai	1.500	1 ton	N/A	1	12
Participant 17	An Lai	2.000	1,3 tons		1	4
Participant 18	An Lai	2.000	1,3 tons		> 1	5
Participant 19	Na Danh	1.500	1 ton		1	15
Participant 20	Na Danh	3.000	> 2 tons		> 2	5

Table 2 has classified the participants into three groups: (1) Edible canna cultivation and edible vermicelli production, (2) Edible canna cultivation and starch production, and (3) Rice and corn growing. Through in-depth interviews and field observations, the authors found positive changes in the economy and people's daily lives. Among the three interviewed hamlets, Canh Bien is the pioneer in growing edible canna. Currently, the whole hamlet has more than 90 households growing edible canna over 101 households which accounts for almost 90 percent. Due to favorable soil conditions, edible canna productivity is considered to have the highest quality in comparison with the other two hamlets. In An Lai hamlet, approximately 50 out of 94 households grow and produce canna vermicelli, reflecting a long tradition of making canna vermicelli. The recent joiner is Na Danh hamlet. The entire hamlet has over 100 households, of which nearly 50 households grow and make canna vermicelli.

Households growing edible canna and producing canna vermicelli have a monthly income from 10 million VND to nearly 30 million VND. These households all grow edible canna on their entire cultivated land area. These are the richest households that have invested substantially in machinery. After one year, they typically achieve break-even, and then start making small profits. Households with incomes over 20 million VND produce a large volume of vermicelli (nearly 40 kg of vermicelli per day). On average, one household can produce up to 500 kg of vermicelli in one month (depending on the

weather factors). Therefore, the determining factor for group 1's income in Table 2 is the amount of vermicelli they produce in a month. One participant from An Lai village shared the straightforward process of making a profit from edible canna, contributing to the improvement of their life quality,

Making a profit from canna vermicelli is much easier than growing corn and rice. My life has improved a lot. The money to build this house came from growing edible canna and making canna vermicelli.

(Participant 2, An Lai village)

As seen in Table 2, there are differences in income between households with different cultivated areas. The reason is that the income of these households depends on the sale of canna vermicelli and the quantity of vermicelli produced. The households that produce more canna vermicelli will have a higher income than the remaining ones. However, producing a lot of canna vermicelli depends on whether the drying yard area is large enough for them to make a lot of canna vermicelli.

The second group is the households who cannot accumulate enough money to start their edible canna production as well as finding an outlet of the products. Consequently, these households will only produce starch and sell it to the first group. Currently, canna edulis starch alone is 30,000 VND per kg. The cost of grinding is 10,000 VND per bag. The monthly income of these households depends mainly on their edible canna, in addition, they also grow corn, and rice and raise livestock.

Because my family didn't have enough manpower or money to buy machines, we dug up rhizome, grind starch, dried it, and then sell the to vermicelli production households.

(Participant 14, Canh Bien village)

For those households who do not grow edible canna, their total monthly income is around 10 million VND because they have stable jobs and salaries. With such income, they only grow rice in a small area to meet their food security needs. The remaining households have a total income of 4 - 5 million VND as they depend on rice and corn. Although these households all want to grow edible canna and make canna vermicelli, the arable land is not good enough to meet the ecological conditions required for edible canna. It can be seen that soil condition is the most crucial factor in the development of this plant. A participant expressed the challenge,

My family also wants to grow canna plants to improve the economy. Households that produce vermicelli have high incomes, but our arable land is only suitable for growing rice, so the income is insufficient.

(Participant 17, An Lai village)

Table 3. A comparison of corn, rice, and edible canna on an area of 1000 m²

Food crops	Productivity	Income (VND)	Price (VND/kg)
Corn	- 50 bags of corn - 16 bags of seeds (after separating the seeds)	6,6 mil.	8,000
Rice	17 bags of rice	10,2 mil.	12,000

Edible canna	- 750kg wet starch - 525kg dry starch - 420kg canna vermicelli	25,2 mil.	60,000
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The expanding market has encouraged people to actively produce canna vermicelli. Over 90% of households believe that edible canna is a plant that can quickly alleviate hunger and reduce poverty. According to the data collected by the author, the author compares rice, corn, and edible canna in Table 3.

The income and output from this edible canna are three times higher than growing rice and four times higher than growing corn. The income of the group of people who grow and make vermicelli is 2.7 times higher than the group of people who produce starch and 4 times higher than the group of people who grow corn and rice. Previously, when edible canna was not widely grown, local people's income mainly depended on rice and corn. The monthly income of poor households is only 1 to 1.5 million VND per month. After edible canna plants were included in the crop structure of households and people learned how to make canna vermicelli for sale, the income gradually improve. Currently, the entire arable land of many households is for growing edible canna.

2.2.1.3. Challenges

In this section, the authors mention the challenges that local people have been facing in the process of promoting the development of edible canna. Canna vermicelli producers in Nguyen Hue commune have gradually changed from using manual production methods to applying modern techniques to increase output and quality. This has met the domestic demands; however, all the products have not been confirmed to meet the standard outlined in the OCOP Vietnam quality requirements. In contrast, the neighbouring province of Cao Bang province, Bac Kan province, exported the very first batch of canna vermicelli to the European markets in mid-2020 [21].

Simply put, OCOP (One Commune, One Product) products are 5-star traditional product certifications with a rigorous evaluation process. Products that meet OCOP standards will be brought to major markets [22]. From the local's point of view, when their products receive OCOP certification, the product price will be higher and there will no longer be concerns about price pressure. Currently, people mainly sell canna vermicelli in 1kg bundles. However, the producers are afraid of losing their brand when traders come to buy the bundles and sell them elsewhere at higher prices. A participant raised their concern.

I made the canna vermicelli, but traders bought it, labeled it, attached their brand name, and then brought it to the supermarket for more than 100,000/ kg. It is very disadvantageous for local people here without their brand and certificate.

(Participant 3, An Lai village)

The second challenge is the insufficient fertilizer support from the local government to the poor households who grow edible canna. Since 2019-2020, the poor households in Nguyen Hue commune no longer received the subsidies, placing them at a great disadvantage in improving productivity. According to the interview data, on average, each household has to spend 5 - 7 million VND per year on planting and maintaining the plants. Moreover, local people urge to have more training courses in association with cultivation techniques and edible canna varieties to improve productivity. The quality

cycle of edible canna often lasts for a decade, after which farmers have to tackle its quality degradation on their own.

2.2.1.4. Environmental Impacts

In this study, the analysis of the impact of growing and producing edible canna on the environment is purely qualitative and based on the primary data. The processing of edible canna has caused serious environmental impacts on people's lives. Wastewater discharged directly to the local streams, lakes, and outlets. It often starts and affects severely from October until August next year following the lunar calendar when people start harvesting and grinding.

Environmental pollution has not been resolved, the wastewater is so smelly that my family does not dare to open the door.

According to information obtained from discussions with the local authorities, the mill is requested to build a wastewater tank. Because of the large volume of rhizome and non-compliance of the mill's tanks with standards, the wastewater discharge has directly impacted the surrounding rivers and streams. People's domestic water sources have turned black due to the residue and sap of the canna edulis rhizome. Underwater creatures such as fish, shrimp, and crabs die, causing a loss of natural habitats. The quality of the water source is no longer guaranteed for irrigation. Moreover, the unpleasant odour has affected households living near streams and milling areas. Local authorities have also proposed to state agencies that they aim to build wastewater treatment tanks. However, building a treatment tank requires a high cost and the local people might get 50 percent support. Almost every household expresses that they cannot afford this solution. Therefore, it is still not possible to build storage tanks for milling and grinding.

Environmental issues also led to disagreement among the local authorities, edible canna growing households, and households that do not grow this plant. The local authorities have provided many suggestions, such as requiring the volume of milling and grinding quantities but edible canna growers opposed this policy. They accept to live with water pollution because, without production, their income is inadequate. On the other hand, non-edible canna growers have dealt with water and air pollution. It can be seen that the environmental issue here has not yet been paid enough attention.

2.3. Discussion

The impacts on the community from growing and producing edible canna in Nguyen Hue commune have been analyzed through local people's experience.

First, since growing edible canna and producing canna vermicelli, household's incomes have changed rapidly, creating a significant difference between those who plant edible canna and those who have not. The complexities of the economic impacts also highlight the confusion of people when poor households no longer receive support from the local government. To date, more attention has been paid to the technical aspects of edible canna growth, and relatively little research on the impacts of edible canna cultivation and production on people. In addition, if one can only grow edible canna without investing in milling and grinding, one's income is unsatisfactory. Additionally, the starch degradation of edible canna is one of great concern for the local people.

Second, environmental pollution is still an issue. The residents have to live with the negative consequences. Until now, the local canna vermicelli has not been certified as an OCOP product, partly due to unresolved environmental issues. Although the local authorities have mobilized funds for sewage treatment tanks, it seems that the costs have not been fully met. Therefore, the construction of the sewage treatment tank is still in the planning stage.

This aligns with previous research on the economic potential and impact of the production process on the environment. The findings show that edible canna is a key economic crop, contributing to job creation, income generation, and poverty reduction in developing countries like Vietnam. However, there are still many shortcomings in the linkages between production, processing, and consumption [11, 20, 23]. The operations of processing facilities and edible canna starch and canna vermicelli production villages are facing serious water pollution issues [24, 25]. This study expands the knowledge by providing an empirical study on the cultivation and processing of edible canna in Nguyen Hue commune, Hoa An district, Cao Bang province. The positive changes in the local area cannot be denied, but rising concerns need more room to be discussed to achieve sustainable development in this area.

To address the challenges with the impact of the National Target Programme on Sustainable Poverty Reduction for the 2021-2025 period approved by the Government in 2021, recommendations are as follows. The government has encouraged poor districts and extremely disadvantaged communes in mountainous, lowland, and coastal areas and on islands to reduce the poverty rate. The National Target Programme launched in 2021 with total funding of at least 75 trillion VND (3.3 billion USD) aims to narrow the gap between the difficult conditions areas and the more favorable conditions areas. One of the important targets of this program is to upgrade socio-economic infrastructure and boost production and trade. To maximize the impacts of this program, there is a need to find out the well-deserved communities receiving this aid. Some suggestions are listed as follows (1) The local government should pay more attention to the edible canna variety improvement and brand building; (2) Having training programs to support the farmers in growing and processing edible canna; and (3) Having an adequate plan to minimize the environmental pollutions from edible canna production as this issue also occurs in Dien Bien and Tuyen Quang provinces [26, 27].

3. Conclusion

The edible canna has proven its positive impacts in several places, especially in the Northern Midlands and Mountainous region in Vietnam. The government aims to expand and promote edible canna associated with sustainable economic development purposes. Nevertheless, it is very challenging to maintain the productivity of the edible canna, to create the local brand as well as the discontinuation of financial support and the environmental problems. The National Target Programme on Sustainable Poverty Reduction for the 2021-2025 period; therefore, is one hope to respond to these predicaments in Nguyen Hue commune. More rigorous research is needed on issues related to edible canna to find the appropriate solutions and produce more rounded outcomes. This will be critically important for addressing the current and future challenges of the ethnic groups in this region.

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