International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 14, Issue 1 [January. 2025] PP: 32-39

Assessment of Wastewater Quality at Vermicelli Production Facilities in Son Binh Commune, Tam Duong District, Lai Chau Province

Vi Thuy Linh, Nguyen Thi Bich Lien*
Thai Nguyen University of Science, Vietnam

ABSTRACT: *This study evaluates the quality of wastewater generated by vermicelli production facilities in Son Binh Commune, Tam Duong District, Lai Chau Province. Vermicelli production, a key local industry, produces substantial volumes of wastewater, raising concerns about its potential environmental impact. The research adopts a systematic methodology, encompassing field sampling, laboratory analyses, and data processing. Key parameters assessed include biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), pH levels, and nutrient concentrations. The findings indicate that wastewater from these facilities frequently exceeds permissible thresholds for several parameters, highlighting inadequate treatment measures and posing risks to local water resources. The study identifies significant deficiencies in wastewater management infrastructure and provides evidence-based recommendations for enhancing treatment processes. These recommendations aim to mitigate industrial pollution and ensure environmental sustainability in rural communities.*

KEYWORD: *wastewater, processing facility, villages, Son Binh commune, water pollution*

Date of Submission: 02-01-2025 Date of acceptance: 13-01-2025

I. INTRODUCTION

The activities of craft villages, with a long-standing history of existence and development, have, to some extent, met the needs of local populations, provided on-site employment for rural residents, and contributed to the economic growth of the region. However, in the present context, the production activities of certain craft villages have given rise to numerous environmental issues, leading to pollution and negatively impacting public health.

Craft villages in Vietnam contribute significantly to socioeconomic development but face severe environmental challenges, particularly water pollution [1]. Studies reveal alarming levels of water contamination in these villages, with BOD5 and COD values far exceeding regulatory limits [2]. Various treatment methods have been explored to address this issue. Activated sludge supplemented with probiotics has shown promising results in treating rice paper processing wastewater, achieving COD reduction of up to 94.4% [3]. Constructed wetlands systems have also demonstrated high efficiency in treating noodle craft village wastewater, with subsurface systems outperforming floating plant systems in terms of COD, TN, TP, and TSS removal [4]. However, the overall situation remains critical, with only a small percentage of craft villages properly collecting and treating industrial wastewater and solid waste [1]. The paper assesses the wastewater quality in the food processing craft village of Dai Lam in Vietnam and aims to develop an integrated, environmentally sound concept for waste management [5]. An integrated ecosystem incorporating renewable energy and wastewater treatment can reduce pollution and enhance sustainability in craft villages [6]. Factors affecting households' willingness to pay for wastewater treatment in agro-food processing craft villages in Vietnam [7]. The treatment efficiency was calculated for all parameters and the results of wastewater analysis were compared with the maximum allowable values as prescribed in the Local Regulation of the Yogyakarta Special Region No. 7 of 2016 on Wastewater Discharge Standards. The results showed that each treatment process could reduce the concentration of pollutants. The overall value of the final wastewater was lower than the standard, so the wastewater could be safely discharged into the environment [8]. Therefore, it is very important to evaluate the quality of wastewater from craft villages to have a reasonable treatment plan.

One of the most common types of craft villages in rural Vietnam is the food processing village, which specializes in the production of items such as vermicelli, noodles, rice paper, and starch-based products. Among these, the processing of vermicelli (a type of vermicelli made from canna starch) has been identified as a significant contributor to environmental pollution, particularly due to wastewater generated during production. This necessitates the implementation of appropriate environmental protection measures [9]. The production process of vermicelli releases substantial volumes of wastewater with a high concentration of organic matter. This

wastewater is often combined with domestic wastewater and discharged directly into the environment, complicating and hindering wastewater management efforts. Tam Đuong, a highland district located in the northeastern part of Lai Chau Province, has been engaged in vermicelli production since the early 1970s. However, it was not until the late 1990s that the district's vermicelli brand gained market recognition and began generating income for local residents. Despite its economic benefits, environmental issues associated with vermicelli production remain largely unaddressed. In recent years, pollution resulting from this activity has been reported and reflected in feedback from local residents. However, no comprehensive environmental assessment has been conducted in the area. Faced with these challenges, a research team has undertaken this study to evaluate the quality of wastewater from vermicelli processing facilities. The goal is to support improved environmental management and safeguard the health of producers and nearby communities.

II. RESEARCH METHODS

2.1. Primary data collection method

a. Field survey method

Observation and photography to collect information on the production situation and the process of generating and treating production wastewater.

b. Interview investigation method

- Interview 2 officers of the Department of Natural Resources and Environment of Tam Duong district, 3 commune officers in charge of land and environment of Binh Lu, Then Sin, Son Binh communes where there are processing and production activities, village heads of Tan Hop, Nam De and Chu Va 6 villages.
- Interview households and surrounding households to learn about the environmental problems they are facing, the environmental management situation, the production and processing of agricultural products and food in the locality, etc.
- Develop a survey form including the following main contents:

+ Awareness and views on environmental issues.
+ Current status of production wastewater treatment.
+ Environmental impacts from production activities.
+ Ability of people to participate in environmental protection work, ...

- Number of interviews;

Due to the characteristics of population distribution and households working in the area, the author interviewed 30 households that process and produce Dong vermicelli, each commune has an average of 10 households, including small-medium-scale and large-scale households and households that do not participate in production

2.2. Sampling methods for wastewater quality analysis

a. Sampling methods

- TCVN 6663-1:2011 (ISO 5667-1:2006) – Water quality – Part 1: Guidance on sampling programmes and sampling techniques.
- TCVN 6663-3:2016 (ISO 5667-3:2013) – Water quality – Sampling. Guidance on sample preservation and handling.
- TCVN 5999:1995 (ISO 5667-10:1992) – Water quality – Sampling. Guidance on wastewater sampling.

b. Sampling equipment

- Use glass or plastic sample bottles with stoppers, cleaned and rinsed with distilled water.
- Gloves, ice thermos to preserve samples.

c. Sampling locations:

- Location 1: Production wastewater of households
- Location 2: Output wastewater of anaerobic treatment system
- Location 3: Wastewater at the outlet of the wastewater reservoir after the anaerobic tank
- Location 4: Wastewater in canals in the commune

The trainees and staff of the Lai Chau Provincial Center for Natural Resources and Environment Monitoring collected 04 wastewater samples: the wastewater receiving area or the area affected by production wastewater. The survey indicators include: pH, DO, TSS, COD, BOD5,... Comparison standards QCVN 08:2008/BTNMT (B1) - National technical regulation on surface water quality.

+ Sampling coordinates

NT1	X: 2470996	Y:568544
NT2	X: 2470862	Y:568195
NT3	X: 2201929N	Y: 103039’56”E
NT4	X: 22020’07N	Y: 103040’02”E

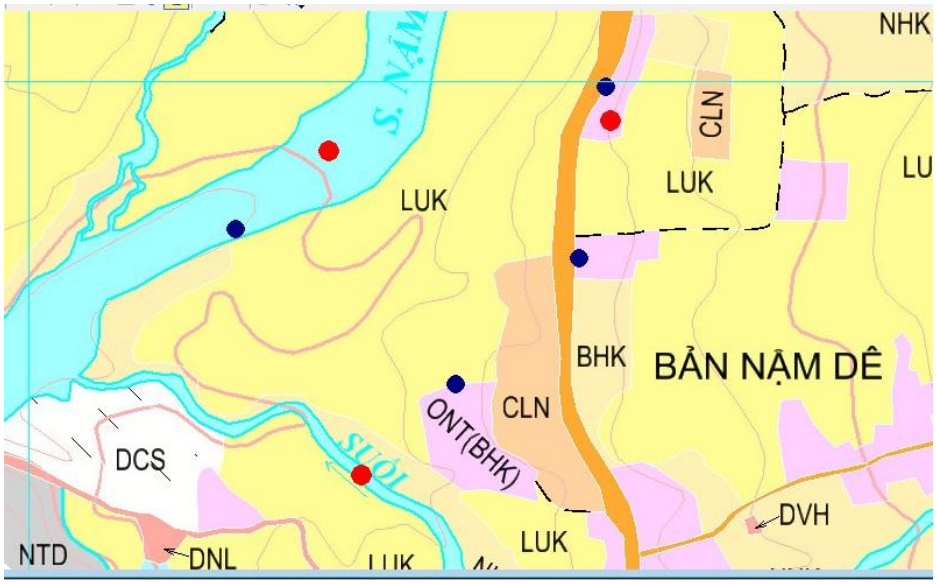

Figure 1. Diagram of sampling locations in Son Binh commune

Analysis of surface water quality receiving wastewater from vermicelli processing and production facilities
- NM1: Surface water sample at Nam De stream, 100 meters upstream from the wastewater reception point, coordinates X: 2470866; Y: 568197
- NM2: Surface water sample at the ditch in Son Binh commune
- NM3: Surface water sample at the end of Mr. Vu Van Chien's pond, Son Binh commune

d. Sample preservation method

Table 1. Methods of sample preservation before analysis

No.	Analytical Indicators	Sample Containers	Method	Maximum sample retention time
1	COD	Glass Bottles	of preservation	
2	TSS	Glass Bottles	Add H2SO4, keep pH = 2	28 days
3	Total P	Plastic Bottles	Keep at 40C	
4	Total N	Plastic Bottles	Keep at 40C	28 days

e. Sample analysis methods

Table 2. Analytical methods and analytical standards

No.	Parameters	Analytical methods, standard number
1	pH	- TCVN 6492:2011 (ISO 10523:2008) Water quality - Determination of pH. - SMEWW 2550B - Standard methods for the analysis of water and wastewater - Determination of pH.
2	COD	- TCVN 6491:1999 (ISO 6060:1989) Water quality - Determination of chemical oxygen demand (COD). - SMEWW 5220 - Standard methods for the analysis of water and wastewater - Determination of COD.
3	DO	- APHA- 5210B Winkler method - TCVN 6001-1:2008 (ISO 5815-1:2003) - TCVN 6001-2:2008 (ISO 5815-2:2003)
4	Total Suspended Solids (TSS)	- TCVN 6625:2000 (ISO 11923:1997) Water quality - Determination of suspended solids by filtration through glass fibre filters. - SMEWW 2540 - Standard method for the analysis of water and wastewater - Determination of suspended solids
5	Total Nitrogen (as N)	- TCVN 6638:2000 Water quality - Determination of nitrogen - Catalytic mineralization after reduction with Devarda alloy. - SMEWW 4500-N.C - Standard method for the analysis of water and wastewater - Determination of nitrogen.

6	Total Phosphorus (as P)	- TCVN 6202:2008 – Water quality – Determination of phosphorus – Spectrometric method using ammonium molybdate. - SMEWW 4500-P.B&D - Standard methods for the analysis of water and wastewater – Determination of phosphorus.

2.3. Data processing method

Use Excel software to calculate and statistically process research results.

Analyze data and compare with QCVN 40: 2011/BTNMT: National technical regulation on industrial wastewater; QCVN 08-MT: 2015/BTNMT National technical regulation on surface water quality (column B1 - Used for irrigation, water resources, waterway transport and other purposes requiring low quality water).

III. RESULTS AND DISCUSSION

3.1. Current Status of vermicelli Production Facilities in the Study Area

As of 2024, Tam Đuong District cultivated over 40 hectares of vermicelli, serving as the primary source of raw materials for the production of vermicelli within the region.

Table 2. Area, yield and production of vermicelli in Tam Duong district

Contents	Units	Binh Lu	Son Binh	Then Sin	Total
2024					
Area	ha	16,70	13,80	3,50	34,00
Yield	Quintal/ha	580	570	500	1650
Output	ton	968,6	786,6	175	1930,2
2023					
Area	ha	17,80	14,70	4,50	37,00
Yield	Quintal/ha	580	560	500	1640
Output	ton	1032,4	823,2	225	2080,6
2024					
Area	ha	18,50	15,60	5,90	40,00
Yield	Quintal/ha	600	575	510	1680
Output	ton	1110	889,2	300,9	2300,1

(Source: Tam Duong district statistics for the years 2022-2024)

Table 2 shows: In Son Binh Commune, the area dedicated to vermicelli cultivation has increased steadily over the years. By 2024, the cultivation area reached 15.6 hectares, an expansion of 1.8 hectares compared to 2022. Yield levels also experienced a modest increase in 2024 compared to both 2023 and 2022, reflecting the positive impact of newly adopted care and cultivation techniques. The production output of vermicelli in 2024 rose by 66 tons compared to 2023 and by 102.6 tons compared to 2022, indicating both quantitative improvements in production value and advancements in processing and production practices in the area.

According to statistics in 2024, Son Binh commune has about 275 households producing vermicelli, concentrated in 3 villages: Tan Hop village (about 110 households), Nam De village (about 80 households) and Chu Va 6 village (about 85 households).

Table 3. Summary of households growing and producing Dong vermicelli in Son Binh commune in 2023

No.	Contents	Households growing	Households producing arrowroot starch	Households producing vermicelli
1	Tan Hop Version	145	110	110
2	Nam De Version	93	80	80
3	Chu Va Version 6	94	85	85
	Total	332	275	275

(Source: People's Committee of Son Binh commune, 2023)

Through Table 3 shows: The number of households participating in the production of villages and the production and processing of vermicelli in the area is quite large. Compared with the number of households participating in the production of growing and making vermicelli in other communes in the province, it is quite high, only less than Binh Lu commune. However, the production households are not concentrated but are scattered in 3 villages in the commune, which leads to difficulties in centralized waste treatment and implementation of environmental protection measures. The majority of households participating in production in the village have their own small and medium-sized workshops. With a floor area of 85 to 420 m2, the usable area is from 70 to 350 m2, accounting for 38.4% to 92.67%

Through the survey of households participating in production of each type: households with medium and small scale (≤2 tons of products/batch). machinery, smaller tanks, less labor and they maintain production. As for large-scale households (>2 tons of products/batch), they often promote more production, machinery, large tanks and more labor. The results of the survey of vermicelli production households in the area are often at the small and medium production scale (≤ 2 tons of products/batch) and 19 households produce on a large scale (>2 tons of products/batch), calculating the average of vermicelli production households, we have a total product of 1473.05 tons/month. In the 10 households producing tapioca starch surveyed, there are 6 households producing on a small and medium scale (≤ 2 tons of products/batch) and 4 households producing on a large scale (>2 tons of products/batch), calculating the average of tapioca starch production households, we have a total product of 672 tons/month.

3.2. Sources and loads of wastewater at processing facilities

According to the survey results in March 2024, the results of wastewater flow by flow meter at wastewater discharge locations from 03 villages with vermicelli production activities in Son Binh commune, the specific results are shown in Table 4

Table 4: Water flow at discharge points

No.	Location of wastewater discharge points	**Discharge flow (m3/day)**
1	Wastewater discharge point in Tan Hop village	850
2	Wastewater discharge point in Nam De village	575
4	Wastewater discharge point in Chu Va village	530
Total		**1.955**

(Source: Survey results 2024)

The total wastewater volume of the 3 villages engaged in the vermicelli production industry is about 1,955 m3/day. Currently, Son Binh commune has piloted a wastewater treatment model with a treatment capacity of 400 m3/day at Tan Hop village.

Thus, there is still a large amount of wastewater produced from Son Binh commune that has not been treated and is being discharged directly into the environment with a volume of 1,105 m3/day.

The vermicelli production village in Son Binh consumes a very large volume of water, of which 15.8% of households in the village participating in production are the main source of water consumption.

The results of the investigation on water supply sources and water usage are shown in Table 5. The water supply for production activities includes 2 sources: well water and dug well water, a few use spring water, but spring water is mostly used for domestic use. For the 50 households producing tapioca starch surveyed, all 50 households used well water, accounting for 100%. 100% of the households producing vermicelli and starch surveyed used well water because the amount of water they used was very large, only well water could meet the demand.

Table 5: Water usage and wastewater in the production of vermicelli

	Number of interviewed households (households)	Minimum (m^3/day)	Maximum (m^3/day)	Average (m^3/day)
Amount of water used in 1 day (m3/day)	30	3	13	8,00
Amount of water discharged in 1 day (m3/day)	30	2,5	11	6,75

(Source: Survey results 2024)

According to the survey results, the average production households discharge about 6.75 m3/day into the environment, the largest household discharges up to 13 m3/day (Table 5). Wastewater is mainly discharged during the process of washing tubers, soaking tubers, washing villages powder. It is continued to be soaked and washed thoroughly to settle sand and all impurities in the filtered powder. After 3 filtrations, it will produce clean powder and cool the machinery, so the discharged water contains many yeast and rancid substances, which is an ideal environment for bacteria to grow.

3.3. Wastewater quality at processing facilities

Wastewater discharged during the processing of vermicelli (especially wastewater from the soaking stage) contains starch and quickly decomposes and ferments with acid. In addition, most of the livestock wastewater from households has not been treated and is discharged directly into the drainage system, so the wastewater has high COD, BOD, Coliforms content, foul odor and low pH.

+ Sampling location

NT1: 01 wastewater sample at the Dong grinding facility of Mr. Nguyen Duy Tien's household, Nam De village, Son Binh commune.

NT2: 01 wastewater sample from the Dong grinding facility of Mr. Nguyen Duy Tien's household at the end of the rice field adjacent to Nam De stream.

NT3: 01 wastewater sample from the Dong grinding facility of Ms. Nguyen Thi Men's household, Chu Va 6 village, Son Binh commune.

NT4: 01 wastewater sample at Dong grinding facility of Mr. Do Van Tinh, Tan Hop village, Son Binh commune, Tam Duong district.

* Results of wastewater quality analysis at survey and sampling points are detailed in Table 6

Table 6: Results of wastewater quality analysis at vermicelli processing facilities of Son Binh commune

No.	Parameter	Unit	Test method	Result			
				NT1	**NT2**	**NT3**	**NT4**
1	pH	-	TCVN 6492:2011	6,8	6,5	6,7	7
2	Total Dissolved Solids (TDS)	mg/L	TTQ - HT - 03	520	380	456	490
3	Biochemical Oxygen Demand (BOD5)	mg/L	TCVN 60011:2008	1180	96,2	335,5	599
4	Chemical Oxygen Demand (COD)	mg/L	SMEWW 5520C:2017	1808	166,4	515,2	928
5	Total Suspended Solids (TSS)	mg/L	TCVN 6625:2000	156	62	81	110
6	Ammonium (NH4+/ as N)	mg/L	TCVN 6179	1,57	0,22	0,73	1,92
7	Total P	mg/L	TCVN 6202:2008	10,63	0,6	7,13	7,34
8	Total N	mg/L	TCVN 6638:2000	59	28,9	40,7	48,4
9	Oils, Grease, Minerals	mg/L	SMEWW 5520B&F:2017	1,8	1,9	2,3	2,2
10	Phenol (Total)*	mg/L	TCVN 6216:1996	0,124	0,098	0,096	0,071
11	Total Coliform*	MPN/	SMEWW 9221B:2017	4700	35000	54000	92000

(Source, Analysis results at Lai Chau Center for Natural Resources and Environment, March 2024)

Table 6 shows that:

The quality of wastewater at most sampling locations has parameters exceeding the Vietnamese environmental standards (QCVN 40:2011/BTNMT - National technical regulations on industrial wastewater).

- The pH values of all wastewater samples are within the allowable range.

- TDS content: 4/4 of the surveyed samples have high suspended solid pollution, all exceeding QCVN 40:2011/BTNMT, the level of exceeding from 3.8 to 5.2 times. In which, sample NT1 - Wastewater discharge point at Dong grinding facility of Mr. Nguyen Duy Tien, Nam Gie village, Son Binh commune, exceeds QCVN 40:2011/BTNMT the highest by 5.2 times.

- COD content: 4/4 of the surveyed samples have COD content exceeding QCCP, the level of exceeding from 1.1 to 12.1 times. In which, sample NT1 - Wastewater at the wastewater discharge point at the Dong grinding facility of Mr. Nguyen Duy Tien, Nam De village, Son Binh commune, exceeded QCVN 40:2011/BTNMT by the highest level of 12.1 times.

- BOD5 content: 4/4 of the surveyed samples had BOD5 content of the samples exceeding QCCP, the level of exceeding from 1.9 to 23.6 times. In which, sample NT1 - Wastewater at the wastewater discharge point at the Dong grinding facility of Mr. Nguyen Duy Tien, Nam Gie village, Son Binh commune, exceeded QCVN 40:2011/BTNMT by the highest level of 23.6 times.

- Ammonium content: 4/4 of the surveyed ammonium samples had low pollution levels, lower than QCVN 40:2011/BTNMT.

- Total nitrogen content: 4/4 of the surveyed samples had low levels of total nitrogen compared to QCVN 40:2011/BTNMT.

- Total Phosphorus content: 3/4 of the surveyed samples were higher than QCVN 40:2011/BTNMT. In which, sample NT1 - Wastewater at the wastewater discharge point at the Dong grinding facility of Mr. Nguyen Duy Tien, Nam Gie village, Son Binh commune exceeded QCVN 40:2011/BTNMT by the highest amount of 1.77 times. Sample NT2 was the only sample with the lowest content, which showed that the settling tank was effective in reducing pollutants in the waste source. - Coliform content: 4/4 of the surveyed samples exceeded QCVN 40:2011/BTNMT, the level of excess was from 7 to 18.4 times. In which, sample NT4 - Wastewater discharge point at the Dong grinding facility of Mr. Do Van Tinh, Nam De village, Son Binh commune, was 18.4 times higher than QCVN 40:2011/BTNMT.

It can be observed that wastewater from vermicelli production and processing activities in Sơn Bình largely exceeds the permissible limits outlined in QCVN 40:2011/BTNMT (National Technical Regulation on Industrial Wastewater). However, in the case of sample NT2, the parameters fall within safer thresholds, as this sample was not collected from the primary discharge point. Notably, the household of Mr. Tình has implemented a basic sedimentation tank system for pre-treating production wastewater. This highlights the critical role of initial treatment systems at the household level.

Given the significant daily wastewater volumes, as reported in Table 3.4, and the fact that most production facilities—particularly small-scale operations—have not implemented or lack initial treatment systems, these facilities represent a substantial source of environmental pollution for the local area.

3.4. Quality of Selected Surface Water Types in the Study Area

Sampling to assess the quality of surface water types receiving wastewater from vermicelli production and processing in the area was conducted to determine the impact level of vermicelli production and processing wastewater.

The quality values of some types of surface water in the area are shown in Table 7

Table 7. Quality of some types of surface water in Son Binh commune

No.	Parameter	Unit	Test method	Result		
				NM1	**NM2**	**NM3**
1	pH	-	TCVN 6492:2011	6,8	**7**	**6,3**
2	Dissolved Oxygen (DO)	mg/1	TCVN 7325:2016	5,2	5,4	5,7
3	Chemical Oxygen Demand (COD)	mg/1	SMEWW 5220C:2017	17,6	18,4	17,3
4	Biochemical Oxygen Demand (BOD5)	mg/1	TCVN 6001-1:2008	11,1	12	11,4
5	Suspended Solids (TSS)	mg/1	TCVN 6625:2000	27	20	21
6	Ammonium (NH4+)	mg/1	TCVVN 6179-1:1996	<0,1	<0,1	0,52
7	Nitrate (NO3-)	mg/1	TCVN 6180:1996	0,285	0,445	0,74
8	Nitrite (NO2-)	mg/1	TCVN 6178:1996	0,023	0,011	0,073
9	Total Oil and Grease	mg/1	SMEWW 5520B:2017	**<1**	<1	2,1
10	Surfactants	mg/l	TCVN 6622-1:2009	0,178	0,155	0,37
11	Al drin*	Ug/l	US EPA Method3510C	KPH	KPH	KPH
12	Heptachlor*	pg/l		KPH	KPH	KPH
13	Toxaphene*	pg/l	US EPA Method 3620C US EPA Method 8270D	KPH	KPH	KPH
14	Total Ecoli*	MPN/100 ml	SMEWW 9221F:2017	KPH	KPH	150
15	Total Coliform*	MPN/100 ml	SMEWW 9221B:2017	140	110	1700

(Source: Lai Chau Provincial Center for Natural Resources and Environment Monitoring)

The analysis results show that:

- All analyzed surface water samples have pH within the allowable range
- TSS content: 2/3 of the samples have suspended solids content within the allowable range according to QCVN 08:2008/BTNMT.
- COD content: 2/3 of the surveyed samples have COD index within the allowable range according to QCVN 08:2008/BTNMT, sample NM3 is pond water receiving direct discharge at Mr. Vu Van Chien's house with COD exceeding 4.72 times.
- BOD5 content: 2/3 of the surveyed samples have BOD5 index within the allowable range according to QCVN 08:2008/BTNMT, sample NM3 is pond water receiving direct discharge at Mr. Vu Van Chien's house with BOD5 exceeding 9.36 times.
- Most of the parameters in the two surface water samples NM1 and NM2, i.e. the surface water samples of the canals in the commune and the Nam De stream, are within the allowable threshold according to QCVN 08:2008/BTNMT, while most of the parameters of sample NM3 exceed the threshold, with some parameters

exceeding 10 times the threshold specified in QCVN 08:2008/BTNMT. This can be assessed that the main surface water sources in the area up to this point are still not polluted, and can still be used for irrigation and water resources purposes. However, in the long term, necessary measures are needed to ensure quality. Through the parameters of NM3, it can be seen that the pond water sources of households producing and processing vermicelli, if the wastewater has not been treated and is directly discharged, will show signs of severe pollution, which will have a profound impact on human health and the environment in general.

IV. CONCLUSION

Son Binh Commune hosts approximately 275 households engaged in villages production, concentrated in three villages: Tan Hop (approximately 110 households), Nam De (approximately 80 households), and Chu Va 6 (approximately 85 households). The total volume of wastewater generated by these three craft villages is estimated at approximately 1,955 cubic meters per day.

Analyses of wastewater quality at sampling sites indicate that most parameters exceed the permissible limits outlined in the Vietnamese National Technical Regulation on Industrial Wastewater (QCVN 40:2011/BTNMT). While surface water bodies receiving this wastewater, such as irrigation canals and the Nam De Stream, generally maintain acceptable water quality, household ponds that directly receive untreated wastewater exhibit pollutant concentrations exceeding permissible thresholds.

REFRENCES

[1]. Thi Loi Nguyen [2020] "Environmental pollution in Vietnam's craft villages" E3S Web of Conferences 175, 06012 (2020)

[2]. T. T. Hue, V. Hien, N. Ha, N. T. A. Hang [2019] "Water quality in Thanh Luong rice vermicelli and fresh noodle craft village, Thanh Oai district, Hanoi, Vietnam" *IOP Conference Series: Earth and Environment*

[3]. T. M. Vũ, Trong Hiep Nguyen, Quang Tuyen Mai, Duc-Thinh Nguyen, Thu Thuy Le, M. Le [2023] "Assess the wastewater treatment efficiency of the rice paper craft village with activated sludge supplemented with probiotics" *Ministry of Science and Technology, Vietnam*

[4]. N. Thanh, D. Hải, N. Thủy, B. T. Anh, Trần Viết Khanh, V. Thanh, D. Hải, N. Thủy, B. T. Anh. [2022] "Evaluating the treatment efficiency of the subsurface constructed wetlands system and free floating plants system for the wastewater from noodle handicraft village in hiep hoa commune, Quang Yen town, Quang Ninh province" TNU Journal of Science and Technology, Vol. 227(08): pp. 367 - 375

[5]. C. Hahn, S. Meier, D. Weichgrebe, N. Tran, Holger Appel, L. Fechter, P. Werner [2012] "Integrated water management concept for craft villages - example from the food processing craft village Dai Lam" J. Viet. Env. 2012, Vol. 2, No. 1, pp. 54-57 DOI: 10.13141/jve.vol2.no1.pp54-57.

[6]. Thanh Hai Le, V. Tran, Quoc Vi Le, Thi Phuong Thao Nguyen, H. Schnitzer, G. Braunegg [2016] "An integrated ecosystem incorporating renewable energy leading to pollution reduction for sustainable development of craft villages in rural area: a case study at sedge mats village in Mekong Delta, Vietnam" *Energy, Sustainability and Society*.

[7]. T. T. Trang, Roberto F. Ra ntilde, ola, N. Song [2019] "Factors Affecting the Households' Willingness-to-Pay for Wastewater Treatment in Agro-Food Processing Craft Villages, Nhue-Day River Basin, Vietnam" *Journal of Environmental Protection*.

[8]. M. Triwiswara [2019] "Efficiency Assessment of Batik Industry Wastewater Treatment Plant in Center for Handicraft and Batik Indonesia" *Proceedings of the Third International Conference on Sustainable Innovation 2019*.

[9]. Luong Manh Hung (2008), Assessment of environmental pollution status at Dong Rieng starch processing facilities on an industrial scale nationwide, Department of Local Industry, Ministry of Industry and Trade.