

**Wastewater from production activities in craft villages
and some mitigation solutions**

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Abstract

Production in craft villages is an economic form quite typical of Vietnam rural areas. Beside the encouraging signs for the traditional handicraft development, a disturbing reality is the high risk of pollution from these activities, especially wastewater pollution. The water pollution, especially water pollution from village production is a pressing problem that is catching the community's attention in all types of craft villages including textile-dyeing, agro-food processing, waste recycling and fine arts handicraft. The environmental sanitation and wastewater pollution in craft villages resulted in serious negative impacts in environmental quality as well as communities' health. The surveys and studies conducted for many years in the INEST presented serious pictures on environmental status as well as inhabitants' health in these villages. In order to improve the current environmental status, comprehensive approaches should be applied in craft villages, in which reasonable production development planning is of foremost importance.

I. INTRODUCTION

Production in craft villages is an economic form quite typical of Vietnam rural areas, particularly in the development of traditional handicraft. The policy for renovating the economy has blown fresh vitality to traditional handicrafts. According to the recent data [1], Vietnam has nearly 1,450 craft villages distributed in the 58 provinces and cities, especially in the Red River Delta with about 800 villages. Over the past 10 years, Vietnam craft villages have achieved the growth rate of 8% per year according to their outputs. The main occupations practiced in villages are textile-dyeing, agro-food processing, waste recycling, fine arts handicraft, and porcelain & construction materials.

Besides the encouraging signs for the traditional handicraft development, a disturbing reality is the high risk of pollution from these activities, especially wastewater pollution. The pollution risk is generated by the production characteristics – petty, scattered, obsolescent technology as well as unprompted development. On the other hand, due to the lack of the knowledge, people do not understand damaging impacts of their activities on their health.

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The population density is often high in the craft villages, so the lack of the production space leads to the interposition of residence and production areas. Since production expands, the pollution caused by chemicals and wastes have contaminated the living environment, particularly in the waste recycling and agro-food processing villages.

The rural infrastructure is in a poor condition. Only about 20% of production establishments having proper workshops, 86% have electricity supply, 37% have their work mechanized and more than 60% do their work by hands.

2. POLLUTION CAUSED BY WASTEWATER IN SOME TYPICAL OCCUPATION VILLAGES OF VIET NAM

The water pollution, especially water pollution, from village production is a pressing problem that is catching the community's attention, could be presented as follows.

Agro-food processing cottage

This is the most long-standing occupation in Vietnam's villages but has been scattered in different households. In the whole Vietnam, there are 197 agro-food processing villages making up 13.58% of the 1,450 occupation villages. This kind of production not only meets the food demand but also provide the material sources for other processing industries.

Agro-food processing consumes a huge volume of water and most of it is discharged directly after use. Wastewater from craft villages is rich in inorganic matter and highly biodegradable. At present, the effluent is not treated before being discharged outside. The stagnated wastewater in the sewage may cause air pollution with anaerobic digestion, soil pollution with over nutrients and the underground water pollution by penetrating into soil. Therefore, ground water in these areas is found to be seriously polluted with high concentrations of COD, TS and NH_4^+ . Water from drilling wells of Tan Do and Ninh Van villages have the sign of coliform contamination. In Hai Thanh, a fish sauce production village, water taken from the well was heavily polluted with COD=186 mg/l. In many craft villages, villagers have to buy fresh water from other places. On the other hand, the majority of the refuse from agro-food production are used for livestock feeding, which also contributes to the water pollution.

Table 1
Waste water characteristics at the agro-food processing

ChØ tiªu	TCCP 5945-1995	Tinh bét B×nh Minh	Bón Phó §«	N-íc m ³ /4m H¶i Thanh *	NÊu r-iu T©n §«	§Ëu phô Quang B×nh
PH	5.5-9	4.6	6.1	9.59	-	5.1
SS (mg/l)	100	926	414	10	266	1764
COD (mg/l)	100	1858	2967	597	3868	1271
BOD ₅ (mg/l)	50	743	1850	250	1700	1080
ΣN (mg/l)	60	145.6	20.9	9.62	1002	67
ΣP (mg/l)	6	27.5	2.79	0.034	44.2	23

According to health survey, community health in these villages is significantly influenced by the production activities. The most popular diseases are gynecology (13-38%), digestion (8-30%), dermatitis (4.5-23%), respiration (6-18%), ophthalmic (9-15%). The main reasons are low environment quality and shortage of clean water. The rate of occupational diseases in Duong Lieu (Ha Tay) and Vu Hoi (Thai Binh) noodle villages is 70%, in Phu Do noodle and Tan Do alcohol villages is 50%.

Waste recycling villages

These villages make use of waste as raw materials and therefore reduce input cost and also contribute to mitigation of environmental pollution. Presently, the development of these villages creates network of waste, scraps and raw materials collecting. These kinds of villages are encouraged to develop. There are 3 sub-groups: waste paper, waste metal and waste plastic recycling, mostly concentrated in the Northern part.

The waste recycling villages in existence are in small numbers, but the proportion of mechanization of 50-70%, is much higher than that in others. Some large-scale occupation villages attract large numbers of local laborers. For example, the plastic recycling village of Minh Khai, Hung Yen contain more than 4,000 workers; the waste paper recycling village of Duong O, Bac Ninh with an annual productivity of 12,000 tons of paper attracts 5,000 workers; the iron and aluminum recycling village of Van Chang, Nam Dinh, which consumes roughly tons of wastage on a daily basic, has 3,000 employees. As newly-established craft villages engage in household scale production, the dynamic and creative spirit in monitoring and diversifying product lines have been brought into full play by villagers, whose incomes and living standards are relatively high.

As for waste paper recycling villages, the soaking, cooking and grinding of materials produce the main source of wastewater. The unrestrained discharge of untreated wastewater into surface water has adversely affected the environmental quality. This wastewater contains extra chemicals, pulp and high organic contents, which results in near zero amount of dissolved oxygen. Pulp and fiber left in wastewater raise the level of canals, ponds and lakes. In Duong O and Phu Lam villages alone, 1,450 – 3,000 kg COD and over 3,000kg of pulp are pushed out to surface water daily.

As to plastic recycling villages, due to variety of material sources and high proportion of impurities, much water is used to wash scrap. This amount of water is estimated as high as 20-25 m³/ton of waste plastic. The single waste plastic Minh Khai village produces 445,000 m³ of wastewater on an annual basis. The composition of this wastewater is very complicated as it carries many organic, inorganic compounds, including toxic substances (from pesticide container, chemicals etc.) and micro-organisms carrying germs.

In metal recycling villages, even though not much water is used, mainly for cooling, cleaning equipment and workshops, wastewater generated by metal treating and coating has relatively high concentrations of noxious chemicals, especially heavy metals.

Table 2
Heavy metal concentration in wastewater in metal recycling villages (mg/l)

TT	Sampling points	Cr²⁺	∑Fe	Pb²⁺	Cu²⁺	Zn²⁺	Al³⁺
1	Lead recycling Chi Dao, Bac Ninh	0.04	0.4	0.35	0.1	0.6	-

TT	Sampling points	Cr ²⁺	∑Fe	Pb ²⁺	Cu ²⁺	Zn ²⁺	Al ³⁺
2	Mechanic Van Chang, Nam Dinh	63 -187	12	0.9	1.5	8.7	10.4
3.	Bronze casting Phuoc Kieu	0.2	7.6	0.6	3.1	1.8	2.1
4.	Mechanic Xuan Tien, Nam Dinh	0.8	0.3	0.44	3.25	2.15	0.32
	TCVN 5945-1995	1	5	0.1	1	2	-

The heavy pollution due to indiscriminate collection and discarding has affected the ecology and human health to a serious extent. It is impossible for fish to grow in most of these villages' lakes and ponds because they are subject to a large quantity of wastewater of high concentrations beyond the self-cleaning capacity of the environment and garbage has raised the level of lake bed and blocked its stream. An international survey team once hired some children in Van Chang village to look for aquatic organisms in the 1 km section of river flowing past the village, but no living creatures were found.

Survey results have revealed that the percentage of occupational diseases in recycling villages is 15-25% higher than in non-production villages. About 30-45% of children and women are afflicted with diseases, primarily respiration diseases, bronchitis, pneumonia in children and gynecology in women. Life expectancy in these villages is low, ranging from 55 to 65. There are frequent outbreaks of epidemic such as diarrhea, sore eyes, poisoning especially in metal recycling villages. [3]

Textile and dyeing villages

With the initial demands for and self-sufficiency of garment, textile and dyeing villages have gradually been established and passed down from generation to generation and continue to live on until today. There are a total of 173 textile and dyeing villages in the whole country, making up 10% of craft villages, of which 85.5% concentrated in the Northern provinces.

Wastewater pollution presents the biggest environmental problem in the textile-dyeing craft villages. Large amounts of water are discharged together with chemicals and dye stuffs (about 10-30% dye stuffs and 85-90% chemicals used are discharged together with wastewater). Properties of wastewater in some typical textile-dyeing villages are presented as follows:

Table 3
Properties of wastewater in some typical textile-dyeing villages

No	Names of villages	Amount of wastewater m ³ /day	Wastewater quality criteria				
			pH	COD	BOD ₅	SS	Color
1.	CoChat silworm cocoons unwinding, Nam Dinh	100	-	6076	2400	764	4110
2.	Phuong La textile and dyeing, Thai Binh	960	8-9.7	320-900	72 -410	14	77-139
3.	Tuong Giang textile and dyeing, Bac Ninh	1.266	8-9.8	120-350	100	55-284	190-250
4.	Dong Yen silworm	20	7.2	632	241	517	69

No	Names of villages	Amount of wastewater m ³ /day	Wastewater quality criteria				
			pH	COD	BOD ₅	SS	Color
	cocoons unwinding Quang Nam						
5.	Bao Loc silworm cocoons unwinding Lam Dong	500	7.8	1.020	780	215	466
6.	Nam Cao silk weaving – thai Binh	-	8.2	372	212	375	260
7.	Thai Phuong textile and dying, Thai Binh	-	6.9	312	272	205	195
	VN standards 5945-1995 (B)		5.5- 9	100	50	100	

The results of healthcare surveys in textile and dyeing villages [2] have shown that diseases like rhinitis, sore throat and nervous debility are widespread among workers in these villages. Production is the cause for 20% of the diseases in silk weaving village of Bao Loc, Lam Dong and silkworm cocoons unwinding village of Dong Yen, Quang Nam and 55% in textile and dyeing village of Thai Phuong, Thai Binh. This figure is 70% for the silkworm cocoons unwinding village of Co Chat, Nam Dinh.

Fine art handicraft villages

Of 1,450 craft villages in whole country, fine art handicraft villages are in a majority: 618 villages. The principal handicraft types include: rattan and bamboo weaving, embroidery, sea grass products, woodwork, lacquer painting, pottery, sculpture, silver carving etc.

As far as the water environment is concerned, lacquer and silver carving villages produce the most pollution. The amount of water consumed is not high, but comprises high concentrations of pollutants. In the lacquer villages of Ha Thai (Ha Tay), the COD, the BOD, SS contents are 1.8 to 3.5 times higher than the allowed level. In silver carving villages, many chemicals such as H₂SO₄, HNO₃ ... are used for coating. Therefore, wastewater from coating has low pH level, cyanide sometimes reaches 0.75 mg/l (1.5 times higher than allowed level) and mercury concentration also exceeds the allowed level. The horn handicraft village of Do Hai, Nam Dinh annually consumes 100 tons of cattle's horns; but the surface water here had the pH level of 4.4, SS and COD exceeds the allowed level dozens of times. Similarly to most of other craft villages, this wastewater, mixed with domestic wastewater, is flushed into the common canal.

III. SOLUTIONS FOR WASTEWATER POLLUTION MINIMIZATION IN CRAFT VILLAGES

In order to improve the current environmental status, reasonable production development planning is of foremost importance.

Environmental management solutions

Environmental policy: Develop appropriate policies for encouraging technology innovation in craft villages towards environmental friendly technologies and products. Besides, there should be a mechanism to apply policy "polluter pays" in craft villages.

Establishing local environment management mechanism including clean environment group, developing environmental programs in the villages (environmental protection statues, penalty regulations, environmental fees and funds, etc)

Local authorities should develop regulations on environmental management, special staffs responsible for environmental problems to help management authorities to have throughout understanding of implementing environmental related regulations, waste treatment in order to develop encouragement policies to initiatives for mitigating negative impacts on environment as well as provide timely decision to cope with problems arisen during production activities in craft villages. ***For craft villages, management in commune level is a core in environmental management as authorities can get close contact with each household to successfully implement management solutions.***

Clustering craft villages in rural areas

This model is suitable with newly-developed craft villages engaged in small scale industry. The cluster is built in the vicinity of villages, which is favorable for overall planning and still retains exclusive advantages of production in craft villages.

A number of projects for clustering craft villages in an area with appropriate infrastructure and waste treatment system have been carried out in the Phong Khe waste paper recycling village, Da Hoi ion village, Dong Ky woodwork village, Duong Noi textile village, van Chang mechanics village and Minh Khai waste plastic village. However, the master plans for these industrial clusters are not well developed and implemented causing difficulties in dealing with environmental problems in these clusters. According to the master plan, waste water from each household will be collected after preliminary treatment and brought to the concentrated treatment system.

The pressing demand for small and medium industrial clusters for craft villages results from the need for better life, the pressure on the environment and accords with the rural industrialization, modernization policies of Vietnam. However, concrete directions and guidelines are crucially important for localities to conduct planning and space organization, sensibly arrange industrial production establishments and rural occupation establishments scattered in villages into medium and small scale industrial complexes and to avoid production expansion from being turned into population displacement.

Environmental education

Build mass education program, enhancing people's awareness of environmental protection in craft villages, especially in use and discharge of wastewater into the environment. Besides, it is necessary to open on-the-spot classes on pollution prevention and treatment in craft villages.

Appropriate technical solutions

In many craft villages, if timely survey and assessment of the production states are conducted in great details, sensible technical solutions might be put forward for improvement of water environment in the villages. It is necessary to combine production area re-arranging, application of cleaner technologies and construction of wastewater

treatment system according to the villages' production reality. Recently, the Institute for Environmental Science and Technology has brought the experimental model of pollution prevention and wastewater treatment system villages into operation in some craft villages: waste paper recycling village of Phu Lam, Bac Ninh, the textile and dyeing village of Tri Nhan, Ha Tay, Zinc coated iron establishment in Khai Hung, Ha Tay, which has delivered promising results and has reasonable cost.

IV. CONCLUSION

It is important for managing agencies, research and environmental technology transfer institutions to pay attention to the environmental pollution caused by wastewater in craft villages in order to find out appropriate and feasible solutions in the production context of craft villages. As a matter of fact, concentrated wastewater treatment is only used in well-established and developed industrial clusters of craft villages. In the short term, preliminary treatment solutions are needed for each establishment to reduce pollutants before discharging into receiving bodies. Looking for funding and financial support from international organizations is also crucial for helping craft villages to solve environmental sanitation and wastewater. However, the prime importance is that environmental sanitation in general and wastewater pollution in particular in craft villages must be understood throughout and dealt with by the local residents themselves.

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