

УДК 911.2(597.3)

Nguyen Khanh Van, Le Van Huong**THE IMPACTS OF SOCIO-ECONOMIC ACTIVITIES ON THE ENVIRONMENT OF HUONG RIVER BASIN****Nguyen Khanh Van, Le Van Huong****THE IMPACTS OF SOCIO-ECONOMIC ACTIVITIES ON THE ENVIRONMENT OF HUONG RIVER BASIN***Institute of Geography, Vietnam Academy of Science and Technology, Hanoi*

The article analyzes, assesses and forecasts initially the impacts of development process of population, industry, aquaculture and tourism on the environment of Huong river basin. The results shows that the increasing of waste water discharge and waste matter from the population is one of the factors which pollute the environment of Huong river basin, especially in urban areas. Besides, activities of home craft at rural areas, the extension of the scale of industrial zones are forecasted that they will increase the solid waste matter discharge, including noxious solid waste matter. The development of raising prawn by industrial methods at Tam Giang – Cau Hai eliminates millions of square meter of waste water per crop, that pollutes surface water and coastal sea water. Besides, tourism activities at the tours along Huong river basin is one of the factors which pollute this river.

Keywords: *pollution; waste water; solid waste matter.*

Нгуен Хань Ван, Ле Ван Хюонг**ВЛИЯНИЕ СОЦИАЛЬНО-ЭКОНОМИЧЕСКОЙ ДЕЯТЕЛЬНОСТИ НА ОКРУЖАЮЩУЮ СРЕДУ В БАСЕЙНЕ РЕКИ ХЬОНГ***Институт Географии, Вьетнамская Академия Наук и Технологий, Ханой*

В статье даны анализ, оценка и прогноз влияния населения, а также промышленности, аквакультуры и туризма на окружающую среду в бассейне реки Хьонг. Результаты исследования показывают, что одним из основных факторов загрязнения окружающей среды в бассейне реки Хьонг, особенно в пределах городов, является возрастающий сброс сточных вод и других загрязняющих веществ в реки. Вследствие деятельности домашних хозяйств в сельской местности и расширения промышленных зон прогнозируется увеличение количества твердых бытовых отходов, в том числе токсических. Развитие промышленного выращивания креветок в районе Там Гианг – Кау Хай приводит к образованию значительных объемов отработанных вод, которые загрязняют поверхностные воды и прибрежные воды моря. Туристическая деятельность также является одним из факторов загрязнения реки.

Ключевые слова: *загрязнение; сточные воды; твердые бытовые отходы.*

I. The beginning

In recent years, Huong river basin is the object of studies of many programs, national projects and international ones in order to reduce pollution and improve environment quality. There are many different impacts on the environment of Huong river basin, but main ones are population development, socio-economic activities of population. In this article, these impacts are: population, urbanization, industrial production, aquaculture and tourism development.

II. The impact of socio-economic activities on the environment**1. The impact of population and urbanization**

Huong river basin includes Hue city, 8 districts and 150 communes and towns by the administrative unit. According to results of population survey in 2006 showed that the total population of this river basin was 1,143.5 thousand people, the density is 226 people per km². Among them, Kinh people makes up 10%, the remaining is Bru – Van Kieu, Ta Oi, Co Tu and others ethnic minorities.

The population of Huong river basin distributes unequally, almost of them concentrates at coastal cities, towns. The network of urban areas includes Hue city and 8 urban towns and the total urban population is 357,682 people, makes up about 31.4% of the total population of whole province.

The increasing of population is synonymous with the increasing of water need, living waste water and wastage. According to forecasts, the population of Huong river basin will be 1,150 thousand people in 2015 and 1,356.6 thousand people, among them urban population will be about 949.6 thousand people, makes up 70% of the total population [5]. According to the fresh water using standard 150l per capita per day, the need of using water in Huong river basin will be 203,490 m³ per day up to 2020. According to WHO, if average waste water is calculated by 80% of water supply, the amount of living waste water in this river basin will be 162,792 m per day.

If the discharge of waste matter in waste water (g per capita per day) is calculated by Table 1, average forecasted waste matter mass in living waste water of Huong river basin in next years will be shown in Figure 1.

At Hue city, there isn't its own drainage for living waste water and rain water now in whole city. Living waste water from residential areas, markets, trade villages, hospital waste water contain bacteria, noxious chemical, latent organic matter, they cause redundant nutrient at unmanaged water supply. Waste water (untreated) flows over culvert systems purely and spills into Huong River directly. In some areas, culverts are open-cast, so when heavy rain happens, surrounding environment is affected. Especially,

Table 1. The discharge of waste matter in waste water into the environment (g per capita per day)

Waste matter	Mass (g per capita per day)	Average mass (g per capita per day)
Suspended solid (TSS)	70 - 145	107.5
BOD ₅	45 - 54	49.5
COD	72 - 102	87.0
NH ₄	2,4 - 4,8	3.6
N	6 - 12	9.0
P	0.8 - 4.0	2.4

Source : Environment Technology Center - ENTEC, 200)

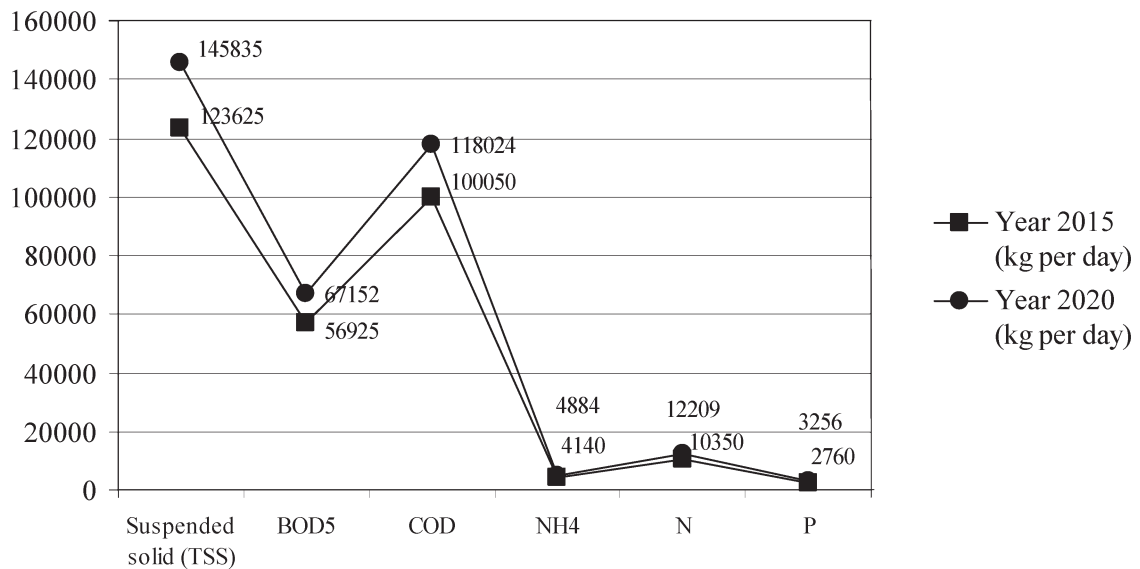


Figure 1. Forecast average amount of waste matter in waste water at Huong river basin in 2010 and 2020

some sullage pits of food processing factories are also affected, they run the risk of having much redundant nutrient and become the favourable environment for the development of many kinds of noxious algae. The samples of research group of Biology Faculty – Hue Science University show that there are noxious algae in Huong river basin individually. Therefore, in dry season, the section of Huong river basin which flow across Hue city has the content of organic matter exceeding Vietnam Standards. In 1999, according to results of urban development project, there were 37 sullage pits at the section river which flows across Hue city, up to now the number of these ones doesn't decrease and even is increasing continuously. Seriously, some of them are filled by grass, some sullage pits which are used for drainage to river is narrowed, some others contain many garbage, thus the drainage of culverts is limited, and it makes surrounding environment become more polluted. The number of route of sullage pits at the Northern bank of Huong river basin, from Phu Xuan bridge to Con wharf is few and they aren't dredged regularly,

therefore if there is a lack of more effective treatment methods, the pollution of natural water resources will increase more quickly.

One of the important sources of causing pollution at Huong river basin is the activities of ten thousands fishing boats in this river. Garbage, waste water of these boats has the direct impacts on the environment of Huong river basin, and this is the hot issue now. According to the statistical data of Hue city People's Committee, there are nearly 5,000 fishers living in inner Hue. Huong River and its tributaries such as Dong Ba, Bach Dang, Ke Van, Nhu Y are the home of about 1,069 fishing households with 6,168 fishers. Ferry-boat is both means of transport for a living and the home of ten thousands fishers. Hundred of ferry-boats are placed near each other to create groups at Gia Hoi bridge, Hen hillock, Bach Dang – Huynh Thuc Khang, there are about 2 – 10 people at each ferry-boat, depending on its size. The education level of each people is low, about 8% of total population is illiterate, primary and secondary education: 90%, higher education: 2%; 85% of them have lived at the

ferry-boat for from 11 to 50 years, the average income per capita is 117,000 VND per month; 22% of the total population raise poultry at the ferry-boat and 100% of them expect to settle on the mainland. Pigs and fish are raised together to increase more income. There are about 6 pigs with 40-50 kg in weight in a small ferry-boat. Waste matter from these pigs and activities of fishers will be utilised to raise floating fish.

The results of water sample analysis at fishing village of Chemistry Faculty – Hue University showed that the content of organic polluted matter is many times more than the standard level. Average feces amount of fishers is 100 kg per day, garbage amount is 4 – 5 m³ per day, and no form of collecting garbage is used. Besides, there are nearly 100 tourism boats and floating restaurants, and their waste matters is poured into the river directly without any treatment methods. Therefore, middle ear inflammation of children, eye sore, cholera, typhoid and petechial fever become commonly each year at fishing villages. The flow speed is small because river-bed isn't dredged and waste matter content is high at the section of Huong River across Dong Ba market and others. Therefore, it is important and necessary to emigrate out Huong River.

Accompanying by urbanization, waste matter also increase, among them household solid waste. According to the statistical data, its potential impacts are very high, especially municipal solid waste and industrial one.

According to the Standard of Urban construction planning by Ministry of Construction, we calculated that the average living waste amount in 2020 for urban people will be 1.1 kg per capita per day. Because the urban population in 2010 is 949.600 people, living waste amount will be 38,126 tons per year. The quick increasing of solid waste, especially organic solid waste, will cause air pollution at urban areas if there aren't any methods for collecting and controlling it absolutely.

In recent years, Hue city development is quite rapidly and quickly, that make the concentration of population and economic-commerce-tourism activities. However, at new urban areas, the area of land is controlled unrationally; almost of it is used for housing, while the area of trees, entertainment areas isn't appreciated. The urbanization makes the area for construction increase, simultaneously, the area of lake and pond is narrowed, almost lakes at the South of Huong River are filled. Therefore, in a long-time, all above things will have the harmful impacts on the environment, quality of public services and other security-social issues. On the other hand, according to almost planning projects and investment ones, agricultural soil area is used for construction ground without researching the economic-social impacts and effects for the population and there aren't methods to control agricultural soil area rationally.

Besides, infrastructure and urban housing construction ... also change appearance and figure of urban areas remarkably. These changes are: concretion increases and surface absorbent decreases, surface flow also increase at urban areas, that cause flood and waterlogging in rainy season, and make dry season more waterless.

2. The affects of agricultural production

Agricultural production is the economic branch which has the most impact on the environment. Thua Thien – Hue is the concentration area of almost industrial activities of Huong river basin, there are high-tech industrial enterprises, food processing businesses, Huda beer factory, Luksvaxi cement one, some State enterprises (sewerage and drainage, refined brick, menfrit, car assemblage). Besides, activities of handicraft villages is concentrated to develop by the local authorities, such as special meal processing, arts and crafts, fine arts carpentry, high technical carpentry, sculpture, wood-carving, export rattan knitting, blond casting, interior decoration, painting...

The operation of trade villages: One of insolvable issue of trade villages in Huong river basin is garbage and waste from enterprises, they are discharged directly into the river, streams, lakes and pond, and that causes the pollution. Ex: At O Sa vermicelli village (Quang Dien district), there are 60 households making vermicelli, among them 32 households make it seasonally, 26 ones do frequently, especially there are 3 householdds which make it at big scale (800 – 900 kg per day). Therefore, the waste water amount from making vermicelli and raising of these households is nearly 260m³ per day without the treatment methods, they are discharged directly into the environment and cause serious pollution. At Van Cu vermicelli village (Huong Tra district), there are 144 households and about 288 labours, among them there is only one household which make it at big scale with modern technology, the remaining ones make it manually, 1 quintal of vermicelli per day and 3-5m³ waste water amount per day are discharged. Besides, each household raises about 5-10 pigs, therefore waste water from raising is poured into the garden and ditch. Waste water from trade village not only causes the air pollution but also makes the edge and soil of ponds surrounding the garden become dead soil, and although many kind of trees have good vitality (spinach, paddy), they can't exist.

Industrial zones: Industrial production at Huong river basin is developed in concentrated industrial zones such as Phu Bai, Tu Ha, Thuan An and others one at the West, North-East, North-West of this city. Besides, there are manual mechanics enterprises, food processing ones which is scattered in residential areas. The unrationall arrange of industrial and home craft enterprises, factories intermixs residential areas (the results of unplanned development process) causes serious pollution of air, soil and water environment

Table 2: Carrying power norm of waste matter is calculated at the average level for one area unit of industrial zone

Waste matter	Carrying power
Waste water	Discharge: 25 – 40 m ³ per day per ha, of which: TSS: 10 kg per a day per ha; BOD ₅ : 6,8 kg per a day per ha COD: 10,9 kg per a day per ha
Air	Dust: 4,9 tons per year per ha; SO ₂ : 12,6-15 tons per year per ha NO _x : 1,7-2,1 tons per year per ha
Industrial waste	0,04-0,05 per day per ha Noxious waste is estimated 10% of industrial waste

Source : Environment Technology Center - ENTEC, 200)

Table 3: The increasing waste matter amount of Huong river basin in 2020, is estimated by the area of concentrated industrial zones (according to the maximum waste discharge)

The area (ha)	Waste water per year				Waste air per year			Solid waste per year	
	Discharge (1000m ³)	TSS (Tons)	BOD ₅ (Tons)	COD (Tons)	Bụi (Tons)	SO ₂ (Tons)	NO _x (Tons)	CN (Tons)	Noxious (Tons)
1350	19224	4927.5	1340.7	5370.9	6615	20250	2835	2463	246.3

and that cause negative impacts on the health of population.

According to the planning [5], the total area of industrial zones up to 2020 of Huong river basin will be 1,350 ha (Phong Dien: 400 ha, Tu Ha: 250 ha, Phu Da: 250 ha, La Son: 300 ha and Quang Vinh: 150 ha). If waste matter is calculated by the carrying power norm of Environment Technology Center (Table 2.2), its amount is shown by the area of industrial zones at Figure 2.

3. The affects of aquaculture activities at Tam Giang – Cau Hai

The area of Tam Giang – Cau Hai lagoon is 21,600 ha, it lengthens 68 km and is one of the largest lagoon of South-East Asia, includes 5 out of 9 districts and cities of Huong river basin consisting of 31 communes (about 300,000 people). Because of the excessive and unplanned exploitation, the natural resources of this lagoon runs the risk of exhausting, environment pollution at here is increasing quickly.

Oil pollution exceeds the standard level now, its content is measured: 0.13-0.5 mg/l, the places which have the high one are: areas near ports, wharfs. The results of water discharge measurement at Tam Giang lagoon show that the salty is 0.1-33‰, pH: 6.8-8.0 and they change continuously and become the harmful factors for creature of this lagoon [9]. Coastal agricultural production makes remaining insecticide amount and that causes water pollution at this lagoon: insecticide amount remains in water: 0.62mg/l, in sediment: 33.5 mg/l [5].

There are two methods for developing aquatic organism at lagoon:

- Fixed exploitation not only obstructs the traffic but also have the serious impacts on the source of aquatic products: The local people use bamboo to catch mynah and utilise small mest of fishing-net to catch small or big fishes and shrimps at the lagoon.

- Itinarate exploitation have the harmful impacts on the aquatic products just like fixed one: using machines and fishing-net to catch almost young fish at the lagoon. The number of boats and ship increase about 300 each year (about engine boats and 200 craft ones). There is an average of one boat at each 4-5 ha of water surface of this lagoon; the density of exploitation activities is dense. In 2015 this density will be more than 1 exploitation boat per 1 ha of water surface at the current increasing speed. From the late 1990s (previous century), light oil pollution happened, the growth of boats and ships and engine capacity were 13.3% per year, therefore more serious oil pollution is unavoidable now .

The spontaneous development of means of catching fishes is very quick while the natural production of Huong river basin reach the maximum threshold, that cause the reduction of natural reserves. Moreover, because of lack of knowledge and hard life, many local people used the unrational catching forms, that destroyed vegetational cover which is the home, places of residence and reproduction of species of aquatic organisms. According to the statistical data of Thua Thien Hue Department of Fishery, aquatic products

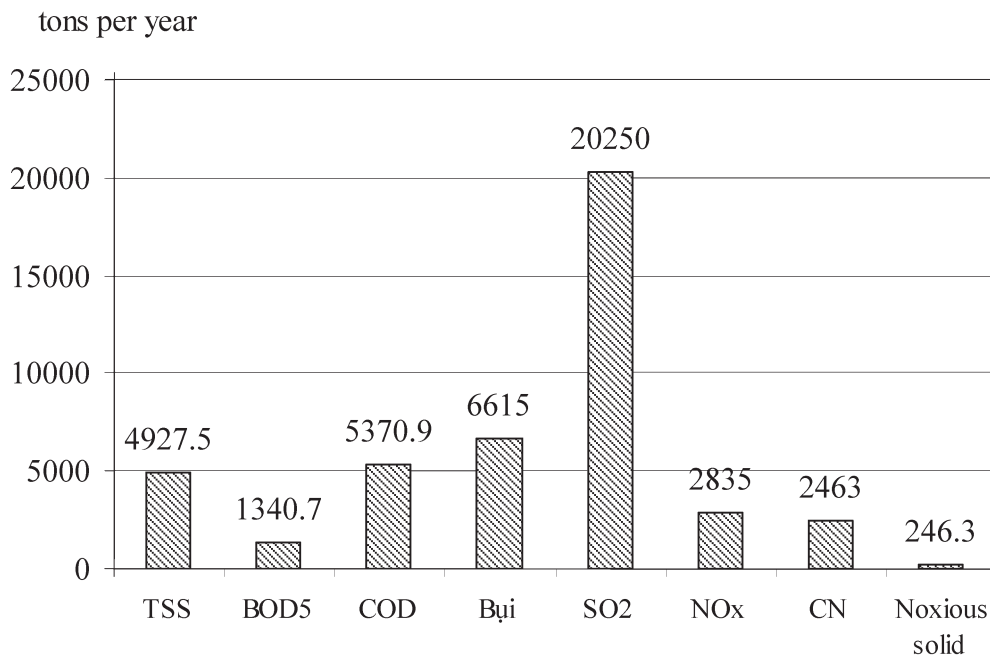


Figure 2. The increasing discharge of waste matter in Huong river basin in 2020, is estimated by the area of concentrated industrial zone (according to the maximum waste discharge)

output at Tam Giang – Cau Hai lagoon decreased approximately in half: from 4,500 ton before 1980 to about 2,500 tons at present. In order to solve this issue, the province agencies are coordinating closely with local authorities and people.

In recent years, supgo prawn raising gives economic benefits for local people but it also makes Tam Giang – Cau Hai lagoon narrowed by the area of prawn raising. The area of prawn raising are extending without planning. In ten years, the raising of prawn at low tide level and mynah make the area of lagoon decrease 10%, about 3,000 ha. The increasing of the area of prawn raising ponds is the reason which obstructs the circulation of flow at the lagoon. At Quang An, Quang Phuoc (Quang Dien province), pond of prawn raising is dense at lagoon surface. Because of the demand of raising prawn, industrial waste is increasing quickly; chemical and foods for aquaculture are poured into the lagoon that cause local serious pollution, and have the negative impacts on Tam Giang – Cau Hai lagoon. Polluted environment cause uncontrolled diseases indispensably and that have the harmful impact back on the life of local people. This phenomenon occurs continuously in Thua Thien Hue in recent years. From 2005 up to now, white or yellow spots diseases... make serial prawns dead at prawn raising ponds in Quang Dien, Phu Vang, Phu Loc, Huong Tra district... Income of many households is lost by the diseases.

At average, millions of waste water from raising prawn is poured into Tam Giang lagoon, among them, especially raising prawn by industrial methods. Waste water from industrial prawn raising has high pollution content, includes chemicals, antibiotic and organic substance from redundant industrial food, if they aren't

treated, serious pollution will occur at surface water and coastal sea water.

4. The affects of tourism activities

At present, tourism is the economic branch which distributes the maximum GDP of the total GDP in Thua Thien Hue and tourism development is the socio-economic development trend of this province, thus it is unable to limit the development of tourism activities.

Due to Hue ancient capital and Hue Empire music become world cultural heritages that make Hue become "the red address" in the world tourism map. Besides, many cultural properties and entertainment activities, eating and drinking... of Hue ancient capital are still conserved. The tourism development contributes to give more jobs for many ten thousands labours of transportation, commerce, industry and other services. At present, there are 1.4 millions tourists to Hue each year, the tourism's turnover reaches about 350 billions VND per year. Developing branches of services, mainly tourism distributes profuse human resource and increases the density, economic growth rate and State fund income. The economic growth rate 17% per year makes Thua Thien Hue become the place which has the maximum number of tourists in Middle Region. In 2007, tourism turnover increased 31.2% more than it in 2006. Material facilities of tourism are always consolidates and constructed more.

The extending and development of infrastructure and material facilities at tourism areas have bad impacts on the ecological environment by dush, the noise from construction works. Moreover, waste matters from hotels, restaurant... - are built at Hue city and some main areas are poured into overloaded

general drainage system of this city directly that makes water environment of this river basin more polluted.

Almost main tourism routes has the tour along Huong river by imperial boat, lantern release festivals or singing Hue songs happen in Huong river each night, that is one of reason which cause water pollution in particular and ecological environment in general at areas along Huong river and the downstream.

Sources of pollution are not only poured into Huong river directly or indirectly but also flown into its tributaries such as Bach Dang, Dong Ba, Ngu Ha, Nhu Y. Garbage and waste water in Dong Ba and Bach Dang river is several tens of times more than it in Huong river. Ngu Ha river was considered the drainage system of Hue city, but now its role is over. In recent years, Hue urban Environment and Construction work Company use boats to collect garbage in rivers, 15 tons per day, however, the contamination status at rivers are more and more serious each day.

At developed tourism areas, controlling garbage and reserving and developing sustainable tourism is inadequate. If each tourist turns eliminates into the environment about 0.3 kg per day in average, 480 tons garbage per day or 175,200 tons per year must be collected at tourism areas in Huong river basin in average. Almost waste components is non-disintegrated organic substance (nylon, spongy plastic, paper, ...).

In future, this is the area which has many favourable conditions to develop ecotourism, sightseeing and visit historical vestiges and because of good infrastructure and tour guides, it is very necessary to invest, improve, upgrade and extend tourism areas and all these activities must be connected environment protection in general and natural reserve areas preservation in particular.

III. The conclusion

Sources of waste matters which has high discharge are from residential areas and urban areas, industry, aquaculture and tourism. The main places which receive waste matters is Huong river, its branches, lakes, ponds in Huong river basin.

In order to reduce the environment pollution in Huong river basin, it is necessary to have the comprehensive planning about industrial parks, invest capital for the environment protection concentratively in the form of the combination between the State and enterprises and control environment situation carefully when any project about industrial parks investment is given a licence. At the trade villages, the change of production forms and the utilization of new technology for their development, especially traditional trade villages must be implemented. The local authorities need promote the current resources, among them the strongest resource is policies such as concessionary policy about land, taxes, vocational training, environment fees from the contribution of enterprises themselves.

In order to control environment situation, the main resolution is preventing environment pollution. Besides, administrative and economic methods and technology applications must be implemented at the areas which are polluting.

The project is implemented in the framework of international cooperation according to Vietnam-Ukraine Protocol: "Geographic basis in the natural resources control and exploitation, environment protection by river basin for the purpose of sustainable development (The case: Huong river, Vietnam and Prudna river, Ukraine)", carried out in the period 2010-2012.

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