

## ENVIRONMENTAL PERFORMANCE IMPROVEMENT FOR SMALL AND MEDIUM-SIZED SLAUGHTERHOUSES IN VIETNAM

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**Abstract.** Slaughtering cattle and pigs is good business nowadays in Vietnam and in Ho Chi Minh City alone there are already 42 slaughter units. Though slaughtering has for a long time been considered a low-technology operation and thus not the sort of subject to be taken seriously by researchers, the recent increase of public awareness on environmental problems caused by this activity however attracts more attention. This article provides an analysis of the environmental impacts caused by the small- and medium-sized slaughterhouses in the Ho Chi Minh City and describes the shortcomings and causes of its present poor environmental performance and management. The main environmental problems caused by the small- and medium-sized slaughterhouses are the uncontrolled use of ground water and the discharge of untreated wastewater with high concentrations of organics including animal feces and blood, parasite eggs and pathogenic bacteria that might easily contaminate the receiving environment and endanger human health. The article concludes that the application of a pollution-prevention concept is crucial to improve the environmental performance of small- and medium-sized slaughterhouses in Vietnam.

**Key words:** Ho Chi Minh City, pollution prevention, small- and medium sized slaughterhouses, Vietnam.

**Abbreviations:** BOD<sub>5</sub>: – Biological oxygen demand; COD: – Chemical oxygen demand; DONRE: – Department of Natural Resources and Environment; LPG: – Liquefied petroleum gas; MONRE: – Ministry of Natural Resources and Environment; MOSTE: – (former) Ministry of Science, Technology and Environment; N: – Nitrogen; P: – Phosphorus; SME: – small and medium-sized enterprise; TSS: – Total suspended solids; VITTEP: – Vietnam Institute for Tropical Technology and Environmental Protection

### 1. Introduction

Until recently animal slaughtering in Vietnam has been regarded in general as a low-technology operation. As a result, this agro-industry sub-sector has never been the sort of subject that would be taken seriously. Recently however, the increase of public awareness on food safety related to and environmental problems caused by slaughtering activities attracts more and more attention not only from the competent administrative authorities but from environmental scientists as well.

## 1.1. SLAUGHTER INDUSTRY IN VIETNAM

*Doi Moi*, Vietnamese for “economic renewal”, took off in Vietnam in 1986 and has brought about unprecedented growth of the national economy. Thanks to *Doi Moi*, the former centrally planned economy has gradually been transformed into a multi-sectoral economy guided by the principles of the market-economy (Wolff, 1999). As a result, rapid economic development has not only been achieved in the industrial sector, but in the agricultural sector as well, including the animal breeding activities. Regarding the animal breeding sector, national statistics (General Statistics Office, 2002) show the rapid growth of the numbers of different categories of livestock, except for buffaloes, in the country over the last decade. See Table I.

These figures provide evidence for the existence of a good basis for slaughtering activities in the country. In fact, according to the Department of Veterinary Science of Vietnam (2003) in the whole country there are some 12,000 units with capacities varying between 1 and more than 1000 animals slaughtered per night.

All enterprises in Vietnam are classified by size according to a Vietnamese definition, which was elaborated by the Government of Vietnam (in its Document 681-CP/KTN issued on June 20, 1998) and which considers small and medium-sized enterprises (SMEs) as the ones that have a maximum registered capital of VND 5 billion (equivalent to about EUR 375,000) and/or employ less than 200 employees. According to this definition, VISSAN in Ho Chi Minh City is the only slaughterhouse in Vietnam classified as large-sized while all the remaining slaughter units have to be classified as small- and medium-sized.

In practice, a slaughter unit in Vietnam is called a “centralized slaughterhouse” when it has a capacity of more than 10 heads slaughtered per night and a “slaughter point” when it has a capacity less than around five heads slaughtered per night.<sup>1</sup> The units called “centralized slaughterhouses” correspond well with the criteria set for SMEs, while the “slaughter points”, although their number is huge, seem too small to be even classified as SMEs and thus should be classified as micro-sized. Among

TABLE I. Livestock population in Vietnam.

	Buffaloes (×1,000)	Cattle (×1,000)	Pigs (×1,000)	Goats and sheep (×1,000)	Poultry (×1,000,000)
1990	2,854.1	3,116.9	12,260.5	372.3	107.4
1991	2,858.6	3,135.6	12,194.3	312.5	109.0
1992	2,886.5	3,201.8	13,891.7	312.3	124.5
1993	2,960.8	3,333.0	14,873.9	353.0	133.4
1994	2,977.3	3,466.8	15,587.7	427.9	137.8
1995	2,962.8	3,638.9	16,306.4	550.5	142.1
1996	2,953.9	3,800.0	16,921.7	512.8	151.4
1997	2,943.6	3,904.8	17,635.9	515.0	160.6
1998	2,951.4	3,987.3	18,132.4	514.3	166.4
1999	2,955.7	4,063.6	18,885.8	470.8	179.3
2000	2,897.2	4,127.9	20,193.8	543.9	196.1
2001	2,819.4	3,896.0	21,740.7	560.6	215.8

Source: General Statistics Office 2002.

the 12,000 existing slaughter units in the country there are only about 350 “centralized slaughterhouses”, which will be called “slaughterhouses” throughout this paper, while the remaining number is “slaughter points”. According to the Department of Veterinary Science of Vietnam (2003) slaughterhouses are concentrated in the Southern provinces much more than in the Northern and Middle parts of the country, while slaughter points are more numerous in the Northern provinces.

## 1.2. SLAUGHTER INDUSTRY IN HO CHI MINH CITY

Although the number of slaughterhouses in Ho Chi Minh City is not the highest in comparison with other provinces of Vietnam, its slaughter capacity is undoubtedly the largest. While the average capacity of all slaughterhouses in the country is far below 30 heads slaughtered per night, is the number for Ho Chi Minh City about 180 (Sub-department of Veterinary Science of Ho Chi Minh City, 2002b). According to the Sub-department of Veterinary Science of Ho Chi Minh City (2002a, b), 42 legally registered slaughter units are scattered around the city, divided between 30 slaughterhouses and 12 slaughter points. Among them, only one slaughterhouse (VISSAN) is large-sized, while six are medium-sized, 23 small-sized and the remaining 12 are micro-sized.

Ho Chi Minh City has been selected to carry out case studies on the environmental problems and management practices applied because of the following reasons:

- the concentration of the slaughter units in Ho Chi Minh City is rather high;
- the range in operation capacities among the slaughter units in Ho Chi Minh City is wide, varying from two heads slaughtered per night at some isolated slaughter points up to 1200 heads slaughtered per night at the Nam Phong Slaughter House; and
- the location of the slaughter units in Ho Chi Minh City are representative for several locations in other parts of the country including big cities, newly formed towns, peri-urban and rural areas.

## 2. Operation of slaughterhouses

### 2.1. CASE STUDY SELECTION AND THE PROFILES

Six slaughter units in Ho Chi Minh City were selected for this study. They include three medium-sized and three small-sized slaughterhouses. The selected slaughterhouses are located in five different districts. The locations of the studied sites are shown in Figure 1. The profiles of the selected slaughterhouses are summarized below.

#### 2.1.1. Binh Chanh Central Slaughter House

This slaughterhouse (Binh Chanh district) is one of the very few slaughterhouses that are located separately from residential areas. Taking up a large piece of land, the

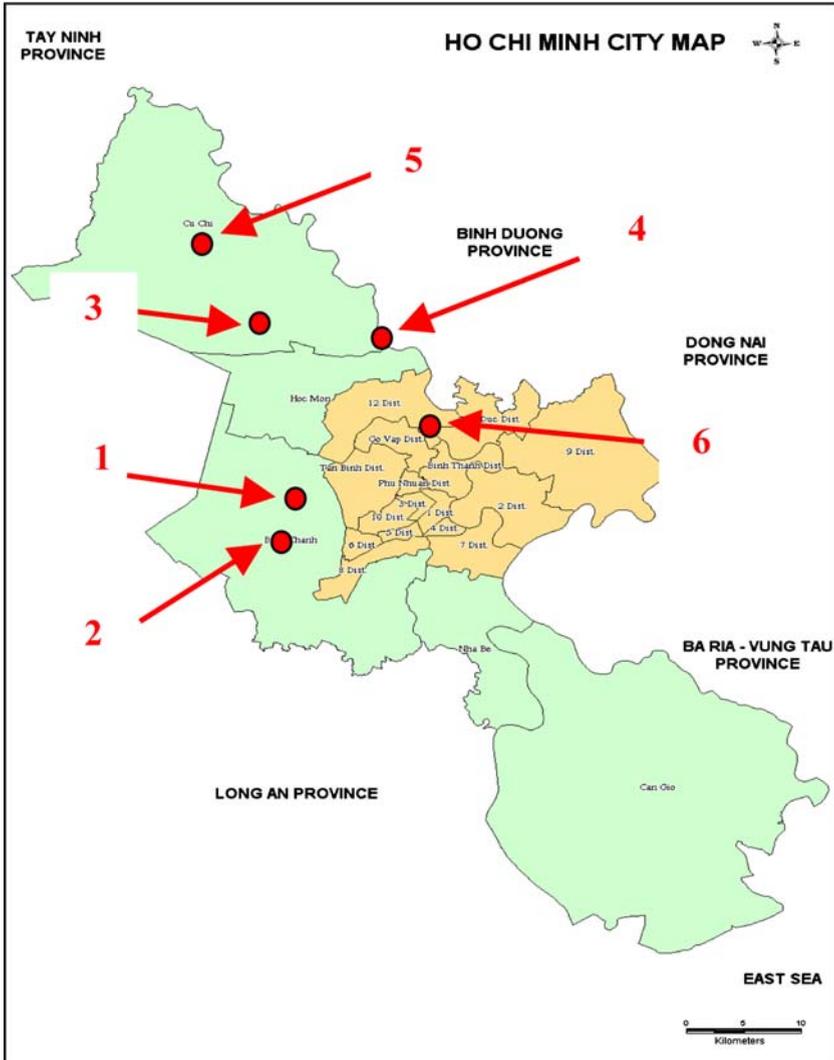


Figure 1. Location of the slaughterhouses studied in Hochiminh City.

slaughterhouse has a large area for pigs to rest before being slaughtered. The slaughterhouse was designed with a capacity of 1000 heads slaughtered per night and actually 900–1000 heads are slaughtered per night depending on the available number of pigs on offer and on the seasonal demand in the market.

Binh Chanh Central Slaughter House is shared by seven owners, i.e. there are seven working groups working simultaneously with a maximum of approximately 150 workers. Each group possesses 2–3 scalding tanks, bringing the total number of scalding tanks at 16. Wood is used to heat the water in the scalding tanks to about 60°C so that after exsanguination intact carcasses can be immersed into the tanks to remove hairs and bristles.

Ground water is extracted from a 250 m deep borehole and a simple sand filter is applied to treat the water before use. A settling tank with dimensions of 30×40×2.5 m. was constructed to retain the wastewater for some time before discharge.

#### *2.1.2. Phong Phu Slaughter House*

Phong Phu Slaughter House (Binh Chanh district) is located within a residential area and constitutes the smallest of the six slaughterhouses selected for this study. With a total area of about 500 m<sup>2</sup> and with a maximum of 20 workers, this site was designed with a capacity of 50 pigs per night; however, its actual production is now about 100 pigs per night.

Wood and rice husk serve as the main energy sources to heat four scalding tanks. Ground water is extracted and passed through a sand filter into two collection tanks of 2 m<sup>3</sup> each, before being distributed for use. A small septic tank is available to treat the wastewater before discharging it into a brackish water canal just behind the site.

#### *2.1.3. Ba Diem Slaughter House*

Ba Diem Slaughter House (Hoc Mon District) is situated in a thinly populated area. The slaughterhouse is owned by seven “owners”. The site was designed with a capacity of 500 heads slaughtered per night and thus medium-sized. However, its actual capacity is only 150–160 heads per night, and hence in practice it has been considered a small-sized slaughterhouse. The total area of the site is about 1500 m<sup>2</sup>, which seems too small even for the existing number of pigs slaughtered, since a large space is already in use to rest the pigs.

The scalding tanks are heated with wood and ground water is extracted for use in the slaughtering process. No treatment measures are practiced for water or for wastewater.

#### *2.1.4. District 12 Central Slaughter House*

District 12 was recently established as an urban district split off from the suburban district of Hoc Mon. District 12 Central Slaughter House, owned by four businessmen, is situated at about 15 km north of the city centre. The location is considered isolated from residential areas.

The slaughterhouse was constructed and put into operation in 2000 with a designed capacity of 400 pigs slaughtered per night. Currently it is mostly operating with a capacity of 300 pigs slaughtered per night. On its 3000 m<sup>2</sup> area, on average about 60 employees are working in this slaughterhouse every night. This slaughterhouse is therefore classified as a medium-sized.

To heat the scalding tanks, this slaughterhouse uses gas (LPG). Ground water is extracted for processing, while no water treatment is needed, according to the owners, thanks to its high quality. Wastewater is passed through a settling tank before it is discharged into a field with vegetables for infiltration.

### 2.1.5. *Cu Chi Town Slaughter House*

Cu Chi Town Slaughter House is located in the rural district of Cu Chi. The site is part of the North West Cu Chi Industrial Park, and therefore isolated from the residential areas. Three businessmen renting this facility share the work, which is the only among the many small- and medium-sized slaughterhouses in Ho Chi Minh City that has a license for slaughtering cattle. It was designed to slaughter 40 cattle and 50 pigs per night. The real numbers of animals slaughtered per night are 40 cattle and 30 pigs.

The scalding tanks used for pig slaughtering are heated with firewood. Ground water is extracted on-site and used without prior treatment. Wastewater is passed through a tank before being discharged for infiltration into the immediate surrounding soils.

### 2.1.6. *Nam Phong Slaughter House*

Nam Phong Slaughter House (Binh Thanh District) is located close to the city center within a densely populated area. The legal owner of this slaughterhouse is the Saigon General Agriculture Corporation.

In terms of its capacity, this slaughterhouse belongs to the largest in the country. Its designed capacity is reported to be at slaughtering 800 pigs per night. However, its actual capacity varies between 1100 and 1200 heads per night. Also in terms of the surface occupied, Nam Phong Slaughter House belongs to the largest ones. The total area of the site is about 7500 m<sup>2</sup>, of which about 4000 m<sup>2</sup> is used for slaughtering while the remaining 3500 m<sup>2</sup> is occupied by offices, internal roads, green cover and a large space for pigs to rest. Since the total number of employees at the site is less than 200, the Nam Phong Slaughter House has nevertheless for a long time been considered a medium-sized slaughterhouse.

The traditional manual slaughtering part of the Nam Phong Slaughter House uses tap water for washing and cleaning the carcasses and ground water for flushing and cleaning the floors. The site is shared by 17 businessmen with their own groups of workers. LPG is used by all groups to heat their scalding tanks, while ground water is extracted from 17 drilled wells for separate use by each group without prior treatment.

Besides these traditional manual slaughtering units, Nam Phong has recently been equipped with a semi-mechanical processing line for pig slaughtering, making it the only medium-sized slaughterhouse in Vietnam with such a facility. The processing line was installed by the Metro Superstore Group through an agreement with the Nam Phong Slaughter House to form a consortium and assure the high-quality of the pork supply for its superstores in Ho Chi Minh City. The capacity of this line is 40–50 pigs per night, but can also be increased to 80 heads per night during the weekends and during holidays depending on the market demand. This new semi-mechanical processing line uses tap water for all steps of the slaughter process including flushing and cleaning the floors.

Although Nam Phong is the only slaughterhouse in Ho Chi Minh City that has installed a wastewater treatment plant, its wastewater is still mostly discharged untreated into a tributary of the Saigon River because the capacity of the wastewater treatment system is limited to only 10 m<sup>3</sup> per hour.

## 2.2. THE SLAUGHTERING PROCESS AND ITS WASTES

Before analyzing options for environmental improvement it is essential to have in-depth understanding of the production process. Possible options can only be implemented successfully when they fit into the current practices, or allow application without drastic changes in the production process as costs may be insurmountable for SME's. Therefore this section will briefly describe the key steps in the process of slaughtering pigs and cattle in the studied slaughterhouses and point to the main environmental problems resulting from them.

Through direct observation during the field visits and interviews conducted with workers, it has become clear that independent on size or location, all the studied slaughterhouses apply the same steps in the slaughtering process and hence their waste streams are also similar, except for the fact that cattle slaughtering is slightly different from pig slaughtering. This difference will be taken into account in the description below.

All steps in the process of pig slaughtering with the accompanying wastes generated are summarized in Figure 2 and for cattle slaughtering at the Cu Chi Town Slaughter House in Figure 3.

The eight different steps involved in the slaughtering process, reproduced in the figures, are further explained below:

### 2.2.1. *Preparation for slaughter*

A rest period of at least 12 h for cattle and 6 h for pigs is required. During this period, the animals are not fed but water can be provided. In case the rest period is more than 24 h, cattle are fed. On the floor of the resting area often feces and urine, and sometimes feed residues, can be found. Every day, water is used to wash the floor, thereby generating wastewater.

### 2.2.2. *Stunning*

Animals must be stunned or rendered unconscious before they are exsanguinated. At all the studied sites pigs are stunned by sending an electric current surge through the brain. Cattle at the Cu Chi Town Slaughter House are stunned by sticking a sharp knife into their spinal cord after they are restrained in a narrow pen.

Pigs are usually stunned while they are still within the rest area but just next to the exsanguination area. Cattle at the Cu Chi Town Slaughter House are stunned on the slaughterhouse floor because the entire slaughter process is manual. Sometimes feces and urine may be found at the stunning area and have to be cleaned later with water, resulting in wastewater generation.

### 2.2.3. *Exsanguinations*

After being stunned, cattle and pigs are usually exsanguinated by opening the major blood vessels at the base of the neck, not far from the heart through a puncture. Blood is often found on floor during exsanguination. The area is then cleaned at the end of the working shift with the help of water.

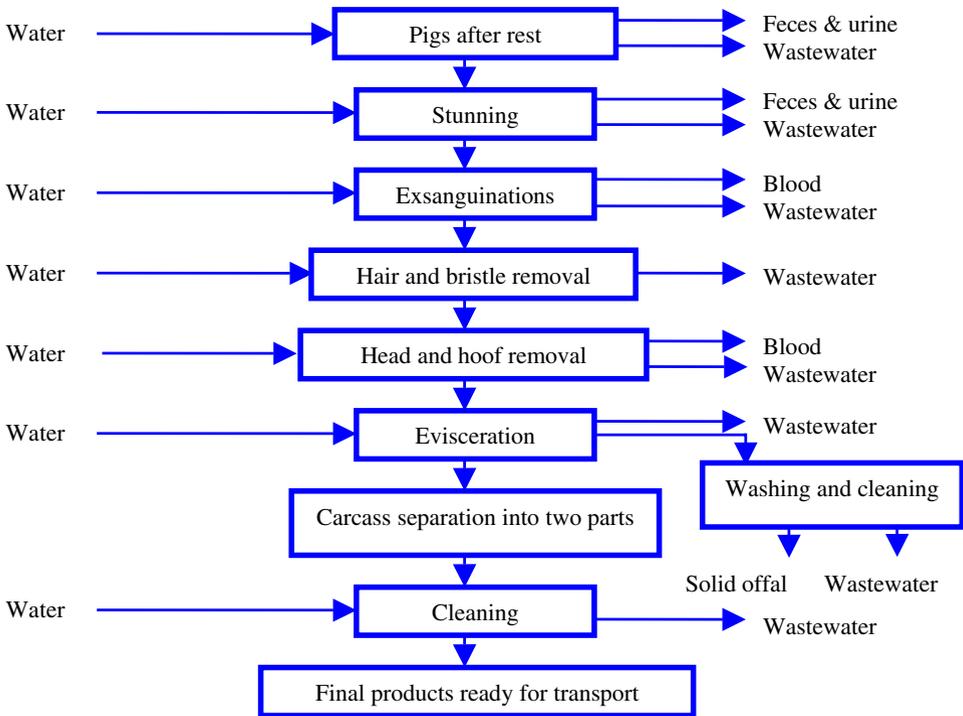


Figure 2. Process scheme and wastes of pig slaughtering.

#### 2.2.4. Hair and bristle removal or skinning

After exsanguination, pork carcasses are placed in a scalding tank containing water with a temperature of about 60°C. Scalding at this temperature normally takes 5 min. Hair and bristles are then removed from the carcasses by using sharp knives. The water from scalding, which contains blood, is disposed off together with other wastewater after the working shift. Blood also leaks to the floor during this step, and is later washed away with water. Usually toenails are also removed at this step. Most of the removed hairs and bristles is dried in front of the scalding tank ovens, and subsequently put into the fire and burnt. The remaining part of the removed hairs and bristles is washed away with water when the floors are cleaned, and is thus joining the other wastewater in the drains.

In the process of cattle slaughtering, the beef carcasses are skinned after exsanguination to obtain hides for tanning. The carcasses are opened by using a sharp knife to make a straight cut allowing the hide to be manually detached from (parts of) the head, body and limbs. This skinning process also results in blood residues and wastewater.

#### 2.2.5. Head or skull and hoof removal

Workers remove the heads of the animals with sharp knives and wash them with water, after which they are ready for transport to the market by middlemen.

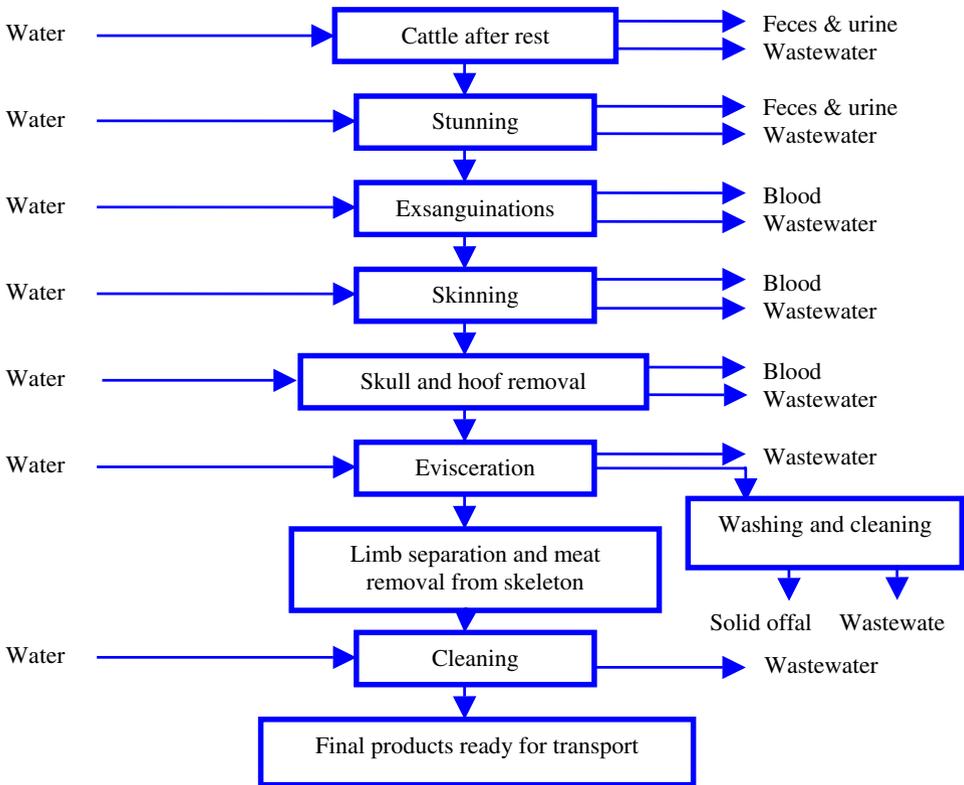


Figure 3. Process scheme and wastes of cattle slaughtering.

At cattle slaughtering, the animal heads are also removed after the skinning process. The remaining hide on the heads, the muscles on the cheeks and scalp are removed subsequently. Then the skull is split open to remove the hypothalamus and pituitary glands, which are put into collection baskets and then transported to the market. The skull and jaw bones are sold with other bones to be processed into a food ingredient sauce (known as maggi) or ground up and processed into animal feed.

During these processes blood leaks to the floor and again water is used to wash the floor, resulting again in the generation of wastewater.

#### 2.2.6. Evisceration

At this stage animal carcasses are eviscerated by pulling out the bladder, intestines and mesenteries, rumen and other parts of the stomach. After cutting through the diaphragm, plucks (including heart, lungs, liver, pancreas, caul fat, spleen and trachea) are removed. The large and small intestines are separated and passed on to a separate area where they are intensely washed and cleaned with water.

The intestine cleaning area is usually located next or very close to the animal rest area and uses the largest amount of water. At all the visited sites, water was running freely from the taps in these areas.

After being cleaned and separated, some parts, for example lungs and caul fat, are sent to cookers where they are processed to obtain grease and animal feed. Most of the other parts of the plucks are sold at the market as edible products.

#### *2.2.7. Carcass or limb separation*

At pig slaughtering, workers separate the left and right sides of the pig carcass by cutting down the midline of the carcass, through the vertebral column. Right after the carcasses have been separated water is used for rinsing and then the two parts are hung on stainless steel hooks.

At cattle slaughtering, the carcasses are separated into five main parts including four parts with a limb and the remaining part including the vertebral system. The limb parts are hung on stainless steel hooks. The meat is then separated from the bone system by sharp knives and later also hung on stainless steel hooks as final products of the process. Unlike at pig slaughtering, meat parts from cattle are not washed with water.

The floors, on which the blood drops down from the separated meat parts that are hung on the hooks, are cleaned with water.

#### *2.2.8. Final cleaning*

Final cleaning is applied for pork carcasses when they have been separated and hung on stainless steel hooks. Only now they are considered end products and just wait for the middlemen to transport them to the market. Final cleaning with water is not applied at cattle slaughtering.

### **3. Environmental problems and impacts**

#### **3.1. UNCONTROLLED USE OF GROUND WATER**

During our field surveys, we observed that one of the main environmental problems related to the slaughtering activities is the uncontrolled use of ground water. At each of the six studied slaughterhouses, ground water is extracted from drilled wells and bore holes with different depths depending on the geological characteristics of the locations.

As it can clearly be seen in Figures 2 and 3, water is used at nearly all steps of the animal slaughtering process. None of the six slaughterhouses that were studied had any means of controlling the amount of water used. Ground water is pumped freely, and it was observed that the amount of ground water extracted always exceeded the actual amount needed. In fact a lot of water was wasted.

Because neither records nor any on-site water meter were available, exact data on the volume of ground water used during the slaughtering process could not be obtained. Only the tap water consumed during the process at the Nam Phong Slaughter House could be measured. Direct interviews with responsible persons at

the new semi-mechanical slaughter line of this slaughterhouse, in combination with checking some available records, revealed that regardless of the exact weight<sup>2</sup> of the animal on average an amount of about 400 l of tap water is consumed for slaughtering one pig. This amount of water can be considered a minimum for slaughtering as it is rather costly to use tap water and therefore it is probably used economically. This would mean that the quantity of ground water used for slaughtering pigs at the other slaughterhouses is probably much higher than 400 l per pig because the extraction of ground water is free of charge (Tran Thi My Dieu, 2003) except for a small fee for the electricity consumed during pumping.

According to Article 24 of the Law on Water Resources (National Parliament of the Socialist Republic of Vietnam, 1998), extracting ground water for use in industry, agriculture, aquaculture etc. requires permission by the competent administrative authorities. This article was subsequently clarified by Decree 179/1999/ND-CP (Government of Vietnam, 1999b) where Article 9 states, that the competent authority for issuing ground water extraction permits with capacities over 1000 m<sup>3</sup> per day is the Ministry of Agriculture and Rural Development, while the city/provincial People's Committee issues permits for less than 1000 m<sup>3</sup> per day. Besides, Article 8 of this Decree also requires the users of ground water to pay for the issue of permits and for the use of the water. Finally, Article 23 of the Law on Water Resources requires water users to provide data on their water use for the purpose of statistics and evaluation whenever requested.

The case studies presented before make clear that none of the above mentioned legal requirements have been effectively implemented in the case of the slaughter industry in Vietnam. Although the Law on Water Resources and other accompanying legal documents have been into force for about four years, it seems they have never been promulgated to the entrepreneurs of the slaughter industry, and so a large quantity of ground water is being used every day without the necessary controls. This lack of monitoring may result in unexpected environmental consequences for ground water, both in terms of quantity and quality.

### 3.2. DISCHARGE OF UNTREATED WASTEWATER

Since the water used for slaughtering activities is not included in the final products, the quantity of wastewater discharged from this industry is equal to the quantity of water used. Measurements conducted during this study showed that around 950 m<sup>3</sup> of wastewater were discharged during only five working hours at the Nam Phong Slaughter House while some 1100 pigs were slaughtered.

A recent study (Ministry of Science, Technology and Environment, 2000) shows that slaughterhouses threaten the environment by discharging untreated wastes, especially wastewater, which generally contains up to 70–80% organic matter, including cellulose, proteins, amino acids, fats etc. released from the animal feces and blood. In addition, the wastewater can also contain parasite eggs and pathogenic bacteria that might easily contaminate the receiving environment and endanger human health.

Wastewater samples from the studied slaughterhouses were collected and analyzed by this study.<sup>3</sup> Table II summarizes the results of the analytical work carried out by laboratory of the Vietnam Institute for Tropical Technology and Environmental Protection (VITTEP)

The high concentrations of pollutants such as COD, BOD<sub>5</sub>, TSS, N and P in the wastewater are the result of the presence of blood, intestines, and solid offal generated during the slaughtering process. Therefore, any reduction of the discharged loads of these matters would result in reducing the environmental pollution.

The untreated discharge of large quantities of this type of polluted wastewater can seriously threaten the water quality of the receiving bodies. In fact, the wastewater generated by the studied slaughterhouses is discharged either to tributaries of rivers or to fields of vegetables. Although national environmental standards were promulgated in 1995, they do not seem to work, especially in this case. As 5200 pigs and 150 cattle are slaughtered in Ho Chi Minh City daily, a rough calculation shows that about 15 tons of BOD<sub>5</sub> are discharged into the environment every day. The lack of monitoring and implementing capacity (Phung Thuy Phuong, 2002; Tran Thi My Dieu, 2003) in this domain results in the degradation of surface and ground water.

### 3.3. LOCATION

Although most of the slaughterhouses in Ho Chi Minh City are located in suburban districts, the problem of location is increasingly sensed. Due to the recent fast rate of urbanization more slaughterhouses are becoming part of residential neighborhoods.

More and more residents move closer to slaughterhouses due to a lack of more attractive and affordable land. As reported by the Sub-department of Veterinary Science of Ho Chi Minh City (1998, 2002a, b), 19 slaughterhouses are currently located in densely populated residential areas, the same number are situated in thinly populated areas, and only five are really separated from residential areas. In their inter-ministerial circular No 05 LB/TT, at Article 2.1 of Part A, the Ministry of Commerce and the Ministry of Agriculture and Rural Development (1997) require slaughterhouses to be located at least a 100 m. from residential areas. This requirement obviously seems already too strict for most of the slaughterhouses nowadays and will probably have no effect in the near future either.

TABLE II. Analysis results of some slaughterhouse wastewater samples at Hochiminh City.

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
pH	5.6	5.8	6.2	5.9	6.8	6.6
TSS (mg/l)	216	82	232	188	134	162
BOD <sub>5</sub> (mg/l)	1,550	1,220	1,370	980	1,210	1,520
COD (mg/l)	2,830	1,980	1,840	1,710	1,690	2,280
Kjeldahl nitrogen (mg/l)	35.2	24.8	33.2	31.7	23.3	38.2
Total phosphorus (mg/l)	6.1	3.7	5.4	6.8	4.1	5.6
Total coliforms (MPN/100 ml)	≥240,000	≥240,000	≥240,000	≥240,000	≥240,000	≥240,000

Source: VITTEP, March–July 2003.

Another problem related to the location is that all the medium- and small-sized slaughterhouses in Vietnam are operating from midnight to about 4.00 a.m. so that fresh meat is available at the centralized open markets early enough for the middlemen to allow them to deliver the meat to the morning markets spread throughout the city. This way the organization of the production corresponds with the local habit of meat consumption, which requires fresh meat. Operating industrial facilities in residential areas during night-time would generally result in complaints from neighbors about nuisance from noise and smell. Interestingly however, although most of the small-sized slaughterhouses are situated amidst residential neighborhoods and operate from midnight till early next morning, there have hardly been any complaints from the neighboring residents. The most important reason for this observation has been revealed with the help of a triad network analysis (Mol, 1995). The analysis of the societal network involved in the small-sized slaughterhouses in Ho Chi Minh City showed in all cases that the majority of the neighboring residents are family relatives and, more importantly, these relatives are all directly involved in the slaughterhouse business.

In general, the situation of the medium-sized slaughterhouses is not much different from the small-sized ones. All the medium-sized as well as most of the small-sized slaughterhouses in Ho Chi Minh City are actually not a single slaughterhouse, but rather “clusters” of small “lines” operated by several “owners”. The workers in these slaughterhouses are mainly relatives or neighbors of these owners. In fact, these business owners get together in one place to profit from the economy-of-scale particularly with regard to the rent. The real and legally registered entrepreneurs of these facilities are either the owners or the leaseholders of the land.

#### 3.4. OBSOLETE TECHNOLOGY

Obsolete technology is, among others, one of the difficulties and limitations faced by small- and medium-sized enterprises in Vietnam in general (Frijns, 2003). In this respect small- and medium-sized slaughterhouses do not constitute an exception. In order to remain price competitive, none of the small- and medium-sized slaughterhouses in Vietnam, except for the Nam Phong Slaughter House, has installed any mechanical processing line. This is not only an accidental characteristic of the slaughterhouses in Vietnam, but it proves advantageous to apply traditional instead of modern technology. This can further be illustrated with an analysis of VISSAN.

VISSAN is the only slaughterhouse in Vietnam that has modern mechanical lines for the slaughtering process and an air-conditioned room for processing meat products. However, because of rather high operating costs, in particular for electricity and skilled labor, VISSAN has gradually lost its advantage on the market. Thus, although designed to slaughter 2400 pigs a day using three modern mechanical lines, VISSAN now only slaughters 400 pigs per day on average. Even more striking is that, in order to cope with the competition on the market, slaughtering at VISSAN is nowadays mainly conducted by hand similar to all other slaughterhouses. The

modern, mechanical lines are only put into operation when the company has to serve special contracts for meat export (or when a customer requires a special treatment).

Slaughtering in Ho Chi Minh City can be regarded as a low-technology operation, but as documented above the environmental problems should be mainly related to the discharge of wastes and less to the technology used.

#### **4. Environmental management**

In Vietnam, the Ministry of Natural Resources and Environment (MONRE), formed in 2002 by merging the former General Department of Land Use, General Department of Hydrometeorology, and the National Environment Agency from the former MOSTE, is the central policy- and decision-making body with overall responsibility for the environment. The environmental responsibilities of MONRE remained the same as those of the former MOSTE, i.e. to develop legislation and regulation, control and enforcement programmes, and monitoring systems for environmental protection throughout the country. At the city/provincial level, the local environmental authorities, known as Department of Natural Resources and Environment (DONRE), have an important role in environmental management and the implementation and enforcement of regulations within their territory.

The current environmental policy style in Vietnam resembles a command-and-control and bureaucratic approach to environmental policy. This conventional approach to environmental policy is characterized by laws, standards and regulations pertaining to emissions and products, and a top-down implementation of legislation. Vietnam's Law on Environmental Protection (1994) provides the legal framework for, and sets out the functions and duties of, environmental management institutions at all levels, from the central government to the local authorities. This strict command-and-control approach to environmental policy has been criticized in general by various authors (e.g. Huber, 1991) for its limited success, especially in the more advanced phases of environmental reform. For different reasons, but mainly because of the cultural characteristics, this approach does not work well in Vietnam either (Frijns et al., 2000; Phung Thuy Phuong, 2002).

Mol and Frijns (1998), Phung Thuy Phuong (2002) and several contributions in Mol and van Buuren (2003) point out that, although a set of Vietnamese environmental standards covering most fields of environmental pollution has been formulated (TCVN-1995 and TCVN-2001), the lack of human resources, knowledge and experience with implementation and enforcement within the governmental agencies seriously limits the use of these standards in practice. The absence in Vietnam of adequate environmental legislation and monitoring mechanisms for industries complicates the enforcement of environmental policies. Because of their number and informal organization of the production practices, this is especially true for the small and medium sized production units.

The Government of Vietnam by its Decree 02-CP dated 05 January 1995 classified slaughtering in the category of services which can only be licensed under mandatory

conditions (Government of Vietnam, 1995). Condition 9.2a in this Decree requires that slaughterhouses “should be located properly as planned by the competent authorities”. In addition, condition 9.3b, also applicable for slaughterhouses, requires that “the participants of this business have to ensure health standards”. The conditions for slaughterhouses were redefined by the Government Decree 11-CP dated 03 March 1999 (Government of Vietnam, 1999a) into four particular requirements: (a) to be registered legally, (b) to have infrastructure according to the standards of the competent state authorities, (c) to ensure the workers’ health, and (d) to meet the requirements on environmental protection and fire prevention. This last requirement has never been put into practice, similar to many other legal documents related to environmental issues, simply because of lack of adequate enforcement capacity.

Under the conditions of a command-and-control policy framework existing in Vietnam, laws and regulations are probably the only available tools for environmental management in small- and medium-sized slaughterhouses. However, the effectiveness of this approach is not complete due to the lack of monitoring and strict enforcement.

### **5. Pollution prevention: a right approach?**

In order to fight the environmental degradation caused by industrial pollution, the environmental authorities of Ho Chi Minh City have been working hard to find proper solutions. During the last decade, the following two groups of measures have been implemented:

Group A: pure command-and-control based pollution control measures, including:

- punishing the industries violating environmental regulations and standards, mainly by using fiscal fines;
- obliging the polluting industries to implement (end-of-pipe) treatment facilities;
- relocating the heavy polluting industries to industrial parks; and
- closing down the most polluting industries that can neither improve their environmental performance, nor be relocated.

Group B: socio-economic measures, including:

- introducing cleaner production technologies in the industries and
- encouraging them to implement waste auditing and cleaner production measures

It should be emphasized that the implementation of measures from group A started a decade ago. There is no doubt that these measures yielded some successes. First, after having been fined for violating environmental standards, hundreds of industrial enterprises installed pollution control facilities. One would have expected that the money invested in the treatment facilities would have produced a significant

reduction of the pollution. However, as described above, due to the lack of adequate monitoring, most of the newly installed pollution control facilities have not been put into operation for economic reasons. The facilities are only running a few times a year for a test or to show the environmental inspectors that they do function.

Second, because they failed to implement pollution control measures hundreds of heavy polluting industrial enterprises were closed down. This has contributed to the (though very minor) reduction of industrial pollution in the city, but it also made thousands of workers jobless.

However, the effectiveness of the two measures mentioned above has never been properly evaluated. Thus, debates are going on between the environmental management authorities on one side and industrial entrepreneurs and scientists on the other. Currently, the authorities in Ho Chi Minh City now focus on a program to relocate the polluting industries (of all sizes) to industrial parks. Frijns (2003) has studied in detail the advantages and disadvantages of relocating SMEs to industrial zones outside Ho Chi Minh City and of renovating the SMEs at their current location by introducing cost-effective cleaner production measures.

Pollution prevention or cleaner production aims at production processes that are more energy efficient, use fewer resources, and re-use waste materials and thus not only reduce environmental impacts but may also reduce economic costs (Frijns, 2003). In the case of small- and medium-sized slaughterhouses in Ho Chi Minh City, this approach seems very promising. The easiest way to limit the current uncontrolled use of ground water and wastage of organic material at the slaughterhouse is to improve the existing housekeeping practices, which is the first and cheapest step in pollution prevention. By successfully controlling the use of (ground) water and the unnecessary dumping of wastes, the slaughterhouses will be able to not only use fewer natural resources but also reduce the amount of waste water discharged into the environment.

Just by introducing some simple adjustments slaughterhouses can tremendously reduce the pollution loads currently discharged into the environment. This has been verified by a recent experimental study at VISSAN (SIDA, DOSTE of Ho Chi Minh City and UNIDO, 1999), where it was reported that thanks to the cleaner production measures applied, VISSAN now saves 250 m<sup>3</sup> water per day, reduces the amount of wastewater by 20% (equal to 90,000 m<sup>3</sup>/year), and reduces the BOD and COD loads by 33% which is equal to 310 ton/year. It should, however, be noticed that also here nothing is for free. Therefore the enterprise should make certain calculations before deciding to take measures to assure cleaner production. Frijns (2003) has mentioned that substantial and expensive cleaner production measures would meet severe difficulties, especially in the small-scale industrial sector where the financial capacity is limited and where the struggle for a living is overriding most other concerns.

Although it is clear by now that pollution prevention or cleaner production measures have many advantages for small- and medium-sized enterprises in general and for small- and medium-sized slaughterhouses in particular, one of the limitations is that most of the cleaner production programs in Vietnam are still focusing on the larger industries only, as are most other governmental and international programs

(cf. Tran Van Nhan and Leuenberger, 2003). The experimental study of VISSAN mentioned above is a clear example of this bias. VISSAN was the only slaughterhouse in Vietnam that was selected by UNIDO as a demonstration project on cleaner production (SIDA, DOSTE of Ho Chi Minh City and UNIDO, 1999). The size and specific characteristics of this enterprise causes considerable challenges for the dissemination of exemplary experiences about environmental improvements among small- and medium-sized slaughterhouses.

## 6. Conclusions

This article has reviewed environmental problems and practices related to small- and medium-sized slaughterhouses in Vietnam in general and Ho Chi Minh City in particular, on the basis of six case-studies. The research done has pointed out that the uncontrolled use of ground water and the discharge of untreated wastewater constitute the main environmental problems caused by these small- and medium-sized slaughterhouses. Having discussed the advantages and disadvantages of the existing potential approaches for improving their environmental performance, the review concluded that simple measures of pollution prevention seem to be the most promising approach for solving the environmental problems caused by the slaughterhouses in Ho Chi Minh City. This study largely shares the main conclusion formulated in the study by Frijns (2003, p. 148) stating that ‘in order to successfully control pollution from SMEs, Vietnamese authorities need to find a careful balance between cleaner production support activities and enforcement of environmental regulations, including relocation of those small and medium-sized enterprises that continue to be an environmental burden to the residents of Ho Chi Minh City’. However, in the specific case of small- and medium-sized-slaughterhouses in Ho Chi Minh City, this study argues that taking pollution prevention measures at the existing location may be advantageous compared with the relocation to industrial parks, because of the high costs involved.

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## Notes

<sup>1</sup> There is no clear official definition to distinguish a slaughterhouse from a slaughter point. The classification depends very much on the existing local conditions in each province. However it is very

common that in big cities and urban areas, slaughterhouses with a capacity of less than 10 pigs slaughtered per night would be considered as “slaughter points”, whereas in small provinces and remote areas a slaughter point would process five and sometimes even less heads slaughtered per night.

<sup>2</sup> In fact pigs for slaughter usually have a weight ranging between 100 and 120 kg, this means that the difference in weight from one pig to another is not much.

<sup>3</sup> The collected samples were time-composite. At all case-studies seven grab samples were collected at the point of discharge with a 30 min interval between 0.00 h and 3.00 h. Each sample was manually collected in a 2-l plastic bottle and then poured into a 20-litre plastic container making a composite sample for each case study. After each composite sample was thoroughly stirred the pH-value was measured on site, and two 1-l bottles filled. The first bottle was acidified with sulfuric acid to a pH below 2 for the analysis of COD and Nitrogen (Kjeldahl), while the second was preserved for the analysis of TSS, BOD<sub>5</sub>, total phosphorus and total coli forms.

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