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# Economic Appraisal of Animal Manure Considered as a Commodity

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*In Thai Binh province, communes have been previously identified with surpluses or deficits in terms of animal organic matters. Since effluents from animal production have been traditionally used within the agricultural system unit, this study analyzes the patterns for pig waste's trade, and tries to estimate the possible changes in the context of the existing industrialization process. At the moment, pig manure is traded in its scraped and unprocessed form; its transport is however limited, so exchanges are restricted to a small area. Links between people are very strong, a guarantee for mutual trust between stakeholders, but this is also what makes exchanges so limited. Nevertheless, the development of a real "effluent commodity chain" could be possible and profitable, even if integrated systems are an efficient way of reducing water pollution. This study gives policy makers a basis for acting.*

## Introduction

Vietnamese agricultural policy encourages farmers to intensify their production systems to increase rural employment and food production (Figure 1). Intensification of livestock farming is possible because the meat market is expanding, and the rural workforce is abundant. In Thai Binh province, the major constraint is the scarcity of land: more than one thousand inhabitants per km<sup>2</sup>. Intensification of livestock farming therefore signifies an increase in production and in employment per agricultural unit. This intensification will be achieved by an increase in animal production and of its share of agricultural production. This implies a break with traditional balance, carried out for the most part at the farm level, between emissions of animal effluents and their recy-

cling. This raises the question of the extension of marketing of these effluents, which must therefore acquire the status of “product”.

From an economic point of view, questions are therefore raised to define this “pig manure” product and to analyze the forms that exchanges of this product could take between “surplus” farms and “deficit” farms. In what form is the product exchanged? Following what kind of commercial negotiation? Do exchanges encourage stakeholders to treat/process the product? Are exchanges local or distant? Are they direct or do they include the intervention of intermediaries? Are these exchanges free or for money? What changes to these exchanges should one expect in the future? What improvements could be proposed for the pork commodity chain?

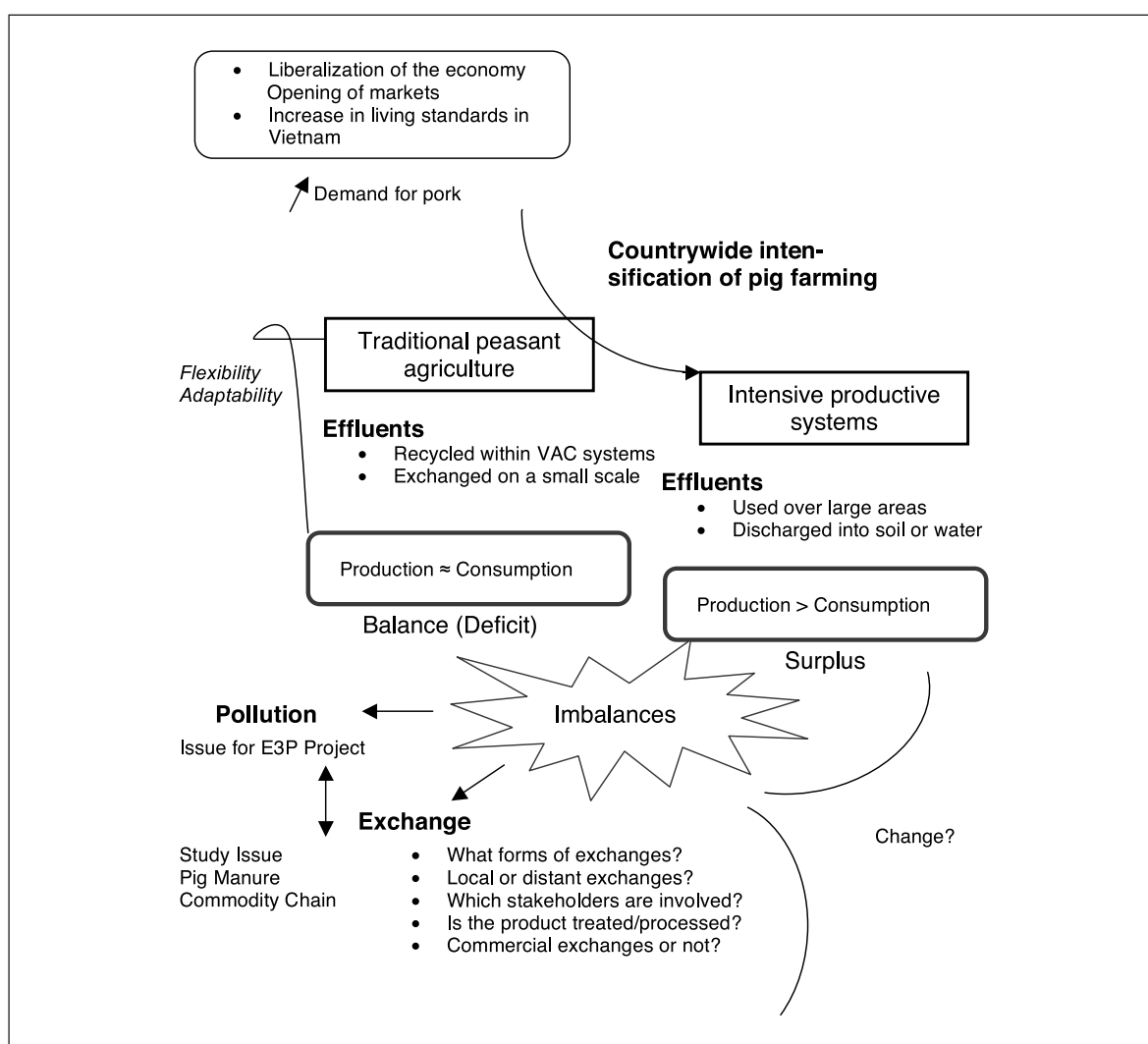


Figure 1: Development possibilities of a pork manure commodity chain in Thai Binh province

## Methodology

There are several definitions of the concept of a commodity chain, but whichever definition is chosen, it is founded on three key constitutive elements: a forum for technologies (succession of treatments/processing), a forum for relationships (set of commercial and financial relationships) and a forum for strategies (set of economic actions) (1-4). The choice made in this piece of work is to study the pig manure exchanges with this concept of commodity chain, even if for they remain for the moment quite rare.

To describe the structure and the operation of the commodity chain (5), we have carried out the following steps:

- i) defining the product, its by-products, and characterizing its various uses;
- ii) identifying the stakeholders and their logics;
- iii) describing exchange circuits and price setting;
- iv) understanding the various kinds of co-ordination and payment of stakeholders.

The possible developments of the commodity chain have been studied by also taking into account outside influences that can alter the structure, the operation, and therefore the performance of this commodity chain. These outside influences can come from either institution (public policy, regulations), or competition (in our context: fish feed, chemical fertilizers, fertilizing organic matter other than pig manure).

The analysis that follows is a synthesis of interviews carried out between April and October 2005 with many farmers as well as other local stakeholders in four districts in the province: political officials from various hierarchical levels, technicians specializing in crops, biogas, co-operative officials, and chemical fertilizer sellers.

## Pig manure: a co-product of pork meat

The term “manure” is used here to mean in a general sense pig excreta, be they solid, liquid or mixed.

Traditional agricultural systems involve the practice of livestock farming for multiple and complementary purposes. The products sought from pig farming are meat for family consumption or sale, and effluents with which to fertilize crops. We can therefore state that manure is a product of livestock farming and not a by-product. From an economic point of view, considering pig manure as a co-product of pork can be justified:

manure valued at the current market price represents 15 % of the total economic value of pig farming products (85 % for the meat).

## Characteristics of the product

Firstly, manure contains elements (nitrogen, phosphorous, heavy metals) and potentially polluting substances if the manure is applied to crops or ponds in too large quantities compared with the needs of plants and soil retention capacities. Manure also contains pathogens that can spread diseases: there is a risk of infection for domestic animals as there is for humans. Finally, manure has an unpleasant smell, and can attract mosquitoes or other insects that can infest the atmosphere and make a place dirty or disagreeable to live in. (see Chapter 4).

Manure is not consumed by man, and neither is it a raw material for making industrial objects. On the contrary, it is a product that is recycled, which can be expensive to treat. It is an input, used for the production of other agricultural products: cereals, vegetables, fruit trees, fish farming. Its scarcity or its high price can constitute limiting factors for production. Manure is heavy and voluminous, its transport difficult or costly. It is therefore often used in the same place as that of its production, by the same entity as that which generated it. Finally, when it is exchanged, these exchanges take place outside any form of state control.

The quantity of manure produced per day on a farm varies depending on the number and kind of animals present (sows, piglets, fatteners). The states of pig manure are very numerous, varying depending on the buildings, the farmers' practices and recommendations from the local authorities. The different forms of manure and co-products have been described previously (see Chapter 7).

## Uses of manure and its substitutes

### Use of manure as fertilizer

Manure is used as fertilizer on crops and in gardens (rice, dry crops, bonsais, vegetables, fruit or medicinal trees, etc.). It is also used as fertilizer in fish farm ponds: spread directly over the water, the fertilizing elements that it contains nourish algae and floating plants. Technically, the closest substitutes are other forms of organic matter of animal origin (poultry droppings, cattle manure): they can be used both as fertilizer and

as organic enriching agent; decomposition of organic matter is slow and fertilizing substances become available gradually.

The intermediate substitute is industrial organic compost. But those few who use it are farmers with a production (bonsais, fish) with a high added value.

The other substitutes are chemical fertilizers (urea, N, P, K) produced industrially. Their exact composition is known: they are easier to use; they cannot be used as organic enriching agents to improve soil structure. The availability of substances in chemical fertilizers for the plant is limited over time. After a fairly short period, the chemical elements are used up or lost by lixiviation or leaching.

### Use of manure as fish feed

In Thai Binh province, manure is used as fish feed for fish farming in freshwater ponds. It is often occurs that it is discharged into village waterways or into rivers. The manure is used by fish farmers to feed fish directly, who eat it in spite of the limited nutritional intake.

The substitutes for pig manure are: mash residue from brewing, rice or maize meals, and industrial concentrates. Substitutes pose fewer risks of sanitary contamination than organic matter of animal origin. They are often much more expensive.

### Supply and demand

With a view to characterizing a possible pig manure “commodity chain”, we have sought to identify and characterize the various potential stakeholders of this product: the suppliers and the users.

### Suppliers of pig manure

Manure is generated everywhere that pigs are present. Every pig farm is therefore potentially a supplier of this product. According to the kinds of buildings, the available storage structures, the kind of cleaning and of evacuation of manure, pig producers are producers of various kinds of manure (see Chapters 5, 6 and 7).

Producers of fresh manure are often big producers. Those who produce liquid manure are both ingenious and recognize the possible commercial value of manure. Those who scrape are often those who don't keep fish. Those who produce traditional manure are generally small producers.

### Which kinds of producers sell manure to other farmers?

Pig producers who operate with the traditional integrated system on a small scale make good use of their waste products on their own farm. Some even have to buy manure. Some specialized fish farmers raise pigs with the aim of feeding their fish. These manure producers consider manure as the product of pig farming. They use their entire production themselves. Specialized pig producers increase their herd without necessarily having crops or fish farming production. These farmers therefore have a surplus of manure.

### Which are the periods when supply is greatest?

Pig producers increase their stock when pork prices are high. Production of manure accordingly increases in winter, before the Têt festival. This seasonal variation in production is particularly marked on medium-sized and large farms, not involved in an intensive industrial system (on this kind of farm, the numbers of stock remain stable).

### What attitude do manure producers have towards existing substitutes?

Manure producers do not know the composition of manure themselves. So they cannot compare substances present in their product with those present in substitutes. This lack of information may be the cause of incapacity to counter competition.

### Users of pig manure

Who are the users of manure? Why do they use manure? At which periods of the year is demand strongest? How do manure substitutes compete for these consumers? It is to these questions that we will now try to find some answers.

### Kinds of manure users

Pig manure users are of two kinds: those who use manure as crop fertilizer and those who use manure as fish feed and pond fertilizer.

**i) Users of manure for crops** – Firstly there are rice growers, who use the manure as a fertilizer for their crops. No rice grower interviewed was “specialized” in rice growing: it is not a very profitable crop, grown because it is suited to the region's soil and climate. It is above all a subsistence crop, constituting the staple diet of farming families, even if an increasing proportion of the harvested crop is sold. The government encourages specializations in fields where products are economically profitable: livestock farming, fish

farming, some crops with a high added value. The crop farmers who in addition to planting two annual cycles of rice plant a cycle of winter crops also use manure by spreading it on the soil just before planting these crops. This initial spreading is done in a solid or composted form, but some farmers sometimes add manure to irrigation water during the crop cycle. Farmers who grow crops with a high added value (vegetables, bonsais, tobacco, fruit trees) usually spread manure in liquid form. These crops are often cultivated in small fields and are given special care on plots of land near where livestock are raised, and hence can be easily accessed regularly.

**ii) Users of manure for fish farming** – Fish farmers use manure as fish feed and pond fertilizer. Depending on the use that they make of the manure, farmers use one form or another. So to feed the fish directly, fish farmers use manure in solid form, which can be actually eaten. To feed the fish indirectly, through fertilization of the pond, fish farmers use manure in solid and liquid form, but without treatment, meaning in its fresh form or possibly after storage. These forms are more easily absorbed by aquatic plants and floating vegetation.

**Which kinds of users receive their manure from other farms?**

Usually, non-specialized fish and crop farmers do not lack much for manure. They produce it themselves and operate the integrated system (VAC). On the other hand, specialized fish or crop farmers with high added value crops often lack organic manure. They produce a little of it, but not enough. They have often invested

in the productions in which they are specialized, and lack the means, be they financial, structural or in terms of workforce to be able to invest in pig production as well. Nevertheless, there are fish farmers who have invested in pig production in order to feed their fish. These fish farmers, if they are specialized, are so within the integrated model, which means that they do not have to buy pig manure and so rely on one or several producers. Everything depends therefore on the adequacy between the quantity of manure produced (linked to the size of the herd) and the area of crops and ponds to be supplied.

**Which are the periods of strong demand?**

Periods of demand depend on kinds of usage. Crop farmers need manure either two or three months before the beginning of crop cycles if they make “compost”, or at muckspreading time, just before replanting. Muckspreading periods are in January-February, in June-July and in October-November (spring rice: February to May-June, summer rice: July to October-November, winter crops: October-November to January-February).

Fish farmers use less manure during the period from January to March: The insufficient sunshine and the colder temperatures can be a limiting factor for biomass production in ponds, limiting the photosynthesis and therefore the development of algae and phytoplankton. When the water temperature is below 18 or 20°C, the pond’s micro-organisms are less active in the decomposition of organic matter. This period also corresponds to the dry season (October to March/May), when it is harder to replenish water for many fish farmers, and the risks of deoxygenating of the environment are greater. On the other hand, the rest of the year, fish farmers have daily manure requirements. Demand is therefore very regular. Often, fish farmers empty their ponds in December, just before Têt.

**What attitude do manure users have with regard to existing substitutes?**

We have also tried to pinpoint farmers’ preferences for one or another form of organic matter and the determining factors that convince them to choose organic fertilization or feed rather than chemical fertilization or industrial feed. We recount here the results of our surveys and thus it is farmers’ opinions that we will try to bring to the fore. In general, pig manure is considered as being of better quality than organic matter from cattle or buffalo because industrial feeds are of high quality, whereas herbivores have a poor diet, usually grazing on the edges of paddy fields.



**Figure 2:** Transport of pig manure by vegetable producers

#### **Users of other fertilizers for production of plants**

Chemical fertilizers are appreciated because they make it possible to boost crop growth. The ease with which crops absorb chemical fertilizers makes them grow faster and stronger than organic matter, for which absorption time is longer. In addition, once the rice is stronger thanks to mineral fertilizers, a better absorption of organic matter is possible. Moreover, chemical fertilizers are necessary when the soil is very poor. Nevertheless, use of chemical fertilizers without spreading of organic matter or an excessive use can lead to disease. With chemical fertilizers, the farmer's work is made easier: transport is quicker and easier than with pig manure, spreading is very simple.

According to the interviews, urea is useful for maize because this crop has a large capacity for absorption during its growth. It is indispensable for a satisfactory development of crops and to boost their growth. Used on trees, it enables them to give more fruit and resist low temperatures more successfully. The use of potash also makes it possible to boost crop growth. Chicken droppings are of good quality according to farmers, but they are only produced in small amounts and create unpleasant smells, which some find worse than that of pig manure. In addition, they are too concentrated and are not directly applicable onto plants, particularly onto the roots of bonsais. On the other hand, once treated, they are a good fertilizer, and weigh less. The proponents of pig manure find several advantages to the use of this product: according to many, its nutritional quality is the best, with a higher percentage of nitrogen in particular than other organic matter. It is not too concentrated and contains better forms of nitrogen for crops, as well as other substances depending on the pigs' diet. For rice in particular, it enables a yield of up to 250 kg/sao (6t/ha). Its quality is slightly better than that of poultry droppings for crops and much better than organic matter from buffaloes or cattle, because industrial feeds contain proteins and other substances not absorbed by the pigs. Its use makes it possible to reduce or even, according to some, avoid the use of chemical fertilizers altogether. Farmers appreciate in particular that it makes rice leaves softer, rice grains bigger, and that it brings about a sustainable improvement in the earth. However, even though smells during storage of pig manure can be reduced by covering, they remain very unpleasant, particularly in inhabited areas. In addition, this smell prevents garden use. Some prefer poultry droppings, because these remain cheaper than pig manure, as well as being easier, quicker and less trouble to transport and spread, because they are a drier, lighter and less smelly product than pig manure.

Exchanges are therefore easier. On the other hand, it is dangerous to spread them directly onto crops and they therefore need treating before use. Once treated, their enriching quality is higher, making the soil looser. The substances contained in them are of high quality because poultry are fed with industrial feed. They also make it possible to avoid using chemical fertilizers while still giving the same yield, making plants grow better and giving an improved resistance to diseases. Rice grains are bigger, enabling better sales of the harvest.

#### **Users of feed for fish farming**

Chicken droppings are used by fish farmers because they find it easier to transport (in bags). On the other hand, rice husks that were used as a litter for the poultry remain mixed with the droppings. These rice husks can cause pollution in ponds. In addition, the province's farmers are very scared of avian influenza, which has done a lot of damage in the region: they therefore feel uneasy about using droppings for fish feed. The remains of pig feed and family household waste also provide fish feed in self-sufficiency, without cost or inconvenience. Industrial feeds give much better yields, but often provoke the development of diseases in fish. In addition, these feeds are more and more expensive, while quality decreases. Rice or maize meals make high quality fish feed, with lower costs than industrial feeds. Fish flesh is better according to some than that of fish fed on pig manure. On the other hand, it is more expensive than manure. We were told that the health of fish decreases with the use of chemical fertilizers. Mash residue from brewing is sold at a much lower price than rice bran or industrial feed, and its meal content is apparently higher. It makes it possible to boost growth, but needs to be used in conjunction with manure. Fish farmers who use pig manure (most cases) consider pig manure to be a high quality and cheap fish feed. Fish eat it all and their weight increases faster than with other organic matter. Nevertheless, it remains unusable when the pond size is too small, when there are too few fish, or when it is impossible to renew the pond's water. Too high a concentration of manure can lead to pollution that can jeopardize fish production. Finally fish farmers who use duck droppings say that they are of lesser quality than pig manure or chicken droppings, but that it was useful during periods without pigs or chickens.

Indicator of commercial exchanges of organic matter  
The calculation of a rating has enabled us to rationalize the logic of buyers and sellers in the commodity chain (6). We have called this rating the "Management Index"; it allows prediction of which kinds of stake-

holders will embark upon the exchange of animal organic matter and in particular pig manure. The rating is calculated at the farm level. It is the relationship between the quantity of nitrogen produced during one year by the pigs on the farm to the quantity of nitrogen necessary for the fertilization of crops and the demand for ponds.

Farms obtaining a ratio of less than 1 have a shortfall of organic matter and tend to buy this organic matter of animal origin off the farm. Farms whose rating is close to 1 are those who have succeeded in adapting production of organic matter to their needs, and who therefore operate in integrated mode. Finally, farms whose ratios are over 1 are those who produce a surplus of organic matter, and who are therefore likely to sell some of it to other farms.

The results of this calculation applied to the farms that we have surveyed enables us to give possible avenues of more precise analysis of this ratio. Farmers' practices in Thai Binh province are less clear-cut than the expected behaviour described above. It would seem that:

For a rating of less of 0.20, farmers buy or receive organic material regularly from off the farm (before each harvest for cereal farmers, and from every day to once a month for fish farmers). 13 cases. We have however observed two cases of farmers with a very low rating, less than 0.20, who did not buy organic matter. These two farmers were large consumers of chemical fertilizers.

With a rating of between 0.20 and 2, farmers often consider themselves "balanced", and do not carry out

exchanges of organic matter with other kinds of farm. 9 cases. Nevertheless, there are farmers whose rating is within this range who do not carry out formal exchanges, but do let family, friends and neighbours have organic matter, occasionally or exceptionally, as a gift. 7 cases.

We have however noted two cases of purchasers with ratings between 0.20 and 0.50. These were: a very large-scale specialized fish farmer (70 sao of ponds), the other a farmer with a large area of crops and ponds (18 sao). We also have 2 cases of farmers with ratings also within this range and who sell manure. One of these is a fish farmer who does not feed his fish with manure but with commercial meal (very rare), the other a farmer who only fertilizes his crops with chemical fertilizers. These two farmers do not therefore use the manure they produce, which is extremely rare in Vietnam, where integrated systems are very common.

It is when the rating goes above 2 to 2.50 that farmers begin to sell their organic matter in a regular commercial exchange (9 cases). On the other hand, we have 5 cases of farms with ratings of over 2.50 who do not carry out exchanges of organic matter. Special attention must be paid to this kind of farm. In fact, out of the 5 cases, 3 are farms with a biogas digester, and 2 with pits that regularly overflow. This kind of farm can therefore be considered as particularly dangerous for the environment: these farms with a high surplus of nitrogen do not put it to good use and evacuate it into the environment. We also have a case of a farmer whose rating is almost 2.50 who does not sell his organic matter, but gives it away occasionally or exceptionally. This farmer admitted to having regular pollution problems in his pond. Once again, the nitrogen surplus can be considered as lost, not put to good use, and can become dangerous.

**Table 1:** Farmers' behaviour concerning organic matter management

<b>Management Index (MI)</b>	<b>MI&lt;0.20</b>	<b>0.20&lt;MI&lt;2</b>	<b>MI&gt;2</b>
<i>Behaviour of the farmer</i>	<i>Regular purchaser</i>	<i>Unpredictable behaviour:</i> - <i>No exchange of organic matter whatsoever</i> - <i>Non-commercial and irregular exchange of organic material</i>	<i>Regular seller</i>
<i>Comments</i>	<i>Possible exceptions:</i> <i>Non-purchaser of organic matter but of substitute products</i>	<i>Possible exceptions:</i> <i>Buyers from large, specialized farms</i> <i>Sellers using competing products</i>	<i>Possible exceptions:</i> <i>Non-seller of organic matter but generator of nitrogen pollution</i>

*MI = Management Index. Ratio of "50 Kg pig" equivalents present on the farm by the number of pigs theoretically acceptable depending on the absorption capacities of this same farm (crops, gardens, ponds, etc.).*



The establishment of the index makes it possible to assess which farms could in the future become suppliers or consumers of the pig manure commodity chain. By observing the current situation, there are two solutions to avoid pollution due to poor management of pig manure. i) Encourage farmers to conserve farming systems with an MI rating that remains between 0.2 and 2, naturally or with the help of incentives. ii) Develop the “pig manure” commodity chain. Indeed, if pig production develops as is planned in the future, one cannot imagine that manure exchanges will be able to continue to be conducted in an informal manner. The large-scale development of the “pig manure” commodity chain appears to be indispensable.

Most farmers will probably remain naturally in the MI bracket between 0.2 and 2 because they operate in integrated systems. Subsistence farms traditionally operate in this way. Family farms also operate in this mode, on a larger scale. On the other hand, the question is to know whether development of large-scale integrated systems is possible. In theory this seems possible, considering that animal feed is produced somewhere other than on the farm. On the other hand, in practice, there are limits to the development of these kinds of structure: the lack of funds and farmers’ limited access to credit, difficult access to large tracts of farmland, and the need for information and technical know-how. In this situation, the government can have a part to play so that, even on a large scale, pig production systems remain integrated systems. The Thai Binh Provincial People’s Committee is aware of this necessity (cf. Paragraph I.4.3.). However, it has taken no practical steps to encourage farmers to maintain integrated operation, and has not set up training courses so that farmers who make this choice succeed in making good use of their investment.

## Transactions and their operators

### Direct sale

In a market economy, suppliers and consumers of a product must enter into contact in order to exchange this product. The link between producers and consumers can be direct or indirect. There are two cases in which producers and consumers of the product are in direct contact: the stakeholders live near each other and meet naturally, or physical places are created (markets) which allows them to meet. In the cases of direct exchanges, these take place without an intermediary. In all of our surveys, almost all exchanges take place within a very localized direct system of sale, involving only the producer and the consumer.

### Calling upon a service provider for transport

In almost all cases encountered, the user of manure must come to the supplier to collect it himself and to transport it to his farm. We met with two carriers, in communes where exchanges in organic matter were frequent and habitual. We were often told about carriers without being able to contact them in order to meet. The carriers met with are “village carriers”: in the area, it is they who deal with transporting building materials (bricks, sand, iron bars, etc.), but also agricultural products. One of them told us that transport of pig manure represented half of his work. However, he who has worked for twenty years in the commune has reduced his manure transporting activity enormously. According to him, this is due firstly to his own health (in less good physical shape, he can no longer work as much as previously), but also to changes in practice concerning the use of manure. Farmers dig ponds and therefore no longer put manure on their crops.

Still according to a pig manure carrier, users of such services are “the rich or the elderly”. Indeed, comparing this testimony with that of user farmers whom we have interviewed, we realize that most farmers consider transport of pig manure as normal, being part of their work. Those who lack for labour force on their farm, those who have sufficient resources to avoid this unpleasant work, or those who are too physically frail to still carry out this transport call upon the services of a carrier. Many stress the unpleasantness of this work, going as far as to say that, among all agricultural tasks, it is the most unpleasant over the whole year. In one village, we were also told that the use of pig manure had gradually disappeared because it smelled too strongly when it was being transported.

To transport pig manure, there are several solutions. It is possible to transport it in buckets, on foot. This mode of transport limits the quantity of manure transported, as well as the distance. It is also possible to transport manure in bags, steel barrels, or in baskets, placed on the shelves of a “carrying bicycle”. This “carrying bicycle”, adapted for agricultural work, is rudimentary but solid: it can carry on either side of the frame a load of up to 125 Kg, is steered thanks to a long stick tied to the handlebars, and is pushed from behind. It is sometimes used over long distances, but it limits transport all the same to an intra-district flow. Transport can also be carried out by motorbike if the manure is contained in bags: the load is a little lighter than on a bicycle, but the distance is covered more quickly. The productivity of transport with these pop-

ular means is limited. Manure can be transported in mini-trailers of 500 kg, attached to a motorbike, or small tractor-trailers containing 2.5 metric tons. This kind of motorized machinery makes exchanges possible over greater distances (inter-district movement), and opens perspectives concerning the quantities transported. That said, the habitual means of transport, although they may seem backward, are those that are usable on narrow roads in poor condition. Depending on the kind of manure being carried, the transport is more or less unpleasant. With fresh and moist manure, smells are very strong, the manure is difficult to handle and it is very heavy. After storage or treatment, manure is drier: it smells less strongly and is sometimes lighter. But in general, this manure is in a pit that must be emptied to obtain it: this work is unpleasant. For example, one of the carriers told us that it takes 20 minutes to fill the trailer, 20 minutes to empty it and only 10 minutes to cover 500 metres.

Obtaining the services of a carrier is simple: one has only to meet him on the road to contact him and ask him to do some carrying. In general, the two parties agree orally to decide when the carrier will work for the farmer. When he is not available, people wait. In general, periods of high demand are those of the rice harvest and the beginning of the year, at the time when fish farmers begin to raise fish. Sometimes, there is an oral agreement between the carrier and some fish farmers who are faithful clients of the carrier: they decide on the price and frequency of transport over one year.

#### **Trading in organic matter, a rare activity but a lucrative one**

We were able to interview a trader in pig manure, as well as a trader in cattle manure. In both cases, these women bought large quantities of organic matter at very low prices, very regularly, from specialized producers, who do not attach any importance to organic matter produced, considering it as waste or not having the time to put it to good use. In this way, they free themselves of this task by calling on the services of a sort of subcontractor. In both cases observed, the traders, even though they have farms or land of their own, spend most of their time transporting or trading organic matter. Daily, they collect, pack, sell and distribute this organic matter. In both cases also, the profit made from this trade is not only a financial supplement, but a real income. The trader in cattle manure assured us that the sale of manure was a little hard physically, but that it was quite well paid: about 45,000 VND/day (€2.2). Let us point out here that the

average wage of an agricultural worker is 2,000 VND/hour or 20,000 VND (€1) for a 10-hour day. She claimed moreover that her annual income drawn from the sale of manure was higher than that earned from her 4.7 sao of crops (2 rice cycles on 4.7 sao, which should fetch about  $200 \text{ Kg} \times 2 \times 4.7 = 1,880 \text{ Kg}$  of rice  $\times 2,500 \text{ VND} = 4.7$  million VND and 1 cycle of kohlrabi on 1.5 sao, which brings in more than 1 million VND / harvest, or a total of 5.7 million VND (€280), from which among other things must be subtracted the cost of chemical fertilizers.

The pig manure trader told us that she made a net annual profit of about ten million VND (or about €500/year). She has obtained by contract the exclusive use of all the effluents produced on a State farm of 200 sows, which produces biogas and sells about 150,000 kg of manure per year. She pays three million VND to obtain this manure. This therefore comes to 2,000 VND / 100 kg of fresh manure, that she uses in part for her own ponds or sells it at 16,000 VND / 100 kg. This means that by buying 100 kg of manure to resell it, she obtains a profit margin of 14,000 VND. She sells about 30% of the manure she collects, which represents 45,000 kg, or a turnover of 7.2 million VND, and a profit margin of 6.3 million dongs (€309). In addition, she benefits from the 70% remaining manure to feed her fish in 27 sao of ponds.

In these two examples of trade in animal organic matter, the advantage the traders enjoy is that they can operate using just-in-time distribution. Neither of them needs to store effluents, since in one case, the trader collects cattle faeces from the edges of paddy fields, and in the other she collects effluents from the storage infrastructures of the big State farm with which she works. This enables the traders to avoid committing to investment, the inconveniences linked to storing manure and any cost for transport or treatment. On the other hand, this weakens the exchange: traders are completely dependent on production and other factors. For example, the trader who collects cattle faeces can no longer work in the rainy season because it is dirty and the faeces cannot be collected. During this period, she must therefore find another source of income.

#### **A special case: the “informant”**

Usually, there is no intermediary agent or structure that might put sellers and purchaser in contact with each other. There are people who give information freely to others, but in no case are these providers of a professional information service.

**Box 1: The stakeholders in the commodity chain**

**Manure suppliers:** these are pig producers, in particular specialized producers and those who have a structural surplus.

**Users of pig manure** who receive their manure from other farms: specialized fish farmers or crop farmers with high added value crops often lack organic matter. They have often invested heavily in the productions in which they are specialized and lack the financial, structural or labour means to be able to invest additionally in pig production.

It is only extremely specialized farmers, with a large surplus or shortfall in organic matter who carry out commercial exchanges; the others maintain a local balance thanks to adaptive flexibility.

**Stakeholders higher up or lower down the commodity chain** depend therefore on the adequacy between the quantity of manure production (linked to the size of the herd) and the areas of crops and ponds.

**Carriers:** the mode of transport (by bicycle, by pedicab ("cyclo"), by motorbike and small trailer, in little motorized vans) limits the distance covered, and it is the form of manure that limits the mode of transport.

**Traders:** these are the best-paid stakeholders in the commodity chain, because they trade in organic matter without treatment and without any other investment beyond the cost of a daily workforce.

**Informants:** these are not professional stakeholders in the commodity chain. However, they make it possible for free to regulate supply and demand in periods of imbalance by putting producer and users into contact with each other.

## Logic of transactions

### Distance between suppliers - users

Manure exchanges seem to take place in a restricted geographic circle. The maximum distance covered is 12 km. The distance between stakeholders determines the means of transport used. Within a hamlet, stakeholders can make do with buckets and go on foot to fertilize their ponds or crops. When the distances are greater, a bicycle or sometimes a motorbike is necessary. If stakeholders can afford it, they sometimes call upon the services of a carrier, often with a pedicab ("cyclo"), or with a bicycle equipped with shelves for carrying heavy loads. On the other hand, when distances are greater, transport is carried out with a motorbike pulling a little trailer, or in a motorized vehicle of the Chinese tricycle kind. Distance also determines the product transported: liquid manure, for example, is impossible (or very unpleasant) to transport with the vehicles described above. The only use of this liquid is generally on the producer's own garden or those of his neighbours. Nevertheless, the kind of product transported also depends on the equipment possessed by the farmer: if he has metal barrels, he can transport liquid or wet manure. A drier manure, on the other hand, can be transported with the help of baskets or even bags.

## Kinds of knowledge and relationships

The most frequent scenario is that where the user and the supplier know each other very well. A pig producer who has regular or occasional surplus manure but of a moderate quantity will propose spontaneously to members of his close family and to his neighbours to come and help themselves. In general, in these kinds of situations, the human relationships are so close that the supplier does not even think of selling his manure. Moreover, it would even be impossible or unimaginable to suggest or propose it. This kind of exchange therefore takes place within a small circle, both in terms of acquaintances and geographically speaking. In general, exchanges with neighbours take place in the same hamlet or the same village. Exchanges with members of the family can take place in the same commune. The small distances covered sometimes permit people to carry out transport on foot (particularly when they go to their ponds or their garden), but if they must go to more distant fields, the most common means of transport in the Vietnamese countryside is the bicycle. The bicycle makes it possible to cover bigger distances than on foot, or with a bigger load (on average 200 to 250 kg for a bicycle according to our surveys). It is above all a means of transport that makes it possible to go along even very narrow dikes that surround irrigated areas. Contacts between people in the same commune are contacts known to all ("in the commune,

we know who the large-scale farmers are”), relationships between people of the same village are very close, all the more so in the same hamlet. This sociological fact is extremely important to understand the logic of manure exchange stakeholders.

The second scenario is that of the supplier and the user who only know each other by sight, because they live in the same commune for example. In this case, they contact each other within the context of the manure exchange and a relationship that is more or less occasional develops between them. The idea is that the supplier, with a surplus of organic matter, needs to get rid of his product, while the person seeking it needs to find this product. Supply and demand sometimes balance each other out for a limited time (spot markets) and at other times for longer, with a relationship of loyalty that builds up between supplier and acquirer. In general, users who only need manure occasionally do not establish loyalty relationships with a supplier. These are either producers who occasionally lack organic matter, or cereal farmers who need manure at the time of fertilization of their crops. At the moment when they need the product, they seek a potential supplier. Often, they will go back to a previous supplier, from whom they have already bought, but not always. In practice, they set off in the morning with their bicycles equipped with shelves and baskets, and visit producers likely to be selling manure. These suppliers either have it, or they do not. In any case, those seeking manure visit all the livestock farmers in the commune that they consider likely to have manure for sale (either because they have a lot of pigs, or because they do not have large areas of crops or ponds...). It is interesting to note that it is often users that go looking for a supplier, and rarely the opposite. Suppliers, when they have a surplus, contact their neighbours, call back their most loyal customers, or contact those who have already taken manure from their farm. Moreover, when they have a customer, they try to maintain a good relationship with him so that he comes back. And if these possibilities do not work out, in general the pits overflow into gardens or ponds (their own or those of their neighbours), but also into rivers. This shows that there are contrasting situations within farms, villages and communes. The situations can be ones of surplus, balance, or shortfall of organic matter depending on the spatial level at which situations are analyzed. Other manure users need it regularly: they are usually fish farmers. They feed their fish every day with manure, excluding perhaps the cold season. These buyers often create a stronger link with sellers. They need organic matter regularly. It is indispensable to the economic manage-

ment of their farm, because without this feed their production becomes much less profitable.

The third scenario is that where farmers meet for lasting commercial relationships. To begin with, they do not know each other, but hear about one another from someone we will call an “intermediary”. This person is in fact a friend or someone from the commune or village of the seller, who tells the buyer about someone wishing to sell and gives the seller’s name and address. The buyer then visits the seller and suggests they work together. Nevertheless it should be noted that what we call an intermediary here is in fact a sort of mediator, but this is not his trade, nor does he make money out of it: this is therefore not an “intermediary” in the sense that could be given this word in the analysis of a classic commodity chain. It is simply someone local who informs a buyer without payment about sellers in his village. The “informants” are never agents or professional intermediary structures; they are never paid for this information service. It also seems important to repeat here how much good neighbourly relationships can influence commercial exchanges in Vietnam: one of the largest-scale livestock farmers in her area, when she could not meet the demand of her manure buyer, proposed free of charge to her neighbours to sell their manure to this buyer, without asking for a commission; in this way she established a link between a big buyer and several small suppliers who alone could not find an outlet for their product. Once again, this person played the part of “informant”, but in an informal way. Finally, the fourth scenario is that of a trader, an intermediary between the supplier and the user. In this case, it is the trader who buys and resells the effluents of one or several suppliers. The producers and consumers do not therefore meet directly, and it is this trader who makes the link between them. The traders that we interviewed were tied by contract to their supplier, but not necessarily to their customers, more or less changeable.

### Relationships of trust

Most of the time, the stakeholders interviewed stated that they had no problem with their manure exchanges. They trust their partner, both for the quality and the quantity of manure exchanged. Nevertheless, it seems interesting to us here to mention several occasional cases: several manure purchases declared that they trusted their supplier because it was an industrial livestock farm: the quality of the manure is therefore the same and it is always produced in the same quantities. A purchaser, a “big” fish farmer, claimed that in spite of

the contract that he had with the producer, sometimes the quantity was not as much as it should have been: members of the seller's family and neighbours regularly went to get manure on his farm, and he was incapable of refusing them this service. The relationship is sometimes so strong between a seller and his purchaser that even if the seller is absent from the farm when the purchaser calls, he may write his order up on a wall, or help himself, taking the product away and paying the seller later. On the other hand, generally speaking, sellers do not give credit to their purchasers. Usually, farmers prefer to favour good relationships than the economic or profitable aspect of the transaction. In this way, sellers will prefer to sell always to the same purchaser, whom they trust and know, than to sell their manure to a new purchaser, even if this one proposes to pay a higher price. These strong social relationships between supplier and purchasers in the "pig manure" commodity chain are useful: They enable an economy of time and of money. In particular they free many livestock farmers from the obligation of lengthily seeking users of their manure. On the other hand, the solidity of this operational mode of society generates an inertia that prevents the development of the commodity chain. These close relationships work against possible innovations: the stakeholders have "no choice", as they often told us during our surveys.

### **Kinds of contract and co-ordination modes**

The various scenarios depend essentially on the kinds of relationships that the stakeholders maintain with the commodity chain. Most observed exchanges take place spontaneously, with no agreement or contract. When stakeholders are too close (family or neighbourly ties), users visit the sellers when they need to; the agreement remains invisible, it is a tacit agreement of good understanding between those who are close to one another. Quantities are often limited (a bicycle load per week...). When manure production is not regular and manure needs are occasional and irregular, there is no agreement or contract either. Producers and users meet by chance and occasionally. There is no relationship of loyalty between them. It is an exchange that suits both parties at a given moment. Either the exchanges take place occasionally, or there is enough manure for everyone and stakeholders do not feel the need to draw up a contract. Nevertheless, some stakeholders feel the need to bind themselves by contract, whether they remain spoken agreements where there is a certain trust between the two parties, or by spoken or written contracts that are more commercial. In some cases, stakeholders told us of "spoken agreements".

In general, these kinds of agreement are made occasionally, but are renewable. The criteria of the agreement are usually the price, the quantity and the time chosen for the exchange. When relationships of loyalty are stronger, with real consideration and trust between user and producer, we can speak of a spoken "contract". If one wishes to contrast this with the former kind, it includes an idea of being over time. Finally, between smaller farmers and State farms, written contracts can be observed. The criteria mentioned in the contract are the price, the quantity, the frequency, etc. This contract is often valid for one year, or for an undetermined length of time. This also shows the indifference of large operations in relation to the clauses of the contract. This was moreover confirmed by this trader who bought her manure from a big State farm: "they're not worried about a few thousand VND here or there, it's nothing to them".

The risks of breaking a contract between two people committed to it are very low. The stakeholders trust each other implicitly, the more so given that the product concerned is not perceived as very precious. On the other hand, one can imagine that the consequences of a break of contract must be great for those concerned: deterioration of neighbourhood relationships, with perhaps a barter system thrown into question, etc.

Currently, pig manure is exchanged in its untreated scraped form. Its transport being limited, the commodity chain is therefore very localized. There are moreover very strong social ties between the stakeholders, which guarantee relationships built on trust, but limit exchanges. However, putting pig manure to profitable use by development of a full commodity chain in the province, in parallel with maintaining integrated systems, could be possible and profitable. It would make it possible to avoid numerous incidences of water pollution.

### **Setting prices**

#### **Asking prices, depending on the stage and state of the product**

The sale price for manure varies little and remains very low. How can this low price be explained? Manure seems to be considered as waste that must be disposed of in the most efficient manner possible, because it pollutes (in particular bad smells and sanitary nuisances = presence of mosquitoes, mentioned here). It has the bad reputation of being diffi-

cult and unpleasant to transport. In addition, according to many accounts, it is never used on its own, neither for fertilization of crops, nor for fish farming. Manure is nearly always sold in the same form (fresh or matured scraped slurry). Among the farmers interviewed, many used manure produced on their own farm and treated it for use rather than exchanging it. None of them treated manure with a view to selling it. Several hypotheses can be put forward to explain this phenomenon:

- The image of waste associated with manure prevents people from seeing a potentially profitable product. Traditionally, farmers produce for their personal consumption, in integrated systems. Production destined for sale, with the aim of increasing income, has been developed in recent years for rice, then livestock products, from pig or fish farming. It does not yet cross farmers' minds to produce manure for sale to others.
- Nobody has really started making profitable use of manure yet. A certain difficulty can be observed for producers to launch into a new or different business activity, even if they have an original idea.
- Treatment of manure requires other knowledge than the empirical know-how that most farmers have, both for the treatment technique and to be

able to market the product obtained at the right price. Moreover, treatment takes time, because all this takes place in an environment with hardly any mechanization, which is therefore labour-intensive.

The market price of pig manure is low and is identical whatever the product: 1,730 VND for 10 Kg of solid manure; 1,000 VND for 10 Kg of composted manure. The price observed just in the case of a farmer who sold "compost" reflects the vision that farmers have of the pig manure product. This farmer sold surpluses at the end of the winter, meaning that he wanted to get rid of a product for which he no longer saw any use, and thus waste whose value he could not assess. The compost in question is what the Vietnamese call "compost", meaning the unfinished treatment of pig manure, carried out on the farm often in an anaerobic environment, without turning, etc. The sale price of an industrial compost made on a composting platform and made up into packets of homogenous and light organic matter, is 11,000 VND per Kg. The difference in price is therefore very marked. The price of manure sold by weight is low when compared with the prices of other products or with the economic worth of the work done:

<i>Scraped manure: 173 VND / kg</i> <i>Composted manure: 100 VND / kg</i>	<i>Paddy: 2,500 VND / kg</i> <i>Live pig: 16,500 VND / kg</i> <i>Agricultural labour: 2,000 VND / hour</i>
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**Table 2:** Price of a kilo of nitrogen depending on the kind of product in which it is contained

<b>Kind of product</b>	<b>Price of a kilo of nitrogen (VND)</b>	<b>Quantity (kg) of the product containing 1 kilo of nitrogen</b>
<i>Scraped pig manure</i>	<i>24,700</i>	<i>143</i>
<i>Farmer's compost</i>	<i>15,200</i>	<i>152</i>
<i>Poultry droppings</i>	<i>12,500</i>	<i>63</i>
<i>Cattle faeces</i>	<i>52,500</i>	<i>333</i>
<i>Urea</i>	<i>9,900</i>	<i>2.2</i>
<i>Ammonitrate</i>	<i>13,500</i>	<i>3</i>

Prices of chemical fertilizers and particularly of those that are not produced locally increase from year to year. In four years (from September 2001 to 2005) on the global market, prices of urea have tripled, the price of potash has quadrupled and other raw materials going into the makeup of NPK have almost doubled (7). The subject is therefore a worrying one for stake-

holders in the local economy. In the magazine of the chamber of commerce and industry (8), a journalist highlights the fact that Vietnam continues to import chemical fertilizers, because its production capacity, even if it has recently increased, does not meet local demand. Prices of nitrogen fertilizers are constantly rising and the prices for importing fertilizers in April

2005 apparently reached a record level since 1990. Local businesses could produce 30 % of the demand according to these same sources, at relatively low prices (about 4,500 VND the kg of nitrogen compared with 5,000 VND on average on the import market). In parallel, the demand for chemical fertilizers reportedly decreases when prices are too high, when farmers abandon the use of such fertilizers.

The price of nitrogen contained in organic matter is very expensive (nitrogen contained in cattle faeces is five times as expensive as urea, the nitrogen contained in scraped pig manure two to three times more expensive than nitrogen from urea), while most farmers interviewed told us that manure was a product of very small value.

These high prices of organic nitrogen could be a restriction to the development of the “pig manure” commodity chain. In fact, if one considers (i) consumers fully informed about the composition, the quality and the ideal uses for manure, and if one considers that (ii) the criterion for consumers’ choice of a product or its substitute is price; then these consumers will not be ready to buy organic nitrogen at the current market price. This means that this price of nitrogen can constitute a blockage to market exchanges between suppliers and consumers, and thus to the more widespread development of the “pig manure” commodity chain.

However, we have made the choice of reasoning according to the composition of nitrogen fertilizers, starting from the assumption that this nitrogen is the most vital substance for plants and that it is this substance that farmers seek in manure. In fact, livestock effluents contain other substances as well as nitrogen (phosphorous and potassium), and they release them in a continuous and sustained way, as opposed to chemical fertilizers, which enable a usable and efficient input only at the time of application. The seemingly high price of manure probably takes these different elements into account.

### **Knowledge of the market**

Among the people who exchange their manure free of charge, few know its market price. They are not interested in it, because whatever price might be commanded for it elsewhere, they themselves could not have sold it. When sale is very common practice in the commune, people who only give it know the market price. In general, price negotiation only takes place between seller and purchaser, confidentially and per-

sonally but in the end, as prices are low, there is little variation and prices remain very close to those of the market. Generally, the seller and the purchaser choose their price together, according to the price paid everywhere else. Therefore there are apparently no differences in access to information that would give rise to a different empowerment and thus a decisional inequality with relation to the price chosen.

We can all the same mention here a very localized practice, in a commune that we surveyed, concerning the price of cattle faeces. This practice appears interesting to us within the context of the possible future development of a real manure commodity chain. In this commune, eight women collect cattle faeces for resale from roadsides and around paddy fields. At the beginning of each year, they meet together to decide collectively the price of faeces for the year to come. It is basically inflation that guides the price they fix. In this way, it is they who determine the market price in their commune. This example is, in our opinion, one worth considering within the context of the manure commodity chain. If producers succeed in becoming organized, they could certainly acquire influence in the commodity chain and better promote their product.

### **Possible development of the “manure” commodity chain**

Is there or not a trend towards development of the commodity chain, with market exchanges and intermediaries? The potential development factors for the commodity chain are pig manure production factors, the quantities produced, pig manure consumption factors, export flows, sale prices and return to stakeholders, the productivity of activities up and down the chain, the cost of transport.

### **Change in manure supply and demand in Thai Binh province: the balance is being disturbed**

The number of large-scale specialized pig producers will increase in the coming years. In this way, the number of producers able to supply manure regularly should increase. In contrast and in theory, consumers of fresh manure will develop at a slower rate. The government wishes to favour fish farming within integrated systems. In addition, farmers themselves often want to nourish their ponds with manure, as this diversifies their production, simplifies and lightens their workload and spares them the search – sometimes difficult – for organic matter. If the situation develops in

this way, the number of fish farmers needing a regular supply of manure will not increase. The available agricultural area in the province will remain constant. Even if efficiency of land use increases still further, the pressure of the number of animals raised with progressively less space for each will increase. The balance between current supply and demand will therefore change, with a relative increase in the supply of fresh manure in relation to demand. We can thus imagine a situation where manure supply increases faster than demand.

For the moment, the overall situation in the province is acceptable at the communal and district levels (see Chapter 8). There is still a shortfall in the overall balance between production and consumption of livestock effluents at the district level; communes, with either a surplus or a shortfall, have been identified; possible supplementary exchanges could be organized between these areas that are often very close to each other (from one commune to the next). The increase in overall supply associated with a certain stagnation in demand will however give rise to a progressively more balanced situation, which will then doubtless become a surplus. As an example, it is in 2014 that the surplus situation could occur in Vu Thu district (Chapter 10). If there is excess livestock waste, there is a risk of discharge of manure into the environment causing widespread pollution. Is it possible to put pig manure, a co-product of pork production, to profitable use by the development of the pig manure commodity chain? Could a commodity chain put these Thai Binh “suppliers” in contact with possible Thai Binh purchasers (in districts with a shortfall) or with purchasers elsewhere?

### **What are the conditions for the development of the existing pig manure commodity chain?**

We have seen that the principal limits to development of the existing commodity chain are currently the limited means of transport and treatment. Action upon these triggers should make it possible to develop the commodity chain.

Transport of pig manure is currently difficult and unpleasant. This makes it costly in terms of labour and energy, and limited to about ten kilometres. To increase pig manure transport capacity, it must be made into a lighter product for transport, that can be handled more easily, and less strong smelling.

It is possible to produce a product that is easier to transport, smells less strongly and poses fewer sanitary risks, but is just as useful chemical. There are busi-

nesses in the province that produce compost. In Vu Thu district, the co-operative of one of the communes visited imports several metric tons of compost from Hanoi. We also met farmers who used industrial compost for fertilization of their ponds, or their bonsais (plant with a very high added value). We can therefore logically claim that an internal provincial market exists, in addition to the potential exterior market. The development of the manure commodity chain with production of compost is therefore possible.

Currently, treated manure is sold for less (100 VND/kg) than raw manure (173 VND/kg). Consequently, nobody makes compost to sell it, since it is less profitable than selling raw manure. As long as consumers are unwilling to buy compost for more, the commodity chain will not interest potential new stakeholders (above all those who might treat the manure) because there is not a sufficient profit margin to be made.

Industrial compost made on a composting platform is sold for 11,000 VND/kg. This compost is not made with pig manure but mainly with plant waste. It is not easy therefore to compare it with pig manure compost from the perspective of relative composition. However, we will all the same try to calculate the economic difference that exists between these two products. To make pig manure compost similar to the kind of industrial compost on sale that is homogenous, stable and rich in humus, one must expect a loss of weight during treatment of more than 70 %. Therefore, to make a kilogram of fully treated pig manure compost (unlike farm compost), about 3.5 kg of fresh manure is required, or a cost in raw materials of 600 VND. If homogenous, composted pig manure is sold at the same price as compost already on the market, that is 11,000 VND per kilogram, the gross profit margin would probably give sufficient profitability to start such an activity. But for the moment the local availability of fresh manure is enough to satisfy the demand of rice and fish farming, and the quantities sought for specialized uses (bonsais, tobacco, etc.) are not significant enough to encourage the start of treatment and marketing of compost processed from pig manure.

### **Is the development of the manure commodity chain in accordance with government policies with regard to livestock farming in the province?**

The development of a pig manure commodity chain could be brought about in parallel with the wishes of the government concerning agricultural and rural



development in Vietnam: increase in pig production and specialization of farms, creation of special areas with concentration of issues associated with livestock farming (supplies, marketing, waste management, etc.), development of biogas. It can develop in parallel with integrated systems that the government wishes to continue favouring. Integrated systems are important because they make it possible to control pollution while allowing intensification of production, an efficient use of land that is scarce in the province, and they enable diversification of farmers' income. But if one considers that the authorities wish to develop pig and fish farming, the development of manure treatment will be increasingly necessary, both for commercial exchanges of organic matter over greater distances,

and for a cleaner vegetable and fish farming production, which will be increasingly essential, for markets both outside and inside Vietnam.

Finally, the development of the pig manure commodity chain will make it possible to provide an answer to the big issues in Thai Binh province: poverty reduction, maintaining employment in rural areas, very high population density, sanitary risks associated with the transport of fresh manure, etc. On the other hand, for such a development of the pig manure commodity chain to be possible, it is necessary to develop technological processes appropriate for the processing of manure into a compost product, to develop the technical training of farmers and to encourage potential investments.

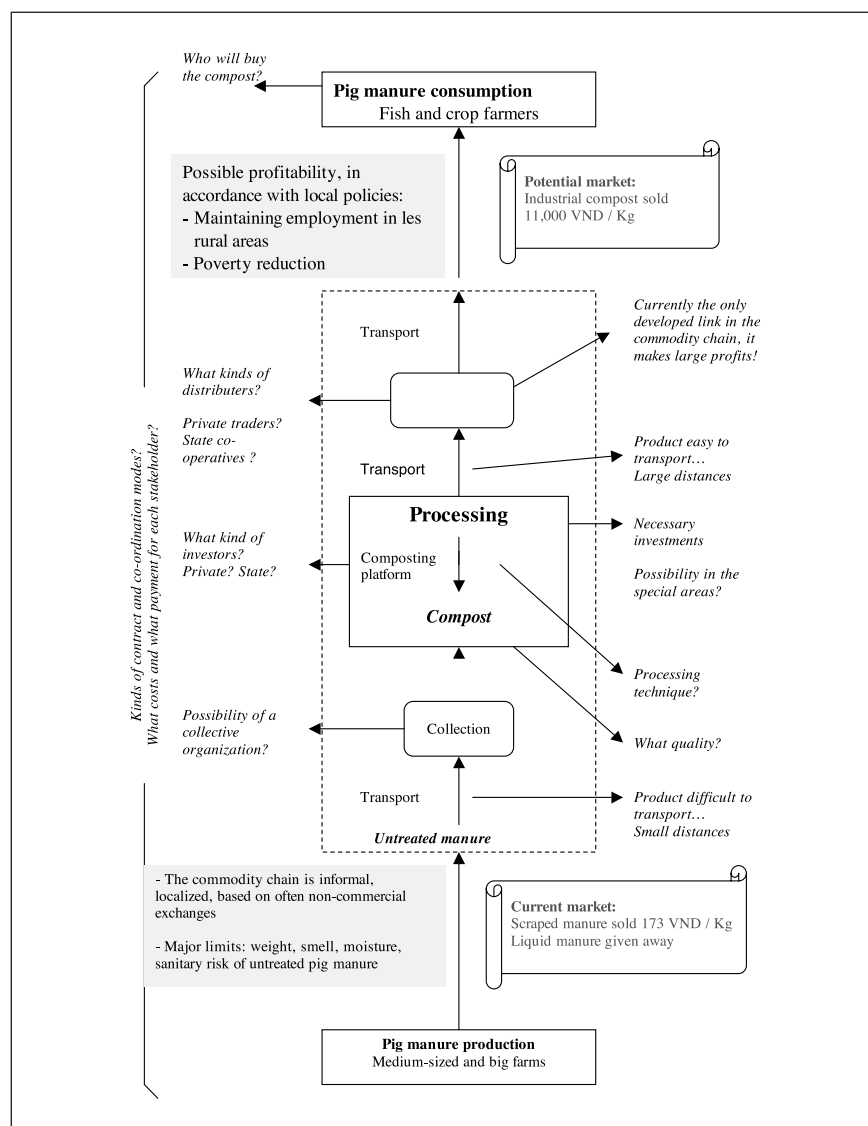


Figure 3: Possibilities for development of the pig manure commodity chain

## Conclusion

At the farm level, small-scale and medium-sized operations can constantly readjust their system. The various means of rebalancing inputs and outputs of nitrogen are: modifying the number of pigs raised, or buying pig manure, mineral fertilizers or fish feed in case of shortfall, or selling pig manure in case of surplus. In this case, disposing of pig manure produced appears to be relatively easy for producers. It is currently possible to identify a few localized areas of surplus production of organic matter, but these temporary spatial imbalances are easily managed within the context of the village, commune, or nearby communes. Producers and consumers “sort it out” locally and generally manage to find ways to meet and carry out exchanges. The question is to know whether, if imbalances increase, it is possible to develop a formal “pig manure” commodity chain, with commercial exchanges that enable all stakeholders in the commodity chain to live from it. The questions of treatment/processing and transport of pig manure must be addressed.

Pig manure is a co-product of pork. In Thai Binh province, it is produced and used in a traditional way. On most small and medium-sized pig farms, the manure produced is used on the farm. This integrated system makes it possible to put this livestock waste to good use by using it as a fertilizer on crops or as fish feed. It has the advantage of optimizing the use of land, precious in the province, and of avoiding pollution caused by livestock effluents thanks to recycling.

For the moment, demand for manure in the province is greater than supply. But our surveys lead us to believe that the development of livestock farming, par-

ticularly in the “special areas” established in some communes, will lead to change towards very specialized pig production systems operating according to the Western model, sometimes abandoning integrated operation where effluents are recycled. Manure supply therefore increases, while the “pig manure” commodity chain remains embryonic, localized and based on frequently non-commercial exchanges.

The major trigger for development of the “pig manure” commodity chain is the processing/treatment of the product into compost. This will make it possible to main problems associated with pig manure: weight, smell and moisture, sanitary risks, packaging difficulties, unpleasantness of transport. Given the prices commanded by industrial compost, it seems that processing/treatment of manure could be profitable. But the quantities necessary for the implementation of this commodity chain on a large scale will not be reached unless fish and rice farmers use significant quantities.

One can therefore foresee manure composting on industrial platforms, with a system of manure collection from producers and a system of compost distribution to users. Nevertheless, to organize this processing and to guarantee markets for manure, a large-scale awareness-raising and extension campaign is necessary with the technical departments of local authorities and with farmers. Manure, although its price is relatively high compared to other fertilizers, suffers from its image as worthless “waste”. But in a context where the prices of all fertilizers are rising and in particular that of chemical fertilizers, it is possible that farmers may be receptive to a change in practices.

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