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In Thai Binh province, intensification of pig farming is accelerating, due to the policy of liberalization and an increase in living standards, which also increases the amount of effluents produced. Analysis of the stakeholders' perception with regard to the management of livestock waste shows that all the stakeholders in the area are very concerned about the impact of poor waste management. In particular, they are worried that their quality of life, health, and economic activity might be jeopardized. To solve these problems, they would like to see various solutions implemented: moderated use of effluents, effluent exchanges between farms with surplus waste and farms lacking waste, implementation of storage and treatment techniques, training for stakeholders, removal of livestock farms from inhabited areas and inspections of these farms. Institutional analysis has made it possible to determine some key courses of action to solve these problems: definition of the precise role of each stakeholder, co-ordination and organization between stakeholders, implementation of directives, legislation and regulations. The dialogue between stakeholders initiated by the results of the survey has led to the beginning of an awareness of the stakes and the limitations of currently implemented solutions. Indeed, although the most popular solutions among stakeholders remain the implementation of biogas, moving farms and implementing regulations, they could nevertheless lead to negative risks, in particular impacting on the quality of drinking water and on the social fabric of the province.

Introduction

The policy of liberalization and the increase in living standards in Vietnam transform the daily habits of its inhabitants. The demand for meat, particularly for pork, is increasing very rapidly (1). To satisfy this demand, the traditional areas of pig husbandry, such as Thai Binh province, seek to develop their production. The development policies currently implemented are therefore aimed at intensifying livestock farming. Although the emphasis is placed on the development of large-scale intensive production units, most production is still carried out on small-scale family farms. Production therefore remains very fragmented: pig farms are omnipresent in the province, where it is said "every family keeps a few pigs in the yard".

Production of pig effluents is therefore increasing rapidly and province-wide. These effluents are beginning to pollute the surroundings of farms and to create a nuisance; they are sources of concern and sometimes tensions within the rural population.

Public policies (agricultural and environmental) are beginning to take into account the problem of management of these effluents while placing priority on the growth of production. Two main measures are promoted: the development of biogas systems to "treat" effluents directly on farms and the consolidation of livestock farms in specialized locations outside inhabited areas. In addition, research stakeholders have initiated a programme targeted on this question aimed at developing mainly technical know-how concerning in particular effluent management and treatment practices (chapter 5), the quality of effluents (chapter 7), exchange procedures for these effluents (chapter 10).

Although the importance of pig farm waste management is beginning to be clear to all, and although measures are beginning to be implemented and new technical know-how to be accumulated, precise knowledge of the perceptions of stakeholders in relation to this issue remains limited. Indeed, this rapidly appears complex when numerous stakeholders are involved and when a public asset, the environment, is at stake. The solution to this situation therefore lies in the development of a "livestock farming waste management" system that is the result of complex interactions between the numerous stakeholders and that depends largely upon them and their perceptions of the problem.

A better understanding of stakeholders' perceptions and an institutional analysis of the situation are therefore necessary to better define courses of action (interventions, research, policies, etc.) taking into account the aspirations of the various stakeholders, and to initiate a collective dynamic for change making it possible to respond efficiently to the challenges involved.

The objective of this article is therefore to analyse the perception of local stakeholders (people, organizations, institutions) in relation to the issues of pig effluents and to identify, on the basis of these perceptions and an institutional analysis, courses of action and to discuss them.

After a definition of the concepts and the methodology employed, the various stakeholders concerned by pig waste management will be presented. Their perceptions of the issue of "pig waste management" will be analyzed and the various potential solutions considered.

Then, the results of the institutional analysis conducted by the PACT method will be presented, highlighting the key stakeholders, the favoured points of access and areas of possible consensus to initiate a collective process of change aimed at responding to the identified issues.

Finally, on the basis of the results of the workshop where the institutional survey was presented to the local stakeholders, the interest, difficulties and limitations of the main identified courses of action will be discussed.

Approach and methodology

Faced with this issue concerning several stakeholders and a public subject (management of livestock waste, and thus the environment), and with an objective of operational support, it was decided to use a method of institutional analysis known as PACT - Pro-Active Conciliation Tool (Box 1) – derived from the patrimonial analysis approach (2, 3).

Box 1: The principle of patrimonial analysis and the PACT method

Patrimonial analysis is both a "method and a tool of analysis of stakeholders' logic in a given territory". This method makes it possible to analyse a territory where there is a conflict concerning the management of a common patrimony, to achieve a process of negotiation and a planned management of this patrimony. With the help of a computer program, the PACT method seeks to promote the co-construction of a solution and an improved dialogue between stakeholders.

It is easy to understand that different people often interpret a situation in different ways. Take the example of a river: some will see a source of drinking water, others a means of transport, still others an ecosystem. All types of stakeholders, whatever their level of activity, take decisions in accordance with what they understand of the situation. This understanding is based on what the stakeholder perceives of the situation. These perceptions are fundamentally biased and incomplete. It is because they are incomplete that they can lead to erroneous interpretations and poor decisions, which are often the source of conflicts.

The PACT institutional analysis method makes it possible to clarify the perceptions of the various types of stakeholders, to understand how these perceptions influence their actions and interactions. In addition, it makes it possible to identify courses of action to make the stakeholders move forward and implement solutions to the identified issues.

The concepts used by the PACT method

- *System: group of actions having an impact on the situation and /or on the decision making of the other stakeholders.*
- *Stakeholder: physical person, institution or organization having an influence on the system or influenced by it*
- *Quality: preoccupation of every stakeholder and his/her wishes in terms of improvement*
- *Demand: wish to see an improved "quality"*
- *Offer: actions having a positive effect on a given "quality"*
- *Conditional offer: offer of which the existence depends on the improvement of a prior action*
- *Field of action: group of actions aimed at improving one or several "qualities"*
- *Capability for current action: what a stakeholder currently does in the various fields of action*
- *Capability for approved and legitimized action: what the other stakeholders think that a stakeholder should or could do in the various fields of action*
- *Key stakeholder: stakeholder having the ability to improve the situation and approved by the others as legitimate to do so*

To implement this method, qualitative interviews were held with all of the various stakeholders concerned by the issue and interacting in the development of the "livestock farm waste management" system in province Thai Binh. In total, 97 interviews were conducted a various levels: at the communal level in four districts of the province (Vu Thu, Quynh Phu, Thai Thuy, Dong Hung), at the provincial level and at the national level.

These qualitative interviews were aimed at discovering stakeholders' point of view covering 4 main points: (1) description of the situation and the stakeholders, (2) diagnosis of the existing actions and interactions between stakeholders, (3) possible developments and their consequences, (4) propositions for future change. For livestock farmers, supplementary questions were asked in order to describe their livestock waste management practices and the constraints they were faced with.

The stakeholders

The interviews made it possible to identify in detail the group of stakeholders of the "pig waste management in Thai Binh province" system according to the perceptions of the stakeholders themselves. Three main types of stakeholders were identified: those affected by the situation, those directly influencing the situation, and those indirectly influencing the situation.

Stakeholders affected by the situation

This first type corresponds to society in general. It concerns in particular inhabitants not raising pigs but also livestock farmers' families. These stakeholders consider that they are affected by the impacts and the nuisances of livestock effluents and that they can do nothing to make the system evolve, or at the very least, that they do not have any precise offer of improvement.

Stakeholders directly influencing the situation

This second type corresponds to those who produce and use the effluents; they are pig farmers (producers of pig effluents) and farmers who use effluents for other agricultural production (consumers of effluents). Pig farmers can be separated into four categories according to structural criteria (size of farm, number of pigs raised) and spatial (location of the pig farm, in the village or outside it) that influence their perceptions of the problem and the perceptions others have of their impact on the system. They are:

- big farms or "*trang trai*" with an integrated system for using effluents, of the VAC kind, usually owning a biogas digester and located outside the village.
- semi-intensive "*gia trai*" and "*trang trai*" pig farms in villages, the lack of space usually leading to lack of a biogas digester, and to raising only pigs, or an incomplete or far from perfect VAC.
- semi-intensive "*gia trai*" pig farms located outside villages.
- small "*nông hô*" farms, systematically located inside villages and for whom pig production is not a significant source of income (home consumption only or presence of other economic activities).

The stakeholders who consume effluents (crop and fish farmers) are likely to influence the situation directly by using effluents as inputs for their agricultural activities.

Stakeholders indirectly influencing the situation

Three types of stakeholders influence the situation indirectly: political and administrative stakeholders, socio-political stakeholders and research and development stakeholders.

Political and administrative stakeholders

The political and administrative apparatus of Thai Binh province is a type of stakeholder likely to modify the situation and the behaviour of other stakeholders with regard to waste management. It entails in particular the head of the Provincial People's Committee (*UBND Tinh*), heads of the District People's Committees (*UBND Huyen*), and heads of the Communal People's Committees (*UBND Xa*).

At each administrative level, there are various departments concerned with the issue of livestock effluents. First of all there are the agricultural planning departments (*So Ke Hoach*). The provincial department enacts the directives coming from the Ministry of Agriculture and Rural Development. It defines the objectives and the means implemented to bring them about. The lower district level also has an agricultural planning department. It acts as a relay to implement provincial policies and decisions but also has some leeway in the execution of these actions. It is also involved in technical consultations with farmers.

Technical support to farmers is the responsibility of extension departments that are administratively separate from agricultural departments. Active at the

provincial and district levels, these departments seek to communicate new techniques to farmers.

At the local level, the agricultural office is operated by the co-operative (*Hop Tac Xa*). Although it is no longer a legal obligation to be a member of this any more, all farmers are members, given its predominant role; indeed, it i) still decides on the important dates in agriculture (sowing, treatment) and in livestock farming (vaccination campaigns, anti-parasitical treatment, etc.), ii) monitors the hydraulic systems and the irrigation of fields; iii) manages the central purchasing agency for animal and plant genetics, fertilizers, medicine; and iv) also organizes training sessions for farmers.

The final administrative department concerned with the issue of livestock waste management is that of the environment. The province has a department of the environment (*So Moi Truong*) whose aim is to monitor the various sources of pollution and to find solutions to problems encountered. With regard to livestock farming, this department basically works with the department of technology, which is responsible for developing biogas. In the districts, links are maintained by the commercial department, which has an office for promotion of biogas.

Finally, health sector stakeholders at the communal level are also considered by the other stakeholders as having an influence on livestock waste management. There are two kinds: veterinaries in the field of animal health and doctors in that of human health, the medical department also fulfilling the role of environmental department at the communal level.

Socio-political stakeholders

In each commune, the inhabitants can join five different socio-political organizations: the women's union (*Hoi Phu Nu*), the youth union (*Doan Thanh Niên*), the war veterans' association (*Hoi Cuu Chiên Binh*), the farmers' union (Hoi Nong Dan) and the association for the elderly (*Hôi Nguoi Cao Tuôi*). With regard to the issue of livestock effluents, interviews have demonstrated the importance of two of these organizations: the farmers' union and the women's union. In particular they make access to funding easier for those wishing to invest, and organize training sessions about agricultural techniques.

Research and development stakeholders

The last type of stakeholder, the least directly mentioned during the interviews, but whose role and influence should not be underestimated, is the research community. In Thai Binh province two research stakeholders were mentioned: the National Institute of Animal Husbandry (NIAH) and the CIRAD with the project E3P.

In order to better understand livestock farming in the province and to verify certain information, representatives of the Livestock Farming Company (*Cong Ty Giong Chan Nuoi*), the former state co-operative, recently privatized, have also been taken into account. This company owns a few large livestock farms and supplies technical advice to many others. It is therefore a driving force in the implementation of the province's development plans concerning livestock farming.

The multiple facets of the livestock waste problem, the perceived issues

For the various stakeholders, the livestock waste problem involves a number of issues. The four main ones are: i) quality of life, ii) sanitary risks, iii) economic risks and iv) risk of local tensions.

Effluents, a factor of deterioration in quality of life

Although there have always been pigs in all the families of Thai Binh province, the increase in the standard of living and the change in the way of life have made its inhabitants progressively more demanding concerning their living comforts.

All stakeholders questioned complained of nuisance linked to livestock effluents. It is interesting to note that sometimes the very families of livestock farmers themselves describe the nuisance they must endure because of the activity of their parents, children or spouses. The kinds of nuisance highlighted by stakeholder are of different orders.

Olfactory nuisance

It is smells that bother people the most. In villages, livestock farms that have expanded greatly generate an omnipresence of bad smells. A city-dweller explained: "*When I go back to my parents' house in the country, there is a livestock farm right next to their house, I have to close the doors and windows so as not to smell the bad odours at home.*" This olfactory nuisance is even more acute in the strong summer heat. The transportation of pigs similarly to that of effluents annoys the neighbourhood because it spreads the smells still further.

Dirtiness of villages and watercourses
After smells, stakeholders would like to see their villages kept cleaner. Once again the transportation of pigs and slurry from farms located in the heart of villages to the fields or to other farms is considered as responsible for the spreading of effluents in the streets. Added to that are piglets that roam free in the streets or near dwellings. In addition, significant numbers of pig farmers discharge their effluents into surface water or canals that pass through the village and the inhabitants complain of no longer being able to use river or pond water for daily tasks (cooking, washing).

Development of insects
The stakeholders questioned also think of their comfort by denouncing the development of insects that they attributed to effluents. In this country with a subtropical, humid climate, insects breed extremely rapidly and the presence of effluents all over the village is considered as an aggravating factor. An inhabitant commented: "*With all the insects that live in the canals where effluents are discharged and that then come into my home, my children often get bitten and cannot sleep well at night.*"

Effluents, a risk for economic activities

Stakeholders stress that the abundance of effluents and their current management carry a certain number of risks for economic activities.

Risks of a mass use of effluents as agricultural inputs
The people questioned know by experience that the excessive use of effluents harms crops (death of fruit trees in gardens; wilting of medicinal flowers that can no longer be sold; weakening of rice that is more easily attacked by diseases and parasites). They also know that the use of too much waste matter to fertilize ponds can kill the fish, either by saturating it with "toxins" (unidentified by stakeholders), or by contaminating ponds with the germs contained in the effluents.

Risks of outbreaks of pig diseases affecting the profitability of the farm
Stakeholders are also afraid that poor waste management on pig farms might lead to animal diseases. In one of the communes visited (Vu Tien, Vu Thu district), many of the pigs had respiratory problems. Most people questioned think that poor waste management is to blame. Veterinaries are unanimous in saying that communes where big pig farms have been developed have seen a very clear increase in parasitic diseases, blaming hygiene problems on these farms. Although farmers do not believe that this can lead to the death of animals, they fear that it will affect their growth and therefore the economic performance of their farm.

Influence of avian influenza on stakeholders' perception and commercial risk
Thai Binh is one of the provinces affected by avian influenza; the consequences, very serious for livestock farmers, have had a significant effect on stakeholders' perceptions with regard to livestock waste management. They worry a great deal about the spread of this disease. They are afraid, on the one hand, of an outbreak among pigs with pathology equivalent to that of avian influenza. On the other hand, the better-informed stakeholders fear that pigs will enable the disease to jump to humans. It is considered that an improvement in livestock farm cleanliness would make it possible to avoid these problems. The authorities also worry about meat export difficulties that would damage the province's economic development.

Poor control of liquid waste penalizes development of economic activities on neighbouring farms
It frequently occurs that liquid waste and water used for cleaning buildings runs onto neighbouring properties, which can penalize neighbours.

For example, there is a situation with two neighbouring pig farmers, one who has just developed his farm into a large-scale operation and a smaller one. While the first pours large quantities of liquid waste into his waterhole, his neighbour with a pond bordering on the other's waterhole tries to raise young fish; he complains: "*Since my neighbour enlarged his farm, every time I buy young fish, I find them dead after a few days.*"

Effluents, a risk for public health

Effluents and fear of disease
Effluents are perceived as products in which there are many germs, eggs, parasite larvae and insects. People worry about the spreading of diseases by effluents, especially skin and eye diseases. The medical services associate the recrudescence in these two kinds of diseases to the increase in livestock farming. People questioned think that diseases can be caught in different ways: through direct contact by handling effluents; by passing through paddy fields where effluents have been spread; by swimming in ponds and rivers where effluents have been poured; by breathing livestock odours that can cause respiratory diseases or long-term illnesses.

In addition to the immediate fear of disease, stakeholders also wonder about long-term illnesses possibly caused by the deterioration of their environment; the increase in the risks of cancers and the reduction in longevity are often mentioned. For example, a communal leader in Quynh Phu district had a catastrophic vision of future health: "*Before people lived until they were 80. Now they only live until they are 65. And that is surely due to the deterioration in the environment and to untreated effluents.*"

Drinkable water

During the hundred or so surveys carried out, only one district leader and a research stakeholder mentioned the problem of nitrates working their way into ground water. The agricultural departments questioned consider that surplus nitrogen remains in plants but does not get into ground water. As an example, a livestock farmer from Thai Thuy district explained: "*As all the water we use comes from wells, if effluents go into the rivers, that doesn't create a problem.*"

Pig effluents, a source of local tensions

Stakeholders also fear that poor waste management will damage peace in the community. Various cases have already been reported: conflicts between farmers and their families, between inhabitants and farmers, between farmers when the activity of one farmer jeopardizes fish farming (pond pollution), crop farming (saturation of soil with liquid waste that kills off plants), or livestock farming (development of diseases) on neighbouring farms.

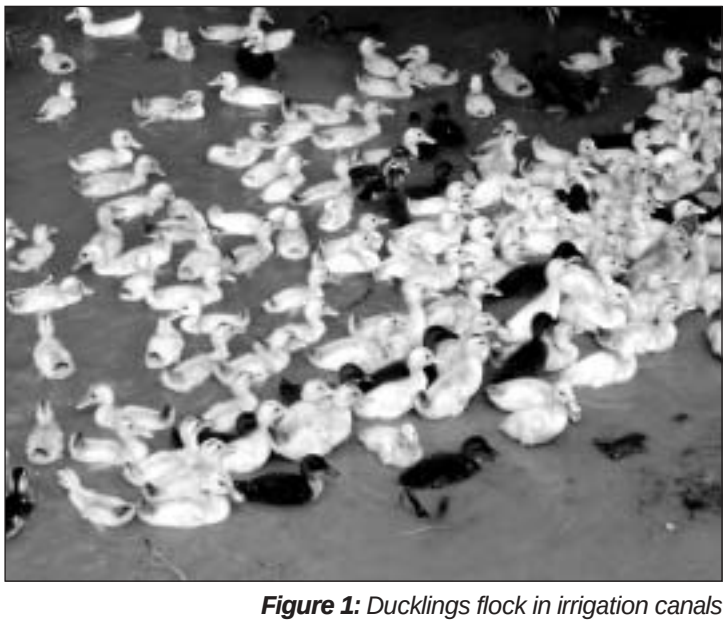

Figure 1: *Ducklings flock in irrigation canals*

Pig effluents, a facet of a wider problem

Although stakeholders associate pig farm effluents with a certain number of risks and issues, they stress that the problem is a wider one and that effluents are only one aspect of the wider problem of environmental pollution. Good liquid waste management is not enough, alone, to guarantee good living conditions, health and economic activities. Therefore, liquid waste management does not always constitute a priority or at the very least, it appears that if one seeks to improve the overall situation, it is necessary to look at the wider issues and not just a single influencing factor.

The problem of liquid pig waste management is closely linked in stakeholders' perceptions to that of other pollutions: chemical pollution linked to agricultural inputs, pollution linked to effluents from other livestock farming and pollution associated with household waste.

Chemical agricultural inputs

Stakeholders often confuse pollution linked to livestock effluents and the risks associated with the use of chemical inputs. Indeed, among the people questioned, some consider that effluents are as dangerous as pesticides. According to an inhabitant of Vu Thu: "*effluents are put on the fields, just like pesticides. The medical services said that this causes skin diseases. All of these products can cause the same problems.*"

This peculiar sensitivity towards the risks of chemical pollution derives from several factors. Firstly, the population as a whole seems to fear the use of chemical inputs following the trauma left behind by the use of Agent Orange by the US army and by the contamination of the ground by dioxins and its observed consequences on human health. Secondly, stakeholders are highly aware of the food risks linked to chemical pollutants by the Vietnamese press that often discusses dangerous practices in the use of chemical inputs: use of banned pesticides, too high frequency and dosages of application, pesticide residues found in excess in foodstuffs (4).

Other sources of livestock effluents: ducks, cattle, water buffaloes

Although the people questioned stress the negative consequences of effluents on their quality of life (in particular in terms of olfactory nuisance) and on the cleanliness of surface water, they never consider pig farmers to be solely responsible for the current situation. Herds of cattle and water buffaloes, even if the herd is a small one, create the same problems and add to the general impression of poor effluent management. Ducks are

held more directly responsible; they are mostly raised in rivers and communal canals, and are considered as a problem for water quality; and noise pollution is not overlooked near buildings.

Change in consumer practices and household waste

In reply to the question: "what are the priorities among measures to be implemented?" three-quarters of the stakeholders questioned answered that to improve the cleanliness of villages, the problem of effluents should be solved but that firstly household waste should be dealt with: plastic bags and other consumer waste are new problems. While producers know how to use livestock effluents in the fields, in fish farming, on gardens, nobody yet knows what to do with inorganic waste. Currently implemented attempts to collect and destroy such waste are not yet conclusive or effective in all communes. Nevertheless, in terms of health, the inhabitants mention effluents first: "Household waste is not such a serious problem as effluents; it doesn't attract insects that spread diseases."

The interviews conducted on the problem of pig farm effluents highlight a hierarchical arrangement of the problems perceived by the stakeholders in terms of the improvement of their living conditions, which is their main preoccupation (Figure 1).

Priority ↑		
	1	*Monitoring of pesticides and chemical fertilizers*
	2	*Collecting of household waste*
	3	*Management of pig effluents*
	4	*Management of effluents from other livestock*

Figure 2: *Order of priority according to stakeholders*

Possible solutions envisaged and fresh issues

Several possible solutions to these issues have been proposed by stakeholders during interviews. As the previous section stresses, they are never envisaged as solutions reserved for pig farm effluents but as solutions to the overall problem of controlling pollution and maintaining the quality of life.

This chapter presents the main possible solutions proposed, the difficulties encountered or anticipated for their implementation, difficulties that enable the identification of new issues linked to management of livestock effluents.

Participation of all stakeholders for a problem with multiple implications

The interviews carried out highlighted a mutual incomprehension between the various kinds of stakeholders. The authorities think that poor liquid waste management is due to lack of awareness of risks on the part of producers. The inhabitants and the producers consider conversely that the lack of dynamism and initiative on the part of the authorities can be explained by their lack of awareness of the situation. A livestock farmer explained: "*Journalists should come into villages to describe our living conditions, the smell… When the authorities are made aware of the situation, they will take measures to improve it.*"

The interviews also highlighted a lack of co-ordination between services. The stakeholders (people, livestock farmers, etc.) do not always know who to go to for advice, information or solutions. They all have lots of ideas about how to solve the problem of liquid waste management, but the perceived lack of a clear definition of roles in the management of these effluents and of an impetus from high-level authorities limits their involvement in the implementation of solutions.

Stakeholders therefore often refuse to apply their ideas if they are not derived from the wishes of the hierarchy. The administrative services do not wish to see liquid waste management become the responsibility of one stakeholder in particular; they want more dialogue in order to find out what others are doing, to identify needs, to avoid repetition and to establish new measures. Some communes have already experimented with crosscutting groups, putting together medical services, veterinaries, farmers' unions, women's unions and co-operatives. Nevertheless, the lack of any status or pay, the multiple roles played by stakeholders prevent a real dynamism developing in these groups. The research community and the provincial authorities think that these groups for idea exchanges and co-ordination should be established at the district level, in order to maintain coherence with the implementation of governmental policies and to remain sufficiently close to the constraints of producers and communes.

Pig liquid waste management thus appears to be an institutional issue (regulations, directives) and an organizational issue (definition of stakeholders' roles and co-ordination of action)

Moderate use of effluents as inputs

The moderate use of effluents as agricultural inputs is also a solution often mentioned by stakeholders. Logically this use should be developed; nevertheless, this solution encounters various difficulties and creates new issues.

An unpopular solution with producers

The use of effluents as inputs traditionally takes place in agriculture and fish farming. Although it enables the regulation of certain forms of pollution, the producers complain of numerous constraints that they have to deal with. The transportation of effluents to cultivated land is often considered as the most unpleasant work of the whole year, needing a lot of time and workforce. Currently, no farm produces dry compost, compact and odourless. Transportation is usually carried out with a bicycle equipped with pallets.

Moreover, growing rice, on which effluents have traditionally been spread and which still currently occupies two thirds of cultivated land, is being progressively abandoned in favour of other, more lucrative activities (livestock farming, other crops, non-agricultural activities). Farmers prefer to use, on paddy fields, a mineral fertilizer less unpleasant to spread and very cheap. Those who specialize in other activities frequently abandon organic fertilization of their paddy fields and in particular those remote from their place of dwelling. In fish farming, livestock effluents do not always have a good reputation. They are accused of affecting the taste of fish flesh or of spreading diseases. In addition, the province strongly encourages fish farmers to increase their yield, which has made many farmers stop using effluents in favour of industrial feed. Administrative departments, political stakeholders and the research community believe however that use of effluents in a moderate and systematic fashion would enable the partial reduction of effluent-related problems. Although agricultural development policy emphasizes the development of pig farming, some of the authorities would nevertheless like to see the increase in the numbers of pigs accompanied by the development of plant and fish production, the prime example being that of the integrated system, the VAC model, in order to limit surpluses (5).

Conditions for an effective use of effluents

To ensure that effluents as inputs in agriculture or fish farming develop despite the constraints encountered by producers, a clear message of incitement from the authorities appears to be a necessary condition. In fact, the use of chemical fertilizers for crops is promoted by the communal co-operatives that are the central purchasing agency for these products. There is therefore a conflict of interest for them between the promotion of use of effluents and the sale of chemical fertilizer. Similarly, for fish farming, the provincial message promoting industrial feed does not improve fish farmers' perception of the use of effluents as inputs.

In addition to the users' disinterest in organic manuring, a lack of knowledge of how to use effluents as inputs has been observed. Indeed, although this use is carried out on the basis of traditional experience, interviews have shown a very great diversity in the practice of spreading and a lot of vagueness concerning the rules governing the management of effluents on the farm, particularly in terms of dosages to be spread to obtain optimum results. In the case of integrated systems (livestock farming – paddy fields – garden), nobody questioned, be they producers or extension offices, was able to give precise information on the quantities of effluents necessary for gardens or ponds, nor therefore on the numbers of pigs necessary according to the type and size of pond. This lack of knowledge has unfortunate consequences and does not promote the consumption of effluents as agricultural inputs. In this way, for example, a livestock farmer has enlarged her pig farm, but not knowing how to calibrate her pond to put the increase in effluent production to good use; it became eutrophic leading to the failure of her fish farming activity.

The implementation of this solution raises two fresh issues: (1) an institutional issue (concerning directives and political choices between intensification and preserving the environment), (2) an issue of knowledge and research: knowledge of the quality of effluents as agricultural inputs, knowledge of flow management of organic matters on the farm (dosages to be spread on the farm to improve the results of other productions and size calibration of the other farming activities to optimize the flow of organic matter within integrated systems).

Effluent exchanges

According to the stakeholders interviewed, the use of effluents on the farm is not sufficient to consume all of the organic matter produced. Indeed, livestock farms that expand within villages do not have the space to dig fishponds or to enlarge gardens. In addition, pig farms are tending to specialize, abandoning other forms of farming. According to the interviews, the current trend is the reduction of garden area to enlarge buildings for

pigs or to develop housing. This reduces the usable area for muckspreading. Some people questioned think that effluent exchanges could be a solution. Nevertheless, the implementation of this solution is confronted with several difficulties and raises several issues: the impact of transport, the co-ordination of exchanges, and the recognition of effluents as a resource.

A solution difficult to implement: the problem of transport

Effluent exchanges pose the problem of transport and of their negative impact in terms of quality of life. In any case, it is only a partial solution that appears possible for dry effluent, but definitely not for liquid waste and cleaning water. In addition, the transport of effluents remains problematic. An example is the case of the village leader who decided to limit the transport of effluents in his commune in order to preserve air quality. This measure had a positive effect on the quality of life of inhabitants, but was criticized by those who considered it more important to develop exchanges making it possible to limit the risks of water pollution and to improve villagers' living standards.

This solution therefore poses the problem of treatment of effluents before their transport to reduce levels of nuisance and the implementation of transport regulations.

Lack of information and co-ordination of exchanges

When crop or fish farmers seek effluents, they know where and how to find them; exchanges obviously exist and a market, though very limited, also exists. Surveys have however exposed the case of some communes where potential buyers and sellers did not manage to meet up with each other. It would seem that a co-ordinator could promote these exchanges, being capable of identifying farms with surplus organic matter and those lacking supplies.

At the communal level, co-operatives already fill the role of a central purchasing agency for mineral fertilizers and chemical inputs. They would therefore be quite capable of performing the role of co-ordinator, since they would only need to extend their field of influence to effluents. Other stakeholders mention communal leaders and farmers' unions. These two types of stakeholders have a good knowledge of the situation on farms. They could thus help producers and consumers of effluents to work together.

However, the authorities and the communal services are not considered as legitimate to co-ordinate exchanges at the district or provincial level. In this case, only the creation of a crosscutting group mixing district stakeholders (agricultural planning departments, environmental departments) and communal stakeholders (co-operatives, communal heads) is perceived as capable of creating a large-scale effluents exchange network.

In addition to the development of an exchange system and the sale of effluents between farms with surpluses and those with shortages, the stakeholders consider that it could be interesting to sell surplus products to private companies who could process them into compost. While this idea seems attractive, nobody has come up with ideas for how to co-ordinate producers and companies, or how to organize the effluents collection system.

This solution raises issues in terms of knowledge (quality of effluents in order to treat and sell them, technological research), as well as organisational and information issues (knowledge of surplus farms, organization and co-ordination of exchanges, etc.)

Deployment of treatment and storage techniques

While the use of effluents as inputs and, by the same token, effluent exchanges are considered as difficult and hard to bring about, all the stakeholders agree that an effluent treatment system would be ideal. Many people questioned imagine and expect an ideal technique, a sort of "black box" in which effluents would be washed clean of all pollutants and from which only water would re-emerge. Some would like to see a treated product that must answer stakeholders' main preoccupations, namely to be deodorised and "made

Figure 3: *Intensified pig farm with biogaz system and fish pond*

hygienic" (free of germs, eggs and larvae from insects and parasites). Some solutions have been considered such as the use of CaCO3 in storage pits or deodorizing products in effluents. But district and provincial authorities seek above all to encourage the development of biogas that, in addition to its treatment capabilities, supplies the household with gas.

By contrast, reduction of nitrogen levels is not considered a priority. The reaction of an official from the provincial department of the environment is characteristic of the perception of members of administrative and political departments: "*nitrogen, phosphorous and potassium are not very dangerous, there are other priorities.*"

Constraints and limitations to development of individual biogas treatment systems

Installation of a biogas system is very difficult. To begin with, there is a lack of space for livestock farmers in villages, land already being used to the maximum for dwellings or livestock buildings. When farmers are expanding, funds are used for the development of their farming activity. Some have stated that the construction of buildings and the purchase of animals left nothing to invest in treatment systems. It is above all the lack of investment capability that reduces the possibilities for installations. Only big farms can afford such an outlay. "*A lot of doors must be opened to get money from the bank. It's too difficult. We prefer to ask our friends or family. But for the moment everyone is in the same boat, we all spend a lot on livestock so no-one has any money to lend*", explained a farmer in Vu Thu. To quote another farmer however: "*It's my health or that of my children that is at stake, of course if I could install a biogas system, I would. For the moment I've increased my livestock, which means that at least we don't have to worry about survival any more, for the rest we'll see about that later*". Despite the scant means deployed, the repeated encouragements of the extension services make biogas systems extremely popular, and many farmers wish to install one as soon as possible.

In addition, installation of biogas systems is carried out either by technicians from the district environmental departments, or by independents. Interviews have shown that there were many problems with these systems. In one of the communes visited, out of 10 biogas systems installed, only 3 worked. The problems can originate from lack of training for technicians, (wrong size of pit, lack of safety valves leading to the explosion of the system, cracks, etc.) or incorrect operation by users. For example, a slaughterer thought he could throw all the waste from his activity into it.

Collective organization of an effluent management system: shared storage systems

In addition to treatment systems, stakeholders wished to install storage systems. But, according to most producers questioned, materials are expensive and much space is needed. This is why many are considering shared systems. Solid effluents are not used all year round in agriculture. Livestock farmers do not know what to do with them during periods when they are not used and could stock them in a shared pit. Nevertheless the construction of such a pit poses the problem of subsequent use of the manure, it being shared, stakeholders fear it may be unfairly divided up between producers when it is put to use. In addition, producers have many problems dealing with liquid effluents, too heavy to be transported, too voluminous to be stored. The construction of shared canal systems could enable them to avoid direct discharges. These canals could lead to a pond outside town, or into paddy fields around the village. Research stakeholders consider that it is always better when effluents go onto crops rather than into surface water.

So the implementation of the "treatment and storage" solution for effluents highlights three types of issue: a research issue (technical research to develop innovative and appropriate treatment methods), an information and training issue (extension for correct use of treatment systems by the "biogas" method in particular), and an organizational issue (for joint storage or treatment management).

Training for stakeholders

Stakeholders often believe that the problem of effluent management derives from lack of know-how. According to the authorities, if producers knew the risks and consequences of their activities, they would better manage their effluents. Producers, for their part, ask to be trained precisely in order to reduce the consequences of their activities on the environment. Technicians ask for more information in order to improve their advice. An official of the district extension department commented: "*We cannot give advice on the organic fertilization of rice, as we lack data both on the needs of plants and on the quality of manure*". Although the information the departments have is sometimes reliable, available data sometimes comes from outdated sources, or from surveys carried out in the communes. A communal leader explained: "*We ask livestock farmers how much they use and we make averages with which we establish recommendations.*" Some stakeholders, farmers or

local officials, mention the lack of training for the installation of treatment systems.

The training of producers is done at the communal level. The medical services take care of carrying out hygiene training campaigns in which they discuss the impacts of effluents. Farmers' and women's unions and co-operatives invite technicians from district and provincial extension, environmental or agricultural departments. Farmers are then called on to participate in meetings, either via the communal radio, or thanks to the village leader who visits farmers. In most cases, only the large-scale livestock farmers are invited. The village leader is then responsible for passing on the information to farmers with smaller operations. However, many small-scale livestock farmers met with complained of not having access to information. The technicians responsible for the construction of biogas systems train themselves through contacts with others with more experience. Vu Thu district had the idea of monitoring their activities, in particular by outlawing independent constructors and giving the monopoly of biogas system construction to the district environmental department, in order to avoid some biogas systems being installed by incompetent people.

Moving livestock farms into specialized areas outside villages

Within the framework of its livestock farming development policy, the province plans to create specialized areas given over to livestock farming. Each commune must therefore reserve 10% of its territory for livestock farming. Land is selected outside villages according to criteria: i) proximity to main roads (to guarantee easy access to shared services – pig collection, veterinary visits -), ii) proximity to a water source (stream, river), (iii) below-average quality soil to limit the potential fall in rice production. The main aim of these areas is the intensification and development of big livestock farms. But the authorities also see the possibility of improving the management of effluents by creating shared systems: "*grouping together for better management*" according to the head of the provincial department for livestock farming. In addition the authorities claim that livestock farmers who set up operations in this area must install integrated systems of the VAC kind in order to use their effluents. In any case, moving farms to specialized areas makes it possible to limit olfactory nuisance and to improve the cleanliness of villages. Nevertheless, few communes have actually succeeded in installing these areas for the moment.

The realization of this project poses several problems. Firstly, in moving farms far from inhabited areas, farmers fear that the monitoring of animals will not be ideal. They also cite financial difficulties. Occasionally, people want to begin operating in the areas, starting a livestock farm although they didn't have one before. But as a general rule, those who wish to move are the large-scale farmers who have already built a farm before the launching of the project. Moving would force them to invest in new buildings, which is very difficult in the current context of fluctuations in pork prices. The final problem encountered is that of access to real estate. Even though communes have defined the perimeter of specialized areas, the land still belongs to farmers. To obtain this land, livestock farmers must therefore negotiate with its owners and offer their land in exchange. These exchanges are particularly difficult to bring about without arbitration institutions. During the interviews with farmers wishing to set up business in the specialized areas, all of them mentioned difficulties with land exchanges: refusal on the part of the owner, unacceptable conditions proposed, the desired plot of land being the property of several different owners, accentuating the difficulty of negotiations.

In spite of these difficulties, the authorities have considered legislating to oblige any farmer wishing to enlarge his operation to go and set up business in a specialized area. In addition, a 2005 national resolution should give more weight to farmers' unions to ease land exchanges when impact on protection of the environment is positive. Nevertheless, the village authorities do not yet know how to manage these conflicts; they do not know whether they should favour moving livestock farms or growing rice. Many request a clear message from the province to know the priorities in relation to rural development, which would make it easier to solve real estate problems. This solution raises organizational issues (definition of stakeholders' roles, establishing role for mediation, arbitration).

Inspecting livestock farms and impact on the environment

Most stakeholders believe that the reduction of negative effects of effluents on the environment requires the inspection of livestock farms to better assess their impact: cleanliness of villages and water, health and olfactory nuisance. This determines the criteria on the basis of which inspections should be carried out. This solution throws up a certain number of difficulties and issues.

Defining stakeholders' roles with regard to inspections

For the moment, nobody is in charge of inspecting farms, because the terms of reference and the status (pay for inspectors in particular) have not been defined. One might think that conflict management, particularly when a livestock farmer disrupts the economic activities of another producer, could be dealt with by farmers' unions. All the small-scale farmers questioned however stated that only large-scale farmers had the right to speak during meetings. Some stakeholders are approved as legitimate ones to carry out inspections. Village heads and veterinaries know the livestock situation in their sector well given their regular visits. They are quite capable therefore of making recommendations concerning livestock farmers. Veterinaries have more technical know-how, but village heads have more authority to resolve problems of conflict between inhabitants and livestock farmers.

Defining rules for inspections: initiation by inhabitants' complaints

To trigger an inspection, political officials require that complaints should be lodged by those that suffer from the nuisance caused by effluents. They state that no inspection can be carried out if nobody complains. Yet interviews have shown that inhabitants refused to complain. An inhabitant from Vu Thu district said on this subject: "*Of course we fear for our health, but nobody will go and complain. Farmers nearby are our friends; others are our cousins, our brothers. The most important thing is to maintain good relations with them.*" Recourse to a mediator doesn't seem possible either. Village authorities and services appear too daunting. A trader from Quynh Phu district explained: "*What can I do at my level? Go and see the head of the village? I don't have the right to do that: he's too important.*"

Inspection criteria, a necessary regulation

In order to carry out inspections, criteria to be checked must have been identified. This is why the people questioned wished to see the implementation of regulations at the communal level and legislation at the provincial level. The choice of regulations depends on the stakeholders' perceptions. The main perceived problems being bad smells, cleanliness and health, communal leaders seek above all to protect the environment (cleaning, forbidding direct discharges into rivers, etc.) and livestock management (control of effluents, installation of systems limiting smells). Some communes have already brought in these kinds of regulations but visits have shown clearly that they are not respected by all livestock farmers. Legislation is decided at a less local level and has a more general intention. For the moment, the proposed legislation would seek to control development of livestock farms: a farm wishing to acquire more animals would have to install a treatment (biogas) system and/or move to a specialized area.

Effluents and the healthiness of meat: market influence?

Vietnamese consumers' quality criteria are above all technological (tenderness, proportion of fat). According to them, only pigs' diet can alter meat quality. They think little or nothing about the sanitary aspect of meat. The cleanliness of farms is sometimes mentioned by city-dwellers as a factor of poor quality but this remains anecdotal.

Consumers are beginning to wonder about the quality of their diet but their prime concern is the direct impact of certain practices on meat quality (contamination of food products by pesticides, hormones or antibiotics). They do not yet consider the impact of activities on the environment. They have other, more urgent preoccupations. The market does not yet therefore appear to have influence over management of effluents.

This last solution, farm inspections, highlights new issues of an institutional nature (regulation of effluent use stipulating maximum dosages, penalty system).

When all is said and done, stakeholders can more or less see several possible solutions currently more or less implemented and from an analysis of which emerge fresh issues relative to the management of pig farm effluents: institutional and organizational issues, issues of inspection and knowledge of production, spread of information and training.

Institutional analysis and possible ways of initiating a process of change

The previous sections having made it possible to specify the stakeholders involved in the "management of livestock effluents in Thai Binh province" system, the diversity and plurality of issues directly perceived by stakeholders relative to effluents and the issues involved to solve problems managing these effluents, the objective of this section is to analyse the relationships between stakeholders in order to specify how a dynamic could be initiated.

To achieve this, the institutional analysis has been made more detailed and followed up by using the computer program for data management and system modelling developed for the PACT method. The analysis makes it possible to specify the priorities in terms of "qualities" of the "management of livestock effluents in Thai Binh" system to be improved, to define areas of consensus between stakeholders, and key stakeholders who could initiate changes perceived as necessary.

The stakeholders and the system's "qualities"

On the basis of the interviews carried out, 20 types of stakeholders have finally been selected for the institutional analysis of the "management of pig farm effluents" system with the PACT computer program (Table 1).

Table 1: *The types of stakeholders selected for institutional analysis with the PACT computer program*

Stakeholders	***Code***	***Stakeholders***	***Code***
Provincial Agricultural Dept.	*Prov_agr_d*	*Women's union*	*Wom_uni_xa*
District Agricultural Depts.	*Dist_agr_d*	*Rural inhabitants without pigs*	*Inhabitants*
Communal agricultural co-operatives	*Coop_xa*	*Large-scale farmers (mixed production, distant from inhabitations) with biogas systems outside villages*	*Big_farm*
Provincial Environmental Depts.	*Prov_env_d*		
District Environmental Depts.	*Dist_env_d*		
District Extension Depts.	*Dist_ext_d*	*Medium-sized farmers/enlarging and sizeable in the village*	*Med_farm1*
Communal Medical Services	*Med_ser_xa*		
Veterinary	*Veterinary*	*Medium-sized farmers/enlarging outside the village*	*Med_farm2*
Political official (province and district)	*Pol_off*		
Communal/village leader	*Lead_xa*	*Small-scale farmers*	*Sma_farm*
Research: CIRAD (E3P), GRET, NIAH, VASI	*Research*	*Fish farmers*	*Fish_farmer*
Farmers' union	*Farm_uni_xa*	*Crop farmers*	*Crop_farmer*

In addition, on the basis of interviews that have made it possible to specify the issues as perceived by the stakeholders, the 22 "qualities" that they wish to see improved have been defined for the system studied (Table 2). For example therefore, the issue "quality of life" has been broken into several qualities: the "cleanliness of villages" (Clean_vil), "surface water cleanliness" (Clean_wat), "air quality" i.e. the reduction of olfactory nuisances (Air).

Table 2: *The issues and the "qualities" selected for the institutional analysis with the PACT program*

Issues	***Qualities/issues***	***Code***
Qualities of life	- *cleanliness of villages/communes* - *cleanliness of surface water* *air quality (reduction of olfactory nuisances)*	*Clean_vil* *Clean_wat* *Air*
Health	- *human public health* - *animal health* - *drinkable water*	*Hum_health* *Ani_health* *Drinkable*
Local conflicts	- *management of conflicts between neighbours (keeping the peace)*	*Conflict*
Economic	- *local agricultural development to ensure that management of effluents does not inhibit production in the province* - *export/image of the province*	*Agr_dev* *Export*
Removal	- *removal of surplus effluents at minimum cost (human, man hours)*	*Removal*
Economic value	- *monetary value of effluents through direct sales of slurry*	*Val_$*
Institutional	- *local regulations at the communal level* - *legislation* - *directives to provide a framework for effluent management and to support local initiatives*	*Regul_local* *Legislation* *Directives*
Organization	- *definition of stakeholders' roles, co-ordination of action*	*Organizat*
Inspection of livestock farms	- *inspection of farms (audits, impact assessment, penalties)*	*Inspection*
Acquisition of knowledge	- *knowledge of quality when used as inputs* - *knowledge of the real situation concerning pollution in the province* - *knowledge of effluent management on farms* - *technological research (storage, treatment)*	*Know_input* *Know_situ* *Mgt_farm* *Tech_res*
Transmission of information	- *heightening awareness of impacts of effluents* - *extension*	*Awa_imp* *Exten*

A complex situation

Stakeholders' demands concerning improvements in the system

Although the issues touching on pig effluent management are many, the "qualities" of the system are not all considered as being equally important. Indeed, stakeholders sometime have differing points of view on the impacts of effluents and on their management. This perception influences the actions that they would like to see implemented by the other stakeholders.

So the assessment of stakeholders' demands (the wish to see this or that "quality" improve) makes it possible to specify the relative importance of "qualities" that the stakeholders wish to see improve (Figure 2).

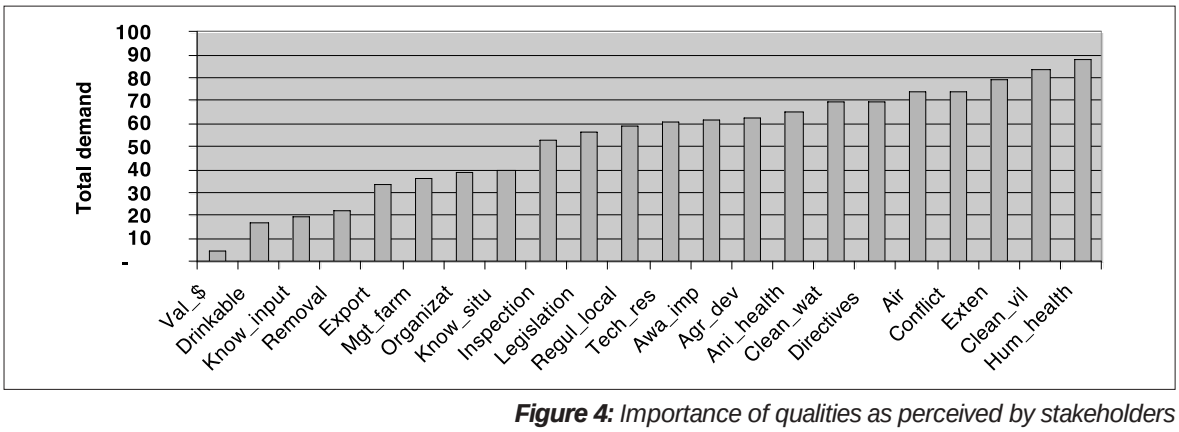

Figure 4: *Importance of qualities as perceived by stakeholders*

This analysis confirms that the main preoccupations and the demands for improvement are primarily concerned with human health and quality of life (cleanliness of villages, cleanliness of surface water and air quality).

It also shows, which was less obvious at the beginning of the survey, that there are significant levels of expectation concerning the improvement of the system in order to reduce tensions between the inhabitants of villages.

It also emerges that the stakeholders have significant levels of expectation concerning extension, which, given the expectations expressed concerning research, shows that they consider effluent management to be a technical issue. Behind this demand can also be sensed a belief in a "miracle technique" that would solve all effluent-related problems.

Finally, the analysis shows a significant demand for clear directives concerning effluent management.

In addition, demand for some "qualities" is relatively low from stakeholders. These results can be considered in two different ways. They could be qualities whose improvement is not seen as a priority (such as whether water is drinkable, for example) or ones that are very far removed form current practice (such as monetary value of effluents, for example). They can also be qualities for which opinions are very clearly contrasted between kinds of stakeholders. For example, know-how in relation to farm management and to the quality of effluents as inputs are qualities that only interest stakeholders linked to agricultural production and research stakeholders. In addition, demand for improvement in effluent management so as not to compromise pork exports is actually very scarce and comes only from the provincial authorities and very large-scale farmers. In such a case with no consensus, it is difficult to involve stakeholders in a process of improvement.

Stakeholders with contrasting interests and offers

An analysis of offers and demands for improvement of the system shows that those who feel the most concerned (significant quantities of offers and demands) are village leaders, medium-sized and large-scale farmers, as well as political officials, local agricultural departments and co-operatives (Table 3). Nevertheless, their current offers of improvement remain limited, except for the direct stakeholders, namely the pig farmers. This confirms their wish to act in order to improve the situation. These stakeholders are therefore to be considered on the face of it as committed to taking action, but a more precise analysis is required.

Table 3: *Stakeholders' interests (total concern of stakeholders)*

Stakeholders	***Demands***	***Offers***	***Stakeholders***	***Demands***	***Offers***
Pol_off	*72*	*3*	*Dist_env_d*	*54*	*6*
Prov_ agr_ d	*65*	*13*	*Med_farm1*	*51*	*28*
Lead_xa	*64*	*15*	*Big_farm*	*50*	*28*
Veterinary	*62*	*5*	*Farm_uni_xa*	*50*	*10*
Coop_xa	*62*	*9*	*Med_farm2*	*50*	*28*
Research	*61*	*4*	*Inhabitants*	*49*	*-*
Wom_uni_xa	*60*	*5*	*Fish_farmer*	*43*	*15*
Dist_ agr_ d	*58*	*14*	*Sma_farm*	*40*	*22*
Med_ser_xa	*58*	*8*	*Dist_ext_d*	*38*	*3*
Prov_env_d	*56*	*5*	*Crop_farmer*	*33*	*14*

Possible improvements of the system

Legitimate stakeholders ready to do more

Although livestock farm effluent management is a recent issue and stakeholders do not often have very clear ideas about action to be taken in order to improve the situation, interviews have made it possible to identify several "fields of action" to solve each perceived problem and to improve the qualities. By grouping these many "fields of action" together, 7 general types of action have been identified:

1. **Improvement of techniques for treatment and storage of effluents;** stakeholders believe that the improvement of effluent management can be brought about by technical solutions at the farm level, namely: development of storage systems, new and simple technical solutions enabling the reduction of smells, techniques that make effluents "hygienic", techniques that can make effluents transportable (reducing volume, weight and smell), canal systems giving control over liquid effluents; the technical solution most often mentioned is the biogas system.
2. **Improvement of livestock management;** stakeholders believe that another way of improving effluent management (and of addressing identified issues, particularly in terms of cleanliness of villages and animal health) can be brought about by implementation of correct practices directly at the livestock management level: not letting animals roam freely in the commune, keeping effluents within the livestock farming areas, cleaning livestock farming areas.
3. **Improvement of farm management;** this type of action concerns: the moderated use of effluents in agriculture or fish farming, implementation of balanced, integrated agricultural systems, muck-spreading on all fields, in order to avoid saturation of fields close to villages and leaving distant fields without any fertilization with effluents. To address human health issues in particular, stakeholders also advise using protection (boots, gloves, etc.) when handling effluents.
4. **Improvement of environmental management;** focussed on the improvement of quality of life and the cleanliness of villages, this field of action brings together the following actions: cleaning of all areas of the commune (canals, streets), "clean" transport of effluents to the fields or to fish farms, not letting effluents flow into surface water (ponds, rivers), not discharging water used for fish farming into communal waters when this water is renewed.
5. **"Spatial" solutions;** this refers to the creation of specialized areas in which livestock farms would be grouped together outside villages to reduce nuisance and for better effluent management, in accordance with the principle of "grouping together for better management".
6. **Organizational and institutional solutions;** this concerns the following actions in particular: 1) Defining and applying local regulations and legislation in order to regulate the behaviour of producers and users of effluents; 2) Organizing exchanges (sale, gift) between producers and consumers of effluents; 3) Organizing collection of effluents; 4) Development of collective effluent management solutions (compost, pond, shared canals); 5) Creation of cross-cutting consultation and co-ordination groups, at communal or district level; 6) Role definition, particularly defining roles of arbitrators or conflict mediators, defining roles for farm audits and inspections; 7) Defining choices with regard to rural development intensification, particularly in order to solve land problems; 8) Defining and implementing financing systems (loans, subsidies) to facilitate application of solutions, be they technical (treatment) or spatial (moving livestock farms).
7. **Actions linked to the transfer of information and to the acquisition of know-how;** this field brings together the following actions: developing information on techniques, impacts of effluents and means of treatment, developing training courses for livestock farmers, training technicians, making it possible to follow these courses, developing new knowledge concerning techniques for treatment and for management (knowing crops' requirements and the proportion of fertilizing matter in slurry, etc.).

On the basis of interviews carried out, it was possible to identify for each of the system's stakeholders, i) their "capability for current action" (what a stakeholder currently does in each of his "fields of action") and ii) the "capability for approved and legitimized action" (what the other stakeholders think that this stakeholder should or could do in each of the various "fields of action").

The analysis shows that for nearly all the actions under discussion, the stakeholders recognized as having the greatest capability to act and often being considered as those that legitimately should and could act more, are the direct stakeholders: the livestock farmers. For example, to improve cleanliness in villages, most stakeholders would like to see farmers clean up the effluents left behind by their animals. It is recognized that this action is being progressively implemented but it is felt that cleaning efforts could be intensified.

Although this result appears trivial, it shows that the stakeholders as a whole place themselves in a comfortable position, since they agree to place the responsibility for the situation and its future on the direct stakeholders.

Nevertheless, a more detailed analysis of the "capabilities for approved action" highlights other stakeholders who, even though they are considered as less effective than the livestock farmers themselves, can or must do more to improve the situation (Table 4).

Some stakeholders for the moment considered as little or not at all involved are approved by the others as legitimate and can carry out actions likely to improve the system and to improve some of the qualities for which demands are strong. They particularly concern:

- improvement of living conditions (cleanliness of villages and air quality): the farmers' union, the co-operative, as well as all types of producers
- health (in particular of small-scale farmers, crop farmers and fish farmers, and to a lesser degree, other types of livestock farmers): the farmers' union and the co-operative
- conflicts: village leaders and the farmers' union
- extension: the environmental and agricultural departments at all levels, while currently the main stakeholder is the district agricultural department
- directives: political officials and the environmental departments; it should be noted that currently for this quality nobody, in stakeholders' eyes, is seriously involved.

Finally for issues considered as superficially less worrying, but whose importance will be discussed in the following section, such as organization (attributing roles and co-ordination between stakeholders) and the inspection of farms, it appears that no stakeholder is deeply involved in this currently but that margins of progress are very significant with in particular the expected and approved involvement:

- for organization, of co-operatives, farmers' and women's unions and to a lesser degree, agricultural and environmental departments at the provincial level, political officials and village leaders
- for inspection, of co-operatives and village leaders as well as the farmers' union and district environmental offices

Table 4: *Main qualities and stakeholders approved for action*

Qualities	***Stakeholders currently involved***		***Stakeholders approved and expected to act***	
	Directly	***Less directly***	***Much more***	***More***
Cleanliness of villages/communes	*Livestock farmers (all kinds)*	*Agricultural Depts. (district, provincial)*	*Farmers' union and co-operative*	*Livestock farmers (all kinds)*
Human health	*Livestock farmers (medium and large-scale)* *District Agricultural Dept.*		*Livestock farmers (small-scale)* *Crop farmers* *Fish farmers*	*Livestock farmers (large-scale and medium)* *Farmers' union* *Co-operative*
Extension	*Agricultural Dept. (district)*	*Extension Dept., Environmental Dept. (district)*	*Environmental Dept. (district and provincial)* *Agricultural Dept.*	*Women's union and, farmers' union, co-operative*
Conflicts	*Livestock farmers (all kinds)*	*Agricultural Dept (district)*	*Village leaders* *Farmers' union*	*Livestock farmers (all kinds)*
Air quality	*District Agricultural Dept.*	*Livestock farmers (all kinds)* *+ Provincial Agricultural Dept.*	*Livestock farmers (all kinds)*	*Village leader and co-operative*
Directives	*X*	*Agricultural Dept. (district and provincial)*	*Political official* *Environmental Dept.*	*Agricultural Dept.*
Inspection of livestock farms	*X*	*(Village leader)** *(Veterinary)**	*Co-operative* *Village leader*	*Farmers' union* *Environmental Dept. (district)*
Organization	*X*	*X*	*Co-operative, farmer's union and women's union*	*Provincial Agricultural + Environmental Depts.* *Political official and village leader*

NB: X indicates that no stakeholder is perceived in this category; (*) indicates very indirectly

Although most current actions can still be improved in stakeholders' eyes, the analysis shows that some things are done but highlight actions for which more could or should be done (since there are those that are recognized as having the capability and the legitimacy to do them). The analysis thus reveals actions that for the moment are embryonic or even nonexistent and that could be initiated or extended:

- Establishing collective systems of effluent management (pond, compost, canals, collection system, etc.),
- Developing slurry storage and treatment systems (particularly in a "hygienic and odourless form" to reduce nuisance and facilitate transport)
- Wearing protection when handling effluents (particularly to reduce risks in terms of human health)
- Developing an arbitration system: for questions of land exchanges or in cases of conflict when poor effluent management leads to negative consequences on economic activities of a third party
- Developing regulations, legislation and directives
- Carrying out livestock farm audits
- Defining the roles of every stakeholder, creating crosscutting groups
- Co-ordinating exchanges between stakeholders
- Acquiring know-how and transferring information concerning the use of effluent inputs for crop farming and fish farming

Conditional offers and potential improvement of the system

In order to define what would be the possibilities for improvement of the effluent management system and possible courses of action, the interviews have enabled the definition of stakeholders' "conditional offers", namely what they would be ready to do to improve the system if certain "qualities" were improved, particularly by the action of other stake-

holders. Thus several "conditional offers" have been revealed; in particular:

- Those that handle effluents (livestock farmers, crop farmers, fish farmers) are ready to implement solutions to improve the qualities "air pollution", "cleanliness of villages and surface water" (for which there is a strong demand), if the qualities "regulations" and inspection improve.
- Livestock farmers, crop farmers and fish farmers will improve the management of their farms by applying "optimal" dosages of effluents, if extension improves, namely if more information becomes available.

In this way, some relationships of conditional progress of qualities have been revealed; in particular:

- Effluent exchanges ("removal" and "monetary value" qualities) will be improved, if the qualities "organization" (definition of authorities' roles) and "technological research" (adoption of techniques reducing the weight, volume, and smell of effluents on livestock farms) improve.
- Conflicts between inhabitants will be reduced if regulations make it possible to "contain" livestock farmers' activities and if some stakeholders play the role of arbitrator and mediator.
- That the issue of inspection of farms will improve, if the roles of communal departments are defined, and if local regulations are established.
- Training, extension and raising awareness of techniques will be more efficient if research identifies the correct dosages for using effluents, if the material and financial means are made available to implement these training sessions, and if stakeholders' roles are clearly defined.
- The organizational aspect (co-ordination between stakeholders, definition of roles, creation of cross-cutting groups) can only be effective if measures are taken to promote such developments.

Stakeholders potentially capable of offering more

The analysis of total offers ("current offers" + "potential offers") in terms of improvement of "qualities" makes it possible to identify the possibilities of improvement of the system and which stakeholders are or would be the most concerned by effluent management.

Table 5: *Stakeholders' interests (total stakeholders' concern)*

	Stakeholders' potential interests			
	Total (Demands + total offer)	***Demands***	***Total offers***	***Potential offer: (Total offer – current offer)***
Big_farm	*107*	*57*	*50*	*22*
Med_farm1	*104*	*58*	*46*	*18*
Med_farm2	*102*	*57*	*45*	*17*
Lead_xa	*97*	*70*	*27*	*12*
Dist_ agr_ d	*90*	*65*	*25*	*11*
Sma_farm	*87*	*46*	*41*	*19*
Prov_ agr_ d	*87*	*70*	*17*	*4*
Coop_xa	*86*	*67*	*19*	*10*
Pol_off	*86*	*77*	*9*	*6*
Farm_uni_xa	*80*	*58*	*22*	*12*
Med_ser_xa	*77*	*62*	*15*	*7*
Veterinary	*74*	*64*	*10*	*5*
Wom_uni_xa	*72*	*62*	*10*	*5*
Fish_farmer	*72*	*47*	*25*	*10*
Research	*72*	*65*	*7*	*3*
Prov_env_d	*71*	*60*	*11*	*6*
Dist_env_d	*69*	*58*	*11*	*5*
Crop_farmer	*60*	*37*	*23*	*9*
Inhabitants	*53*	*53*	*0*	*0*
Dist_ext_d	*49*	*43*	*6*	*3*

This analysis makes it possible to underline the importance of three overall kinds of stakeholders, in terms of current and potential involvement for the improvement of the system:

- Livestock farmers, particularly large-scale and medium-size, whose "potential offers" are especially significant as well as, to a lesser degree, small-scale livestock farmers who, although they have significant potential offers, have only a low demand for improvement;
- Communal leaders, whose demand is especially significant but whose potential offer is equally high;
- District agricultural departments and co-operatives (as well as, to a lesser degree, the farmers' union and the women's union), which like village leaders, have high demands and relatively high potential offers.

It is also surprising to see that some stakeholders, who it could be anticipated would be directly involved, actually come at the bottom of the list:

- Crop farmers and, to a lesser extent, fish farmers who, although they can have relatively significant conditional offers, in fact have relatively low demands for improvement (and do not perceive themselves as very involved);
- District and provincial environmental departments, who although they have significant demands in terms of improvements in fact have few offers, neither currently nor potentially (actions judged inappropriate and insufficient);
- Extension departments (and to a lesser degree veterinaries), little involved due to a low demand for improvement and who have few offers either currently or potentially.

Potential collaborations

Some stakeholders want some qualities to improve (significant demand) and others can potentially develop actions to improve these qualities (significant total offer). It is thus possible to imagine a potential collaboration between these stakeholders (either that there are total offers complementary to the demands of other stakeholders, or that there are similar offers and demands). Although stakeholders are often aware of a certain number of these similarities and complementarities, a formalization and rigorous analysis of this information makes it possible to highlight areas of collaboration that are less immediately obvious.

Thus stakeholders taken as a whole mainly make their demands towards livestock farmers, since it is they that produce and manage effluents, and think that it is they that must take the decisions to implement actions that can improve this management. Stakeholders consider that work must be done primarily with medium-sized farmers located within villages, rather than with other categories of livestock farmers. These farmers are indeed considered as those that cause the most problems from a nuisance perspective (cleanliness, smell), but also those who are most at risk from a human and animal health perspective. In addition, stakeholders often consider that large-scale farmers already have means of treatment, and that they know how to use their effluents. Similarly, livestock farmers outside villages are considered as less of a priority since thanks to the location of their farms, they cause fewer problems from a quality of life and spread of disease perspective. Finally, concerning small-scale livestock farmers located in villages, stakeholders do not believe that they have a very great capability for action, and currently can foresee no solution for these very small-scale livestock farmers omnipresent in all villages, even though they are aware of their importance due to the nuisance they create (cleanliness of habitat and risk of diseases).

In relation to this overall perception that places emphasis on only medium-sized livestock farms located in villages, the analysis of complementarities between total offer and demand shows the importance of all kinds of farmers. Indeed, large-scale and small-scale livestock farmers appear to have significant total offers of improvement, complementary to demands for improvement made by other stakeholders. This surely shows the potential interest in bringing them together and argues in favour of their effective involvement in the definition of solutions to solve effluent management problems.

Secondly, the analysis highlights the importance of crop and fish farmers who have many offers complementary to the demands of other stakeholders. This indicates the necessity of bringing these groups of stakeholders together to consider how best to improve the management of effluents (particularly in relation to their use and exchanges).

Thirdly, the analysis of offers complementary to demands shows that, among all the bodies identified as having an influence on the system, stakeholders from agricultural departments (provincial, district and co-operatives in villages) and, to a lesser degree farmers' unions, are those who can potentially bring improvements to the management of effluents. It can be seen once again that environmental and extension departments propose few offers complementary to the demands of others; they are

therefore considered as less dynamic and their involvement is not always clear to the other stakeholders.
Fourthly, the analysis highlights the importance, currently only dimly perceived by stakeholders, of communal leaders. In fact these stakeholders seem to have many offers complementary to the demands of other stakeholders.

In addition, the analysis of similar offers and demands highlights the potential interest in getting the various departments and offices to work together at the communal level. It also highlights a breakdown in communication between communal offices and departments at the higher levels (district and provincial). But at the same time it demonstrates the significance of hierarchy by pinpointing the proximities between the communal agricultural co-operative and the district and provincial agricultural departments.

District and provincial political officials, the women's unions, veterinaries and the medical services are three kinds of stakeholders who understand the great importance and consequences of effluent management. Nevertheless, for the moment they have few offers (even potential ones) of improvement complementary to the demands of others. Their genuine involvement would require a very voluntarist approach. In addition, this underlines the current absence of perception of political officials' capability to improve the system.

Key stakeholders and key changes: triggers to implement a process of change

The analysis having shown that some stakeholders were ready to act and that potential means of improvement of the system existed but were conditioned by the implementation of actions themselves conditioned by the instigation of fresh interactions between stakeholders, the objective here is to identify the key stakeholders capable of influencing significant progress in the system, and the triggers; these are the "qualities" whose progress determine more than anything the future of the system and which should be used to initiate a dynamic of positive change towards the resolution of perceived problems.

The influence of stakeholders on the system: identification of key stakeholders
To identify the stakeholders who could be the initiators of change, an analysis of the stakeholders' positions in terms of influence and dependence has been developed (Box 2).

Box 2: Influences, dependences: some notions and means of calculation in the PACT program

The influences and direct dependencies of each stakeholder on each of the others are assessed on the basis of interviews conducted with stakeholders. Taking conditional offers into account, they capture the influence of the decisions of one stakeholder on another, and for the "qualities", they capture the influence of the improvement of a "quality" on another "quality".

By matrix calculation carried out in the PACT program, the level of influence and indirect dependence of every stakeholder (or "quality") on every other is established. Then, by adding together the direct and indirect influences and the dependencies respectively, a level of influence and of total dependence respectively of one stakeholder (or one "quality") on one other is defined. It is worth pointing out that although the relations of dependence and influence between stakeholders (or "qualities") are by and large perceived by the stakeholders, the ties of influence or indirect dependence and the levels of influence and total dependence are quite difficult to appreciate given the complex web of interactions within systems.

The sum of all of a stakeholder's influences and dependences respectively defines his level of total overall influence and of total overall dependence respectively. Once weighted to have an average of 1, these values carried over onto a graph of influence/ dependence make it possible to "place" stakeholders (or "qualities") relative to each other (Figure 3 and Figure 4). On such a graph with the levels of dependence on the abscissa and the levels of influence on the ordinates, 4 kinds of stakeholder (or "qualities") can be defined according to their position:

- *Stakeholders (or "qualities") located in the upper left-hand quarter are those exerting a strong influence over the others while being little influenced by the others; these are the determining stakeholders to make the system progress or "driving" or determining "qualities" for the system's progress;*
- *Stakeholders (or "qualities") located in the lower right-hand quarter are heavily dependent and not very influential; they are stakeholders dependent on the decisions of other stakeholders, or of "output" "qualities" whose improvement in the end depends on the improvement of "driving" qualities;*
- *Stakeholders (or "qualities") located in the upper right-hand quarter are those that are strongly influential and heavily dependent; they are pivotal stakeholders or "qualities";*
- *Stakeholders (or "qualities") located in the lower left-hand quarter are not very influential or dependent on others; they are "associate" or "autonomous" stakeholders (6)*

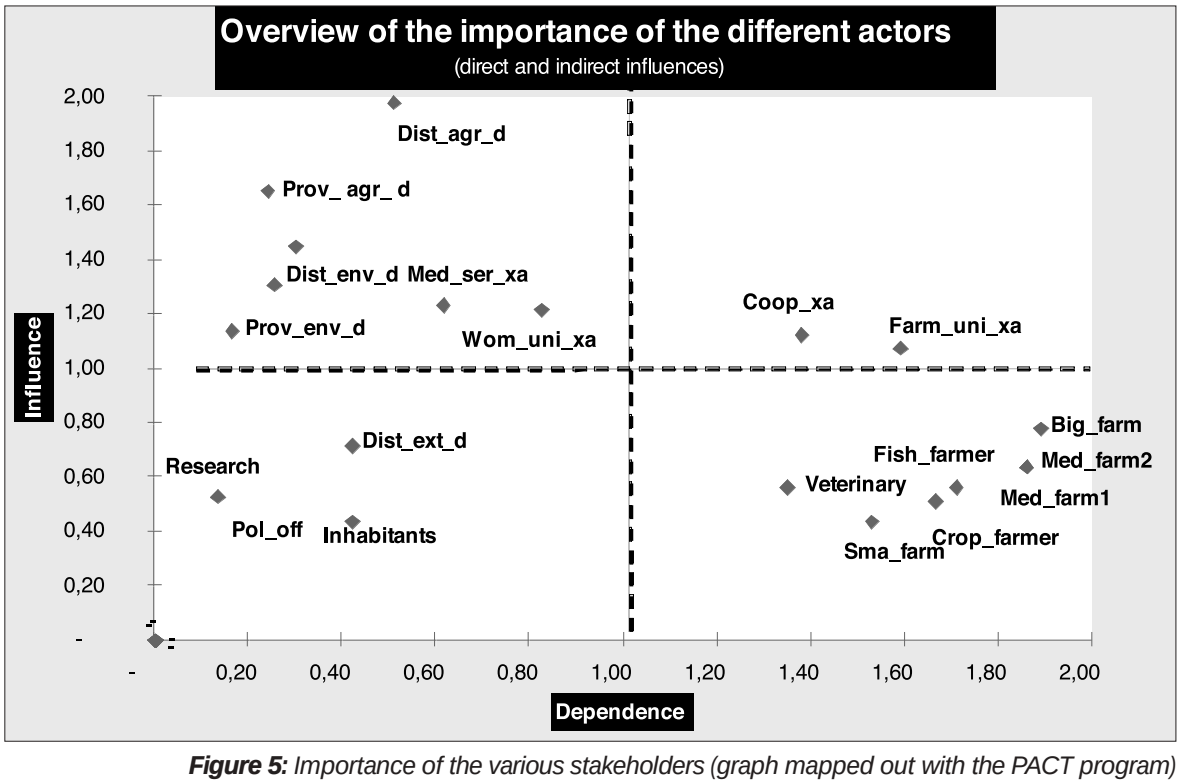

Figure 5: *Importance of the various stakeholders (graph mapped out with the PACT program)*

Analysis of the graph showing influence/total dependence of stakeholders makes it possible to identify the key stakeholders for change, i.e. capable of indirectly modifying the behaviour of the other stakeholders.

These key stakeholders, exerting the most influence over the others and not very dependent on others, are the agricultural departments (district and provincial) and the environmental departments (district and provincial) as well as communal leaders (off the scale of the graph), strongly influential over both producers and communal offices.

At the communal level, two other kinds of stakeholders are located halfway between being initiators of change and "pivotal": the medical services and the women's unions. These two stakeholders have an overall vision of the system, their direct influence is quite weak but they can influence most of the other stakeholders indirectly.

Analysis enables the identification of two "pivotal" stakeholders who can play a part in a dynamic of change thanks to their capability to reach the producers; these are the communal co-operatives and the farmers' unions.

The stakeholders who appear as the most dependent on others are the livestock farmers, crop and fish farmers. They are indeed dependent on the organization and decisions of the authorities and administrative departments.

It is more surprising to note that veterinaries are also considered as not very influential but very dependent stakeholders. This derives from the fact that, for the moment, their role is poorly defined from the perspective of effluent management. However, if the authorities decide to give veterinaries an advisory and inspection role for livestock farms, the veterinaries will become important people for the improvement of the system. Nevertheless, this could only be a voluntarist policy as at the moment, they are only faintly perceived as stakeholders capable of doing something to even potentially improve the system.

Finally, the research community, the extension department and the authorities actually appear as quite inde-

pendent from the other stakeholders and as not very influential. This does not mean that they have no influence on effluent management or that they are inactive, but the system's other stakeholders are poorly informed about what they do, and do not perceive their influence on the system. This was predictable for the research community and for district and provincial political officials. However for the extension department, this seems more surprising; it seems to bear witness to the fact that their expertise is not clearly identified, or that their expertise and their involvement in this field for the moment remains very limited.

Although their demands are significant, inhabitants seem to have very little influence on the other stakeholders; indeed, their position is relatively resigned and passive; they do not propose actions and have not organized themselves in order to make their voices heard and influence decisions.

Influence of qualities and underlying triggers

Analysis of the relationships of influence and dependence between the qualities makes it possible, following the example of that carried out on the stakeholders, to study the relative importance of qualities to initiate a dynamic of change (Figure 4).

In this manner, the "qualities" for which demands of improvement were the most significant, namely the cleanliness of villages, air quality, animal and human health and whether the water is still drinkable, agricultural development and the export of pigs, appear as "output" qualities heavily dependent on others. Although the stakeholders currently concentrate on these qualities, they do not seem to be driving forces for change; the interest of work concentrated on these qualities to initiate a change in the system is therefore limited.

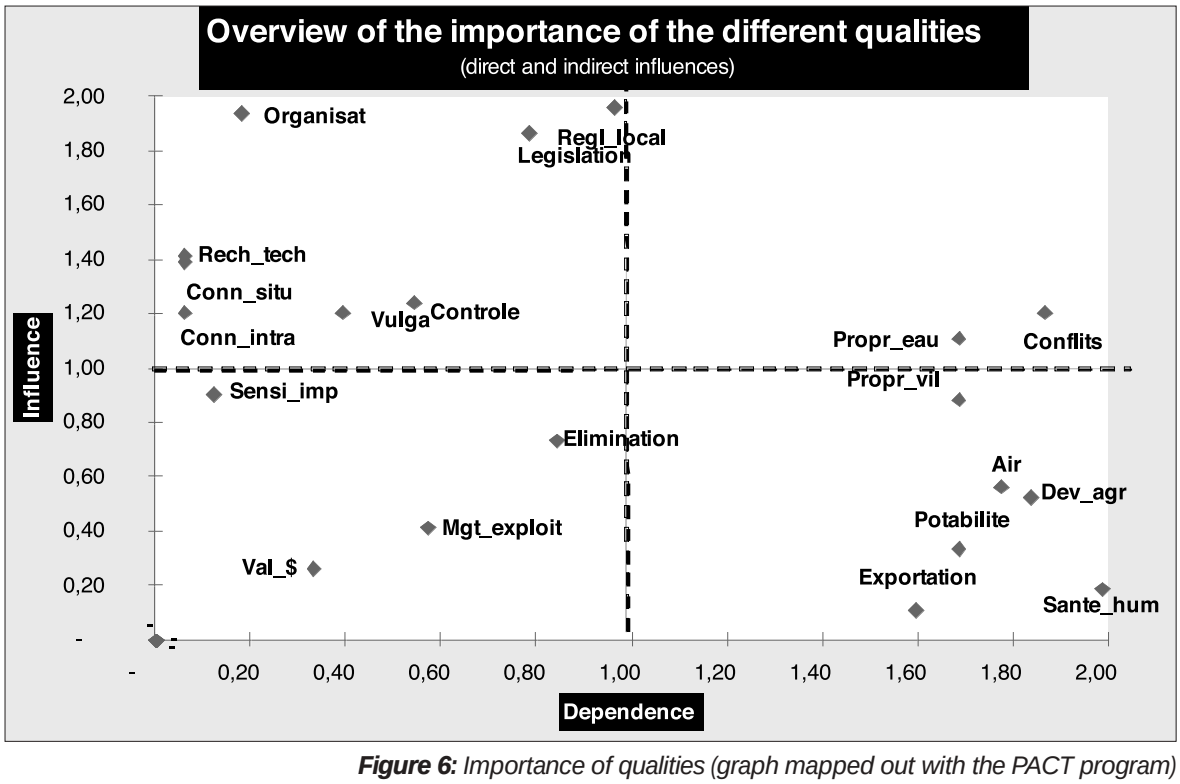

Figure 6: *Importance of qualities (graph mapped out with the PACT program)*

Conversely, analysis made it possible to highlight the most influential "driving" qualities in the system that can thus constitute strong triggers for promotion of development of the system.

Firstly, the qualities that appear as significant (the most influential of all and the least dependent) are those of "organization and "directives" (off the scale of the graph). This underlines the importance of working towards a clear definition of the roles of all stakeholders (and in particular the roles of de co-ordinators and mediators), to the establishment of fresh forms of co-ordination and to the definition of directives recognizing the importance of the issues and generating an overall momentum to deal with them.

Secondly, "local regulations" and "legislation" appear as very significant. Indeed, they make it possible to legitimize and reinforce directives (in the case of legislation) and fresh forms of organization (in the case of local regulations).

Thirdly, the qualities of acquisition of know-how (about treatment techniques, use of effluents as inputs and the real situation from the pollution perspective in the province) appear as important for the development of the system. Indeed, even if the current stakeholders' expectations in these fields are low, this dimension indirectly influences the system because it brings with it organizational and technical solutions for the improvement of the system.

Fourthly, "extension" and "inspection of farms" appear as driving forces for the system, despite being not considered very important by the stakeholders. Indeed, the lack of shared information appears as a limitation to further progress in the system and extension (i.e. transfer of information from the research community to producers, training in techniques or awareness-raising of stakeholders) is a significant response. Similarly, the inspection of farms appears as a necessary variable as without it all efforts at regulation and extension could be pointless.

To move on from these driving "qualities" promising to initiate a process of change to the heavily dependent qualities, "pivotal" qualities (influential and dependent) seem to be able to play a role. They are:

- Conflict resolution: an improved arbitration between neighbours or between farmers when the activity of a livestock farmer disrupts that of another producer or in the context of land exchanges, could make it possible to bring about an improvement in all the qualities affecting the quality of life (nuisance, health) and production (export, rural development, animal health), but this arbitration depends on the deployment of new directives and fresh forms of organizations.
- Water quality: a better management of water quality could bring about an improvement in other qualities (quality of life, and especially human and animal diseases) but it also depends on know-how, directives and on forms of organizations.

Finally, it is interesting to note that exchanges of effluents ("monetary value" quality and to a lesser extent "removal") and their use as inputs ("farm management" quality) appear as qualities that are at once of very low dependence and influence. For example, stakeholders make no link whatsoever between poor use of effluents on crops and whether water is drinkable. In addition, stakeholders do not perceive the effects potentially brought about by better management of effluents on farms. According to them, managing effluents means treating them to avoid problems of health and nuisance.

Conclusion: elements for raising awareness and a beginning of dialogue

Although it must be put into perspective in relation to the overall issue of waste management, the issue of pig effluent management is a cause of concern for all stakeholders in Thai Binh province, be they producers, inhabitants or political and administrative officials at all hierarchical levels. The stakeholders of this province firstly appear worried about the impact of such management on their quality of life (olfactory nuisance, cleanliness of villages) and on human health. In addition, the analysis of stakeholders' perceptions demonstrates that they are very concerned by the local conflict-generating nature of current effluent management. To deal with these issues, it appears that stakeholders envisage several courses of action. In addition to solutions currently promoted by the authorities, such as the deployment of storage and treatment techniques (mainly the biogas system for medium-sized and big livestock farms) and the movement of farms out of inhabited areas, fresh solutions are identified such as the more moderated use of effluents, the development of effluent exchanges between farms with surpluses and those with deficits, training for stakeholders, and inspection of livestock farms.

Based on stakeholders' perceptions, the institutional analysis conducted according to the PACT method made it possible to identify potential improvements in the situation and to reveal elements that could initiate a necessary process of change.

Many possibilities for improvement appear. Although stakeholders taken as a whole expect improvement in the situation to originate from livestock farmers, it appears that they are indeed prepared to act. In addition, other stakeholders, not generally taken into account in the resolution of these issues, seemed to be approved by the others to have power for improvement; these are village leaders and socio-political organizations such as the women's and farmers' unions. Finally, some stakeholders are approved to act and accept to act alongside medium and large-scale livestock farmers: these are small-scale livestock farmers, crop and fish farmers who are consumers of effluents as agricultural inputs. In addition, actions that are still little explored but that nevertheless offer solutions have been revealed such as the establishment of collective systems of effluent management (ponds, canals, storage, etc.), the definition of an arbitration role in conflicts over negative economic impacts or land allocation.

Therefore, although many courses of action are envisaged, and although stakeholders are ready to act to respond to the expectations of other stakeholders, "obstacles" seem to persist preventing the effective establishment of a dynamic for change. Analysis has made it possible to highlight several key factors, which are not immediately apparent, and that all constitute subjects for work and reflection to remove some of these "obstacles". The main key factors are the establishment of "organizations" and the definition of "directives". The lack of directives giving an impetus to recognize these issues and to fix policy, the lack of a co-ordination mechanism between stakeholders (information sharing, collective decision making), the lack of clearly-defined roles for each stakeholder (concerning co-ordination, mediation and inspection) all appear to be primary obstacles to the effective implementation of a dynamic of improvement. In addition, other key factors have been revealed: the definition of local regulation and a legal framework, the acquisition of know-how (about treatment techniques, forms of farm management and the province-wide situation), the improvement of extension (concerning treatment techniques and effluent management), and the establishment of livestock farm inspections.

To initiate these changes, key stakeholders with a strong influence on the evolution of the system have also been identified; these are stakeholders not currently much considered in relation to these issues, namely village leaders, agricultural and environmental departments at district and provincial levels, as well as, to a lesser extent, communal medical services and the women's union.

On the basis of these results that make it possible to shed new light on the issues under discussion, the beginnings of a dynamic of change have been activated. The feedback-discussion workshop conducted on the basis of the results of the institutional analysis enabled a start to raising stakeholders' awareness of the limitations of current management practices and implemented solutions. Solutions entailing biogas or movement of livestock farms to specialized areas are very selective and their strict application runs the risk of heavily penalizing small-scale producers. In addition, such solutions only partially solve problems, especially that of water quality (contamination by nitrates in particular). On this basis, the workshop also provided a forum for discussion and stimulated debate on the procedures for establishing fresh forms of management little explored up until now. This is a first step towards information exchange, reconciliation of stakeholders' viewpoints and the creation of fresh links making it possible to broach a process establishing fresh solutions or ones complementary to current actions.

So this survey and its primary function demonstrate the capital importance of continuing and intensifying technical research on effluents (their management on the farm, their processing, etc.) since this is a key factor for the future of the system. However, it makes it possible to put into perspective stakeholders' current interest in some issues underlined by research such as water quality (risks of nitrate pollution) and some possible solutions such as the establishment of a system of exchanges of effluents, thus conferring monetary value upon them. Finally, it encourages the continuation of research-action to support the development of collective management regulations, the emergence of multi-stakeholder consultative frameworks, as well as the establishment of negotiated public policies for a better management of livestock effluents in Thai Binh province (7).

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