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ANIMAL PRODUCTION INTENSIFICATION IN VIETNAM AND ENVIRONMENTAL PROTECTION: A DIAGNOSTIC GIS TO PROMOTE A SUSTAINABLE PIG PRODUCTION

MISSION to Vietnam
May 4-20, 2005



By

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1. Recall of context and objectives

1.1. Context

The pig production is a key sector of the livestock economy in Vietnam and its growth remains constant. Between 1990 and 2001, the annual growth of the production is 7%; virtually identical to that of consumption. In 2010, the production of carcass equivalent should reach 2 million tons, against 1,5 million in 2001. Three systems of production coexist:

1. The family model, which is most frequent. It covers 80% of the farms, which are small in size and integrated into the local agricultural system
2. The industrial model, which is strongly related to the markets. It is based on great manufacturing units having genetics with high potential and consuming a great quantity of feedstuff
3. The intermediate model in process of intensification, which is directed towards the market and which functions according to a more rational mode of exploitation.

The Red River delta (RRD) is the hub of all economic activity in Northern Vietnam, where the majority of the region's population is concentrated. It is under threat due to its strategic position and its unchecked population growth that is putting an increasing strain on resources. Population densities exceed 1,000 inhabitants per square kilometre in Northern Vietnam. Water pollution is a grave risk in this delta area. The RRD is underlain by a number of highly productive aquifer, which are very important both for large-scale water supply and for drinking and domestic purposes in rural areas. But, as recharge is mainly from the river system, rainfall, and irrigation water, water quality depends strongly on human economic activities. Pollution due to agriculture – crops and livestock - is one of the main issues. It is felt all the more sharply since the 1,800,000 inhabitants of Thai Binh depend directly on the water resources of the Delta, as well as the 18,000,000 people living in the whole RRD.

The pig production is one of the major official priorities for rural development in Vietnam. Fuelled by a growing population, rising incomes and urbanization, demand for livestock products is growing at a dramatic high rate. Thus, livestock production's intensification, and most especially the pig production, is bringing authorities and producers together to meet the challenges of the next decades. This trend will be better able to respond to the animal protein demands of a wealthier population as well as reach the international export markets. On the provincial level, agricultural services have been dedicated as project managers for national development plans and most especially the National Program for Lean Meat Pig Development, which has clear quantitative goals. Centralised orientations favour investing in animal husbandry infrastructure, concentrated feed production commodity chains, slaughtering facilities and the introduction of high growth potential breeds. In the Red River Delta area, pig production development objectives call for 8,500,000 pigs and 500,000 tonnes of animals slaughtered per year.

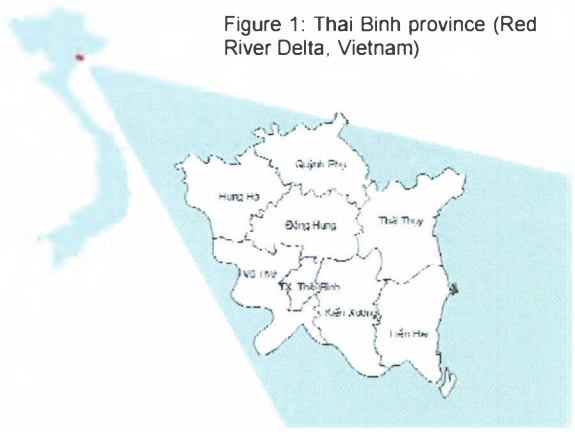

Figure 1: Thai Binh province (Red River Delta, Vietnam)

Thai Binh is located in the RRD at 150 kilometres from Hanoi. The Ministry of Agriculture and Rural Development (MARD) foresees the creation there of 500 animal husbandry units with 10-200 sows and 100-1000 fattened pigs (1,200,000 heads in total) by the year 2010 to reach 80,000 tonnes of lean meat per year. In addition, private smallholders' initiatives and investments will also join this evolution towards intensification. In order to support these objectives, the province turns already from its low-income rice production (1,050,000 tonnes/per year) to increase maize and soya bean production (20,000 tonnes and 6,500 tonnes/year respectively) for animal feeding. We can be afraid intensive agricultural methods may damage soils and water tables. Well-balanced pig manure's transfer would remain critical for sustaining soil fertility and would change a polluting material into a fertilizing product. Even if farming systems are mainly based on livestock-crop integration, decision makers are set upon increasing the number of lowland industrial large-scale models.

1.2. *Some illustrations*

Figure 2: Fattening Pigs on a scraped surface in a family household of the commune of Viet Hung. In the background, the glance for the urines and washing water drainage

Figure 3: Pond of urine and washing water at the rear of a family fattening pigs unit of Viet Hung

Figure 4: Body of farm with its eutrophyzed fishpond

Figure 5: Rice plantations and corn fields separated by a hedge from banana trees on an alluvial terrace of the Red river located in the background

Pictures: J.-M. Médoc, 2005

1.3. *Objectives*

Located in an overpopulated rural province of Northern Vietnam, the project aims to design and implement a geographical information system as a diagnostic tool dedicated to the pig production's development in order to assess the surpluses of animal wastes, the needs for nutrients by crops and fishponds, and define the more reliable manure management and technologies' options. This diagnosis will support the agricultural production intensification as an income-generating activity in rural areas and protect threatened environment and natural water resources in deltaic areas.

The project addresses policy makers responsible for agricultural development policies at the national and provincial level, and involves farmers and producers' organizations in their development strategies towards intensification.

The main activities will be diagnostic works focusing pig farms, fish ponds, crops, with a pro-active approach of the 'pig manure, fertilizers and fish feedstuff' commodity chain, an preliminary appraisal of appropriate pig manure processing and a participative validation of results by creating scenario of development. With this intention several specific objectives were defined:

1. Baseline reference study on livestock, agriculture and environment interactions at the level of Thai Binh, through:
    a. A geographical and technical appraisal of the supply and demand by crops and aquaculture for animal waste nutrient in the province;

b. A pro-active analysis of the perception of stakeholders about the environmental issue due to animal production and their possible role to solve the problem; and a cost/benefit analysis for pig manure considered as a commodity;

2. Definition and design of a geographical information system for diagnostic analysis:
   a. To appraise the pollution sources due to pig production development and needs/lack for nutrients by crops and fish farmers with the help of a geographical interpretation;
   b. To identify existing, expected and possible manure management and technologies' options at the regional level, and their impact on global economical performances of concerned farmers;
3. An interactive atlas illustrating the various scenario depending on agricultural development schemes, farming practices, technical options and provincial regulations.

Table 1 presents the agricultural types of ground occupation and their surface.

Table 1: Thai Binh Province ground occupation

Ground occupation	Province of Thai Binh	
	Ha	%
Total land	154,601	
Agricultural land	96,392	62
Annual crops	91,424	59
Rice	87,491	57
Perennial crops	1,513	1
Mulberry trees	1,220	1
Industrial crops	70	0
Gardens	3,386	2
Fishponds	7,309	5
Forests	3,394	2
Natural forests	0	0
Production forests	3,394	2
"Planned-use" land	26,569	17
Dwellings	12,443	8
Unused land	8,494	5

2. Mission's terms of reference

2.1. Mission of Jean-Michel Médoc

According to the specific objective 1a (cf. §1.3), this mission to Vietnam (May 4-17, 2005) was justified by the presence, in the province of Thai Binh, of Benoit Hillion an agronomist student carrying out for 6 months (April-September 2005) its end of studies' training course. Its work is entitled "Study of the adequacy between the production of livestock effluents and their potential use to fertilize crops and fishponds in a District of North Vietnam. District of Vu Thu, Thai Binh". This mission aimed to carry out a follow-up of the work in order to validate the methodology and the preliminary results obtained, and to make the necessary recommendations for the following work. It also allowed giving a general support to the activities of E3P project and making contact with the study area and the local partners. The detailed program of the mission as well as the list of the people met are consultable in appendix.

2.2. Mission of Jean-Luc Farinet

The mission of Jean-Luc Farinet proceeded from the 10 to May 20, 2005. The detailed program of the mission as well as the list of the people met is consultable in appendix. According to the specific objective 1a, this mission aimed to give an overview of current practices in waste management, characterizing the risks which they cause for the environment. It also allowed to study with local partners a sampling and analysis campaign in order to characterize the production of solid and liquid pig wastes. On Friday 13/05/2005 in the morning, a conference was done in the presence of the technical officers and policy makers, introducing the environmental situation in France with an overview about basic chemical and physical information and describing existing treatment technologies in Europe for pig manure.

3. Current practices and risks for environment

These considerations follow our field visits in the Thai Binh province as also our discussions with technical officers and farmers.

3.1. A practice to be preserved: the separation of solid waste...

On all of the 7 pig farms we visited, the solid wastes are scraped 1 to 3 times a day before cleaning the concrete floor with water. This waste consists with dung and part of urine from the pigs.

Figure 6: Solid waste collected in a pig farm

Figure 7: Collecting tank for solid waste

It is collected and used either as compost or as food for the fishes. In the first case, it is sometimes mixed with vegetable residues (rice straw and/or husk,...) and other components (lime, ashes,...) before natural composting. In the second case, the waste is dried in edge of the ponds.

The quantity of solid waste could be estimated with the classical ratio of 0.05 kg.kg live weight^{-1}.day^{-1} or starting from the known indices as:

- Boar/Sow: 10 kg.day^{-1}
- Post weaning pig (8-30 kg): 1.5 kg.day^{-1}
- Fattening pig (30-110 kg): 6 kg.day^{-1}

But these gross ratios don't take into account the particularities of pig races or alimentation, the losses of urine along the day as also the losses at the time of scraping.

On the other hand, the composting method for this waste is very different from a farm to another. In the majority of the cases, it seems that waste is protected during composting by a layer from mud or straw or with a plastic bag. This practice is not very recommended because it decreases ventilation however, it makes it possible to protect the compost at the time of the strong rains and to decrease the nitrogen losses by ammonia volatilization. If the quantity of compost can be estimated at 50% of the initial quantity of waste in the case of a traditional aerobic composting, it will undoubtedly be more in the case of a composting under protection.

3.2. ...but a real preoccupation: the management of liquid manure

As often observed in tropical countries, a lot of water is used to clean the concrete floor of the farm...as also to cool the animals in hot season. In our observations, the quantity of water used in such small pig farms varies from 75 l.head^{-1}.day^{-1} in the Tahiti Island to more than 100 l.head^{-1}.day^{-1} in southern Vietnam.


Figure 8 : Water cooling and cleaning in two pig farms

On 5 of the 7 pig farms we visited, the liquid manure flow was collected in a concrete channel or a plastic pipe and it was supplying a biogas digester (Chinese model). At this stage, it is very important to remember that anaerobic digestion does not constitute a treatment of pollution as such. Indeed, this technique only makes it possible to break down part of the organic load, the mineral components (nitrogen, phosphorus,...) being completely preserved. In the two others pig farms visited, the liquid manure was rejected directly into the natural environment: for the small one, with only 3 boxes and 5 pigs, it constituted a muddy and nauseous area behind the livestock building and for the other, the manure flowed directly through a pipe into the near river.

Figure 9: Liquid manure channel in a pig farm

Figure 10: Muddy and nauseous area behind a small pig farm

Figure 11: Biogas digester immersed in a fishpond

Figure 12: Upside part of a biogas digester

Biogas is used for cooking or for hot water production. In the case of cooking, the saving in coal can reach 35%. The liquid manure at the outlet of the digester is more stable and without odor.

In the pig farms using a biogas, after supplying the digester, the liquid manures were always rejected into ponds of which only some of them could be qualified as "fish ponds". Indeed, if the pond was too small according to the liquid manure flow, all the fish had died for a long time and it was rather an overloaded lagoon of purification. When the fishpond size was sufficient, with an area of more than 12 m^2.pig place^{-1}, the water was clear without apparent signs of eutrophysation or fish mortality.

Figure 13: Fishpond in good condition

Figure 14: Eutrophysed pond without any fishes

4. Characterization of pig effluents

Taking into account the precedent observations, it was decided to carry out 2 characterization campaigns, the first one concerning liquid manure and solid waste produced in the pig farms and the second one concerning solid co-products as compost and fish food.

4.1. Characterization of pig farms effluent

To precise effluent production rates, measurements will be made moreover of what was envisaged in term of sampling and analyses. These measurements consist with weighting the quantity of solid waste as also the quantity of liquid manure produced in one day. In addition and to hold seasonal effects, measurements and samples will be realized on 10 pig farms in July then in November 2005 (to be confirmed by the NISF project group). The methodology and sampling form as also the analysis methodology are given in appendix. For 10 farms, 2 samples per campaign and 2 campaigns, the number of samples to be analyzed will be 40.

4.2. Characterization of solid co-products

Taking into account the farmers practices, the survey of the transformation from waste to co-products will be very difficult and too heavy. Moreover, this method will not make it possible to approach the variability of the composition of the products. Also, we preferred to conduct a campaign of sampling and analyzes on a broad range of compost and fish food.

For compost, 40 to 50 samples will be taken in June 2005 which is one period of spreading on rice fields. For fish food, we planned to take around 20 samples in the period from June to November 2005 according to the availability of the project team. The methodology and sampling form as also the analysis methodology are given in appendix.

5. Study of the adequacy between livestock effluents production and their potential use to fertilize crops and fishponds in a district of North Vietnam (Vu Thu)

The support to Benoît Hillion consisted on the organization of two field visits and several working sessions aiming at making a precise point on:

1. The gathered and missing data
2. The selected study area
3. The methodology implemented
4. The expected results
5. The planning of activities

5.1. Data recovery and relevance

Benoit spent much time for data collection without obtaining a satisfactory result because of many access difficulties to these data or inexistence of information. A certain number of key information, often spatialized and digitalized, would be available to "purchase" near the popular committees, but not always with accessible tariffs. As for the recovered data, they are rather many and general, but are not always highly reliable and relevant for our needs. This constrains us to check the data with several technical partners, to build assumptions and to make risky choices for such a diagnosis. At the beginning of June, Benoît Hillion have to send an intermediary report of work which will sum up all the gathered data and the methodological choices made with J.-M. Médoc during his mission.

5.2. Study area

Taking into account the difficulties to recover the data and the extent of the province, we decided to reduce the extension of our study area only on the district of Vu Thu. Vu Thu is one of the four districts of the province where the pig breeding is the most developed and where the effort of development will continue. In addition, the access to the basic agricultural data (vegetable productions –surface, tonnages- and livestock productions –herds, meat tonnages-) was facilitated. This work will be then reproduced in the other communes of the province. The data necessary being clearly identified, the result obtained with Vu Thu will serve as example to facilitate the necessary data recovery.

5.3. Methodology

5.3.1. Define and characterize current production of animal wastes in Vu Thu at commune level

We have much information on the pig, bovine and aviary herds. However, these data do not allow, in particular for the pig, to calculate in a reliable way the quantities of effluents produced. Pig herds are with variable geometry at the district level, because of the 8-10kg piglet imports intended for a pre-fattening and which are exported when they reach 25kg. This piglet flow is unknown or is inalienable. According to the local agricultural technicians and our observations, it seems consequent taking into account the market demand. Being given that we have the number of mature sows, the calculation of the pig effluents production could follow the assumption of a farrow to finish sow, producing 2 ranges of 10 piglets per annum, excreting X m^3 of faeces and urine, if we cannot approach the value of the piglet flow. Then, we will use the volumes determined by the diagnosis of J.-L. Farinet. The analytical references to characterize these effluents are rare. Currently, we have a single reference going back to 1974. On this date, the Vietnamese pig herds were composed of Moncai pigs raised up to 40-50 kg and nourished traditionally. The diagnosis of J.-L. Farinet should enable us to have more relevant data. However, it seems to us that the pig-feeding mode is very heterogeneous from one farm to another; traditional farmers used a mixed food, associating factory feedstuffs and varied traditional food according to their availability (corn, sweet potato, rice bark...).

5.3.2. Identify the spatial (*i.e.* location & surface) distribution of the crops and the fishponds at commune level

The crops distribution is complex in the Red river delta. According to the localization of a plot, in particular compared to its "floodness", crop rotations will be different. The rice plantations or dammed

up soils in general receive per year two cycles of rice (spring, summer) followed by a dry crop (groundnut, corn, soya...). Dry crops develop the alluvial soils, flooded annually. The data are available twice per year. However, the diversification of the activities remains the most current strategy. The farmers want to feel free from the risks of prices fluctuation. Associated to a high density of population, that makes difficult precise censuses, so as the families are very opportunist and can change activity very quickly. In his work, Benoît have to consider these crop rotations during the year to include the residues produced in the balance calculation. For the rice, meeting with experts will allow us to gather or not the different varieties (*e.g.* local *vs* improved). We consider that all the cultivated lands are available for spreading.

5.3.3. Draw up assumptions on farmers' waste management pratices in order to calculate effluents production and crops requirements

The farmers always use organic matter to fertilize their crops. For corn and rice organic fertilization, the advice given by the cooperatives or the communes is 300 to 400 kg per sao[1] added to an inorganic fertilization with NPK and urea. The expected yield is around 5.5 tons of grains per hectare according to the communes' data.
In our study, two approaches are envisaged to estimate the needs of crops in organic matter:

- The first approach is based on the current practices of fertilization of the farmers
- The second is based on theoretical calculations integrating the principles of the reasoned fertilization.

The mass balance equation we are going to use will be the following:

$$[N_f-N_e]+R_f = R_e+[M_{hb}+M_{ha}+M_{hp}+M_r]+X_a+X \qquad (1)$$

$[N_f-N_e] = N_u$ = requirements of the crop between the assessment opening N_e and its closing N_f, *i.e.* nitrogen uptake
R_f = residual nitrogen at the end of the assessment, *i.e.* unabsorbed N by the crops
R_e = residual mineral nitrogen at the assessment opening
M_{hb} = net mineralization of the humus
M_{ha} = supplementary mineralization due to the back effects of organic matter applying
M_{hp} = supplementary mineralization due to pasture removal
M_r = net mineralization of harvesting residues
X_a = applied nitrogen in organic fertilizer form *i.e.* equivalent to a direct effect in mineral nitrogen
X = applied nitrogen in mineral fertilizer form

Here, the difficulty is to pass from this assessment, which is in theory carried out at the farm level to the commune level. Some assumptions should be made on the different mineralization rates according to the available data and to experts' sayings and on nitrate leaching and volatilization process, which will be neglected. Two of the major limits are the unavailability of precise and sufficient information on soils nitrogen supply and on effluents behaviour in the soils.

5.3.4. Build the database and design effluent balances at commune level, today and future

This information system is a database, which will be built with the Excel spreadsheet. The implementation of such a base of information under the database management system Access will be more relevant if the volume of data to be treated increases. This software would facilitate the work of the future users of the tool but they are not trained yet and to date the volume of data does not justify such an investment.

As for the crop fertilization to calculate the balance, we will follow the outline presented in figure 15.

[1] 1 sao=360 m² ; 1 mau=10 sao

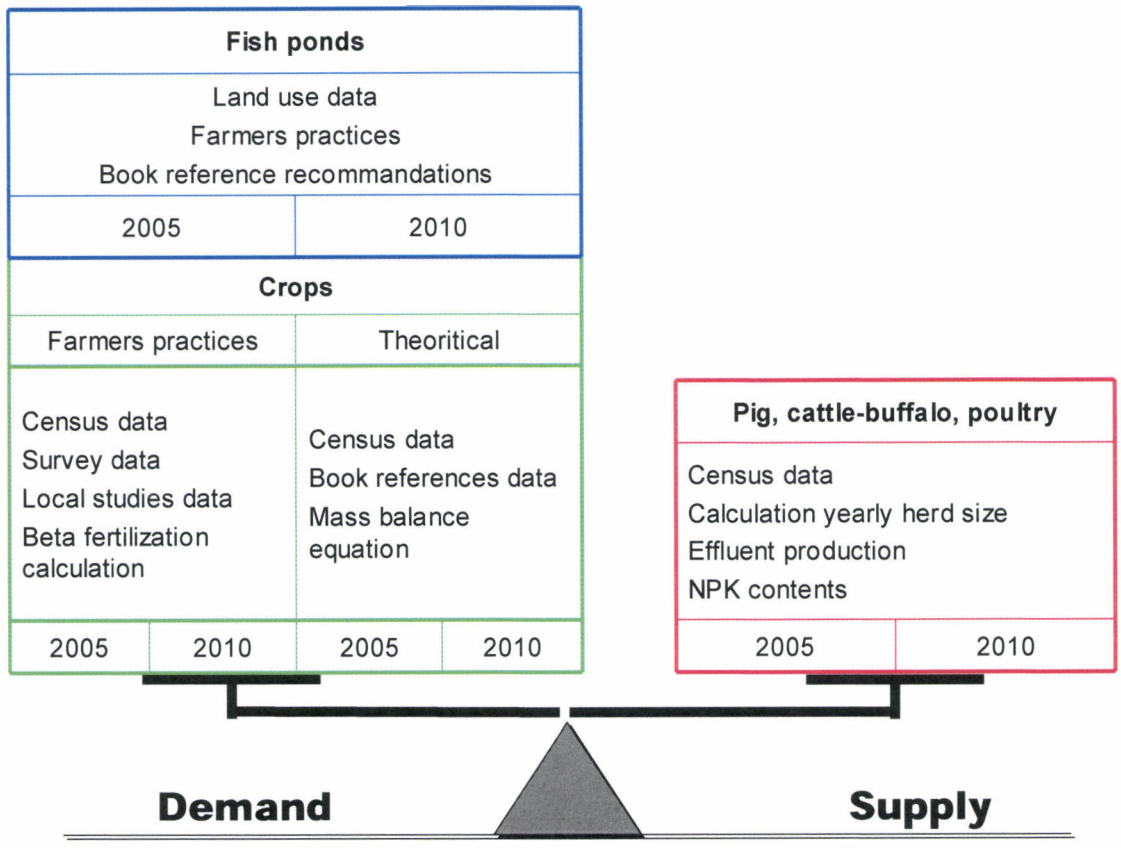

Figure 15: Crop requirement – livestock effluent supply balance calculation

5.3.5. Link up to a GIS

The reference unit will be the commune scale. Most of the recovered data are with this granularity and moreover we have a digitalized chart of the communes of the district. This activity will be lead with M. Huy Chu Xuan from VTGeo who will support Benoît to design the different maps needed to illustrate the results at corresponding to each scenario.

5.4. Expected results

The expected results for the district of Vu Thu are sum up in the list below:

1. Pig, cattle and poultry effluents production
    a. Total quantity per commune
    b. Total N, P, K contents
2. Crops distribution and requirements
    a. Two approaches for fertilization
        i. Farmers practices
        ii. Reasoned fertilization
    b. 2005, 2010 according to surfaces evolution
3. Methodology conception to implement a database and agronomic equations able to calculate « livestock effluents supply/crops requirement adequacy » at commune level in 2005 and 2010
4. Express limits of collected data and of the study
5. Make Vu Thu a reproducible example on all Thai Binh's districts

5.5. Program

The following Gant diagram presents the activities to be lead by Benoît Hillion until the middle of September 2005.

Activities	Apr.	May	June	July	Aug.	Sep.
Field appropriation						
Data collection, questionnaire,						
Farmers interview						
J.-M. Médoc mission						
Bibliography						
Interview analysis with M. Phuong (NISF)						
Context and objectives drafting						
Missing data collection, data validation						
Data base implementation						
Validation with agricultural stakeholders of the district						
Results analysis						
Report drafting						
Talk preparation						

6. First elements for effluents treatment

6.1. Which effluent has to be treated ?

As we saw in §3, the main problem in term of risk for the environment relates to the management of the liquid manure, even in the case of passing though a biogas digester. If the manure is rejected directly in a river, harmful effects could be observed in the future in terms of eutrophysation and lower quality of water. In the other hand, if the manure is supplying a too small area of fishpond, this one will be transformed into eutrophic and putrid pond with risks of proliferation of insect and bad smells as also of infiltration of harmful compounds in the underground sheet of water. Moreover, at the time of the strong rains, this pond will overflow directly in the natural environment.

For solid waste, the principle of their separation to the source must absolutely be preserved. At this time, the scraping of waste is carried out manually and does not seem to pose problem of availability or working time of labour. So thereafter, if such difficulties appear, in particular in the largest pig farms, mechanical systems of scraping exist on the market and could be adapted to the boxes of the pigsties.

6.2. Treatment of liquid manure

We make a difference between adapted treatment technologies for very small pig farms (< 10 pigs) and those for larger one.

6.2.1. Case of the very small pig farms

We recommend a complete elimination of the liquid in this situation. Initially, it would be advisable to reduce the quantity of water used at least by equipping the farmers with scrapers and adaptable flow reducers on the flexible pipes which they use for cleaning. In this case, the quantity of water used can decrease drastically to 20 $l.head^{-1}.day^{-1}$. This liquid manure could then be adsorbed in a "biobed" made up of rice straw. In this biobed, combined evaporation and fermentation will occur to produce finally compost. The biobed is simply a concrete tight pit filled with rice straw and protected from the rain by a light roof.

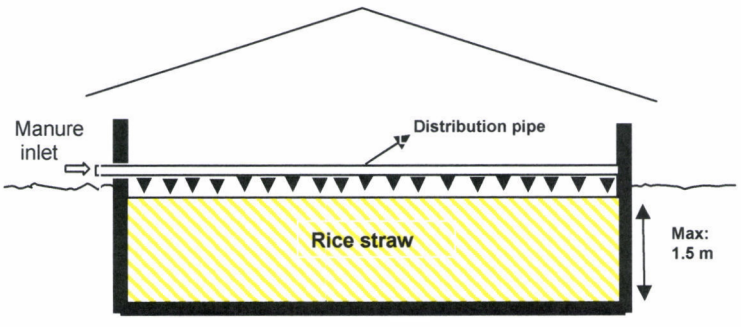

Figure 16: Scheme of the biobed

The principle of operation consists in maintaining the water content under 70% in the biobed. A reversal and mixing of the straw bed is necessary after the 2 first months and then every month. After one year, the compost must be evacuated and the biobed filled with new rice straw. The sizing of the biobed depends on the flow of liquid manure, the moisture and the temperature of ambient air and the capacity of adsorption of the rice straw. In first approach, on the basis of a biobed section of width 2 m out of height 1.5 m, we would propose a length of biobed near to 0.067 m.l manure^{-1}. The initial bulk density of the straw must be near 50 kg.m^{-3} and it will require a strong compressing to reach this value with the dry straw.

6.2.2. Case of more larger pig farms

Anaerobic digestion is a first barrier to only reduce the organic load of the manure but it is not sufficient. A reduction of the water consumption is always the first step as for the small pig farms. In the case of a biogas digester, that will improve its performance by increasing the residence time.

If raw or digested manure is used to feed the fishpond, the right quantity has to be calculated depending on the results of the liquid manure analysis. Remaining manure could be stored and spread in the closest fields using an appropriate system.

Indeed, it is important to note that the treatment of pig manure is expensive and requires a certain technical level. With our opinion, these techniques will be accessible only to the largest pig farms.

7. Conclusion and prospects

The problems met in the province of Thai Binh seem rich to us. The products resulting from this project of diagnosis will enable us to judge interest to continue our intervention.

The observation of local practices in the pig farms have shown that the separation of solid waste is very precious and must be encouraged. For the environmental protection, the main problem comes from the management of large quantities of liquid manure coming from the cleaning operation. A characterization campaign has been prepared for pig farm effluents and co-product. First measures were proposed to prevent environmental impacts and a technique adapted to the small farms could be tested on a pilot scale.

Guidelines for project running
According to the number of participants, so much in animation of the project (3 major partners) that on the field (more than 18 people) and in order to ensure best coherence, semi-monthly thematic seminars should be organized. The contents of these seminars would be scientific with presentations by topics followed by exchanges between the various participants of the team.

8. Appendix

8.1. Program of Jean-Michel Médoc

	Morning	Lunch	Afternoon
D1: may 4, 2005	-	-	1:40pm Arrival in Hanoi 3:00pm Meeting with V. Porphyre and B. Hillion at NIAH on work already carried out and organization
D2: may 5, 2005	8:00am Hanoi: meeting with V. Porphyre and B. Hillion to prepare the afternoon meeting 10:00am meeting at VTGeo on landuse and available data, maps	12:30pm	2:00pm Hanoi: Meeting with the E3P project decision committee. Discussion on B. Hillion training objectives 6:30pm Departure to Thai Binh
D3: may 6, 2005	8:00am Meeting with the people committee of Viet Hung (Vice President) 8:30am Interview of M. Dung (farmer) 10:30am Interview of M. Quang (director of cooperative)	1:00pm	3:00pm Thai Binh: Field visit with B. Hillion 5:30pm Departure to Hanoi
D4: may 7, 2005	9:00am Hanoi: Brainstorming session with B. Hillion	12:30pm	1:30pm-6:30pm Brainstorming session with B. Hillion
D5: may 8, 2005	Free		16:00 Départure to Thai Binh
D6: may 9, 2005	8:00am Thai Binh: Brainstorming session with B. Hillion	12:00pm	1:00pm Thai Binh: Discussion with Virginie Emonet 2:00pm Brainstorming session with B. Hillion
D7: may 10, 2005	8:00am Thai Binh: Field visit with B. Hillion 10:00am Brainstorming session with B. Hillion	12:30	13:30 Thai Binh : Discussion with O. Mikolasek on aquaculture. Brainstorming session with B. Hillion 4:30pm Departure to Hanoi
D8: may 11, 2005	8:30am Hanoi: Meeting with M. Phuong at NISF	12:30	2:30pm Hanoi: Brainstorming session with B. Hillion
D9: may 12, 2005	8:00am Hanoi: Mission report drafting	12:30	1:30pm Hanoi: Brainstorming session with B. Hillion
D10: may 13, 2005	9:00am Hanoi: Mission report drafting 10:30am Brainstorming session with B. Hillion		Discussion with J.-L. Farinet Debriefing with M. Phuong
D11 & D12: may 14-15, 2005	Halong bay: Team socializing seminar		Halong bay: Team socializing seminar Debriefing with V. Porphyre and J.-L. Farinet
D13: may 16, 2005	8:00am Hanoi: Brainstorming session with B. Hillion		Hanoi: Brainstorming session with B. Hillion
D14: may 17, 2005	8:30am Hanoi: Brainstorming session with B. Hillion. Mission conclusion	11:00am	1:30pm Departure to Réunion Is.

8.2. People met by Jean-Michel Médoc

Cirad
Vincent Porphyre, E3P project leader
Benoît Hillion, trainee Ina-PG
Gaëlle Guerrin, trainee Ina-PG
Virginie Emonet-Denand, trainee Ina-PG
Charlotte Colson, trainee Esa Angers
Dominique Pillot, trainee Isara
Jean-Luc Farinet, expert in mission
Olivier Mikolasek, expert in mission

NIAH (National Institute of Animal Husbandry)
Coi N'Guyen Que, head of department of small livestock research
Bien Dang Hoang, research assistant

NISF (National Institute of Soils and Fertilizers)
Toan Tran Duc, vice-director
Phuong Nguyen Duy, research assistant
Tuan Vu Dinh, research assistant

VTGeo (Institute of Geomatics and Remote Sensing)
Huy Chu Xuan, research assistant

Thai Binh Livestock Breeding Compagny
Khanh Tran Duy, director

M. and Mrs Dung, farmers
M. Quang, director of cooperative

8.3. Program of Jean-Luc Farinet

	Morning	Afternoon
D1: may 11, 2005	-	6:40pm: arrival in Hanoi (flight AF)
D2: may 12, 2005	8:00am Hanoi: visit of the laboratories in the Institute of Soils and Fertilizants 10:00am Meeting with M. Phuong, researcher in the same Institute	12:00am: departure to Thai Binh 4:00pm: meeting with a commune people committee
D3: may 13, 2005	9:00am Thai Binh: conference done at the Livestock Breeding Company	2:00pm, Thai Binh: field visits 4:00pm: departure to Hanoi Discussion with JM Medoc
D4&D5: may 14-15, 2005	Halong Bay: Team socializing seminar	
D6: may 16, 2005	7:00am: departure to Thai Binh 10:00am: Vu Thu district: field visits	2:00pm: Vu Thu district: field visits
D7: may 17, 2005	8:00am Thai Binh: field visits	2:00pm Thai Binh: field visits
D8: may 18, 2005	8:00am Thai Binh: Field visits	2:00pm Thai Binh: meeting with the chief of environmental management division of the Dpt of Resource&Environment. 4:30pm Departure to Hanoi
D9: may 19, 2005	8:30am Hanoi: writing the protocol for pig manure sampling and analysis	2:30pm Hanoi: brain storming session with V. Porphyre and B. Hillion 4:00pm : writing the protocol for pig manure sampling and analysis
D10: may 20, 2005	8:00am Hanoi: mission report drafting	2:30pm Hanoi: meeting with V. Porphyre and M. Vu Dinh 4:00pm Hanoi: mission report drafting 8:00pm Hanoi airport: departure to Paris

8.4. People met by Jean-Luc Farinet

Cirad
Vincent Porphyre, E3P project leader
Benoît Hillion, trainee Ina-PG
Gaëlle Guerrin, trainee Ina-PG
Virginie Emonet-Denand, trainee Ina-PG
Charlotte Colson, trainee Esa Angers
Dominique Pillot, trainee Isara
Jean-Michel Medoc, expert in mission

NIAH (National Institute of Animal Husbandry)
Coi N'Guyen Que, head of department of small livestock research
Dr. Doan Thi Khang, chief of laboratory

NISF (National Institute of Soils and Fertilizers)
Dr. Nguyen Cong Vinh, head of department of land use research
Nguyen Duy Phuong, research assistant
Vu Dinh Tuan, research assistant

Thai Binh Livestock Breeding Compagny
Tran Duy Khanh, director

Thai Binh Department of Resource & Environment
Phi Van Chin, chief of environmental management division

8.5. Characterization of pig farm effluents - Methodology and sampling form

10 farms, 1 sampling in July and 1 sampling in November (to be confirmed by NISF project group)

Farm ID

Name of farmer :
District/Commune/Village :
GPS Latitude / GPS Longitude:
Already surveyed (Y/N) :

Farm Description at sampling day

Date

Maternity (M):
Nb. pens
Nb. Pregnant sows
Nb. Lactating sows

Post weaning 8-25 kg (PS):
Nb. pens
Nb. piglets

Fattening (E):

Weight of pigs	(1) 25-50 kg	(2) +50 kg
Nb. pens		
Nb. pigs		

Weighting and sampling of solid waste (dung)

N° scraping	1st				2nd				3rd			
Categories	M	PS	E1	E2	M	PS	E1	E2	M	PS	E1	E2
Bucket weight (kg)												
Total weight (kg)												
Waste weight (kg)												
Total per scraping (kg)												

Final average sample of solid waste : approx. 1 kg per sample

N°scraping	1st	2nd	3rd
Sub-sample ID			
Balance for average sample (%)*			
Average sample ID			

*** : based on proportions of sub-samples weight**

Measuring and sampling of liquid manure (dirty water flowing from the pens)

N° cleaning	1st				2nd				3rd			
Categories	M	PS	E1	E2	M	PS	E1	E2	M	PS	E1	E2
Index before cleaning (m3)												
Index after cleaning (m3)												
Time (mn)												
Volume water (m3)												
Total per cleaning (m3)												

Final average sample of liquid manure: approx. 500 ml per sample

N° cleaning	1st	2nd	3rd
Sub-sample ID			
Balance for average sample (%)*			
Average sample ID			

*** : based on proportions of sub-samples volume**

Needed equipments

- cold box 50 l and ice-packs
- bucket or basket to collect and weight solid dung
- balance or scales, spoon, gloves, boots,
- plastic bags 1 kg and labels, water proof pen
- water flow meter, adaptable on water pipe or water pump
- bottles 500 ml and labels, buckets 100/200 ml or similar (glasses), one funnel
- balance (precision 1 g) to prepare the average solid sample,
- graduated can 500 ml to prepare the average liquid sample.

Recommendations for measures/samples

- All samples should be labelled with unique ID which contains related information as above (both on the sample's package and the form)
- To weight solid manure, use a big bucket that can collect all the dung at once for a scraping, in order to do one weight and avoid cumulated errors,
- To sample solid manures, put it on a concrete floor, mix and sample at several places,
- Before sampling liquids, clean rapidly the evacuation channels or pipes with fresh water,
- Please take the samples at the end of the 'collector' (i.e. before biogas digester),
- Wait for a regular flow to collect liquids with a glass every 5 minutes and put it in a bucket; at the end of the cleaning, mix the bucket's content and take a 500ml sample ; add 2 drops of concentrated chlorydric or sulfuric acid.

8.6. Characterization of solid co-products - Sampling form for compost and fish food

Fish pond ID or field ID
Name of farmer :
District/Commune/Village :
GPS latitude/longitude :
Already surveyed (Y/N) :

Description of sampled compost

Date:

Type of animal waste (pig, poultry, others):
Type of vegetal residues used in compost (straw, rice husk, other):
Other additional components (ash, lime, other):

How long has farmer composted waste pile?
Type of protection of the pile (straw, mud, plastic, other):

This compost is spread for which crops?
Surface of the parcel where the spreading is done:
Average dose of compost applied on the parcel:

Sample ID (1 kg) :

Description of sampled fish food

Date

Type of animal dung (pig, poultry, others):
Other additional components (ash, lime, other):

How long has farmer stored the waste:
Method of production (cover, drying, mixing,...):

Size of pond:
Fish species:
Average daily dose:
Frequency of food supply in the pond:

Sample ID (1 kg):

Recommendations for measures/samples

For compost:
- It is important to focus on all the compost used in one parcel or field,
- Let the farmer spread himself according to his own experience, and then sample time to time an handful of compost in a bucket,
- At the end of the spreading, please mix the total content of the bucket, and take one sample of 1 kg.

For fish food:
- Proceed similarly, by focusing one session of feed distribution.

8.7. Analysis of collected samples - Analysis methodology for liquid and solid samples

IMPORTANT:
Each compost sample has to be divided into 2 sub-samples by NISF laboratory:

- 1 sub-sample will be analysed by NISF with classical methods as below;
- 1 sub-sample will be analysed by NIAH with Near Infra Red spectrometer (NIRS).

In the laboratory, analyses results should be put in Excel files to help data storage, calculation, synthesis, and quality control.

Preparation of <u>COMPOST</u> samples for NIRS analysis

- Drying 500 g of compost at 45°C maximum,
- Use same ID than initial sample,
- The sample has to be transmitted to NIAH laboratory (Contact: V.Porphyre or Ng.Que Coi)
- In NIAH, crushing and NIRS spectrum determination

Classical analyses of solid materials (dung, compost, fishpond food)

Water pH on solids (50 g, 1/5 ratio with water)

Dry residue at 105°C until constant weight (100 g)

Organic matter according 2 methods on the 20 first samples:
- Ashes at 550°C, 2 hours
- Organic Carbon with Walkley-Black method and fitting.

Total Phosphorus
Total Potassium
Total Nitrogen
Ammonia nitrogen (N-NH4) with 2 methods applied on the 20 first samples : with/without acid extraction before distillation.

Analyses of liquid manure (cleaning waters)

Direct pH (50 ml)

Dry Residue at 105°C until constant weight (100 g)

Organic matter with the method validated with the solid samples

Total Phosphorus
Total Potassium
Total Nitrogen
Ammonia Nitrogen (N-NH4) with the method validated for the solid samples

Additionnal Analyse on liquids (if possible, depending on the budget) :

Chemical Oxygen Demand (COD)
Biological Oxygen Demand for 5 days (DBO_5)
Suspended Materials :
- filtration of 50 to 100 ml of manure with filtering paper 0,45 microns (after taring),
- drying at 105°C to constant weight and weight of the filter
- measure of N-NH4 in filtered water