

INTEGRATED AND PARTICIPATIVE MANAGEMENT OF PIG WASTE IN VIETNAM

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Disclaimer: *This paper presents a project under construction. The material may change slightly according to the evolution of the idea.*

SUMMARY

Southeast Asia is the largest pork-producing region in the world. High demand is leading to intensified production and huge environmental issues. Tons of pig slurry are discharged into the environment, and 75% of rice straw is burned in the fields. In Vietnam, communities and local authorities now recognize the need to manage and treat these waste products. This project addresses these problems in industrial and small-scale production where intensive agriculture and aquaculture are overwhelming traditional recycling methods.

The project aims to develop an environmental service to simultaneously treat pig slurry and rice straw using a treatment process called Agrifiltre® to produce compost on a pilot site in South Vietnam. An Agrifiltre® treatment plant will be implemented on a large-scale pig farm. A network of 16-20 farmers will deliver 50 tons of rice straw to treat 3,200 m³ of pig slurry. On a second site in North Vietnam, before a treatment unit is built, a participatory decision-making process will identify approximately 50 small-scale pig farms and 30 rice farmers to transform 5,000 m³ of slurry and 75 tons of rice straw per year.

The project creates a virtuous circle: gathering pig slurry and rice straw in order to transform these into compost and clean liquid effluent. It employs simulation models to determine the most efficient systems for

delivering raw materials and finished products which the project experts and local stakeholders will use together. Finally, it employs the innovative Agrifiltre® waste processing system (patented by CIRAD and Guyomarch).

1. INTRODUCTION

The saying goes: "You can't turn a pig's ear into a silk purse" – but we can and must do so today!

Livestock production in Vietnam is expected to grow by 5% to 9% each year over the next 10 to 15 years. As tons of pig slurry are released into the environment, agricultural fields and fishponds traditionally used for the recycling of animal wastes will soon be saturated. Heavy nitrogen and phosphorus overloads in the Mekong Delta and in the Red River Delta (RRD) derived from animal – particularly pig – manure [1] were confirmed by the results of the EC-Asia ProEco-funded project "Animal Production Intensification in Vietnam and Environmental Protection". By 2010, it is estimated that there will be 16,400 small-scale farms and 1,600 large-scale farms in the province of Thai Binh creating overwhelming pollution problems if they are not addressed through a preemptive strategy now [2]. Vietnam is also the world's second biggest rice exporter and 75% of rice straw, considered waste by most farmers, is burned in the fields.

The project addresses problems in both industrial and small-scale production – where intensive agriculture and aquaculture are overwhelming traditional recycling methods – through the promotion of the innovative Agrifiltre® process. Recent studies at global levels have clearly

shown that nutrient recycling, particularly nitrogen excreted by animals, is a viable solution for balancing the loss of valuable elements in the environment [3]. Biogas digesters are a known technique, but they don't treat nitrogen and phosphorus and their operation is often incorrect due to lack of training or proper construction. This is why many are considering shared treatment systems [4].

2. PROJECT OBJECTIVE

The project develops a technology and networks for collective integrated treatment of pig wastes and rice straw, with 3 main links. It aims to:

- 1) Develop conditions for allowing farmers to benefit from collecting, selling (or transferring) and recycling rice straw and pig manure.
- 2) Transform these residues into compost through the AGRIFILTRE® treatment process.
- 3) Use this compost on vegetable and rice crops as a substitute for mineral fertilizers – with multiple ecological advantages.

The project will be implemented at two sites (Fig. 1). At one site the supply chain will be designed after the treatment plant is built at the farm level (demonstration); in the other, the supply chain will be established before a collective treatment plant is constructed.

In Southern Vietnam, in the Province of Dong Nai, the expected results will allow Vietnamese stakeholders to validate the experience and replicate it at other selected sites:

1. A rice straw suppliers' network is created along with management policies to supply the Agrifiltre® process (number of suppliers, quantity to deliver, delivery dates, transport means, and net return for the sale of straw). A demonstration group of 16 to 20 small farmers will supply nearly 50 tons of rice straw per year to transform 3,200 cubic meters of slurry from one large-scale pig farm.

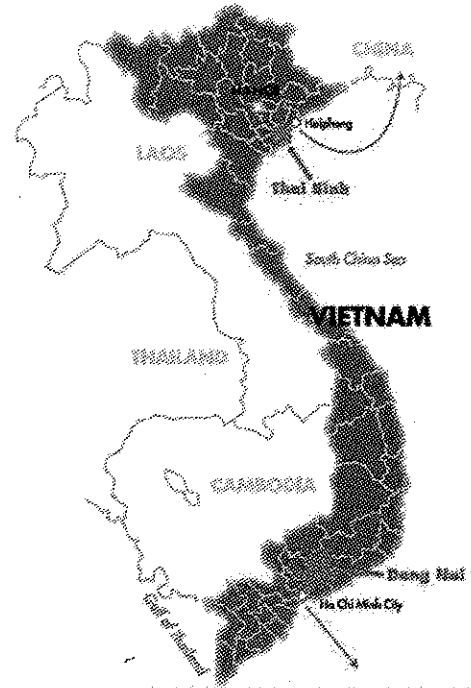


Figure 1: Agricultural stakeholder participatory design at two sites.

2. Agrifiltre® process is optimized in the local situation: The Agrifiltre® treatment plant will produce more than 250 tons per year of a clean and balanced in NPK compost and more than 2,300 cubic meters of an eco-friendly filtered effluent to irrigate crops or to fertilize fish ponds. Nearly 2 tons of nitrogen and more than 2 tons of phosphorus will be saved from release into the surrounding environment, while greenhouse gas emissions (GHG) will be reduced by about 151 Mg CO₂-equivalents per year.
3. A compost distribution network is identified with appropriate plans (compost requirements, number of consumers, both market garden farmers and rice farmers involved.). Compost requirements of crops are experimentally determined within this network.

In Northern Vietnam, in the Province of Thai Binh, similar results are expected, but they will be planned in a participatory decision-making process creating:

1. A rice straw supply network – potentially 30 farmers selling 75 tons of rice straw per year.
2. A pig slurry supply network – potentially 50 small-scale pig farmers producing around 5,000 m³ of pig slurry.
3. A treatment unit sized appropriately.
4. A compost distribution network – nearly 420 tons of compost may be produced.

On both sites we shall have trained local experts to disseminate the supply chain design methodology and to monitor the Agrifiltre® process.

Achievement of the project objectives will be monitored by three performance indicators:

1. Input of pig slurry and rice straw to the Agrifiltre® treatment plant. Number of farmers who switch to sustainable pig slurry-treatment and straw-collection (effective in the Province of Dong Nai and planned in the Province of Thai Binh).
2. Decrease rates of organic matter, nitrogen and phosphorus contents in the treated pig slurry (effective in the Province of Dong Nai).
3. Output of compost. Number of farmers who switch to sustainable compost

use (effective in the Province of Dong Nai and planned in the Province of Thai Binh).

3. KEY PROJECT DESIGN ELEMENTS

3a. Innovation

Two innovations are implemented in this proposed project: the Agrifiltre® process treating at the same time pig slurry and rice straw, and the participatory methodology using simulation models to design the virtuous circle.

The project creates a virtuous circle for the transformation and use of pig farm slurry and rice straw with multiple social and ecologic benefits. These include producing compost, reducing emissions of GHG, conserving soil's organic matter, reducing health risks, and providing financial gains for small farmers. The treatment process uses a method of pig slurry filtration through a straw substrate as the core of its virtuous circle (Agrifiltre®) (Fig. 2).

The process was jointly patented (No. 01 00386) by CIRAD and Guyomarch, in 2001. A complete treatment process has been approved in terms of a reasonable cost/ef-

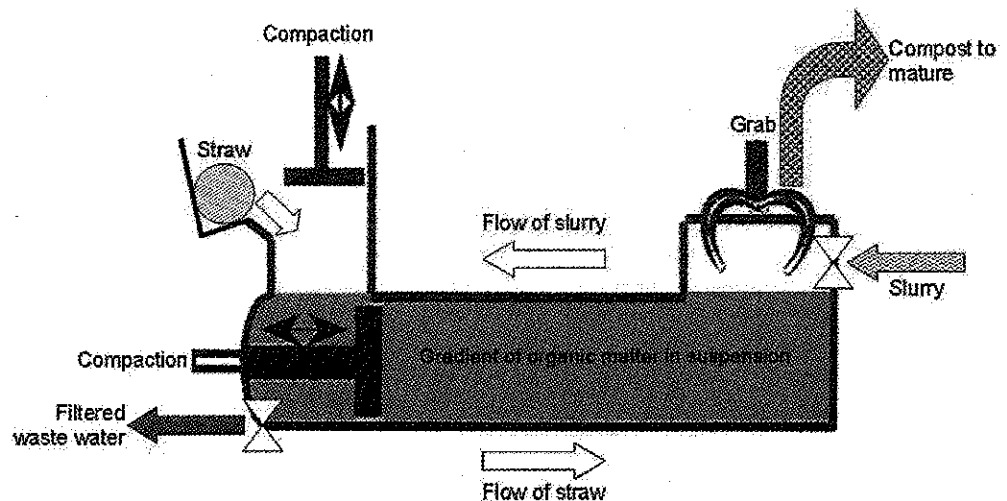


Figure 2: Sketch of Agrifiltre® process

efficiency compromise by the French Loire Bretagne river basin agency in July 2001. The process is also comprised of nitrogen removal and compost maturation. This is a new agricultural technology for Southeast Asia.

In terms of environmental issues, this project brings changes that can go farther than two projects currently underway in Vietnam which focus on biogas technology to deal with pollution factors such as nitrogen and phosphorus. Extraction of nitrogen and phosphorus by reverse flow filtration of the pig slurry on a rice straw substrate produces a solid, odorless and hygienic compost, containing 31% of initial nitrogen and 60% of the initial phosphorus. Hence, the filtered effluent may be used directly to fertilize crops or fish ponds.

Rice husk is not considered in this project. It is difficult to collect/transport this by-product and it is not a good media for the filtration of slurry. In the implementation area it is mainly used as chicken litter and sometimes mixed with other manures.

The expected fertilizing value of the compost after maturation (natural drying) is presented in table 1.

Quantity of compost obtained from one cubic meter of pig slurry (kg)	Dry matter (kg t ⁻¹)	Total N (kg t ⁻¹)	P ₂ O ₅ (kg t ⁻¹)	K ₂ O (kg t ⁻¹)
84	320	13	17	11

From a technical standpoint, Agrifiltre® needs minimal daily monitoring. The farmer or the technical manager of the plant need 1 hour per day for straw input and compost stirring and 4 hours every 2 months to remove the compost. Agrifiltre® has a low operating cost of 7.6 US\$/m³ of pig slurry treated (in French context), which includes a low energy cost (1.0 US\$/m³ in French context).

For the treatment process, we must design the supply networks in rice straw and pig slurry and compost distribution. To be virtuous and continuous, Agrifiltre® treatment must be efficiently supplied with rice straw and pig slurry. Agrifiltre® treatment must provide quality compost to farmers according to their demand and in a timely

way. To meet these criteria, the design and evaluation of the supply chain require the use of specific dynamic simulation models (developed by our research team, several international publications and 10 years of research), enabling the stakeholders to test various options. This method and the simulation models were devised and used in La Reunion for collective management of pig slurry in a small livestock area where a collective treatment process will be operational at the beginning of 2009 to transform 20,000 cubic meter of pig slurry [5]. The proposed project will extend that work into a total network that uses slurry and straw and valorizes compost.

3b. Project's Geographic Area of Influence

Pig production in Vietnam has been booming since 1990 with average annual growth of almost 10% between 1990 and 2003. The swine population is now the largest in the ASEAN region, and growing. Today pork represents 80% of the total meat produced in the country and the evolution of production is impressive: 1 million tons in 1995, 2.1 million tons forecasted in 2005 and 2.9 million tons by 2010. The style of Vietnamese pig production, mainly concentrated

in the South and also recently exploding in the North, is very specific. More than 90% of the pigs are still held in small traditional farms integrated with rice and crop production [6]. This provides good opportunities for the implementation of the project. The selection of two sites allows for design of recycling systems, with Agrifiltre, in varied contexts.

Province of Dong Nai (DN)

Dong Nai province is in South Vietnam, North-East of Ho Chi Minh City. The province was populated by 2.25 million people in 2006 (380 inhabitants per square kilometer) with more than 60% living in rural areas. Agricultural land in this area is limited, but there is a good

supply of rice straw. The area produces rice, rubber, corn, coffee and cashews, with about a quarter of the land devoted to rice production. Livestock production is very much developed. In a heavily polluted peri-urban environment, 300,000 pigs were grown in the province in 1996. Production increased by 33% in the next four years. In this area, pig wastes have not been widely used for fertilization, though chicken and cattle manure are used. Transformation of pig slurry and rice straw into compost would therefore provide a new, attractive product for farmers. In its effort to maintain stable agricultural growth, Dong Nai People's Committee is focusing on solutions to develop livestock production and, in this context, promoting waste treatment.

Province of Thai Binh (TB)

The Province of TB is located in Northern Vietnam in the Red River delta, Southeast of Hanoi. The RRD is North Vietnam's economic core and is populated by 18 million people, with a population density four times that of DN province. Strong industrial, agricultural, economic and demographic growth is putting unsustainable pressure on the region's natural resources. The demand for livestock products is growing quickly, particularly in Hanoi, and authorities and producers are facing the challenges of this "livestock revolution". The Agricultural Services of TB are in charge of the national development programme, especially the National Programme for the development of lean pork production which has clear quantitative targets. The guidelines for livestock development in TB province for the period 2004-2010, are intended to change the structure of agriculture, industrialize agricultural production and meet the market demands for livestock production. The People's Committee fixed specific targets hoping that, in the province of TB, the value of livestock production in agriculture would reach at least 40% by 2010. The two preferred farming methods - industrial farms and family farms - aim to produce 1.4 million pigs per year (on 1,600 large farms and 16,400 family farms) by 2010. The transition from traditional livestock breeding

to industrial techniques would increase the quantity of products while improving their quality and responding to consumer demand. It may well create more pollution also unless properly managed.

4. COMMUNICATION WITH PROJECT STAKEHOLDERS

On the two sites, local stakeholders (farmers, carriers and agricultural decision makers) will be involved via the People's Committees in the design of the supply chain. Simulation models will serve as tools for discussion in direct interaction with stakeholders, to design and test scenarios for the supply and management modes, the destination of output products and the organizational rules at the technical, economic and geographic levels. An organizational framework with three levels (action, coordination, decision) will be set up to gather the various stakeholders concerned by the issue of pig slurry treatment and rice straw recycling. At the first level, action groups will be organized to discuss issues and elaborate tentative solutions on specific topics: pig wastes supply, rice straw supply, compost distribution, transportation and location of the treatment plant. Stakeholders will run the models on the real situation and discuss the simulation outputs to make operational decisions. These action groups gather farmers, agricultural advisers and representatives of farm cooperatives, agricultural services, People's Committees and, when needed, other experts. The main results issued from the groups are presented to other participants via the coordination group. The decision committee, gathering farmers, cooperatives and private or public investors' representatives, endorses all the final decisions. It is within the action groups that the different simulation models will be used and discussed.

5. REFERENCES

- [1] Gerber et al. 2005. Geographical Determinants and Environmental Implications of Livestock Production Intensification in Asia. *Biores. Technol.* 96(2): 263-276
- [2] Porphyre V. & Nguyen Que Coi (Eds). 2006. *Pig Production Development*



Animal-Waste Management and Environmental Protection. A Case Study in Thai Binh Province, Northern Vietnam. PRISE Publications pp 181-204

[3] UNEP & WHRC, 2007. Reactive Nitrogen in the Environment. Too Much or Too Little of a Good Thing. United Nations Environment Program, Paris, 2007. 51p.

[4] Porphyre V. & Nguyen Que Coi (Eds). 2006. Pig Production Development Animal-Waste Management and Environmental Protection. A Case Study in Thai Binh Province, Northern Vietnam. PRISE Publications pp 55-82,

http://pigtrop.cirad.fr/initiatives/environmental_protection_and_pig_production/references/e3p_edited_book

[5] Médoc J.M., Guerrin F., Courdier R., Paillat J.M. 2004. A Multi-Modelling Approach to Help Agricultural Stakeholders Design Animal Waste Management Strategies in the Reunion Island. In Pahl-Wostl C., (ed.), Schmidt S., (ed.), Rizzoli A.E., (ed.), Jakeman A.J., (ed.). Complexity and Integrated Resources Management. Trans. 2nd Biennial Meeting iEMSs. Volume 1, 462-467. 2004/06/14-17, Osnabrück, Germany.

[6] Caldier P. 2006. Vietnam's 'Pig Business'. Pig progress. 22(1):8-10. www.agriworld.nl