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Workshop 2 : Farming and rural systems methodologies

Implementation of a certified environmental management system in pig farms in Brittany. A systemic approach for a prospective analysis.

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Abstract : In 1970, French authorities set up a plan for modernising French pig production. The development pattern born out of it was structured around a productivist paradigm and a free organised market. It led to a regional specialisation of the pig production, particularly in Brittany. Hence pig density increased what has involved water pollution. Because this pollution is altering ground water ecosystem but also the legitimacy of pig farms, changes in pig farming are needed.

For in steered systems, the decision-making system is the key point in change achievement, we need to think about change in the one of pig farms. Indeed, one can note environmental concern is quite absent from pig farmers' decision-making process. Therefore, a new management system is required. In 1996, the ISO set up a new set of standards (ISO 14000) in order to cope with environmental issues. These standards are defining what is an environmental management system (EMS).

The implementation of an EMS in a pig farm (farrowing-fattening system) require changes in the labour organisation but also new competencies. Indeed, managerial tasks demand more and more time and deal with new things. Moreover, technical tasks need more specific knowledge's. So, training is necessary. Besides, it involves a broader professional network extended to non-agricultural firms. From an economic point of view, the cost of EMS implementation is varying from 7000 to 25000 € a year. Its effect on the pig production cost is between 0.02€/kg carc to more than 0.5€/kg carc. The need in labour force (3 full-time workers) and the cost determine a threshold of interest of 6000 pigs per year.

Beyond changes in pig farms, implementing an EMS require changes in the whole production chain. They may concern all the three spaces structuring it : the technological space (innovation process), the strategic and relational spaces ("green pig market"?, total quality as a condition of access to markets). All this leads to conclude pig production in Brittany is experiencing a structural crisis which will generate a new development pattern.

Keywords : Brittany, decision-making process, environmental management system, ISO 14000 standards, pig farming, pig production chain, sustainability, systemic analysis, training.

Introduction

In 1970, French authorities set up a national plan for rationalising pig production because it was quite insufficient regarding the consumption level. One of the main reasons of this situation was the type of pig production systems. They were mainly unspecialised system with few pigs. In 1968, there were 800,000 pigs holders which farmed an average 12-pigs herd [Teffène et al, 1998].

This plan for rationalising pig production was structured around two points : i) the modernisation of pig farms and ii) the organisation of the French pig market. The first point is made up of a support to technical improvement (farmers' training, genetic improvement of animals) of pig farms which leads to specialisation of pig farming systems, notably farrowing-fattening systems. Consequently, the pig production is concentrated in fewer farms, mainly in Brittany. In 1995, there were 90,000 pig farmers which held an average 157-pigs herd (1,223-pigs herd in specialised farms vs 37 in 1968) [Tefféne et al, 1998]. The second point relies on producers groups, on a payment scale and on an auction system (Marché du Porc Breton). In the same time, up-farm firms (feedstuffs industries) and down-farm firms (slaughterhouses, food-processing industries) developed themselves, once again mainly in Brittany. Socially, this model of development found its legitimacy in the fordist compromise which prevailed in the French society until the 80's.

This development pattern has emphasised productivity as an achievement. In Brittany, this leads, among others, to a huge increase in pig density and thus in N amount spread. One of the consequences is water pollution by nitrates and phosphates.

In a social context where environmental concern has arisen as a key value, the question of a new development pattern has come up more and more acutely. Authorities have intended to regulate environmental impacts of pig production using statutory means such as the national Classified Installations for Environment Protection Act (CIEP) or the European Directive on Nitrate (DN). The implementation of these regulations has not achieved its goals yet. Therefore we need to think about another approach to enhance the previous one.

Environmental management systems (EMS), as defined by ISO 14000 standards, have caught our attention. In France, no pig farm has implemented an EMS yet. Therefore we intend to use a systemic approach in order to aim at a prospective analysis. First, we need to understand where the environmental problem of pig farms lies. Afterwards, we will present briefly what an EMS is. Once it is done, we will analyse what are the consequences of the implementation of an EMS in a pig farm.

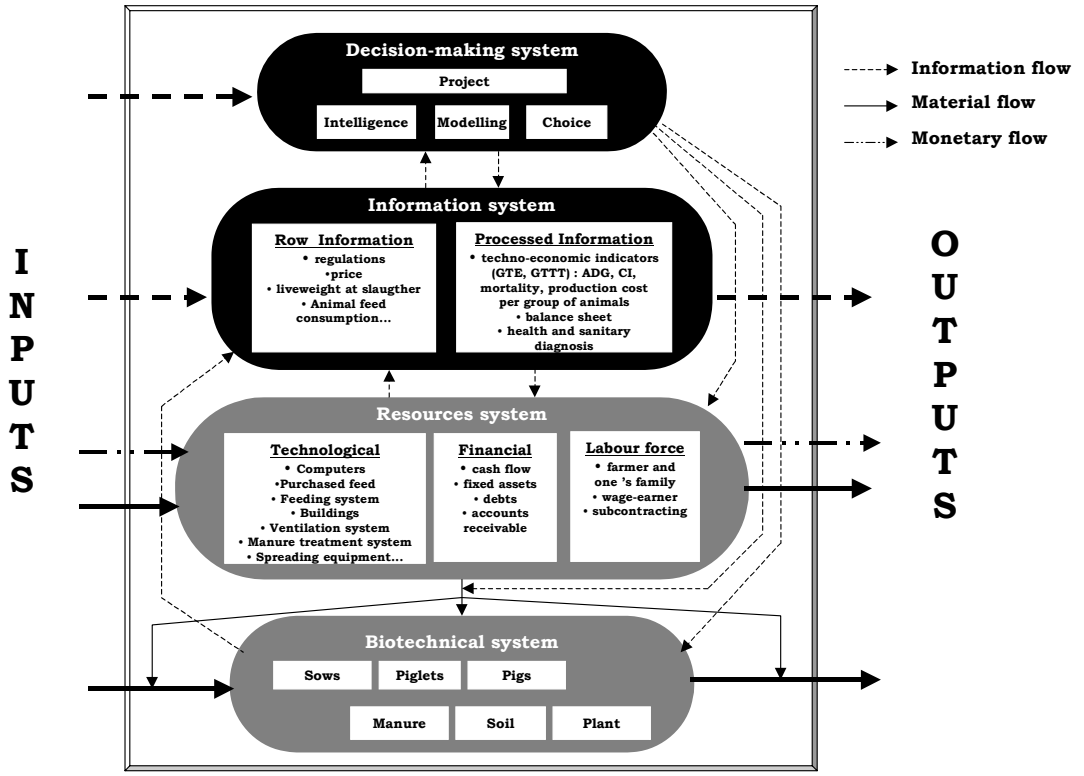
1. Where does the environmental problem of pig farms lie ?

1.1. Pig farm as a steered system

As we have chosen the systemic approach to cope with environmental issues of pig farms in Brittany, we ought to define the pig farming system. First, we state pig farms are steered and open system which sets up its own project. Using Le Moigne's systemic approach [1984], we consider such a system is made of a decision-making sub-system, of an informational sub-system and of an operating subsystem. Regarding agricultural activities, the latter can be divided into two other systems. The first one gathers the labour force, the technological and financial resources. We call it the resources system. The second one is the set of biological processes controlled by the farmer. It is the biotechnical system [Landais & Deffontaines, 1991]. Analysis of decision-making process will use Simon's IMC (Intelligence-Modelling-Choice) model [Le Moigne, 1974]. Considering Breton pig farms, we present the system in Figure 1.

From a general standpoint, we call environmental problem of a system any problem posed by changes in the relations with its environment. They may be due to changes in the environment and/or in the system itself. Therefore, we will analyse how the environment of pig farms has changed.

Figure 1. Pig farm seen as a system.



1.2. Changes in the environment of pig farms : from pollution to illegitimacy.

As far as pig farms are human activities, we are to consider the anthropogenic environment (society) and the un-anthropogenic one (ecosystem but its anthropogenic elements) which we call natural in order to light the paper though we know nature and society cannot be opposed.

Regarding the latter, pollution is the major change. A pig farm is linked to its natural environment by, among others, various flows : organic matter, nitrates, phosphates, ammonia. As long as a kind of balance is maintained, these flows do not alter the integrity of the natural environment. Hence, one may consider there is no change in the natural environment. But, as soon as these flows modify its integrity, there is pollution. In the case of pig farming in Brittany, the increase of animal density has implied an increase of N amount to be spread per area unit. Because the cleansing capacity of the soil has been overstepped, nitrates and phosphates leaching has occurred and created modifications of the continental water ecosystem such as eutrophisation. But this pollution has an other consequence. Indeed, continental water is used as a source of drinkable water. In Brittany, one may note that some sources are closed for the nitrate drinkability standard (50 mg/l of NO_3^-) is exceeded. At that point, the ecological problem becomes an health problem and thus comes in the anthropogenic environment of pig farms.

One of the main relations between a system and its social environment is the relation of acceptance. This relation is determined by the conformity of the system to a set of values prevailing within the society. Such a conformity gives it legitimacy. Without legitimacy, no activity can sustain its functioning because some in-flows are depending on people will (financial receipts for instance), but also its very existence if it breaks the law. Pig farming in Brittany by making water undrinkable and because of nuisances (odours, noise) has reached the limits of its legitimacy. Recent trials show it quite well.

While the society is changing, its values are changing too. Environment concern has arisen for nearly twenty years as a key value first in the western societies.

Consequently, we state the environmental problem of pig farms in Brittany is due to pollution which alters the ecological integrity of its natural environment and its social legitimacy.

When we look at the process leading to this pollution [Capillon, 1992], it appears it results from an interaction between the natural ecosystem of the field (air-water-soil-plant) and the NP amount spread. The latter is resulting from the implementation of spreading practices.

Practice is a set of co-ordinated actions modifying the state of a system in order to aim the farmer's project. At its very first step a practice is built at the decision-making level. Le Menestrel and Panes [1996] have proposed to distinguish three level of legitimacy for the decision-making process : the consequential legitimacy, the procedural legitimacy and the cognitive legitimacy. We will use this analysis pattern to assess how pig farmers have integrated the environmental side in their decision-making process.

1.3. Environment and decision-making in pig farms : an assessment.

Intelligence of the environmental situation of the farm was almost non-existent until the early 90's. Indeed, the only tool enabling the farmer to assess one's environmental impacts was the fertilisation balance which is not environmentally designed and is not farm-wide. At the end of 1993, French authorities and farmers association concluded an agreement to support a national plan of agricultural pollution control (PMPOA). Among the various measures, there was an environmental diagnosis of the farm, the DeXeL® [Dockès et al, 1995]. But this diagnosis method is partial for it deals only with nitrates and phosphates pollution due to farm wastes (animal excrements , dirty water). Therefore, the intelligence step of the decision-making process remains mainly focused on technical and economic sides. Consequently, cognitive legitimacy is lacking. Besides, use of DeXeL is linked to PMPOA which is to last until 2001. One may fear once the plan is achieved DeXeL will not be used anymore, at least not widely.

The modelling step is from a general point of view barely implemented by the farmer oneself [Bourgeat, 1999]. Moreover, this step is often not formally made in regulation and steering decision for the farmer gives greater place to routine procedures, using Cerf and Sebillotte's words [1997]. One must note that these procedures have not been greened yet because few references are existing. They are under construction. For planning decisions, the modelling of the various alternatives is seldomly environmentally sound. As these decisions bind the farm for a long time, say at least five years, pig farms may remain in a controversial situation because they cannot reach their procedural legitimacy.

Regarding the final step, choice, we must notice neither there environment is taken into account and the choice lies on technical and economic criteria or on previous experiences.

At this point of our paper, we ought to conclude that pig farming systems need at least to deeply change their decision-making system to solve their environmental problems. We must underline nitrates and phosphate are not polluting themselves. Pollution occurs when there is an excess. As far as this excess is due to farmer's decision, pollution is likely to be controlled if the decision-making system is changed. According to Llerena [1996], this is an organisational failure of the system.

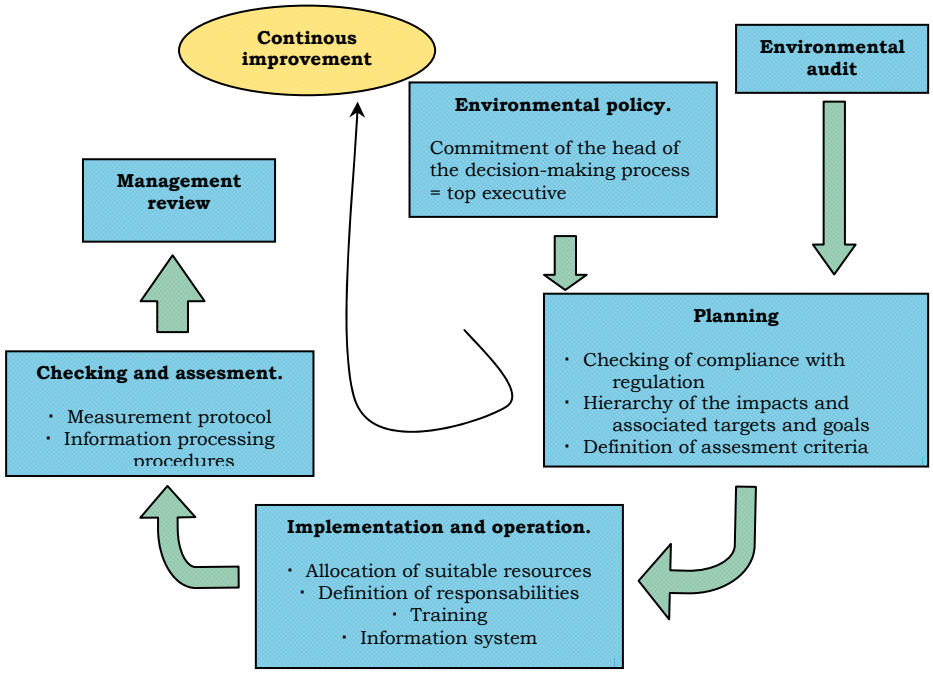
In 1996, following the Earth Summit held in Rio de Janeiro in 1992, the ISO set up a new family of standards (ISO 14000) designed for any human activity from chemical plant to forest management. These standards tell what is an environmental management system (EMS) and they intend to supply guidelines to implement a greened decision-making process.

2. An environment management system in a pig farm : a prospective analysis

2.1. What is an environmental management system ?

According to the ISO 14000 standards [AFNOR, 1996a and 1996b], an EMS is a set of procedures whose aim is to enable a firm to achieve its environmental goals. The primacy is given here to the more satisfying method to build an environmentally sound decision over the best *ex ante* alternative. This is justified by the complexity and singularity of environmental issues [Llerena, 1996]. As shown in Figure 2, an EMS relies on an environmental audit and five points and is driven by continuous improvement.

Figure 2. Principles of an environmental management system.



2.2. Implementation of an EMS in a pig farm

First of all, the system in which the EMS will be implemented has to be determined, in particular the decision-making system. At a first glance, it is quite simple : the farm seems to fit. But if we are interested in subcontracting fattening we ought to reconsider our position for decision power does lie in the hands of both contractors. So, in that case, it is not easy to tell where is the head of the decision-making system. It may depend on the sort of contract.

Once the head of the decision-making system is identified, an EMS can be implemented only if there is an actual environmental commitment. This is the very first condition to achieve it [Bezou, 1997, p.197 ; AFNOR, 1996a and 1996b ; IISD, 1996]. Such a commitment involves the farmer must change one's system of values by including environmental concern. This (r)evolution may help the farmer in rebuilding one's legitimacy. To aim this, information and education are necessary.

Planning is the next stage. This is the first step from commitment stated in environment policy towards the very implementation of EMS. The farmer must check one's farm is in compliance with all the environmental regulations (DN, CEIP, medical wastes and so on). This implies basic juridical training. Then, using an exhaustive environmental audit, the farmer must define a hierarchy of the impacts on environment and the corresponding targets and goals according to one's environmental

policy [Table 1]. In order to follow up the functioning of the EMS, specific indicators have to be created, what is supposing a joint work with research and extension services. From the previous elements, the farmer set up one's plan of priorities and expiry dates.

Table 1. Some examples of environmental impacts and associated targets and goals in a pig farm.

Impacts	Targets	Goals
Non-point pollution by nitrates	Nitrate amount spread per area unit	Balance supply-demand in the soil-plant system
Ammonia emissions	Manure storage and spreading	Minimise emissions from storage buildings
Soil pollution by heavy metals (Cu, Zn)	Cu and Zn content of feedstuff	Decrease total Cu et Zn content of feedstuff

The implementation itself requires the various resources (labour force, money, technologies) are adequately allocated to it. So a formal investment plan has to be designed, what is not a so widespread practice among pig farmers as noticed by Bourgeat [1999]. Each worker's responsibilities (from head-farmer to part-time wage-earner) must be defined. This demands a kind of formalisation of the labour organisation in the farm. Such a change is likely to involve an increasing functional specialisation but not a taylorian labour organisation. The question of decision-making autonomy is arising at this point : « to what extent each person is autonomous, and then responsible, in the decision-making process ? » From the answer at the previous question, a training program is needed.

As to EMS being a mean to reach environmental aims, it needs a measurement protocol and an information processing system. For instance, to actually balance fertilisation, the farmer has to know how much nitrates remain in the soil. Therefore, soil analysis are required. Once they are done, information has to be processed and registered. Afterwards the farmer, or another person whose task it is, must assess environmental performances of one's farm according to one's goals. Keβeler and Schiefer [1997] have underlined this can be formalised within an environmental information operational system, nourished by internal either external information and using computer technologies. Once again, we ought to point out the need in training and in research (expert-system).

In the first section, we have shown pig farms need social legitimacy. Certification of products or processes is a way leading to it. So, the implementation of an EMS is really suitable for solving their environmental problem if it is certified by a third party. This will involve non-agricultural actors such as certification companies.

Before considering the economic side of the implementation of an EMS in a pig farm, we summarise the main points of our analysis :

1. an important need for farmers' training,
2. enhancement of functional division of labour between managerial and technical functions,
3. broadening of farmers' professional network to more and more non-agricultural actors.

2.3. Economic assessment : an attempt to determine a threshold of interest

In order to assess the kind of pig farms which are able to implement a certified EMS, we need to determine a threshold of interest. We will consider two things : its effect on pig production costs and the demand for labour force. Our threshold is expressed as a pig-fattening herd size (pigs/year).

The suitable labour force is at least of three full-time worker for there are two technical functions : farrowing and fattening, and a managerial function which requires at least a third-time worker. Using a ratio proposed by ITP [1993] of 100 sows per full-time worker, this leads to state that a 300-sows farm (producing 6000 pigs per year) has the necessary labour force to implement an EMS.

As mentioned in the introduction, there is no ISO 14000 certified pig farm in France yet. Therefore, we do not have specific cost references. So we ought to make some hypothesis based on experiences

in other sectors, an interview with an executive manager of a certification company and bibliography. We assume the specific cost of EMS implementation (without investments non-related to the EMS itself) are independent from the herd size. It is a structural cost.

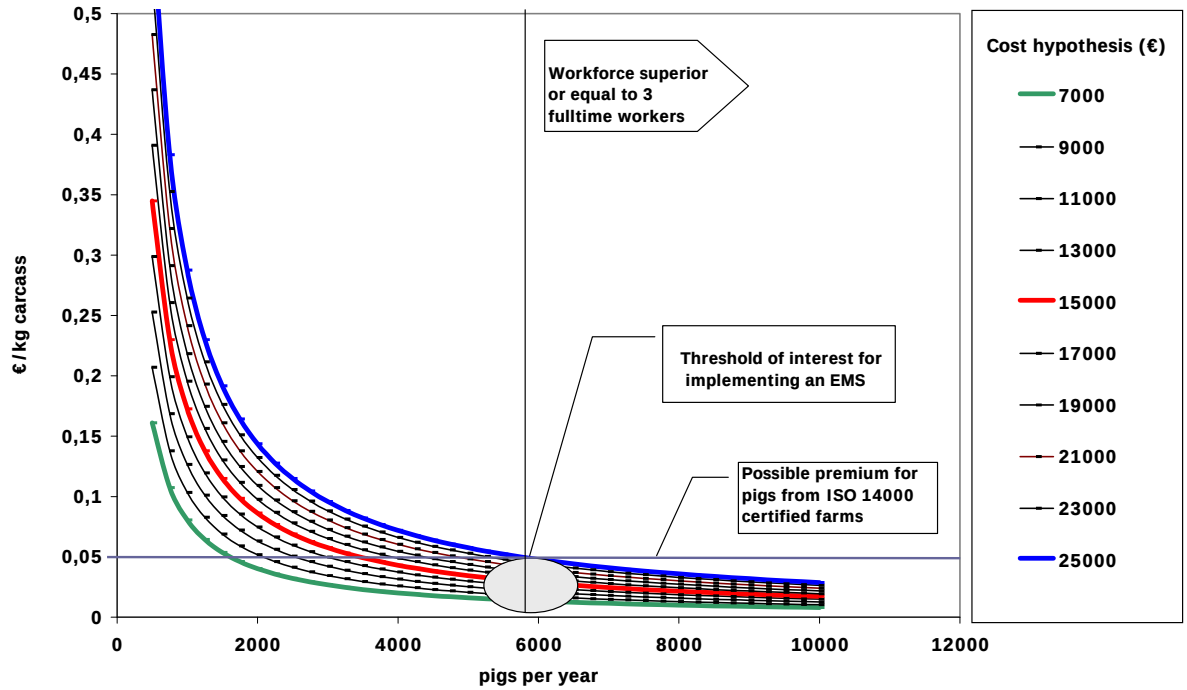
The estimation of this cost is presented in Table 2. The certification cost contents the cost of the certification itself and the cost of two audits to follow it through. For certification expires every three years, we have divided the whole cost by three. Training is one the key for succeeding in EMS implementation. Therefore, farm workers must attend to training courses about every five years. Concerning labour force, we have made the hypothesis that an EMS is a third-time task. The other costs correspond to computer technologies, measurements (soil and manure analysis for instance or captors for gaseous emissions)

Table 2. Estimation of the annual cost of EMS implementation in a pig farm.

	Estimated cost per year
Certification	2 500 to 4 000 €
Training	1 000 to 2 000 €
Labour force	0 to 12 000 €
Measurement	1 000 to 2 500 €
Assessment	about 1 000 €
Registration and others	at least 1 500 €
Total cost	7 000 to 25 000 €

As shown in Figure 3, the cost per kg pig carcass varies from more than 0.5 €/kg to about 0.02 €/kg. To determine the threshold of economic interest we have made the hypothesis that an ISO 14000certified pig production may have a 0.05 €/kg bonus (according to present quality bonus). It is not a bonus directly due to it for such a certification does not concern the products themselves. But we may imagine a quality certified production chain whose specifications may include ISO 14000 certification.

Figure 3. Effect of EMS implementation on annual pig production cost



From what precedes, we can state that an EMS may be successfully implemented in pig farms producing more than 6000 pigs a year, i.e. whose sow herd is bigger than 250 to 300 sows, if it can create economic value-added. The Danish Kvamilla® system experience underlines the damning effect of lacking trading enhanced value [Petersen, 1999]. This experience also points out the importance of labour force for EMS requires time and competencies.

3. What does implementing an EMS in a pig farm mean for the whole production chain ?

This prospective analysis has led us to the following conclusion : EMS implementation in a pig farm involves important changes in the farming system, particularly in the decision-making system but its success depends on the commitment of down and up-farm companies. In order to assess how this may involve modifications in the whole pig production chain, we will consider the three spaces structuring a production chain : i) the technological space, ii) the strategic space and iii) the relational space [Lossouarn, 1994].

3.1. Need for innovation

Implementing an EMS does modify the organisation of the farming system but also requires numerous innovations. For instance, an EMS may require computer technologies such as software for processing registered information, but also waste treatment technologies. These are likely to create new competencies, hence new jobs in the pig production chain companies. Building this new technological space may need partnership with non-agricultural companies. In the case of manure treatment system in Brittany, one may note a partnership between a pig co-operative and a big cement producer, and one between an agricultural co-operative and an oil company. Regarding audit tools, we quote the example of the DIAGE® method set up by a regional association of pig producers groups and the INERIS, a French industrial research institute. This is closely akin to what Joly and Zuscovitch [1995] have pointed out about changes in organisation going with innovation process.

3.2. Need for new relations

Besides, as previously mentioned, trading enhanced value is necessary to achieve the implementation of a certified EMS in a pig farm. In a first step, we think about using the ISO 14000 certification as mean to set up a new enhanced value market. This is possible if a global quality approach is implemented throughout the whole production for environment is one of its dimension [Thiebaut, 1995]. Bezou [1997] has pointed out the complementarity between ISO 14000 and ISO 9000 (quality management) standards. This should ease the implementation of such a global quality management system. Once this is done, a problem remains : « Will there be enough pigs ? ». In Brittany, the share of pig production held by pig farms whose size is higher than our threshold is about 30% what seems quite sufficient (in 1997 14000000 pigs were produced in Brittany, i.e. 55% of the whole French pig production). But, the trend in quality management is to consider that quality does not justify enhanced value but that non-quality deserves penalties.

From this standpoint, it appears in a five or ten-years time non-global-quality-certified agricultural productions are likely to be excluded of the largest solvent markets (in France mass marketing). These latter companies are committing into certification processes in order to increase their market shares. So, the question of how many pig farms are likely to be ISO 14000 certified is of paramount importance. Therefore, we ought to think about an other kind of EMS.

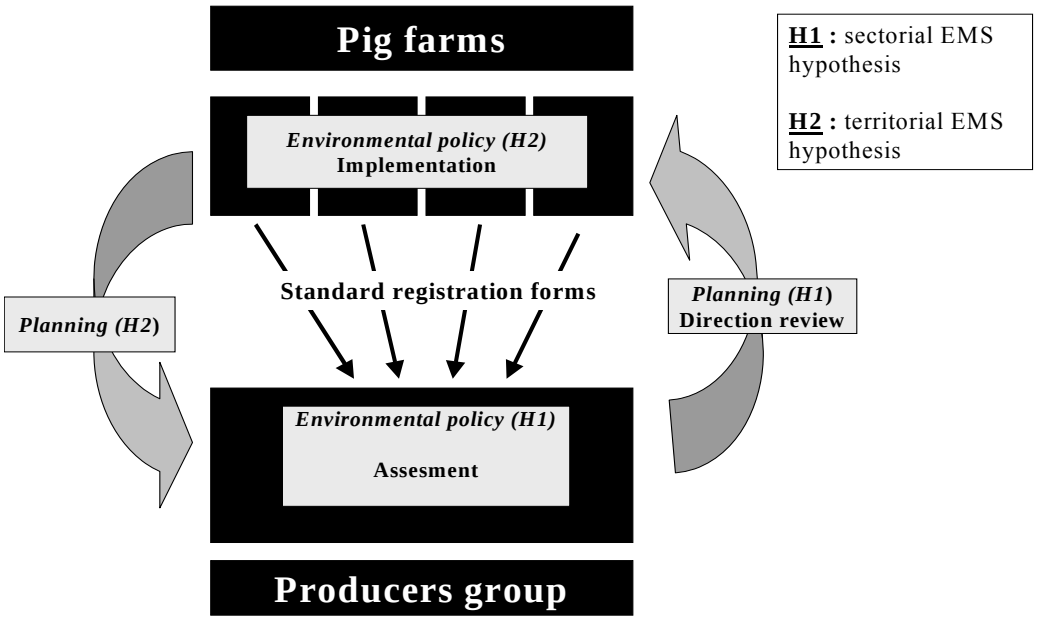
If we remind the organisation of pig production in Brittany, we can note that 95% of it is marketed through producers groups belonging to their members. Moreover, from an economic point of view, pig producers and the corresponding group make up a consistent economic unit for production and marketing are gathered. The interest of choosing a collective EMS is it allows to share part of the cost between each farm and the group for certification concerns the EMS itself. In addition to that, such an EMS enables to use the competencies of group staffs for information processing and assessment.

At that point, two alternatives can be built on that base [Figure 4]. First (H1), the environmental policy is defined by group. In that case, we must consider that each farmer has lost a piece of one's decision-making autonomy. This can be the first step towards integration. Second (H2), each farmer

keeps one's autonomy by defining one's own environmental policy. Nevertheless, in both case, the certification of the farm EMS is linked to the adherence of the farm to the group.

Resuming what precedes, we can write that the implementation of EMS in pig farms involve changes in the relational and strategic spaces of the production chain which seem to tend to be more and more tied up.

Figure 4. Proposal for a collective EMS.



Conclusion

Thinking about the implementation of an EMS in pig farms has led us to consider global quality management too. This has highlighted that new standards of production but also new management principles are emerging. Moreover, consumption behaviour have changed for the past twenty years as the social values founding the legitimacy of human activities. All these elements seem to give evidence of a deeper change in pig production. The whole development pattern is changing. As underlined by Boyer and Durand [1998], beyond internal difficulties, changes in a productive system meet barriers within the society itself : set up new professional relations, new education system and even new patterns for state intervention.

The systemic approach has enabled us to build a prospective thought by giving us a formalised representation of a complex and changing reality. Such an analysis seems interesting for anticipating changes. This work has arisen more questions than it has brought answers because of its very nature. Among these questions, some need further researches :

- economics has surely much to tell about change in development pattern [Allaire, 1995].
- sociologists and ethnologists may be interested in studying changes in the labour organisation in pig farms and their consequences on relations within the local professional network [Darré, 1996]. They may be also interested in how pig farmers will build their practices, their know-how in a information-rich environment.
- jurists' point of view ought to be listened to, particularly about the way new regulation patterns can be built.

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