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Farm Certification and the implementation of HACCP in agriculture: a cost/benefit analysis

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December 2002

Paper presented at the

Annual meeting of the American Agricultural Economics Association

July 27-30, 2003

Montréal, Canada

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Abstract:

This article aims to highlight the methodological bases and principles, sometimes implicit, that have served as support for the development of a referential similar to the one retained as part of the French decree on “Agriculture Raisonnée”, namely the Quali’Terre® referential. We show that the innovations introduced by this referential are of various natures: i) a change of perspective by taking a position at the level of the farming system and not of a given parcel of land or production, ii) use of the HACCP[5] method for identification and most especially the prioritization of risks and the preventive measures to be implemented, iii) the introduction of the concept of *continual improvement* for the farmer. Even, if from an agronomic point of view, the application of this type of referential does not seem insurmountable, we show that, based on a study of about one hundred farms in Picardie, its global approach on farm management, unstead of just applying technical requirements, involves changes in farmer’s practices that are more difficult than what was expected first.

Key Words: HACCP, methodology, cost/benefit analysis, farming system, risk assessment.

JEL : Q16, Q20, M11, D21

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[5] HACCP: Hazard Analysis Critical Control Point, Analysis of hazards – Critical points for their control.

Introduction

The development of ecolabels or other signals constitute an attempt to turn environmental management, along with the quality of the products, into an instrument of differentiation and a way to make the market remunerate the producers for their efforts (Wall et al. 2001, Grolleau, 2001). Farmer's practices with regard to environmental management were taken into consideration and later became part of a logic for revalorization of the farming profession and promotion of citizen agriculture. The recent debates in France on "*Agriculture Raisonnée*" subscribe directly to this logic and furthermore there is the question of labelling and the necessity for a loyal information system for consumers (Paillotin, 2000) [6]. Nevertheless, these debates were not enough to settle the question of method and of necessary tools to facilitate the application of this type of referential by the farmers.

This article proposes an examination of the methodological and scientific principles supporting the development of the Quali'Terre® referential, which greatly inspired a basis later adopted with regard to the decree on Sustained Agriculture (Paillotin, 2000). The principal innovation proposed by this referential rests on its global approach on farm management, in other words, it does not take into consideration a production or a particular risk (environmental, for example) individually, as do most guides to good practices or specifications (Aubry and Mousset, 1998). Even if, strictly from an agronomic point of view, its application does not appear insurmountable and was criticized (Girardin et al. 2002) [7], taking into account transversal requirements to several production systems at the farm level is also considered a problem.

A study carried out on a hundred farming systems makes it possible to specify the degree of requirements for the referential and the nature of its problems. But in reality, this change of level in the analysis requires a questioning of the logic of the farmer's actions and the interdependence between productions in the technical organization of the farm (Aubry et al. 1998b&c, Aubry 2000, Papy, 2001b). In other words, it leads us to assess the specifications and most especially the method of their development under a completely different angle than that proposed by Girardin et al. (2002). In particular, the proposed approach requires that attention be

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[6] This referential was developed by "Agro-transfert Picardie" together with the Picardie Chamber of Agriculture and with scientific support from INRA SAD-APT (Aubry and Mousset, 1998a, Mazé et al. 2000, 2002).
[7] Girardin et al (2002) suggest that "*except for a few particular points, the charters and referentials have a slight impact on the environment*", as well they have less requirements for the farmers due to the concern of being accessible to most of them.

brought to the management practices of the farmers, in other areas than the application of technical procedures.

I – the definition of Good farming practices: methological issues.

The multiplication of referentials for good practices, as much in the environmental field as in the quality of products, has brought new concerns to the farmers. These referentials rarely take into account the global logic of the farmer's operations and the interdependency between land utilization systems in farming (Papy, 2001b), just as they rarely recognize the often contradictory character of the objectives associated with the quality of products or with the protection of the environment (Pujol et Dron, 1998). The goal of the Quali'Terre® referential is to bring a solution to these concerns by way of an adaptation of the HACCP approach widely used in the industrial field. Unlike the agronomic approaches of the ecophysiological operations or unlike the agri-environmental indicators that are generally proposed, it is oriented towards the comprehension of the logics of the farmer's actions and the identification of their margins for manoeuvre and progress (Aubry 2000, Papy 2001b).

1.1. The evaluation and definition of Good farming practices

The process of developing a guide to good farming practices, as well as the assessment of referentials, comes up against a double constraint. First of all, that of entering into a logic of adding and compiling the regulation or technical measures, without prioritizing their real relevance with regard to the particular situation of the farmer. In this case, respect of the regulation is imposed on all the farmers in the same manner, even if these specifications are not the most important ones with regard to the particular situation of certain farms. Secondly, it is a matter of restricting these good practices to one or two productions or criteria (in particular environmental). Most guides to good practices are developed for a particular type of production (IRTAC Guide,…), with a risk of multiplication of measures within the farming system and of an inadequate result obtained with regard to the objectives particular to each approach[8].

The development of guides to good practices presents specific problems due to the difficulty in assessing the impact of agricultural practices. These guides define the requirements

[8] Therefore there exists no standard definition of what comprises good agricultural practices. See Beigbeder (2000) for a recension of the various definitions of the concept of Sustainable Agriculture according to the countries of the European Union. Certain countries include sanitary safety, others the welfare of the animals (northern countries),

pertaining to the means as much as the requirements pertaining to the results. One of the difficulties is due to the fact that environmental risks are perceptible and measurable on a long term scale (over many years even up to ten years), but they also concern space scales that exceed the territory of the farming system (drainage basins,…) while the decision-making entity relates to the farming system.

Thus, Meynard and Girardin (1991) pointed out that the use of indicators of the environmental impact on the farming systems, pertinent from a theoretical point of view, was very complex and implementation into each parcel of land was very costly. Moreover, a certain amount of reports (Aubry et al. 1998b, Coleno and Duru 1998) showed that the planning of technical decisions was not done within a single parcel of land (or a single animal), but within more elaborate management units (formation of lots or blocks of crops, batches of animals). These decisions are also often taken by the farmers based on observations made with regard to parcels of land that are considered representative of a block or a lot and transposed to the others.

Therefore it is essential to take the logic of the farmer's actions into consideration when developing the specifications and producing decision-support tools pertaining to the management of environmental risks (Benoît et Papy 1998)[9]. The decisions for intervention on a crop are closely dependent on the choice of intervention made by the farmers for other crops. Then as pointed out by Papy (2001c), the existence of interdependence in the organization of the crops system is the consequence of a hierarchy of the crops according to the priorities retained by the farmer (economic, technical,…). The farmer coordinates his practices by taking into account his entire production. Thus, the same specifications are not necessarily applied in the same manner by all farming systems.

The assessment *in abstracto* of the impact of different specifications, as proposed by Beigbeder (2000) or Girardin et al. (2002) poses considerable problems with regard to method. The method proposed by Girardin et al. (2002) for assessing the environmental impact of the stipulations included in a certain number of specifications does not avoid these obstacles. Based on the use of agri-environmental indicators (phyto, nitrogen,…) the method tries to measure the

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others include only a few cultural practices (Portugal), while yet others refer to the ISO 14000 standards (Denmark). They cover particular techniques (for example integrageted fruit production).

[9] Aubry et al. (1999) indicate that between 1980 and 1990, the Seine-Normandie Water Authority reported 356 polution related accidents with regard to phytosanitary products on surface water, 61% related to field treatment procedures, 17% following treatment and only 6% during treatment.

impacts of practices on the environment calculated with regard to the parcel of land, then later combines the information using multi-criteria methods to obtain an assessment on the scale of the farming system (Girardin et al. 1997, 1999, 2000). But this approach does not take into account the diversity of the objectives to which the farmers must respond (quality of products, environment,…..), nor the economic feasibility.

With respect to the farmers, it is more a question of being able to prioritize and to concentrate efforts on a restricted number of priorities, but having a significant impact *a priori* on risk control, whether they are related to quality or environment. "*A cropping system results, on behalf of the farmer, from an adaptation of the production objectives and of the means of obtaining them in the environment in which it is practiced, but also from the reciprocal adjustments with the other crops systems of the farm"* (Papy, 2001b). The objective of the method adopted for the development of the Quali'Terre® referential is to propose an adaptation of the HACCP method for identification and prioritization of the risks linked to agricultural activities, but also to introduce the concept of *continual improvement* to the farmer.

1.2.- The HACCP methodology and its adaptation to agriculture.

Unlike the strictly agronomic approaches, the objective of this type of methodology is to emphasize the conditions for prioritization of risks and priority preventive measures to be implemented. Today the HACCP method is a benchmark method for risk control, most particularly in the area of sanitary safety (Mortimer and Wallace, 1996, Unnevehr, 2000). Initially used for sanitary risks, its principles are general enough to be extended to other areas, such as the safety of persons in the workplace or the protection of the environment[10]. The HACCP method is a risk control system based on prevention. It is supposed to lead to a decrease of product loss at the end of the production process, a more efficient management of technical resources focusing on management of the critical control points. The objective of the HACCP method rests on breaking down the analysis into differents steps to be followed (Outline 1).

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[10] With regard to the farming systems, this method was mostly applied to the breeding systems and the farm's production workshop (the HECTOR method developed by the French Breeding Institute is an example).

Outline 1 : the different steps of the HACCP method (Mortimer and Wallace, 1996)

- Carry out an analysis of hazards: identify the steps of the production process where significant hazards may appear, and describe the preventive measures;
- Identify the Critical Control Points (CCP) ; CCP is defined as, a point, a step, a procedure that can be controlled so as to prevent, eliminate or reduce hazards to an acceptable level;
- Establish the critical limits for the preventive measures associated to each CCP.
- Establish requirements for monitoring the CCP's ;
- Establish the corrective actions to be applied when the monitoring indicates a deviation with regard to the critical limit established.
- Establish efficient registration procedures.
- Establish verification procedures for proper functioning of the HACCP system.

Generally, this analysis is carried out for a given production process and results in a matrix represented by table 1 below.

Table 1 : le tableau de maîtrise HACCP (d'après Mortimore et Wallace, 1996).

Process step	*N° CCP*	*Hazard analysis*	*Preventive Measurement*	*Critical Limit*	*Supervision*	*Corrective Action*	*Responsability*

Unlike a theme such as product safety, for which the hazard analysis is carried out product by product, from operation charts, as in the case of the environment (also concerning the safety of personnel), the hazard analysis must take into account the **entire production of the farming system**. In fact, certain steps of the production process relate to more than one production at a time and are of a repetitive nature. A large number of activities and cultural interventions are common to these multiple productions (for example, storing of phytopharmaceutical products, filling of the sprayer tank etc…). Therefore, the "*criticality"* of these steps in relation to the risks incurred depends on the frequency. For instance, the phase of filling a sprayer would be a step that is more or less critical according to the nature of the production but also according to the surface to be treated, the amount of treatments to be carried out and the nature of the spray mixture[11].

Certain adaptations with regard to the general principles of the HACCP method are necessary in the case of an analysis of farming activities of large crops. They concern, for the most part, environmental risks but also include certain problems linked to the sanitary safety of plant products (Doré, Le Bail and Vergès 2002). Contrary to many industrial activities, the pollution risks are, for some, vague and influenced by the characteristics of the natural environment (climate, soil) and by the cropping systems in place. The same practice would not have the same impact according to the sensitivity of the environment. For example, to determine the risk of nitric pollution, Meynard and Sébillotte (1990) determine the situations at risk according to the environment and the cropping systems. Moreover, the impact of these agricultural practices covers time scales that are too great (20-30 years) to make an accurate assessment and implement corrective measures. The concept of *"critical limit"* proposed by the HACCP method is therefore often difficult to define accurately.

These specificities therefore modify the apprehension of the key concepts of the HACCP that are the concepts of *"critical point"*, *"critical limit"*, and *"degree of criticality"* of the problems to be solved. Therefore, the concept of *"critical points"* is generally executed by choosing an entry for the environmental analysis within the stage of the production process that must be controlled first in order to limit the environmental risk. But this entry of the "production

[11] Aubry and Mousset (1998) indicate that for the risks and practices linked to the phytosanitary protection of the crops, the steps before and after the field intervention are the main generators of the risks, as much for the sanitary safety as that of the environment or the health of the applicator.

process stage" recommended by the HACCP seems insufficient in identifying the critical points. It is necessary, based on previous works (Meynard-Sébillotte, 1990) to proceed with a phase of characterization of the various situations "*environment* x *cropping system"* so as to prioritize the risks and determine the most appropriate actions in each situation.

The analysis of the conditions for extending the HACCP method to an agricultural context emphasizes the existence of two possible alternative strategies.

◆ **Strategy 1:** applying the HACCP method conventionally with respect to the farming system, with a hazard analysis and identification of the critical points, in addition to identifying the preventive measures most appropriate for the farming system under consideration. This would be an analysis on an individual basis or on a small number of farming systems. The operational translation of the HACCP leads to the development of a **simplified** method of risk analysis. The performance of an environmental analysis, or an Agri-Environmental Diagnosis (AED), as set out by the ISO 14000 standard, on the environmental management subscribes to this logic.

◆ **Strategy 2:** applying a list of preventive measures, identified beforehand during a hazard analysis performed on a local or regional level, by a group of experts, regardless of the production system. In this case, the application of the HACCP method is defined as the development of a referential for good practices. In this case, the points of the referential correspond to a set of preventive measures that will have been predefined by a group of experts. But this referential is really the result of the application of the HACCP method.

With regard to strict application of the HACCP method, these adaptations in no way take away the validity of the method. First of all, the production processes are based on agriculture and an entire group of *activities* (soil preparation, sowing, treatments, harvest,…), of which the sequences are sufficiently similar from one farming system to another within one same region so that the choice of performing this analysis on a regional scale remains pertinent. Then, there exists a relative homogeneity of the potential risks from one farming system to another, as a result of a relative similarity of the farmer's practices. The main difficulty remains however, the characterization of the crossover effects of the environment and the practices. The choice of one strategy or the other for adaptation of the HACCP method therefore depends on the objectives pursued by the actors.

1.3.- The choice of methodology: a cost/benefit analysis.

To assess the motivations or the obstacles related to the adoption of the HACCP method in the agro-food sector, many studies have been performed based on a cost/benefit analysis (Unnevehr, 2000). These studies show that the time allotted for reading of the requirements and adaptation by the developer with regard to the HACCP method is under estimated (Colatore et Caswell, 2000). These adaptation and comprehension difficulties are *a priori* all the more significant when the method is used to solve problems for which it was not originally developed. They entail, in any case, the training of the personnel responsible for its application and management costs related to the information. From this viewpoint, the development of self-diagnostic guides used directly by the farmers is not enough to ensure this initial diagnostic. The analysis grid proposed by Colatore and Caswell (2000) therefore defines many categories of costs associated to the application of the HACCP[12] method.

Table 2: The costs related to performing a HACCP analysis.

	Total Costs for Adopting the HACCP method	Indicators
I	**- Development phase**	*Complexity of the HACCP plan, function of the number of critical points and time and cost related to development*
II	**- Training costs**	*Internal/external Training costs*
	- Control and information management costs	- Recruitment of personnel - Additional analysis costs - Equipments costs - Costs for corrective actions Costs for modification of practices *Costs evaluated by the farms*
	Revision and maintenance costs of the HACCP system	
III	**Validation and external control costs**	Qualification system

According to Colatore and Caswell (2000)

In these studies, the development costs were evaluated according to the complexity of the HACCP plan (assessed with regard to the number of critical points) and the necessary time (in proportion to the number of critical points). In the case of farming systems, an individual analysis is necessary in certain problematic situations for many reasons: i) the necessity of implementing

[12] Unlike the studies performed in the works of Unnevehr (2000), where the assessment of the conditions for application of the HACCP method was made *ex post*, generally by questionnaire, the approach adopted was contrarily that of intervention research and an analysis *in situ* of the options adopted during the execution of the project and the difficulties encountered by the developers (David et al. 2000).

measures and analyses on an individual basis that are very costly (soil analyses,…) depending on the size of the farming system; ii) the very existence of scientific reference materials not available on a local level; iii) the necessity for specific qualifications in the performance of an analysis and use of outside advisors. The choice of strategies for the adaptation of the HACCP method therefore depends on many factors.

The first factor takes into consideration the *degree of critcality* of the problems to be resolved. For example, the localization of certain farming systems in sensitive zones justifies the use of individualized Agri-Environmental Diagnosis (AED), permitting implementation of measures that are more accurate and better adapted to the local conditions (identification of critical points, prioritization, impact assessment…). By performing risk analyses on a regional scale, or on a relatively large territory, determination of the situations at risk could be less accurate.

The second factor relates to the *reproductibility* of the method in different territorial contexts (in particular it is linked to the crossover effects of the *environment* and the practices), that is to say the ability to perform this type of analysis for a greater number of farming systems at a reasonable cost. The performance of a risk analysis on a regional scale, rather than on an individual basis permits a reduction in costs of developing the HACCP plan. The referential for good practices therefore corresponds to an operational translation of a set of pre-identified preventive measures.

When choosing one strategy or the other for adapatation of the HACCP method, arbitration must be carried out between the expected degree of accuracy of the analysis and the effectiveness of the approach. By performing the risk analysis on a regional scale, or on a relatively large territory, the risk may lose in accuracy what may be gained in ability to apply the method on a greater number of farming systems (table 3). These two strategies should therefore be considered complementary rather than competitive.

Table 3: The adaptation of the HACCP methodology: A Cost/Benefit structure

Conception cost at the farm level	**Strategy 1** **Simplified HACCP**	**Strategy 2** **Traduction into good farming practices recommendations**
Accuracy level /error's risks	+	-
Reduction of initial conception costs	-	++

From an agronomist's and/or economist's point of view, the translation of the HACCP method in the form of a referential for good practices appears to be less "efficient" than the individual approach to risk analysis (Girardin et al. 2002). Nevertheless, the objective of this method is to propose a definition and a choice of *indicators* that remain appropriate and most of all easy to implement within the farming system. The choice of translating these HACCP principles to a referential for good practice is justified by an analysis of the intial costs of development, adaptation and training of the actors. One of the principal difficulties is, in fact, connecting the agri-environmental indicators of the actual practices of the farmers and the underlying methods of reasoning for these practices.

II Application of the HACCP method: the Quali'Terre approach:

An example of an adaptation strategy for the HACCP method in the form of a guide to good practices is given by the Quali'Terre® referential. The principles of this referential are based on an adaptation of the HACCP method (Aubry and Mousset 1998). But it also covers areas that are often ignored in the specifications developed for a certain production or crop, such as security in the workplace, information management…. These measures were given considerabe re-examination in the decree regarding Sustainable Agriculture. After having recalled the principles from which this referential was developed **(2.1),** we will come back to the conditions relating to the application of the HACCP method and the adaptations carried out in order to take into account the specificities of the agricultural activity **(2.2).**

2.1. Creation and principles of the Quali'Terre® referential.

Following the *"Mad cow crisis"* in 1996, farmers were faced with a multiplication of specifications and requests for information and traceability, often contradictory and rarely taking into account their practices and management scales[13]. The chamber of agriculture of Picardie, concerned with the brand image of the regional crops, hoped to bring about contemplation of the guarantees for quality and the methods for ensuring greater readability of the practices and methods of production of the farmers. The Picardie region is however not very involved in the processes for product certification (Label type, Protected Denomination of Origin, Organic farming,…). Another approach was therefore favoured, inspired more by the quality and environment management systems defined by the ISO 9000 standards for quality and ISO 14000 for the environment (Mazé et al. 2000, 2002).

The objective of the local agricultural supervisors was to respond to the expectations of society and to regain a positive image in the eyes of the consumers. It was a matter of developing an approach, with advisory and support tools, able to reach the highest number of farmers possible. Picardie had fixed the objective at 50% of the qualified farmers within 10 years. This concern with targeting a large number of farmers greatly assisted in the orientation of the entire concept of the method. This choice led to favouring the development of a comprehensive guide to good practices for the farming systems, rather than a direct application of the ISO 9000 and ISO 14 000 standards judged to be too elitist. But in regard to the specifications or *"guides to good practices"*, of which circulation has been considerable within all sectors of agriculture since the mid 1990's, the Quali'terre® approach introduced an important change.

Indeed, the guarantees do not concern the intrinsic characteristics of the final products measurable following the harvest (protein content, dry matter content, pesticide residue content etc…), nor the techniques for production particular to a given production (characteristics of the seeds, sowing date, etc..). The heart of the referential is concerned with the farmer's methods of production, not for only one or a few productions, but across the entire farming system. Most of the farming systems do not specialize in a unique production or crop. Therefore interdependencies exist in the manner in which crops or productions are managed (Papy, 2001b). The referential is therefore rather expansive.

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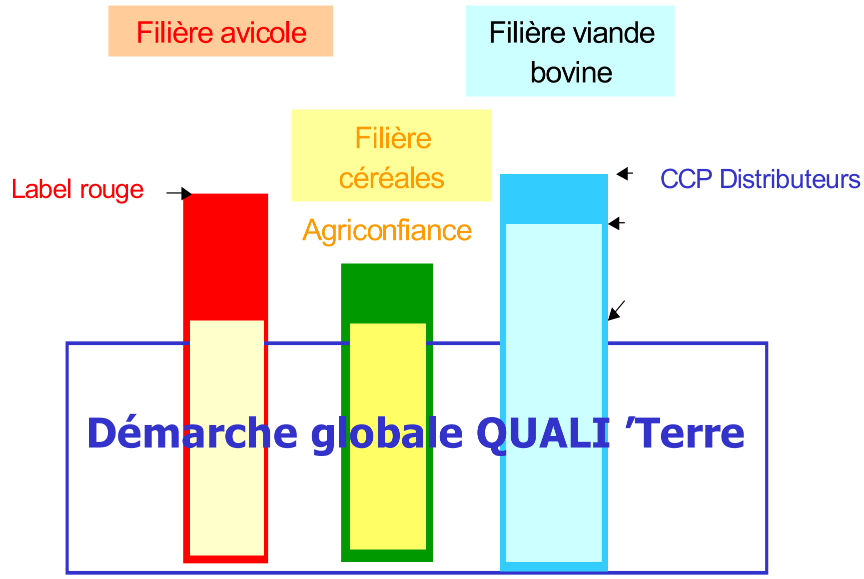
[13] For example, the information requested relating to the traceability procedures often concern one parcel of land, while the farmers generally manage blocks of land within a plot, even entire plots of crops (Aubry et al. 1998, Aubry 2000).

SCHEME 1 ***a basis for good practices, for the approaches by chains***



This expansive approach to the Quali'terre® referential, like the one proposed with regard to Sustainable Agriculture, is compatible with an approach by chain, provided that a large number of cultural activities are common to the different productions of the farming system (cf. Diagram 1). But the development principle retained avoided the typical approach that would add the criteria of the *guides to good practices* developed for each production, as well as making a compilation of the environmental regulations concerning the agricultural activity. Components that surpass the field of environment and product quality (safety in the workplace, information management,…) were taken under consideration because they reflected the expectations perceived or presumed by society. On the other hand, the latter is generally not integrated into the chain's approaches or into the product certifications.

The development of the referential was carried out using farming systems with large crops and crop productions as central references. For animal productions, an equivalent principle was adopted with regard to the *guide to good breeding practices*, developed on a national scale. On the theme of environment, the referential takes into account risks such as water pollution, quantitative water management, soil erosion, waste management, maintenance of biodiversity and landscapes. In addition, it integrates themes such as the sanitary safety of the foods, personal safety, the transparency of the methods of production, animal welfare. Its translation into a guide to good practices responds to the concern of supplying farmers and agricultural advisors with diagnostic tools that are easy to implement[14]. The structure of this referential contains three parts: a) management of the farming system, b) the crop productions and c) the animal productions. (cf. table 4).

Table 4: The chapters of the Quali'terre referential

Content of the Quali'Terre® referential		
A – Management of the farming system	B – Crop Productions	C – Animal Productions
Transparency and traceability External relationships Training and qualifications Material and installations Management of waste on the farm Erosion Landscape aspects of the farm	Phyto sanitary protection Fertilization Irrigation Storage of the harvest	Identification Sanitary follow-up Feed Environment and access to breeding Hygiene and welfare.

One of the difficulties encountered during the development and the formulation of this referential relates to the definition of indicators easily manipulable by the actors responsible for its application. Rather than direct application of the ISO 9000 and ISO 14 000 standards (and for the latter its environmental diagnostic), the choice of this method responded to the concern for higher consideration of the logic of global management of the farmer and the impact of these practices. Contrary to the environment analysis (AED) performed in regard to an ISO 14001

[14] Various tools have been developed by Agro-Transfert Picardie supplementary to the Quali'Terre® referential: an audit manual and its electronic application in ACCESS, instructions for use, collection of documents from a Quali'Terre® advisor. These tools permit taking into account the characteristics of the environment (regulation zoning, type of soil) and those of the production system of the farmer.

approach, for which a hazard analysis is performed on an individual basis, the principle adopted by Quali'Terre® was to perform this analysis on a regional scale.

2.2. Development methodology of the referential.

The development of the Quali'Terre referential was done is three stages (see annexe). The first stage led to the performance of a "theoretic" HACCP analysis from the most recent agronomic information concerning large cropping systems. Its objective was to identify a set of potential risks *a priori* and from consultation with scientific experts. The second phase permitted a prioritization of these risks with regard to the regional situation observed in Picardie. A second group of experts (mainly advisors belonging to the chamber) were consulted with regard to their knowledge of the regional environment and the farmer's practices. The last phase validated the feasibility of the referential by way of a series of tests on the farming systems.

PHASE 1 – Theoretical hazard analysis and identification of possible actions

In standard HACCP analyses, the hazard analyses are performed product by product using a fabrication diagram as a basis. As a result of the interdependencies between productions within a large number of farming systems (Papy, 2001b), the method followed by Aubry and Mousset (1998) was carried out with two different entries according to the type of problems. The analysis of *"environmental hazards"* was performed, by adopting an entry for "activity" (sowing, provision of fertilizers, phytosanitary protection, ...) , then for each activity, an entry "process stage" as in industry. For a certain number of environmental problems an entry of "potential risks" (erosion, water pollution,…) more in keeping with the method generally adopted for the AED was retained. The activities for which a risk analysis grid was rendered are: nitrogenous fertilizing, management of breeding effluents, use of phytosanitary products and use of mud and fertilizing material.

Table 5: extract from the risk analysis performed for the activity of "mineral fertilization".

Productive process step	**Potential Hazard**	**Possible actions**	**Efficiency**	**Feasibility**
Nitrogenous mineral fertilization : **-** Storage and maintenance of materials - Choice of input dates - Choice of quantities provided	Water pollution Air pollution Content of nitrates in food products	Leakproof tank insulated for water holes Soil analysis, Waterholding basin around the tank, Reasoning according to the "method of bilan"		

The method developed by Aubry-Mousset (1998) is general enough to be applied in other regional or territorial contexts for large cropping systems. For the second phase, the choice made is therefore a matter of translating this risk analysis into a referential for good practices corresponding to a set of preventive measures (strategy 2).

PHASE 2 – Prioritization of risks and assessment of actions on a regional scale.

The validation of the preventive measures to be included in this referential for good practices was performed by a group of "regional" experts.

In a first step, they tried to define the principal situations at risk for a given hazard and identify the most appropriate practices to be implemented by the farmers. The appropriateness of this method rests on the fact that the sequences of cultural actions within a same region are sufficiently similar from one farming system to another, within a same region. For example, extensive intercultural situations on sandy soil, following cultivation of a leguminous plant and after providing an organic conditioning of type II (Cf. Use of the Quali'terre®, 2000 audit manual) have been identified as being situations where the risk of nitrogen lixiviation was the greatest for the Picardie region. For these situations, the group of experts determined that a vegetation cover (undersown crops, crop regrowths) was the most appropriate practice on a regional scale. This recommendation could differ in other regions.

In the second step, this group of experts was asked to prioritize these good regional practices according to 4 specific criteria: is it an element contained in the regulations? It is an efficient element with regards to the targeted objectives? Is it easily implemented or executable by the farmer? Are these practices verifiable by a third party? (Aubry et al. 1999). According to feasibility, efficiency or their regulatory traits, the measures were therefore arranged into two levels (level A and level B). Level A applies to the entire farming system, while 80% of the criteria of level B have to be respected for the farming system to qualify.

This differentiation of measures into two levels permits an introduction of a certain individualization of the referential with regard to constraints particular to each farming system. For example, a farmer who has no situations that are at great risk of nitrogen lixiviation would not be encouraged to plant undersown crops. This method permits taking into consideration the existence of a flexibility of the practices according to the farmers, but also the existence of regional differences in the advisory practices and technical recommendations defined by the agricultural development organizations.

Phase 3: Application on the farming system level.

The last phase of development of the referential is based on a validation *in situ* with application of the referential into the farming systems by agricultural advisors. This last phase allowed considerable improvements to be made in the formulation of points in the referentials and their comprehension by the advisors/auditors. In many situations encountered in the farming systems, there was a margin for interpretation to see if one measure or the other applied or did not apply. These margins for interpretation are all the more significant when there is a verification of the farmer's application of a method of reasoning, rather than one agronomic technique or another. The referential was therefore completed by supplementary documents destined for the advisors/auditors (audit manual and and instructions for use) facilitating this interpretation and the development of a diagnostic of the farmer's practices.

With regard to the extension of the approach to other regions, it was decided they should decline the referential regionally, that is to say they should identify the situations at risk and the most appropriate actions on a local scale (Toublanc, 2001). This translated into a second version of the referential that was more generalized (the same for all regions), but accompanied by different auditing instructions according to the regions. For the auditors, it is a matter not only of assessing the farmer's practices, orienting them towards the most appropriate level B measures but also determining themselves the techniques best adapted to the farmer's situation. This change had major implications on the conditions for assessment with regard to respect of the referential.

For example, in the second version of the Quali'Terre® referential, measures for nitrogenous remains in the soil are not recommended in all regions due to the fact that they do not always exist and are not always interpretable (in particular calcareous soils) but on the other hand the taking into consideration of the soil supplies in the rationale for nitrogenous fertilizing of the crops is generalized[15]. It therefore follows that the farmer must be able to prove the actions were implemented. The application of the HACCP method requires that the farmers establish efficient recording procedures and define the measures that allow for the verification of proper functioning of their HACCP system. This is an essential principle and precedes the implementation of each concept of progress and continual improvement of quality.

III The implementation of the Quali'Terre® referential: the limitations

In the case of the Quali'Terre® referential, the choice of translating the application of the HACCP method into a referential for good practices was done thinking that its application at the farming systems level would be easier. Here the point of reference was the implementation of management referentials, such as the ISO 9000 and ISO 14 000 standards in agriculture (Wall et al. 2001, Grolleau, 2001). But, even from strictly an agronomic point of view, the level of requirements does not seem insurmountable, on the other hand, by experience the transversality of the referential proves relatively demanding for the farmers. A study perfomed in Picardie during the year 2000 (Van den Bossche, 2000) permitted an assessment of the feasibility of the referential in large cropping systems and the nature of the difficulties encountered.

3.1 – Testing of the implementability of this referential by farmers.

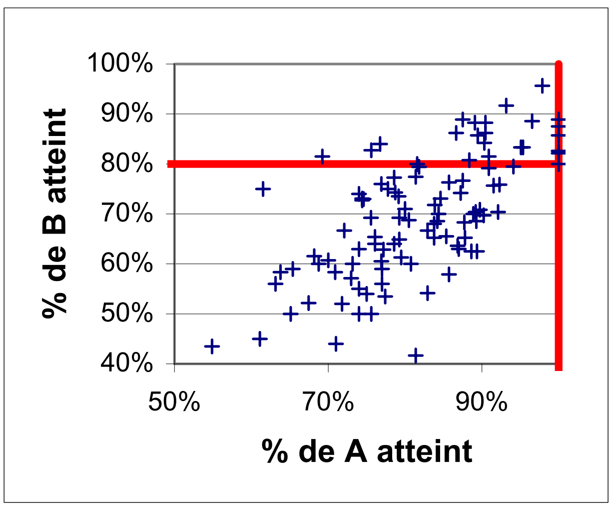
A testing of the referential was performed in January and February, on a sample of 102 farming systems, of which 65 were multiple cropping systems and 37 were multiple cropping-breeding systems. The dominating productions in the farming systems studied were those of the Picardie region, namely crop production of potatoes, cereals and beets. More specific productions, such as chicory, fruits, grasses or asparagus were also present in the sample (see Annexe). Almost all types of farming systems in the Picardie region were represented. We note however that the small farming systems for productions of cereals and beets as well as small

[15] This principle explains the absence from the referential of obligations relating to use of certain agronomic techniques, interpreted by certain agronomists as an insufficient level of requirements. It is not a matter of giving one's opinion on the appropriateness of one method or the other (for example, the azobil® method) compared to

dairy farming systems were under-represented. While the average UAA (utilized agricultural area) in Picardie is 78 ha, the average area of the farming systems studied is 198 ha, with 80% of farming systems cultivating more than 100 ha. The structure of the sample also integrated farming systems of greater size than the average size of the farming systems of the region.

On a sample of 102 farming systems, only 6 met the conditions for qualification being 100% of level A and 80% of level B at the time of the study (cf. graphic 1). There were no production systems that seemed to be significantly favored by the referential. Even if the multiple cropping-breeding systems have more requirements to fulfil than the multiple cropping systems, the multiple cropping-breeding systems on average do not obtain worse results than the multiple cropping systems. Contrary as to what was expected, the referential was thus revealed to be relatively restricting for the farmers included in the sample.

Graph 1 : Results of the audits of the farming systems in the sample



The principal sources of restraint with regard to the application of the referential are indicated in the table below (table 6). This table shows that the obstacles do not come only from the cost of investment necessary to fulfil the requirements of the referential (in particular with regard to the question relating to construction of waterholding basins around the tanks of pollutant products). They are mostly the result of technical and organizational constraints, in particular in terms of information management (recordings of activities relating to a single parcel

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other methods, but more simply a matter of assuring that the farmer uses a certain method, that he is able to show that he can rationalize his practices and how he does so.

of land, storage, archiving of this information,….). Information management is one of the principal constraints encountered by the farmers with respect to the application of the referential.

Table 6: The principal points of restraint with regard to the referential (version 2000)

Points of the referential	Number of non-compliant farming systems	Number of farming systems concerned
Waterholding basin around the hydrocarbon tank	85	88
Waterholding basin around the liquid nitrogen fertilizer tank (if more than 100 m3)	75	4
Empty non pierced tanks, not stored in a specific place	61	102
Locked facility or cabinet reserved for storage of phytosanitary products	54	102
Authorization "installation is recorded when there is more than 100 m3 of liquid fertilizer"	50	2
Control of the sprayer every three years	46	101
Compliance of work related equipment when there is presence of labour	45	71
Recording of the date of planting and the species of the undersown crop	40	70
Recording for each parcel of land with regard to conditioning and fertilizing	38	89
Sanitary tests upon introduction of animals into the ovine herd	38	8

The points of the referential relative to materials and the workshops were of most importance. The waterholding basin around the hydrocarbon tanks is the requirement least respected in the sample. Then there are the requirements relating to phytosanitary protection (accommodation facility, sprayer control, protection of the applicator, and storage of empty tanks). Recording of information (recording of inputs and treatments, date the crops were planted,…) is also part of the points that could easily be improved. The identification of the points of the referential least applied is not sufficient to determine the feasibility of the referential and the possibilities for improvement for farmers to comply with the requirements.

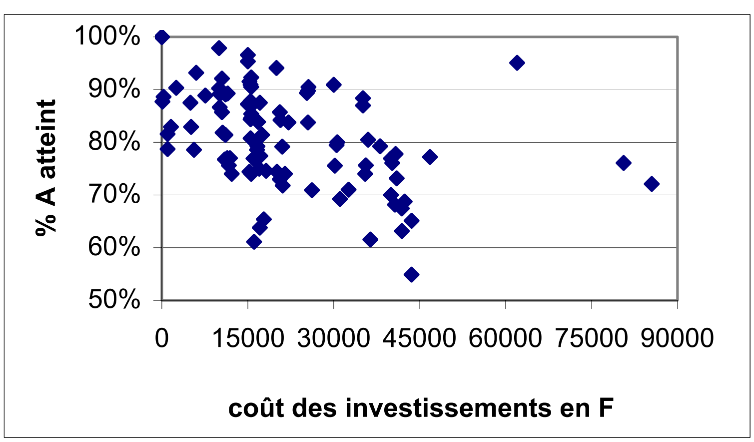
3.2 – the Obstacles for farmers: organizational and information management

A more indepth analysis attempted to characterize difficulties relating to the application of the referential with regard to the type of constraint it would impose. The criteria of the Quali'Terre® referential corresponded to different categories of constraints classified in the following manner:

- **Organizational,** of which implementation compels the organization of activities on the farm (materials, organization of fields,…),
- **Informational,** in particular linked to traceability and recording of practices on paper or electronically. The recording constraint is great if the action requested is repetitive and boring for the farmer. If no recording is requested, the point of the referential does not come into play.
- **Technical,** with regard to criteria of which implementation requires a particular technical skill (rationale concerning fertilization or phytosanitary interventions, observation of the condition of the crops,….)
- **Financial,** for criteria of which implementation depends on acquiring investments or has an operating cost for the farmer.

For farms that have salaried labour, one of the principle obstacles is caused by compliance and protection of the installations. For the entire group of measures of the referential, the significance of each constraint was assessed on a scale of 0 to 2. With regard to the financial constraint, an average cost was estimated for each criterion of the referential. From this analysis grid, it was possible to assess the average level of investment that the farmer would have to acquire to respect the points in the referential (Graphic 2). An analysis of the results showed that the investments necessary were, for more than half of the farms, less than 20 000 FF (approximately 3000 euros).

Graph 2: average investments to be acquired by the farms to achieve qualification.



The financial constraint, if considered a reality for certain farms, is however not insurmountable. Taking over part of these investments as part of the Land Management Agreements allowed for a decrease in the constraint. Simulations produced from the farming systems samples show that, even if this financial constraint is lifted (for example, as part of the Land Management Agreements), most farms will not reach the required level of the referential. The principle constaints in the application of the referential must be researched elsewhere.

The objective of this type of characterization is to permit the formulation of a diagnostic and to adjust the actions to be led with the farmers in order to facilitate the implementation of this referential. The necessary delays for achieving compliance to the standards prior to qualification (generally 12 to 18 months) highlight the significance of the changes requested of the farmers. Despite everything, one of the principal difficulties of the referential remains its expansive character. It is not enough for a farmer to be good with regard to a crop or a particular production, as is the case for the specifications relating to particular products. On the contrary, it is necessary to assure the application of the good practices on the entire cropping activity. It is therefore at the farming systems level that the level of requirements of the referential is heightened. These requirements are not necessarily translated in terms of direct financial costs, but rather by new constraints on the organization or on the follow-up of the productions.

3.3 – A comparative analysis of the two strategies of HACCP implementation

The choice made by the designers of the Quali'Terre® approach was initially to develop a referential for good practices rather than passing on directly to the development of quality and environment management systems (QEMS) of the ISO 9000 and ISO 14 000 type. These management standards appeared to stray too far from the actual practices of the farmers and their concepts were considered too abstract or related to areas rarely or poorly taken into consideration. The creation of the Quali'Terre® referential appeared to be an application more easily adapted by a large number of farmers. However, its permanent implementation into the farming systems was revealed to be slower that expected, translating into a level of requirements relatively significant for the farmers. The results of the study performed with regard to the farmers led to a questioning of the appropriateness of the choice of strategy itself adopted within the framework of the Quali'Terre® referential, namely translation of the HACCP method in the form of a guide to good practices on a regional scale (strategy 2) rather than carrying out an Agri-environmental diagnostic on each farming system (Strategy 2). Assessment of the different strategies must simultaneously take into consideration the various development and implementation costs but also the costs relating to training, advices and control at the level of the farming systems for each strategy (table 7) [16].

Table 7: Comparative analysis for costs of development and implementation

	Training costs	Costs for development of the risk analysis or environmental diagnostic	Costs of implementation by the farmer	Cost for advice and training	Individual costs for certification
Strategy 1 – Indiv analysis (QEMS).	+++	+++	+	+ of 2 days	+++
Strategy 2 Quali'terre referential –	+	+	+++	2 days	+

If we perform a comparative analysis of the costs/benefits of the two strategies for adaptation of the HACCP method, the related gains identified at the level of development of a referential for good practices on a regional scale (strategy 2) are partly compensated for at the level of the farming system, by a heightened level of requirements at the time of implementation. As part of a collective approach, the same minimum is imposed on all farms. In the case of a QEMS or an AED (strategy 1), the approach is strictly individual and therefore allows each farm to establish its insertion into the *continual improvement system* at its own rhythm. The approach can therefore be more progressive for the farmer. The latter defines the priorities and the means retained to implement environmental actions. Certain costly actions may even be postponed without this having any effect on the awarding of the certification.

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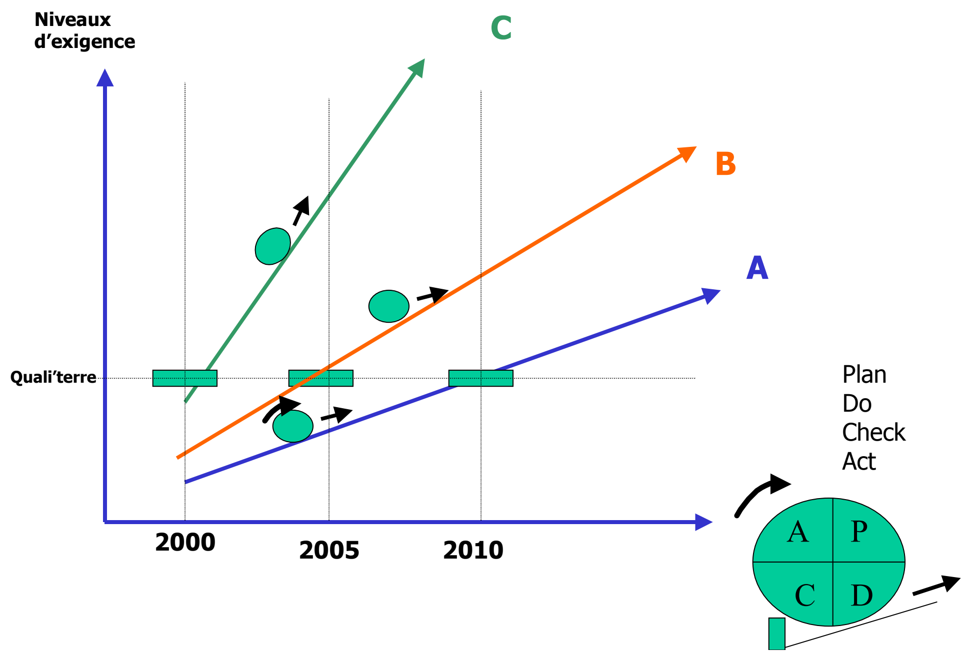
[16] The costs/benefits analyses applied to the HACCP methods (Unnevehr, 2000) or to environmental management (Wall et al. 2001) compare these costs, either to those of a regulartory approach therefore compulsory (Unnevehr 2000), or to the financial benefits of a certification (Wall et al. 2001). In the present case, interviews with the farmers show that their interest for these management systems lies less in obtaining increased remuneration than it does in gains from a better organization of the activity.

Schéma 2 : Une démarche de progrès



The initial objective of the project was to include the farmers in the implementation of the continual improvement system for quality and environment within each farming system (Aubry et al. 1999). Since the official launching of the Quali'Terre® approach, two years ago, the farmers have been converting, investing at their own rhythm in a progressive manner to slowly comply with the referential. Their efforts, however, go unnoticed in the sense that qualification rests on the respect of the referential. Therefore, strictly speaking, these farmers are not qualified. Given the choice of the rhythm of progression, they manage the priorities that are generally linked to the production activity. The manner in which they determine the choice of actions, of which they assess the priorities is not expressed, however they apply the principles of the Deming model. Thus, a referential, such as *Quali'Terre,* or in the future *Sustainable Agriculture,* already introduces, even if it is still limited, the concept of progressive improvement of the farmer's practices.

Conclusion: Toward individual environmental management systems

The paradox of the *Quali'Terre®* approach is having become a referential for good practices, while the intitial objective of the project was to develop a management system for quality and environment inspired by the ISO 9000/14000 standards and adapted to the agricultural activity. This referential is revealed as being much more constraining for the farmers than initially expected. Unlike most technical referentials, specifications or guides to good practices developed until now, the basis of *Sustainable Agriculture* (i.e "Agriculture Raisonnée") greatly inspired by the *Quali'Terre®* referential, subscribes to a logic of progression and continual improvement of the environmental management practices of the farmers. It is a fundamental change of position possessing at least two major implications:

- for agricultural development, first of all, by redefining the position of the agricultural advisor, not with regard to reporting prescriptions, where the advisor is responsible for finding *"the"* correct technical solution, but requiring a more global approach to the farming system.
- for agronomic research, secondly, by requesting the development of scientific references, no longer resulting uniquely from the practices within the parcels of land, but also from the information concerning the farmer's *management practices* at the level of the farming system.

From this viewpoint, Sustainable Agriculture should be considered as being the first step before the implementation of individualized quality and environment management systems (QEMS) within the farming systems. In conclusion, the notion to be retained should be that of a complementarity between these two types of approaches, with the objective of performing an effective assessment of the environmental performances of the practices implemented by the farmers[17].

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[17]Environmental performance is defined as "*a measureable result of the environmental management system, in relation with control, by the organism, of the environmental aspects based on their environmental policy, objectives and environmental targets"* (ISO 14001)

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ANNEXE : Composition of the sample and representativity.

Table 8 : types of farms involved in the sampe and comparaison with the general farm population in Picardie.

Type	**Nb of farms involved**	**% sampple**	**Picardie**
Large sugar beet producer (BG)	19	19%	9%
Small sugar beet producer (BP)	7	7%	11%
Small Crop system (C0)	5	5%	16%
Céréalier moyen sans MO (C3)	12	12%	3%
Gros Céréalier avec MO (C4)	11	11%	4%
Laitier intensif avec herbe (L5)	2	2%	2%
Polycult./lait grande dimension (LG)	11	11%	11%
Fresh Potatoes producers(P1)	10	10%	3%
Pomme de Terre indus (P2)	4	4%	2%
Pomme de Terre Fécule (P3)	5	5%	3%
Polyculture-Eleveur HS (V1)	3	3%	1%
Polyculture –ovin (V2)	5	5%	1%
Polyculture bovin allaitant(V3)	7	7%	5%

D'après Van den Bossche (2000)

Annexe : The operational steps followed for the conception and development of the Quali'terre®

	Les étapes de conception et de mise en place du référentiel Quali'Terre®	
Step 1	Analyse théorique	- Consultation d'experts scientifiques (INRA) : sept-dec. 1997, - Réalisation de l'analyse théorique HACCP sur les systèmes de grandes cultures : 1er semestre 1998, - Elaboration d'une 1ère version du référentiel : juin 1998.
Step 2	Analyse régionale	- Validation par un groupe de conseillers : hiérarchisation des risques et évaluation des actions possibles à l'échelle régionale Juin à décembre 1998.
Step 3	Faisabilité	Tests de faisabilité auprès de 110 exploitations pour valider la formulation des questions et leur compréhension : Fev-juin 1999
Step 4	Lancement officiel	Lancement de la démarche en Picardie : décembre 1999