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Technology Transfer Study of Integrated Farming Systems in a Small Arable Crops Region with Environmental Constraints

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Summary

Integrated Arable Farming Systems take into account all natural and agronomic environment of the farm to reduce the level of external inputs. Those systems require an holistic approach of the crop production with regard to rotation, varieties selection according to their disease sensibility and quality, sowing dates and densities, crop protection adjusted to diseases populations and crop stages, fertilisation adapted to soil potentials and plant needs. We have setting up in 1993 "Plot-Farms" with farmers from a small arable crops region. Integrated farming systems are conceived to give an answer to the triple problem of the region: agronomic (landcare), economic (low incomes) and environmental (water pollution). We want to test on those farms, the feasibility of IAFS technology. This study is split into four chronological steps: territory diagnosis, farm agri-environmental diagnosis, building up of a farm evolution project and carrying out this project. In order to carry on the project, the farmer has to bring a farming system up to an integrated system. The acquires the decision making process specific to IAFS throughout crop-walks, workshops, and crop observations.

The technology transfer evaluation is made by identifying the major psychological constraints of the farmers to the evolution of their farming system, the technical and economical feasibility of the proposed decision making process and the environmental effects of integrated farming systems.

Introduction

In France, the research on integrated arable farming systems (IAFS) within I´ "Institute Technique des Cereales et Fourrages (ITCF)" begins in 1990 by the setting up of Microfarms". We test on these farms the feasibility of integrated arable farming systems (VIAUX et al., 1995). IAFS are farming systems which take into account all the parameters which run the farm in order to reduce the level of external inputs. Moreover, integrated production is defined as a farming system which "integrates natural resources and regulation mechanisms into farming activities to achieve maximum replacement of off-farm inputs, secures sustainable production of high quality food and other products through ecologically preferred technologies, sustains farm incomes, eliminates or reduces sources of present environmental pollution generated by agriculture, sustains the multiple functions of agriculture" (OILB/SROP, 1993). In 1993, in a small arable region, La Ferte-Vidame in France, a new step has been get over, by the setting up of a network of Pilot-Farms. We have identified three major constraints in this area: agronomic, economical and environmental. The small arable crops area concerned by the study is a watershed providing Paris in drinking water. This water is run by a company. For 30 years, the increasing of nitrates concentration in this water is about 1,2 mg NO_3^-/l a year. The drinking water is also polluted at some periods of the year by clay particles (turbidity). Our aim is to evaluate in real conditions the technical and economical feasibility of IAFS decision-making processes. This study is a « research-action » as defined by CHIA and RAULET (1993); it aims to test the technology transfer feasibility of IAFS in a specific context where two objectives are opposed: the economic profitability of the farms and the environment care, in particular the water quality.

On pilot-farms, the searcher has to compare his experimental references with the reality of the farmer. The field or the plot is no longer his study object, but the farm and the farmer who work in an environment defined by its natural, economical and social characteristics. The « Pilot-Farm » study objective is: to identify the technical, economical and psychological constraints to the IAFS technology transfer and find solutions with the farmer, to demonstrate the technical and economical feasibility of IAFS; to organise training courses for farmers and farm advisors to acquire and know how to bring the current farming systems up to integrated farming systems. These objectives are similar to the one of several other studies or projects working on Pilot-Farms in other regions of France or other European countries (JORDAN at al. 1995, EL TITI 1990, BROSSIER, CHIA, 1993, BLUM, ROUX, 1994).

Materials and methods

During this campaign 1995-1996, we are working with 15 pilot-farms. They produce cereals, peas, oilseed rape. Some of them produce also poultry, pig, dairy or cattle. A technical committee manages this study. This committee brings together technicians and searchers of ITCF and the extension service of the department. We discuss on the realisation of the objectives of the study and find solutions to the identified problems. There is also a piloting committee composed of the different actors concerned by the evolution of agriculture in the region and by the environmental problem of the watershed. The study is split into four chronological steps: -the territorial diagnosis of the watershed; the agricultural and environmental diagnosis of each pilot-farm; the construction by the farmer of his own evolution project; the implementation of the project.

The territorial diagnosis identifies the major advantages and constraints of the region concerned by the study: mostly the economical problems, human characteristics of the rural and agrarian environment of the region. The farmer will have to take into account all these elements to elaborate his personal evolution project. The farm agri-environmental diagnosis uses the classical methods of characterisation of farms (technical, economical, environmental topics) and tries to replace them in a sustainability perspective. We insist particularly on the analysis of the cultural practices of the farmers and their consequences on the environment (water pollution potential, landcare, biodiversity).

We identify also the economical viability of the farm and its long-dated survival. During the next step, the farmer has to build up a project based on the results of the two diagnosis and his own evolution plans. It is a mid-term project. For the implementation of his project, the technical committee and the farm advisor help the farmer. At La Ferté-Vidame, projects of farmers include an evolution of their farming systems towards integrated farming systems in order to answer the economical and environmental challenges (VIAUX, 1995). Hereafter are some more details on the last step of our study: the implementation of the farmer's project. During this phase, the farmer acquires all the technical, economical and regulation matters wich will help him to realise his project. The farmer signs a contract with the technical committee. It means that the farmer has to realise as good as possible his project and test the application of integrated farming systems technical on his farm. At any time, the farmer takes the decision; he may or may not act in accordance with the technical advises given. However, whatever his decision may be, it has to be justified. In the line of the results of the two first campaigns, the technical committee puts forward several actions following the objectives of integrated farming systems.

Three types of services are given to the farmers. The first ones are training courses: PK and nitrogen fertilisation, information on pesticides, diseases cycles, identification of weeds and pests and thresholds. Training courses are organised aiming at a better grip on environment problems at the farm or watershed level. These specific training courses pay regard to the protection of the sensitive areas, the fertilisation balances, and biodiversity. All the information given during those training courses are valorised during the crops-walks: we observe crops stage growth, pests or diseases populations: These crop walks are opportunities for discussions with and between the farmers on the feasibility of the techniques proposed according to the integrated farming systems. Farmers spent 20 days to attend those training courses and crop walks. At least, at the beginning of the campaign, a cultural calendar is given to the farmer. It is a monthly record of crops observations to do and decision making processes to follow afterwards. The farmers base the analysis of the integrated technology transfer on the realisation of the recommendations and strict rules of those systems. Furthermore, we have to see if the technical advises bring about effectively an evolution of their cultural practices.

Results

At the beginning of the study, we met anxious farmers about their future because they were facing a few time ago to a new charge: their farming system is not compatible with the environment, and specifically the quality of the water. The first action of the company managing the water was to propose the possible purchase of the farm fields located in sensitive areas. The farmers rose up against this proposal and it spoiled the relationships between the two groups of actors. The farmers were worried because no technical and economical solutions were given in order to make compatible their way of farming with the environmental problem.

The study began in that psychological climate, similar to the one described by CHIA and RAULET (1993) in the watershed of Vittel (France). The territory and farm diagnosis allowed the farmers to identify the major constraints and advantages of their environment. A second step consisted into the implementation of the project elaborated by the farmers. The first way of analysing the technology transfer of integrated farming systems may be the study of the feasibility of the recommendations and strict rules. The acceptability of the decision making process and thresholds by the farmer may be directly evaluated by his cultural practices and their justifications. Most of the farmers comply with the recommendations, but only a few observe the strict rules.

The farmer needs at least three campaigns, probably more, to reach an auto-evaluation of the interest of the proposed decision making process. Based on that evaluation, the farmer may accept or not the propositions. At first, the evaluation criterion is mainly economical, and sometimes, is related to the organisation of the work. After, the role of the farm advisor is to give other evaluation criteria like, in our case, farmer's health, water quality, and biodiversity preservation. We noted that farmers try to get a better understanding of the physiology of the plant and a better evaluation of the loss risks. But until now, that knowledge is not followed by deep modifications of their cultural practices. This is particularly true for the diseases and pests' protection. For example, even if farmers choose more resistant varieties, they do not adapt well their cultural practices to the potentialities and sensitivities of the varieties chosen. However, the systematisation of the treatments is decreased and replaced by a better adjustment of the products to the stage growth of the crop and the diseases or pest's population levels.

With regard to fertilisation, the technology transfer is faster. After two campaigns, the farmer is able to calculate by himself his PK fertilisation farm plan according to his rotation, crops potentials, soils type and early fertilisation. This fertilisation plan is followed by most of the farmers. The only constraints to the practical application of this plan are fertiliser's availability by the co-operative and the organisation of the work on the farm.The farmer learns to elaborate a nitrogen fertilisation plan according to the balance method. This method supposes that the farmer measures end winter residues in reference fields, evaluates his fields yield potential and adapts his fertilisation to the several elements of the nitrogen balance. However, this method is difficult to apply: the farmer is afraid of loosing yields with the level of nitrogen calculated and, in general, he overestimates the potential yields of his fields. Especially during this campaign 1994-1995, the effective yields were lower than expected. Then a potential amount of nitrogen has been lost. Also the technology transfer can be considered according to the psychological perception of the farmers for the study in terms of constraints and interest.

The first identified constraint is related to the -real or supposed- work time required by the application of integrated farming systems. As previously mentioned, farmers spent 20 days to get involved in the study in 1995. And this does not include the crops observations made by the farmer himself. Our experience shows that one farmer is not able to survey all his fields if he cultivates more than 130 ha of arable crops. A second constraint relates to the quality and the reliability of the field observations and the validity of the decision taken according to these observations. To strengthen the confidence in our proposition, farmers ask for more technical references to improve and elaborate decision-making processes adjusted to their specific environment. At least, another constraint has been formulated: farmers of the pilot-farms group feel socially isolated regarding to the other farmers of the watershed. The latter are reproaching to the first for favouring little by little the elaboration of new agri-environmental regulations more constraining.

Thanks to the « services » we spoke above, farmers gain a better technical control of their farming system. This study gives them a tool to get an easy access (before the others), technical, political and regulation information. A small local dynamic has been created between the study group of farmers. They become real and constructive interlocutors for the company managing the water in their region. Indeed, especially the farmers of the pilots-farms accepted after negotiations and contractualisation to implement grass beds along sensitive areas of their farms as the water company proposed it. It is possible to analyse the economical effect of the technology transfer having a look to the variable costs of the several pilot-farms. The Figure 1 gives the different levels of the wheat variable costs. There are four values: 1993, 1994, 1995 and « 1995 Low Input (RI) ». The year 1993 is given as a reference to see the evolution of that parameter since the study has began. The years 1994 and 1995 are the two first campaigns of the study. The value « 95 RI » corresponds to the results (without premium) on specific fields cultivated with lower nitrogen inputs, according to the European agri-environmental measures.

Five farmers show a decrease of their variable costs since the beginning of the study. For two others, this value does not change and for one, it increases. In all the cases, we note an increase of the gross margin (Figure 1). The obtained gross margins on low-inputs fields are in average higher than the ones on the other fields. But, on those low-input fields, we note that the farmers do not have an integrated strategy: they have got short-dated practices by just decreasing the pesticides or other inputs quantities. All those results are specific to the two last campaigns and need to be considered carefully. We will have to check if those trends are conserved during the next campaigns.

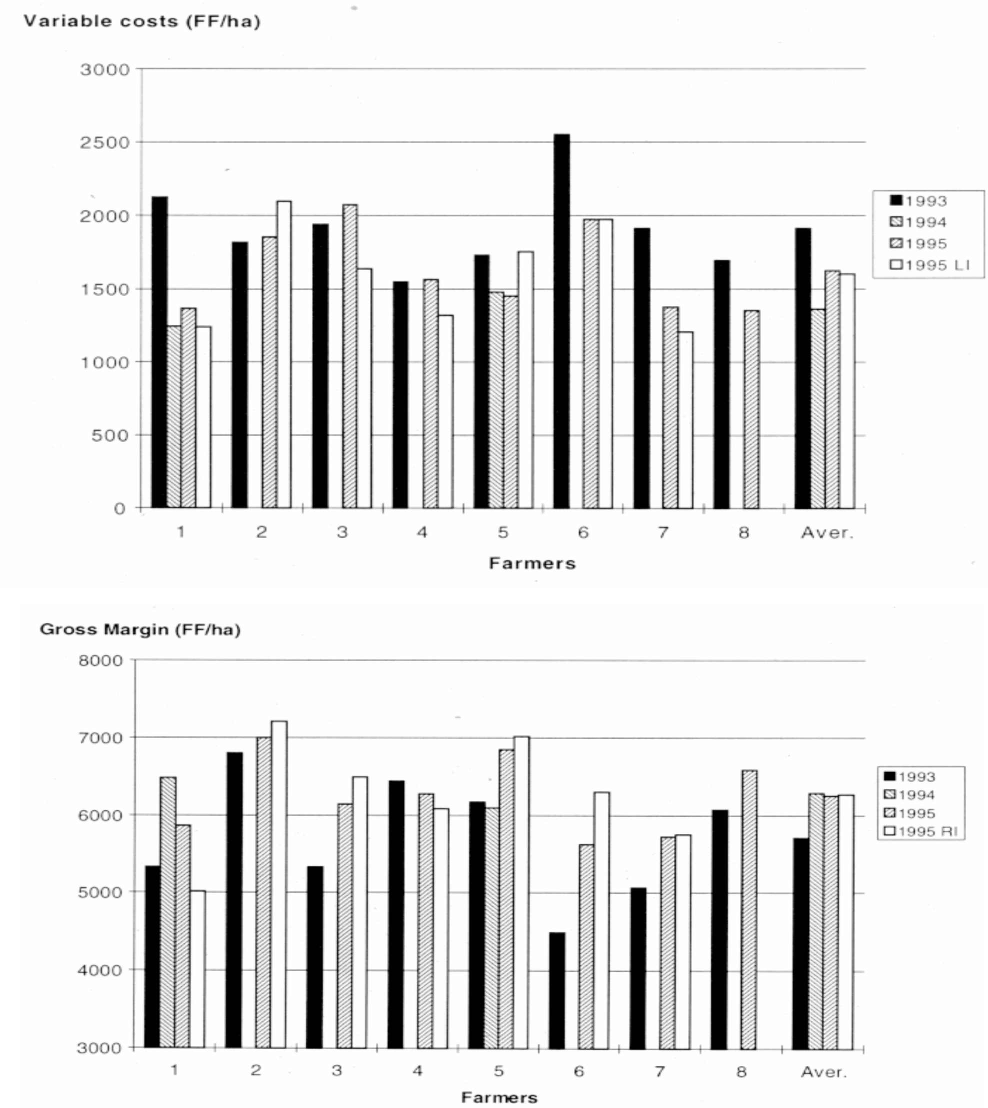

Figure 1: Evolution of the variable costs and of the gross margin of Winter Wheat in the pilot farm

For the wheat, these quantities are adjusted along the campaign according to the crop needs by a measure of the stem-base juice (JUSTES, 1994). On the low-input fields, 20% less of nitrogen has been given to the crops with few losses of yield. We may think that less nitrogen has been lost on these fields. Moreover, there is a single spring crop on 3 to 15% of the farm surface. By this way, it is easy to reach the 65% of winter soil cover. The cover reduces the leaching of elements, like nitrogen, during this sensitive period. 4700 m of rivers run into the pilot-farms network. These rivers are sensitive areas to pollution. 87% of that length is protected with grass margin of gramineas mixed with or without leguminous. These grass beds have been implemented between 1992 and 1995 thanks to free or fixed set-a-sides and notably water company contracts. Those grass beds are the only technical found to limit losses of clay particles, which is the cause of the water turbidity. They play also a role in limiting the leaching of nitrogen and pesticides.

Discussion - Conclusions

Thanks to these two campaigns, we are able to identify the major constraints to the technology transfer of integrated farming systems towards pilot-farms. The major constraints are first psychological and secondly, technical. But we note that both types of constraints are interdependent and have cumulating effect.

The appropriation by the farmer of the integrated technology is obtained thanks to the training courses, crops walks and his own acquired experience. But advisors must supply technical references and decision-making processes adjusted to his local environment. That is one of the major constraints of the farming systems; they have to be adapted to the local conditions. No « recipe » can be applied. Therefore, the farmer has to understand the bases of the biological mechanisms (VIAUX, 1995). The technology transfer of integrated farming system takes time and is high technical farming demanding. A farm advisor for eight farmers seems to be the minimum for an efficient technology transfer. We can also find this technician/farmers ratio in other similar studies (WIJNANDS, 1992; Groupe National pour le réseau des exploitations pilotes PI, 1992).

Moreover, we shall have to increase rapidly the number of involved farms in the study to break the social isolation of the pilot-farms' farmers. For that purpose and in order to economically valorise those more sustainable systems, we will have to integrate to the reflection the other actors of the agrarian marketing chain like, for example, the co-operatives.

Concerning economical aspects, the obtained incomes are slightly positive but these results have to be confirmed all along the evolution of the farming systems during the next campaigns. That evolution assumes the acquisition of new references and more fields observations but also more time. The risks are generally higher when the farmers are learning the new decision making processes. To be integrated by the farmers, those new methods must give a higher economical result.

From the technical point of view, the farmer adopts easier some cultural practices than other ones: it is the case of the fertilisation for which our working margin between the actual practices of the farmer and the one we reach is high. It is more difficult to make the farmer to change his habits regarding the choices of varieties and pesticides. We will have to work on these different topics with the farmers, managing compromises between their anxiety (regarding to the innovations), their own experience and our objective of technology transfer of IAFS.We still have many questions. During the following campaigns, we will try to find some answers to them. Indeed, such a study represents a high financial cost related with the high technical framing of the farmers. Moreover, it takes time to bring farming systems up to integrated systems. How can farmers, working on many hectares, find enough time to reach those new farming systems? Furthermore, the collectivity is also concerned by the evolution of the farming systems. (VIAUX, 1995). Therefore, we will have to identify the means the collectivity is able to give to the farmers the financial and technical helps in order to transform their actual farming system into IAFS. Labelling « integrated products » would be an interesting way of increasing the income of those systems. According to a study in VITTEL (France) labelling this kind of products would suppose an increasing of the cereals price (for example) by 50 % to make the farmers been interested by those products.

This study gives rise to some other questions to which we will have to answer all along the next campaigns: when will the farmer be technically independent in managing his farming system as an integrated one? How and when can we say that a farming system has brought up to an integrated system? How can we quantify the « level of integration or sustainability » of the system? To end, we are working now on 10% of the watershed area used for agriculture; in order to see direct effects of IAFS on the environment, we need that at least 80% of this area has brought up to integrated agriculture.

Acknowledgements

The financial support of the European Community and the Ministry of Agriculture and Fishing (DPE) is gratefully acknowledged. We thank also the farmers of La Ferté-Vidame for supporting our study and the Chambre d'Agriculture d' Eure-et-Loir for its technical contribution.

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