Applied research in poultry: a university perspective

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Applied research institutes in the poultry sector and university could have crossed benefits from establishing and developing links through shared research and pedagogical acts. On one side, applied research is defined as multidisciplinary with a mixing of several time scales and the need for additional human workload compared with basic research. On the other side, university teachers are involved in multiple activities which can be detrimental to their own research, since the priority is usually devoted to students. To cope with this major aim, academic staffs develop various pedagogical tools to enhance the learning process. Some of these approaches are described hereafter. Special emphasis was paid to “Problem based learning” and several of its constituents, as on-field inquiry, qualitative and quantitative literature review, systemic modelling and lab work. These different skills and methods applied within the poultry sector are shown as included in a triangle with the three following actors: private firms, applied research institutes and university. Moreover, these tools are articulated all along the curriculum both at the university and during practice training. From the authors experience, it seems that students strongly connected with the industry and/or the applied research sector have less difficulty to find a first consistent job within the private sector compared to more fundamental research oriented students. However, for historical reasons in France, few university curricula are strongly connected to the applied research sector. Several specificities of the poultry production chain are presented to persuade university staffs to improve their links with this sector. Efforts are proposed by the authors to reach a consistent employability level of the students through strengthened interactions between applied research institutes and university.

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Introduction

The authors of this overview on the current and future status of applied research in poultry are fully convinced that increasing the connections between university and research institutes are highly desirable with regards to both the overall quality of higher education and, also, the mutual sustainability of university and scientific staff. Besides their main activity as teachers or scientists, the authors have long experienced some aspects of their colleagues’ field of interest, thus adding some value to their personal expertise. Due to the authors’ locations, this talk will mainly focus on the European situation, with a special emphasis on the French system.

The aim of the present paper is to provide some insight on the following questions such as “Is it worth having exchanges between university and applied research institutes? What is relevant in each case? What is the current state of exchanges between university and research institute in this field? Can we expect some innovation?” Three parts are presented: definitions of applied research in poultry and of university community actions, interactions between both sides and perspectives of the applied research – university system development.

Applied research in poultry: a tentative definition
This area of research does not deal with its content but with its target: it should be answering practical questions raised by on-field practices. Consequently, it does not preclude the use of top of the art technologies but, rather, mixes the different approaches. In the poultry sector, questions are usually submitted by stakeholders such as primary and secondary breeders, feedstuffs and veterinary companies. One difficulty linked with the actors implied is the timescale difference observed between companies (short-term approaches circa 1-3 years) and research institutes (mid-term approaches circa 5 years) which are themselves dedicated, at least in part, to more basic programs. Therefore, the first task of the researcher is to appropriately comprehend the question raised by the stakeholder before its transfer in a larger research field.

Quite often in poultry research, similar questions can be raised by several companies at the same time, a consequence of their common difficulty to solve a practical problem. As an example, in fast-growing broiler flocks, transition between diets are often source of troubles ultimately leading to altered growth performances and, also, impaired financial return. Consequently, research programs are developed with several axes: on-field inquiry to identify candidate factors acting on the phenomena, description of the diets on usual (nutrient content) and innovative parameters (set of physical parameters obtained by direct measurement or by image analysis), analytical study of the animal reaction at lab scale, modelling of the animal feed intake, etc… Each program could be characterized by three parameters: the involved disciplines, the time scales proposed (by the firms) and adopted (by a compromise between actors) and the human workload needed. Consequently, applied research in the poultry sector might be described as multidisciplinary from epidemiological and sociological sciences to animal physiology and behaviour. Applied research should therefore be performed in a network of skills and knowledge, including several categories of actors from researchers focused on a given topic and/or method to animal production systemic analyzer. Due to their interactions with a large number of subjects, lecturers are often good candidates to be the systemic analyzer while researchers are more devoted to the focused approaches. The second characteristic is the mixed time-scales: background basic research should be performed whereas applied results should be produced continuously to exchange between the partners. Therefore, researchers have to react quickly to the firms’ request. To cope with this constraint, a consistent way is to devote several MSc theses (with the French definition, i.e. including a practice training lasting between 5 and 8 months with a final report and defence) to the different topics involved in the overall project. From these student fluxes, several features could be noted. Firstly, this turnover implies a nearly continuous reporting between the different partners and at least two levels of external communication on the technical and on the scientific side, even thought confidential restrictions are commonly negotiated. Secondly, the students and the short-term experiments are usually at least partially financed and thirdly, the topics are by definition well-adapted to the job market and could therefore be a decisive step toward a relevant first employ.

**University: a community involved in contrasted activities**

University education process includes several components: basic and applied knowledge transmission, scientific and technical skills improvement, and also up to a given level, social integration in a professional environment. Moreover, most of the teaching teams have simultaneously to develop their own research topics. However, due to their large teaching and coaching activities, the critical mass is not always reached on the research side. One way to cope with this weakness has been to implement teams mixing researchers and teachers since, in the agricultural education system, both populations were nearly segregated until early 90’s. Regarding the links between research and education, it has been slightly clarified by the implementation of the Bologna agreement (i.e. harmonization of student degrees all over Europe, with three levels License, Master and PhD), research processes being broadly involved in Master and of course PhD framework. However, in several cases, two orientations are proposed for a given type of Master: “research oriented” and “professional oriented”. The first one is compulsory to enter a PhD curriculum, but does include very few links with the applied research in the poultry sector whereas the second one is strongly in interaction with this applied research.
To illustrate this fact, the Master Animal Production at the University of Tours could be presented as in deep connections with both the applied research institute in poultry and the research sectors from the private firms. A high percentage of the lectures are given by permanents from the two previous sectors within applied orientated modules and most of the final practice trainings are applied research questions addressed within private firms. As an example, one student in 2005 worked on feed intake prediction in turkeys in a research team at INRA but she studied 32 diets issued from 7 private poultry nutrition firms (more than 70 % of the market turnover) and her steering committee was including representatives from every partners. Consequently, on the firm side, her work raised and began to solve some practical problems and on the applied research side, through a scientific publication, alternative ways were proposed to deal with the feed intake prediction topic.

Moreover, if the lectures and the practice training could be linked with applied research, the interactions are also observed through the different modules developed all along the curriculum as presented in the next section.

**Interactions between university and applied research: pedagogical side**

One of the main problems of the teachers is to ensure that the students have understood properly the different concepts and methods and that they are (more or less) able to use them in different contexts and to articulate them. Therefore, they try to propose several modules built within a triangle private firm - applied research – university teachers. Each of the partners has a plural role. The firm gives the professional context, the technical support, the operation field and a first version of the problem to be dealt with. The applied research institute acts as an expert, a source of scientific and methodological supports. University teachers have key-roles by translating the domain languages used by researchers and other stakeholders, by (down-) sizing final targets of the work to be delivered by the students and by articulating the different modules to use the different proposed tools. As an example, six of them commonly used in Masters such as “Animal Production training” (University of Tours) or in some French “Grandes Ecoles of Agriculture” have been listed hereafter.

Lecture was the usual way to give new knowledge to students. However, an alternative way is the use of “Problem based learning” approaches, broadly developed in The Netherlands. A question is raised by a firm or a researcher and a student, or usually a small group of students, have to gather the knowledge and the skills in a limited time (from some days to one academic year) to solve at least partially the initial problem. As an example, a slaughter house could ask for farmers’ guidelines to collect the broilers to avoid any loss and wounds during this operation. This study requires a quite exhaustive understanding of broiler behaviour and of animal management. Theoretically, the students will increase their abilities to act autonomously. Nevertheless, teachers have to tutor the groups all along the process and ensure that the different deliverables are performed on time and with a given level of quality. The outputs are improving every actor’s aims: firms have some answers on a given question; researchers could have a look on actual on-field topics and could test if their methodologies and knowledge could help to solve the problems. Finally, teachers may, thanks to students input and tutoring, have a broad and actualized overview of at least some aspects of the poultry sector, thus enforcing their professional and research network.

“Problem based learning” approaches could be cut into different modules that can be or not articulated due to the devoted time to each task within the curriculum. An interesting tool is on-field inquiry. Following a researcher (in epidemiology, sociology or economics) or a private partners’ request, students can build, write, fill and analyze a questionnaire. As an example, following the withdrawal of some feedstuffs or antibiotics in animal production system, large decreases in technical (and consequently economical) performances could have been observed. Therefore to develop relevant research, on field practices have to be known. Inquiries were performed to collect the information and isolate candidate risk factors. It could also be used to describe the actual variability and to propose flock management systems decreasing these variations. These inquiries could be considered as explanatory work which gives the frame of applied research approaches. Performing inquiries with students have several advantages: they learn how to do it, they can fill a high number of questionnaire and they are supposed to be more neutral in their standpoint compared to actors involved for years in
the sector. However, this neutrality could be biased during the building processes and teachers’ role is to avoid this common trend. University staffs could be acting as a mediator.

A third tool is the literature review. This gathering of knowledge is theoretically a basic module within university curriculum. However, they are not so often performed due to the lasting of this exercise. Two parts can be considered: firstly, the gathering of the published information and of the existing expertise and secondly analyze and synthesis of these sources. However, both parts are seldom equally treated. Consequently, the person who proposes the topic has to rank his targets: either, he wants to collect the information or he wishes a real analysis. In the second case, he has to give the sources to the student. Literature reviewing is a common way to establish links between university and applied research institutes although it is not always the more fruitful one. Reasons raised could be that a strong coaching has to be done, that researchers are so used to review that they do not know how to explain it to the student and last but not least, the topic has to be clearly supported to sustain the students’ efforts. Examples of literature review topics are numerous in poultry (nutrition, reproduction, herd’s management, etc…) and thanks to the large number of published works, information is available. Highly specialized topic should be avoided since the student will be short of elements and will easily stop his effort. The exchange between the researcher and the students might as much as possible be focused on well-known areas. The interest for the researcher will be to have updated version of usual topics, but he could not expect a renewal of the treated concepts.

Most curricula in the animal production area are including modules of statistical analysis. These tools could be considered as key elements in the industrial or the research worlds. Consequently, data analysis skills are highly welcomed and should be strengthened during the academic years. At least, two ways of using data tools are used. Firstly, a database could be given by a researcher and classical analysis (ANOVA, linear regression, multivariate analysis) could be performed on these values. Poultry sector has a strong advantage regarding data accessibility. As an example, growth experiment or digestibility trials could be performed on a weekly or monthly basis with a large number of treatments multiplied by numerous individuals. Consequently, datasets are very interesting to analyze since they include a lot of factors and variability within usually well controlled environment. This is not the case for large animals as pigs and ruminants. Secondly, meta-analysis could be proposed. Broadly used in medical areas, it is increasingly performed in the animal production sectors. The underlying concept is that by gathering published data from a large number of papers, global statistical analysis could help emerging multiple laws of responses. However, since the obtained datasets are, by definition, strongly unbalanced and biased by the within experiments (and/or labs) effect, quantitative analysis should be performed very cautiously. Multivariate analysis mixing quantitative and qualitative methods (Principal Component and Corresponding Factor Analysis, Hierarchical Clustering) are implemented together with the basic, and commonly forgotten, tools which are the X-Y plots and population one dimension display. These approaches are fruitful for the students since they manipulate complex data sets, they learn the order of magnitude of the treated data and they stress the relativity of the results obtained from a limited number of experiments. As an example, phosphorus metabolism has been (and is) extensively studied regarding different responses from the bone breaking strength to the feed efficiency without avoiding the environmental impacts. Several hundreds of scientific publications can be easily gathered. However, precise multiple laws of responses (i.e. simultaneous variations in several animal parameters) are not totally developed. Meta-analysis should be performed, but a huge workload is needed between the data set building and the statistical analysis. To obtain relevant results, researcher and teacher should therefore cooperate to limit the size of the analyses and to ensure an iterative exchange between them and the students. Without this active management, the results are usually quite poor due to the innovative work devoted to this approach.

Close to meta-analysis methods, systemic modelling seems to be an innovative way to help the students to deal with complex systems. Modelling has for quite a long time frightened the students involved in biological sciences, since they linked modelling with a compulsory high level in mathematics and/or statistics. Up to a given level, this assertion was relatively true. But nowadays, thanks to computer science, easy to use freeware deals with 99 % of the maths. Only four inputs are needed from the practitioner: definition of the model limits and aims, diagram of the structure (compartment, flow, agent...), generic shape of the response law and order of magnitude of the involved parameters. These different steps are performed interactively between the students and the
tutor who could either be a researcher or a teacher. These exchanges are fruitful since the building and implementation of the models require a clear view (from each of the different actors) of the embedded concepts and response laws. As an example, in Animal Production Master at the University of Tours, groups of three students devoted one week of their curriculum to build a simple compartmental model on the freeware VENSIN®. Egg production curve from 20000 hens was modelled. It was the opportunity for the students to decide which parameters were compulsory and which could be dismissed due to environment: feed intake was not taken into account since it was assumed to be given ad libitum while age was used as the driving force for the probability for one hen to have an egg a given day.

Laboratory analysis could also be included as a possible pedagogical tool allowing collaboration between applied research institute and university. However, the methods are mostly usual ones, as basic proximal composition when feedstuffs are analyzed. As an example, pellets could be collected during on-field inquiry and chemically analyzed afterwards. It stresses for the student that some data are obtained from laboratory analysis and are not absolute values, which could help when statistical treatments are performed.

A seventh tool is obviously the practice trainings proposed all along the curriculum. They include all the previous approaches with an additional aspect: the direct tutor is either a researcher or a private firm employee and the environment is the professional one. Interestingly, Master and PhD students educated in a strong network within the triangle university -applied research institute - poultry sector got their first consistent job much more in their field of expertise compared with less poultry sector related students. From the experience of the authors, over 60 % of the first population is employed in poultry related jobs compared to 30 % for the other students.

**Interactions between university and applied research: statements and perspectives**

In the poultry sector, except in the above described university curricula, applied research as such at the university is poorly developed in France. Usually, the animal model is rat or mouse due to on one side practical reasons but on the other side on physiologist tradition more involved in mammalian metabolism. As an example, to the author’s knowledge, less than 5 (out of at least 100) teachers from 10 French “Grande Ecoles” in Agriculture have a background in poultry science, which has to be compared to the high poultry production in France. Additionally on the university side, teachers’ post-graduation profiles are mainly from the medical or the fundamental physiology area. Those combined facts lead to a low involvement of university staff in developing links with private sectors and consequently with applied research in the poultry sector. Moreover, due to the ongoing financing and evaluation systems at the university (mainly based on the number of scientific publications times their impact factor), there is no professional interest to conduct research in the applied field.

However, poultry sector could be the convenient animal production area to build exchanges with the university since it has a nearly unique characteristic: the different actors of the production chains are strongly interacting. Consequently, if the academic staffs wish to develop a network with a given industrial and agricultural area, poultry production can be easily on top of the pile. However, from an objective standpoint, the authors should stress the lack of teaching expertise specifically devoted to the poultry sector. Therefore, given the obvious qualities of the poultry sector and its applied research as pedagogical tools, an increased effort is expected from both public institutions and, also, from the poultry industry to support new teaching and research positions in the field, a necessary step, to our view, for its future development. The approach proposed by Dr PREISINGER (The role of contract research in educating poultry science students, EPC 2006) could be one way to strengthen the links between the industry and the university through applied research. One additional way could be to use an interesting feature of the poultry sector which is to be internationally distributed and strongly interconnected, both at the industrial and at the research level. A practical step might be to develop a European network of students, teachers, researchers and private partners to propose, through ERASMUS or ERASMUS-like structures, the build-up of multi-level exchanges, as presented by Pr
KWAKKEL (Re-allocation of educational resources in Europe: example of international cooperation, EPC 2006).

To put all in a nutshell, interactions between university and applied research institutes through iterative process allow the students to reach multi-level targets ranging from basic knowledge to practical skills including relevant social behaviour. This interactive training is positively perceived by employers who are searching for highly reactive new staffs, which push academic staffs to pay more attention to students’ employability.