Veterinary Services and research

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Summary: In conjunction with other international organisations, the OIE contributes to the promotion and coordination of research in animal health. The authors recall the methods of evaluating research projects and the fields of research which at present appear priority for greater efficacy of the Veterinary Services.

Among the items of research recommended by the International Committee of the OIE, the authors list economics of animal health, laboratory diagnosis techniques, epidemiological research in animal diseases, quality control of biological products and veterinary drugs, the application of molecular biology in immunology, the development of new vaccines, mainly by genetic engineering, the treatment of parasitic infestations and the contamination of food of animal origin.

The veterinary authorities are the most competent to supervise research in their sector of responsibility and to ensure application of the results. Their choice must be established in relation to the needs of the community and be guided by the experience of other countries while taking into account the specificities of their own country. In order to facilitate coordination of research projects and to promote research networks, the authors propose the setting up of a Unit for Coordination of research within the OIE.

KEYWORDS: Animal health - Antiparasitic agents - Diagnostic techniques - Economics - Epidemiology - Immunology - Information services - International organizations - OIE - Planification - Quality control - Research projects - Veterinary research - Veterinary Services.

Every country, whether a developing country or a developed country, is involved in the progression of animal production and particularly in increasing its productivity. No country can ignore this fact without impeding the cause of social and economic progress, which is the aspiration of all.

The importance of research in finding solutions to every sort of problem which arises in the agropastoral sphere has been recognized for a long time. In the sphere of health, an essential branch of animal production, the International Office of Epizootics was the first international organization to clearly express the promotion and coordination of research as one of its chief activities (1).

There is, at present, no international organization devoted to technical cooperation in agriculture which does not include research programmes on animal health. This is particularly evident on the world scale in the case of the FAO, the European Commission and (in America) the IICA. The latter has recently issued a publication which describes the role and scope of international organizations in research on animal health (2).

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The object of the present article is to survey the techniques used in planning research, and to define those fields of research which would seem to warrant priority in order to make the Veterinary Services more effective.

**EVALUATION OF PRIORITIES IN RESEARCH**

The time has passed when research programmes were decided on the advice of certain influential men of science. However, it is only in recent years that research workers and administrators have been obliged to resort to objective and quantitative methods of evaluating research and of selecting projects. This has come about because of rapidly mounting costs of research and the necessity, particularly in developing countries, to make the best use of available resources, which has led economists and experts in operational research to try to find a rational basis for decision concerning the appropriation of research resources.

Progress made by various disciplines in the optimization of decisions concerning administration and implementation is reflected in numerous studies devoted to agricultural research, which are the subject of an FAO publication (3), addressed mainly to those in charge of the financing of agricultural research. However, as the author of this publication points out, it is impossible to plan and programme agricultural research without the participation of agricultural researchers. It should be added that “researcher” does not only mean those carrying out research work, but also those in charge of research administration. National animal health authorities, to the extent that they originate and may administer specific research programmes, should be aware of the methods of planning research. These will be summarized taking account of the above-mentioned FAO publication.

**Planning research**

There are three stages in the planning of research: identification of the objective, choice of the strategy and implementation of tactics. The first two points constitute the establishment of a programme, which always has to take into account the overall national policy. Drawn up by economists who have specialized in planning and the scientists responsible for administering the research, the programme should specify the sectors to be studied, their relative importance, a provisional budget, and the manner of financing.

Final approval of the programme is made at political level, and researchers can still make a contribution at this stage by providing explanations to assist the authorities of the country to come to a decision.

Once the objectives have been defined clearly, the administrators of research programmes can draw up a list of themes for research, indicating for each one the object or type of research activity, the main product or resource which is the object of the research, and the disciplines involved. In this way it is possible to build up a ‘three-dimensional’ classification of the research sectors.

Of course, such a list must be permanently brought up to date according to the requirements and progress of science. For instance, twenty years ago (4), classification of agricultural research fields did not foresee, among the different sectors, the ‘protection of man and animals from toxic substances present in food’ or, in the scientific fields, ‘ecology’, ‘epidemiology’, ‘biometry’, ‘computer science’ or ‘communication systems’.
We do not propose to discuss the decision-making process involved in allocating funds to animal health from the national research budget, which has to take into account particularly the need for a good balance between fundamental and applied science, and between short-term and long-term planning. Each country has its own way of doing this, and the animal health authorities seldom have the opportunity to intervene in the process. However, it is essential that they know the procedure followed by their country well in order to play their role in the orientation of the final decisions.

The methodology of formulating research programmes is a priority subject, and it is important to ensure that each country has a nucleus of experts in the planning of animal health research, within the national body responsible for planning agricultural research.

Without attempting to deal with all the problems which such experts may encounter, mention must be made of the importance, advantages and also the limitations of utilizing previous research, for it is true that "to a large extent research originates from earlier research". It is also necessary to underline the danger of the common tendency to allocate funds to the different sectors in proportion to their gross value, which penalizes the new sectors of production, and those which have so far been the least profitable.

The commonly practised method of allocating state funds to supplement private financing has some advantages, but it also has the disadvantage of discouraging innovation. There should be a good balance between short-, medium- and long-term research, which is not always easy to bring about. Long-term research is often neglected because it does not have the electoral impact of short-term research. The indispensable feature of fundamental research is to extend scientific knowledge and, by its educational value, to equip personnel to deal with medium- and short-term problems. However, it is true that the progress accomplished in developing countries largely arises from applied research based on fundamental research which can be performed economically only in the more advanced countries.

Finally, the 'preventive' aspect should occupy an important place to deal with problems which might arise in the future, such as the development of methods to identify and prevent exotic diseases.

Ways of evaluating research projects and of determining priorities

In each country the group of experts responsible for planning animal health programmes should also be responsible for planning research. The methods used to evaluate research projects and to select priorities need to be adapted to conditions prevailing in a given country. The method used for establishing priorities should essentially have an applied character, utilizing the principles which are well established for this purpose. The different approaches applicable, whether economic analysis, operational research or decision theory, depend on political, technological, biological and environmental conditions. The system used in the State of Minnesota (USA) since 1971 is an interesting example in this respect (5).

Among the various methods of assessing priorities, that chosen by most countries is based on the notation of projects, because it clearly identifies the subjectivity of the elements of each decision. This method, which has been derived from the approach of decision theory (6, 11), is one of those which has withstood the passage of time (12, 13).
The key to any system for programming and the choice of priorities is, of course, the research project. This is supported by a proposal which should include all the information which has a bearing on its justification. Before the proposal is presented, it should be subjected to a preliminary evaluation within the department which will be responsible for implementing the project. As an initial step, the department needs to assemble all the relevant information from the scientific literature and from its own archives.

The formal proposal should mention:
- the objectives of the project
- the importance of the work and its relevance to the achievement of the objectives
- any innovations which it entails
- the responsibilities of the various participating groups
- a realistic estimate of its cost
- a detailed presentation of the problem, of the research strategy and of the techniques to be used
- an estimate of the time required.

The system of presenting projects has been the object of numerous criticisms, some of which are well founded.

“Projectitis” is a deformation of the system which may lead to errors by the misuse of favourable predictions usually only uncovered at a late stage, impeding other research which may be more fruitful.

The refusal of projects attached to well-established programmes is often a result of their weak points: questionable importance or opportunity, inappropriate approach to the research subject, or inadequate qualifications of the scientific staff (14).

The relative priority of research projects

The commonly used expression ‘relative priority of research projects’ needs to be understood in terms of examples taken from the animal health field. Among projects relevant to this field, attention may be focussed on advantages considered to be essential for improving public health and promoting social and economic progress.

Economic and social progress may come about through better feeding of the population, which may in turn depend on improvement and augmentation of animal production. It is also dependent upon international trade in animal products, expansion of which (governed by the state of health of the animals) brings money to the exporting country, which can be used to purchase goods otherwise lacking.

Priority may also be accorded to the identification of current technological limitations — bottlenecks which hamper the progress of livestock farming — and the elaboration of solutions to remedy them. Two examples serve to illustrate this point. The movement and bringing together of animals for dipping in acaricide favours the transmission of foot and mouth disease and other contagious diseases in areas where they are endemic. Under such conditions, the development of alternative solutions for the control of ectoparasites should be given priority.

Another example is the spread of contagious diseases by using unsterilized syringes for numerous vaccinations or treatments. Although there is considerable risk of
spreading contagious diseases by this procedure, there seems to be no research pro-
gramme for methods which can replace those traditionally used in developed countries.

The motivation of owners of livestock in certain regions who refuse to have their
animals vaccinated should be taken very seriously. Even when there is good reason
to think that the cost of the intervention is the main reason for this attitude, there
seems to have been little research aimed at reducing the cost of production, transport
and administration of vaccines, or even at overcoming the problem of poverty-stricken
herds which escape vaccination and help to maintain the disease.

Recognition of the importance of bottlenecks in the choice of priorities may en-
counter opposition from the social sector to the allocation of funds to research pro-
grames which have no prospect of immediate results. This applies particularly in
periods of economic or political crisis. Moreover, it is obvious that even the most
important and best conducted research will give poor results if it does not overcome,
from the outset, the problem of limiting factors. Apart from the economic waste which
will result, the entire research programme will become discredited.

An example of a limiting factor, which merits priority research in any programme
for foot and mouth disease prophylaxis, is that of the displacement of unvaccinated,
susceptible animals brought about by exceptional circumstances, such as flooding
occurring in a zone where foot and mouth disease is endemic.

In addition, the choice of priorities may be biased in certain cases, when difficulties
brought about by poor general planning are attributed to the project itself. An in-
ability to fulfil the preliminary steps to realizing research may also result in the rejec-
tion of a project which would otherwise be valuable.

A lack of training programmes for research workers, and an inadequacy of cen-
tres for dealing with documentation, are often sufficient reasons for aborting extremely
important projects, although this can be remedied by direct contact between the poten-
tial research worker and other research workers, or indirect contact through the in-
termediary of scientific publications.

Among the important factors for acceptance of a project are the existence of ade-
quate laboratory facilities, providing protection for research workers from the risk
of infection, laboratory animals bred and kept according to the established norms,
equipment for maintaining cultures of various tissues; access to data concerning the
livestock population, its geographical distribution, husbandry methods and health
status; and also the existence of facilities for biometry and statistics.

It is not always possible nor desirable to put a project into a priority or non-priority
category. "Priority" is, in fact, often a relative concept. It may happen that a good
project does not fulfil the conditions necessary to allocate a priority to it, so that
it is postponed from year to year, until the time when all the evidence indicates that,
because of this fact, a major opportunity for advancement has been lost, with con-
siderable repercussions as a consequence.

This type of project arises from "exploratory research", devoted to the study of
original or unorthodox ideas. Their evaluation can be accomplished without the need
for the investment required by an exhaustive study of the research project. Whether
fundamental or applied, "exploratory research" may lead to revolutionary discoveries.
To neglect this sort of research for reasons of convention or cost could result in a
considerable loss for the livestock industry or public health sector (3).
SOME RESEARCH PRIORITIES IN THE SPHERE OF ANIMAL HEALTH

It is out of the question to supply a complete register of research priorities for the Veterinary Services. This account will be confined to some of those recommended by the International Committee of the OIE during past years, and which are still needed.

The order in which the research topics are presented does not constitute an arrangement by priority.

The economics of animal health is an area of research which involves a number of disciplines. Much work has been done on this subject by experts in various countries during the past decade (15, 16), and by international experts who have approached the subject mainly from the point of view of western countries (17).

The OIE has examined this subject in some detail during the 48th and 49th General Sessions, and has made the following recommendations (18, 19):

• establishment of a methodology for socio-economic analysis, suitable for adaptation to different regional situations;
• creation of data bases suitable for research purposes;
• introduction of programmes of training, education and research on epizootiology and veterinary economics at all appropriate levels and on a regional basis;
• elaboration of techniques of economic analysis to assist planning, evaluation and implementation of programmes for production and animal health at farm level and on a national level;
• integration into the information systems for animal diseases of the data needed for economic analyses, particularly the structure of herds, parameters of productivity, the effects of disease on them, and the cost of prophylactic measures available to governments and to farmers.

Techniques of laboratory diagnosis are a constant field for research. It is rare that, following meetings of the OIE, resolutions have not been adopted calling for more research on the development of reliable, rapid, simple and economic techniques.

A recent study (20) was devoted to evaluating laboratories of the American continent in the special subjects in which they were competent. This report should be read by all those in charge of research programmes, not only for the information which it contains, but also the critical analysis of the functioning of each laboratory, indicating their potential for fulfilling a role as a reference or training laboratory.

Another report (21) followed the 5th Conference of the OIE Regional Commission for Africa, which investigated the laboratory facilities for avian diseases on the African continent.

These studies have shown that the coordination of research in the field of diagnostic techniques is indispensable. Arellano came to the same conclusion, and proposed that the Inter-American Institute for Cooperation in Agriculture (IICA) should perform this function for the American continent (22).

It is particularly important for countries where extensive husbandry is practised to develop simple techniques for obtaining samples and, in this respect, the World
Association of Veterinary Laboratory Diagnosticians is playing an important role, together with the intergovernmental organizations (23).

It is also necessary to study the possibilities for economic application of immunoenzyme tests, as well as the recent progress in molecular biology which has led to the purification of specific antigens and the use of monoclonal antibodies.

Modern biochemical techniques make it possible to analyse the viral genome and its products (viral proteins), facilitating studies of the evolution of viruses in the field, and the detection of any modifications in them. This may have a considerable impact on knowledge of the epidemiology of animal diseases. Study of the epidemiology of viral diseases should benefit from the new diagnostic methods, the application of which is comparable to the introduction of bacterial typing by means of phages or specific sera, which greatly assisted work on the epidemiology of bacterial diseases.

Epidemiological research needs to be expanded, particularly in third-world countries, in order to provide the information required for economic analysis and planning, and to establish the prerequisites for successful prophylaxis.

Epizootiology, considered by some to be a branch of epidemiology devoted to diseases of animals, while others regard it as a quite different discipline, its primary objective being economic, is no longer devoted solely to the study of the distribution of animal diseases. It is, in fact, concerned with the "interaction of factors causing disease, animal health economics, and the socio-economic dimension" (24). Since its inception, the OIE has recognized epizootiology as having a primordial role as an instrument in the service of the economics of animal production. There is now universal agreement that the epidemiological approach is definitely pluri- and interdisciplinary, and that it can provide solutions outside the grasp of even the most eminent specialists acting separately.

In the case of hydatid disease (echinococcosis), of which the importance for public health is well understood, recourse to epidemiology expertise could lead to better control if coupled with the development of an effective anthelmintic which is cheap and easy to administer. The epidemiological approach would combine studies of the herbivore host, the canine host and the ecological, anthropological, socio-psychological and economic aspects. On the question of economics, the study would look at the economics of losses, particularly those due to condemnation of carcasses and the deaths of herbivores while grazing. Without doubt the time will come when all the effort integrated by epidemiology will be crowned with success.

The consequences of such projects for animal production and the quality of life make them worthwhile. The indirect advantages, being difficult to quantify, should nevertheless be taken into account when drawing up research projects, from the aspect of allocating priorities.

Methods for checking the quality of biological products and veterinary drugs could also be improved by appropriate research at two different levels:

(a) Evaluation of the efficacy and safety of a new product. Here the rules are well established for pharmacology, immunology and clinical trials in human medicine.

(b) Quality control of production batches. The development of new methods of testing, if possible by in vivo techniques (as recommended by the WHO for products for human use) is an essential prerequisite for preventive and therapeutic measures.
A major difficulty for the success of vaccination campaigns against foot and mouth disease has been the relative uncertainty about the efficacy of batches of vaccine against the different variants of virus present in a given area. One reason is the high cost of testing the efficacy of a vaccine against all variants of the virus.

Two factors have a bearing on this particular difficulty: the first is the lack of continuous monitoring of the precise nature of the viruses in circulation, which could be overcome by improvements in epidemiological surveillance. The second concerns the way in which the 50% protective dose for cattle is determined, using three dilutions and five cattle per dilution, which is less accurate for measuring potency than the technique of percentage of protection utilizing a total of 24 cattle (25). The protective dose technique is, in fact, a poor application of inductive logic arising from an application to quite different conditions (such as rabies).

In the field of immunology, new perspectives have been opened up by the extraordinary developments in molecular biology during the past few years.

The identification of polypeptide components of the protein of picornavirus, detailed knowledge of the aphthovirus genome, the possibility of producing specific aphthovirus antigens by chemical synthesis or by recombination with the DNA of \textit{E. coli}, and the preparation of monoclonal antibodies, the extreme specificity of which permits a detailed study of the immune response, are important features of immunological research being conducted to some extent throughout the world. Research which leads to a better understanding of factors responsible for a high cellular response has important implications for the control of brucellosis, bovine tuberculosis, protozoal infections and numerous viral diseases.

Equally important is the study of specific stimulation of local, humoral immunity in infections with rotavirus, coronavirus, aphthovirus, bovine herpesvirus-1, parainfluenza-3 virus, and others.

The techniques of immunological diagnosis referred to above have given rise to recent developments applicable to a wide range of diseases. These techniques have yet to undergo further improvements, particularly from the aspect of the speed of testing.

The pursuit of research on the application of genetic engineering to the control of animal diseases was recommended by the OIE Committee during its 51st General Session (26).

On the question of vaccines, the progress achieved should not be allowed to obscure that which remains to be done in explaining why the antigens obtained by genetic engineering are less efficacious than inactivated aphthovirus. Similarly, further information is required on the factors which come into play to reinforce and prolong immunity when adjuvants, such as those incorporated in vaccines against foot and mouth disease, are used. The irregular responses obtained by using a synthetic lipid amine as an adjuvant (27) suggest the intervention of factors not strictly related to the physical structure of the adjuvant, as seems to be the case with a combination of aluminium hydroxide and saponin, and an emulsion of water and mineral oil which provide for delayed release and stimulation of macrophages.

The \textit{in vitro} culture of \textit{Babesia bovis} (28) has considerably assisted research into the immunization of cattle against babesiosis. It has been possible to prepare soluble antigens (29, 30) which provide protection against the homologous parasite. Such
results lead to the hope that cattle can be vaccinated against babesiosis with killed antigens, thus averting the risks of premunization, but there is a need for more intensive research on this subject, as recommended by the OIE Committee during its 53rd General Session (31).

The treatment of parasitic infestations has been advanced considerably by the discovery of substances active against ticks, the various mange mites, larvae of Dermatobia hominis and also gastrointestinal nematodes parasitic in the various species of animals. Pharmacological research in this field is still only in its infancy, and it will no doubt come to play a very important role in the control of parasitoses, which have an adverse effect on the productivity of livestock, particularly in tropical and subtropical countries. Research should particularly be aimed at finding products which are easier to apply and cheaper than the present acaricidal dips, which suffer from the inconvenience of bringing together animals for dipping.

The problem of contamination of food of animal origin by potentially toxic substances — pesticides, mineral residues, etc. — which are present in the environment, has assumed considerable importance in recent years. Priority should be given to multidisciplinary ecological research to estimate the true extent of the problem and to find appropriate solutions.

CONCLUSION

Those responsible for the national Veterinary Services are not usually involved in decisions concerning the funding of research, but it is advisable that they be acquainted with the procedures followed in order to have a better chance of seeing their demands satisfied. For this reason the first part of this article is devoted to a fairly detailed discussion of methods of evaluation and the selection of research projects.

It is those in charge of Veterinary Services who are confronted daily with problems concerning the improvement of the effectiveness of action in the spheres of animal health and public health, and who are well placed for identifying the most important problems which should be given priority in research.

However, their intervention need not be limited to the identification and formulation of research projects. As indicated earlier, they should also become the administrators of programmes relevant to their field of activity. A study of agricultural research in third-world countries carried out in 1981 came to the conclusion (32) that "probably a third of the countries studied had reached a level of research in which the chief constraint was not the lack of money, premises or qualified research workers, but the faulty management of resources". Because of their knowledge of all the various constraints which act against the desired improvements, and the best ways of surmounting such difficulties, the Veterinary Service is the best placed authority to manage research in its sector of responsibility, and to ensure an application of the results.

Any division which may exist between the Research Service and the Veterinary Service would seem to act against the general interest. An integration of routine testing and research would be advantageous for both sectors which would otherwise operate in isolation. In this way an epidemiological or a diagnostic service which takes part in a research project within their respective fields would become better motivated in routine work if they had to evaluate the results themselves. They might well find solutions to problems which would elude research workers operating exclusively in a central research unit.
The choice of priorities for research topics in relation to the needs of the community, and the results obtained would obviously be very important for the credibility of the Veterinary Service.

It has been mentioned that each country has its own methods, and the direct transposition of techniques used elsewhere runs the risk of failure. However, this should not mean that the door is closed to experience gained in other countries (33). On the contrary, the exchange of information between research workers is very important, and it is deplorable that research workers often operate in almost complete isolation, while identical research is being done by other teams, sometimes within the same country. Organizations which finance international research seem to make little effort to coordinate projects. Research systems which are sometimes created spontaneously for the study of different aspects of a problem by many teams have generally been shown to be highly efficient.

The suggestion has already been made (34) that an arrangement of this type should be set up for animal health research, in which the OIE would provide the support necessary for the initiation of any system, to the extent of influencing the research priorities of the Veterinary Services.

In the absence of coordination, the simultaneous operation of research activities may lead to duplication of work and a waste of resources. The establishment of a Unit for the Coordination of Research within the OIE would conform to the spirit and the letter of the International Agreement leading to the formation of the organization. The necessary investment would be repaid rapidly, for it would enable the best use to be made of national and international resources in the field of research.

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REFERENCES

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