

Chapter (non-refereed)

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base which defines environmental and land characteristics, current (and past) land use, habitats and species distributions. A key feature is for these data to be compatible in resolution and spatial presentation. Such base-line data are not an end in themselves, but provide a basis for planning and for assessment of potential and actual change, and enable local and regional features to be placed in a national context.

5.2 Monitoring

Recurrent debate about the rate and direction of change in land use and associated wildlife and landscape could be more profitable, if the fragmented monitoring schemes were integrated and related to forecasts.

5.3 Prediction

Whilst information on the current state of land use and wildlife and on recent change is important, it is more important to assess the options for change and to predict probable change. Descriptive research tends to dominate, but an essential requirement in planning and decision-making is for ecological research to be more predictive, and to anticipate change rather than react to it.

5.4 Large-scale experiments

The need for large-scale experiments, including catchment studies, arises from the recognition of the interaction between land uses (2.2) and management practices (3.1-3.5) and the importance of an integrated ecosystem approach to research (5.1). Such experiments need not necessarily involve major management treatments, but require a multidisciplinary approach to the study of selected areas. The danger of non-replicated experiments was emphasized, as was the need to link main study sites to the wider range of upland variation through more extensive sites with a lower intensity of research input.

5.5 Communication, interpretation and implementation of research

Communication of research results from research scientists to managers and policy-makers needs to be improved. It requires a willingness on both sides and, in some cases, an intermediate stage of field demonstration through organizations such as ADAS. The efficiency of communication and interpretation may be a key research area in itself, with analysis of the variety of mechanisms involved. There was repeated comment that a wealth of information and experience on upland ecology already exists but that this capital is not being fully utilized, often because of the artificial barriers of technical expression of results by scientists, and resistance to sophisticated methods by planners and managers.

A final point, expressed by many, was that much of the research and its implementation does not usually fall simply within the responsibility of one organization. The research often requires experience from different backgrounds and disciplines and demands both in-

creased collaboration between organizations and more flexible funding arrangements, particularly in the funding of strategic research designed to clarify and solve the problems of tomorrow, rather than *ad hoc* research on today's problems.

References

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REPORT ON THE DISCUSSIONS OF THE SYNDICATE ON THE USE OF AGROCHEMICALS

I Newton, Reporter

The aim of this syndicate was to define the research needed for a better understanding of the long-term effects of chemicals on agricultural ecosystems. Discussion was limited to chemicals used in agriculture, and excluded those (such as sulphur) which reached farmland from other sources. As most pesticides and herbicides are not specific, they inevitably affect many non-target species, and thus alter the whole community of animals and plants. Despite the importance of the problem, large gaps in knowledge emerged, probably due to the research needs in this field falling between the traditional remits of existing research organizations (particularly AFRC and NERC), or at best being near the borders of their remits; hence, neither organization has funded substantial work in this field. Discussion centred on the following aspects.

1 Detection of problems caused by chemicals

Monitoring programmes are at present run by MAFF (incident scheme), Water Authorities (water quality and pollution incidents), BTO (bird censuses), ITE (organochlorine and metal residue analyses) and others, while beekeepers and other members of the public have often reported mortalities associated with chemicals. In these schemes, vertebrates are well covered, but, with a few exceptions, invertebrates and plants are not.

More monitoring of invertebrates and plant communities was thought desirable, along the lines of the Game Conservancy's North Farm project, and with the aim of following changes in the whole ecosystem which accompany changes in total chemical use. Such work is costly and time-consuming, and may be best done as a joint project, involving several organizations. One way to begin may be in conjunction with autecological studies of particular farmland species.

In any agricultural system, most of the changes resulting from chemical use may have already occurred, and the best that can be achieved is to follow the further changes as one group of chemicals is

replaced in time by another. On the other hand, in commercial forest plantations, pesticide use is just beginning, thus providing opportunities to follow from the start the resulting changes in wildlife. Such monitoring programmes may detect changes in fauna and flora, but further research is needed to identify the cause of these changes, and to assess the importance of chemicals, as opposed to other factors.

2 *Specific chemicals*

The main stated need was for more information on the fate of fertilizers and persistent chemicals (including organochlorines) in the environment, and particularly on the persistence of different chemicals in different types of soil. This need was felt in relation to the growing nitrate problem, to eutrophication, and to the continuing persistence of DDE in soils and wildlife samples. The whole field of soil biology, including the effects of different chemicals on soil organisms, was seen as requiring more attention. In particular, little research has been done on the cumulative effects of repeated applications of chemicals over large areas of cereals grown year after year on the same land.

Work on the toxicology and environmental effects of specific insecticides was not regarded as a priority, though further monitoring of organochlorine levels and of mortality incidents should continue. For herbicides, further assessments were considered desirable on the effects of leaving field margins unsprayed, both on crop yields and on fauna and flora.

3 *Pesticides in non-cultivated areas*

In addition to the foregoing, more information was thought necessary on the extent of pesticide drift and transfer from treated to untreated areas. In districts of intensive agriculture, most wildlife survives on small islands of uncultivated habitat in the midst of large areas that are under chemical treatment. The drift of chemicals from farmland could easily endanger wildlife on these unsprayed havens. Further work is required on the persistence of different animals and plants on these islands, on the dispersal of different species between them, and on long-term trends in species abundance.

In addition, further work was considered desirable on the value of chemicals to control unwanted vegetation in nature reserves and other uncultivated habitat.

4 *Studies of different pesticide regimes*

In the MAFF project at Boxworth, the effects of different frequencies of pesticide application on crop yields, profits, and wildlife are being investigated. Further experimental work of this type was considered highly desirable, but difficult to initiate because of the need for control of experimental farms and the high costs involved. It should nonetheless be considered a priority, and be designed in a way which will satisfy statistical as well as biological considerations.

5 *Mis-use of chemicals*

More information is needed on the extent of mis-use of agricultural chemicals to kill vertebrate pests and birds of prey. Illegal use of strychnine, mevinphos and other chemicals, mainly for fox control, may incidentally be limiting the distribution and numbers of several bird of prey species in Britain. Work on specific poisons for killing mammals, such as moles and foxes, was considered desirable, but is probably too costly to attract commercial interest.

6 *Alternatives to pesticide use*

The need for substantial reduction in the current level of chemical use on farmland was considered paramount, on grounds of economy, human health, environmental effects and ignorance of long-term consequences. Priorities were to expand existing limited research effort in the following aspects.

- 6.1 Studies of predator/pest and predator/pest/pesticide interactions, in the hope of maximizing the influence of the predators, as opposed to the pesticides, in controlling invertebrate pests.
- 6.2 Studies of correlations between pest populations and damage levels to assess 'threshold populations' of pests, beyond which significant damage is likely. Better knowledge of pest/damage relationships may help to reduce the 'insurance use' of pesticides, by defining those pest population levels below which pesticide use is unnecessary.
- 6.3 Studies of the development, spread and nature of resistance in pest populations, in the hope of slowing the development of resistance, so that particular chemicals will remain effective for longer.
- 6.4 Studies of biological and integrated pest control, including, besides pesticides, predators, parasites and diseases of the pest.
- 6.5 Studies of the application and fate of pesticides to ensure maximum uptake by target organisms from minimum use.
- 6.6 Further work on the breeding of resistant plant varieties, in order to make protective chemicals less necessary.

In all these fields, agricultural research interests have so far played the major role, and limited work is being undertaken now. There is great scope for further work, but, for such methods to be accepted by farmers, they have to be cheaper than existing methods of chemical control.

7 *Communication of research findings*

There is a need for better communication of the findings of research, in a form that is readily understandable by farmers. Greater understanding of the

attitudes of farmers to chemicals might also help to bring farmers and environmentalists closer together.

Summary

The main research needs concerning agrochemicals are for:

- i. more long-term, large-scale monitoring of wildlife communities in agricultural habitats in relation to total chemical use;

- ii. more research on the effects of chemicals on soil organisms, and on the persistence of different chemicals in different types of soil; and
- iii. more research on alternative methods of pest control.

The most immediate need, however, is to find some way in which research in these fields can be funded, in the face of a shrinking budget, when it is not central to the traditional concerns of any one organization.

Conclusions

This symposium on the relationship between agriculture and the environment has had several unexpected outcomes. I think that most of us taking part in the symposium were surprised to discover that this was the first opportunity that participants from so many diverse fields of activity had had to discuss this important topic. While there has, of course, been much discussion of the topic within each of the separate groups of interests represented at this symposium, there has been no discussion of the kind we have had over the past few days. From the vigour of our discussions, and the very large measure of agreement that has been reached, it is clear that something similar should have been attempted before, and that we should now try to widen the range of participants in further discussion of these issues.

From the start, it has been apparent that there is some polarization of views about the need for further research. As one might expect, the research scientists have been anxious to point out the need for more research, and have been at pains to identify the particular issues on which research is required. Understandably, they have emphasized the painful fact that ecological and environmental research has a long lead time, so that today's research scientists need to be working on the problems with which we will be faced in 5, 10 or 15 years' time. Those participants who are closer to the more practical tasks of agriculture, while accepting the need for research on tomorrow's problems, have been equally emphatic that today's problems still have to be solved, with or without the help of the research scientist. If research scientists have a practical contribution to make, then the transfer of information from our papers in scientific journals to formats which are capable of being understood and used by farmers, administrators, and the general public needs to be given as much, if not more, attention as the planning of new research.

The truth undoubtedly lies somewhere in between the 2 extremes. Certainly, we need to plan for more

research, and this research needs to be both efficient and relevant to tomorrow's, rather than today's, problems. On the other hand, there are problems which have to be faced now, and there exists information which is not freely available, but which could make a substantial contribution to their solutions. We need to find ways to make this transfer of information effective.

Having embarked on this strategy of bringing together the providers of research information and those who might use this information, ITE will continue to do what it can to develop and extend the discussions, and to translate them into practical actions. The publication of the proceedings of this symposium will provide a basis for further collaboration between the various research interests and between research and agricultural practice. In order for this symposium to be a practical proposition, the numbers of participants were limited to those invited because they were known to have a strong interest in the topic. We now know from the expressions of interest and, indeed, often of disappointment by those we just could not squeeze in, that perhaps at least 3 times as many people would have liked to take part. We hope that they will continue to show the same interest in the further meetings on this and related topics that we intend to arrange.

Finally, I would like to thank all the participants for their encouragement and for the way in which they have debated the issues forcefully, but with good humour and tolerance. It would be very easy, in discussing so emotive a topic, for tempers to become frayed and for arguments to become heated rather than enlightening. That neither of these things happened is a credit to everyone who took part in the symposium and bodes well for future collaboration.

J N R Jeffers
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