UNEP Environmental Management Guidelines, No. 1

ENVIRONMENTAL GUIDELINES FOR

Pesticide use on industrial crops

Editor: Yusuf J Ahmad

UNITED NATIONS ENVIRONMENT PROGRAMME

PESTICIDE USE ON INDUSTRIAL CROPS

Environmental Operational Guidelines

1. Pesticide Use on Industrial Crops
2. Irrigation in Arid and Semi-Arid Areas
3. Watershed Development
4. Pulp and Paper Industry
5. Hides and Skins Industry
6. Coastal Tourism

PESTICIDE USE ON INDUSTRIAL CROPS

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United Nations Environment Programme
Nairobi · 1982

United Nations Environment Programme
P.O. Box 30552, Nairobi, Kenya

Typeset by UNEP Publications Unit
Printed by Colourprint Ltd.
P.O. Box 44466, Nairobi, Kenya

First published 1982
ISBN 92 807 1051 6

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FOREWORD

It has been our concern, shared by other bodies and agencies within and outside the UN family, that development projects and programmes should take due account of basic environmental parameters and constraints. It is, indeed, clear that broad-based sustained development is not feasible, especially in the long-term perspective, without sound environmental assessment and management at the inception.

These guidelines have been prepared by UNEP in close consultation with the United Nations specialized agencies concerned and were jointly financed by UNEP and UNDP. These guidelines were adopted by UNDP and are included in its Policies and Procedures Manual.

As noted in the conclusion to the guidelines for watershed management, but equally applicable to the other guidelines, there are many pitfalls to be avoided in initiating activities in different sectors of development and many opportunities that can be missed. Experience during the last ten years has also shown that remedial measures identified must be incorporated, if they are to be effective, in the very conception and design stage of projects and of planning procedures. Later attempts may prove to be only cosmetic changes as the ecosystems under consideration are particularly fragile and complex and may not recover from the stresses to which they are exposed if they exceed certain limits.

The guidelines for remedial or preventive measures which have been presented in this study are meant to be illustrative rather than exhaustive in character: there are substitutes for local experience, foresight and prudence. We have only attempted to draw attention to the kinds of considerations which must be kept centrally in mind. The objectives for which we strive in this subject area are multidenominational and interrelated, requiring a formidable array of diverse technologies and disciplines. It should be noted that although the guidelines presented here are essentially national in nature and scope, international cooperation and co-ordination to bring into play the different inputs required may often be necessary.

I sincerely hope that the present set of guidelines will be acceptable and meet practical needs, particularly in developing countries. Additional sectors will be examined and further guidelines prepared in collaboration with the United Nations specialized agencies, UNDP and other multilateral and bilateral development financing institutions, taking fully into consideration comments and advice which we expect to receive regarding the present set of guidelines.

Mostafa K. Tolba
Executive Director

PREFACE

At an informal meeting held in Rome in September 1978 the Designated Officials for Environmental Matters (DOEM) of the United Nations Administrative Committee of Co-ordination recommended on the basis of a report prepared by a consultant, Mr. O.M. Ashford, that UNEP undertake, in close collaboration with the United Nations specialized agencies, the preparation of environmental operational guidelines to assess and minimize the possible adverse environmental impact of development activities. The report of the meeting states "that priority should be given to the preparation of guidelines aimed at improving the consideration of environmental aspects at all stages in the planning and execution of projects. It was recognized that the level of sophistication in such guidelines would depend on the audience for which they were intended. Much of the available material was of a general nature which would mainly be of interest to university circles or to senior international and national officials. At the other extreme, detailed guidelines based on in-depth studies of specific projects would be very useful for specialists but difficulties were foreseen in obtaining the necessary information for such analyses, which would take a long time to complete. The meeting agreed that at this stage the primary need was for guidelines which would be useful at the operational level. For this purpose each of the major categories used in the consultant's report (e.g. agriculture) would have to be broken down into a number of subareas (e.g. crop pest control and rangeland management). A first list of subareas on which guidelines should be prepared soonest was agreed on as follows:

1. pesticide use on industrial crops
2. irrigation in arid and semi-arid areas
3. watershed development
4. pulp and paper industry
5. hides and skins industry
6. coastal tourism

At a subsequent meeting the DOEM determined that the operational guidelines should "avoid undue technicalities. They should be clear-cut

statements of the environmental concerns, environmental parameters and environmental constraints arising in the area of interest. A distinction should be made between what would be useful for informed laymen, such as UNDP resident representatives or officials in the Ministry of Planning or Ministry of Economic Affairs of a developing country, to reach a decision on the need for and nature of environmental considerations in a given project at a very early stage of its formulation on the one hand, and the analytical tools required by engineers, economists and other scientific consultants in the form of coefficients, etc., to implement a project on the other. The latter should not be a part of the operational guidelines but on manuals of implementation." In the event, the six guidelines that have been prepared vary in the nature of the material assembled and the technical details analysed. This has been done deliberately.

In order to afford an opportunity to assess the practical utility of different approaches to the preparation of guidelines, it was considered necessary to establish models which could be compared and evaluated in terms of practical utility. UNEP would gratefully receive views on the analytical frameworks and approaches adopted in the different guidelines as well as suggestions for their improvement or amendment.

The environmental operational guidelines in this series are not intended to be prescriptions for corrective action or constraints on the methods, nature and scope of development activites. They are presented in the belief that dynamics and change induced by development aims are not without environmental hazards and risks; it is necessary to identify such hazards and risks where they arise and take early steps, in so far as prevailing circumstances permit, to contain or reduce them. It is necessary to take early steps, because later attempts at remedial action may be illusory, and always more costly than preventive action taken at the outset, and, as has been stated in the Conclusion to the Guidelines on Irrigation in Arid and Semi-arid Regions, "in some cases may be so costly as to bring into question the overall economic viability of the project".

We acknowledge with gratitude the contribution received from the United Nations specialized agencies, particularly the Food and Agriculture Organization, for the preparation of guidelines. Without financial assistance from UNDP, the operational guidelines could not have been completed effectively within the short time available. We are also dependent upon the assessment of the Resident Representatives and

the Headquarter staff of UNDP in regard to whether guidelines meet specific needs in the field.

Within UNEP, a number of colleagues have assisted in the preparation and editing of the operational guidelines. I wish to thank in particular Mr. Nat Htun (for the guidelines on the pulp and paper industry and on the hides, skins and leather industry) and Mr. Mohamed Tangi (for the guidelines on coastal tourism). Ms. Merran Van der Tak, Ms. Shahida Chaudhary and Mr. Mark Aeron-Thomas have assisted in the research and editing of the series.

Yusuf J. Ahmad
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INTRODUCTION

Pest control is directly related to two of man's most pressing problems: the provision of food and agricultural commodities for ever-expanding populations and the maintenance of health by the suppression of vectors of human disease. Although many crop pests have been overcome effectively by cultural management or by other non-chemical means, during the past three decades there has been a continually increasing use of pesticides in the control procedures. Insecticides have been used most extensively to protect agricultural crops but more recently herbicides, fungicides and various other kinds of pesticide have been increasingly used, particularly in developing countries.

In many fields of production these uses have undoubtedly made major contributions in the control of pests which from time immemorial have minimized yields and limited profitability in crop production. In many instances, the use has enabled crops to be produced where this had not previously been possible and many disastrous crop losses have been avoided or arrested. Their use has also often enabled relatively stable producitivity levels and quality standards to be maintained, thus permitting the production of foods and other basic commodities to be undertaken on a regular commercial basis.

New pesticides are being continuously developed and introduced. At present some three hundred pesticide chemicals are in common use in a range of formulations and for different purposes throughout the world. Not all of these are used on industrial crops, nor would they all be suitable for use on a given crop or against a given pest species. The needs of particular circumstances depend on the susceptibility of the particular pest, on the properties of the different chemicals available and the environment in which the crop is situated. The choice in such matters should be made by appropriately trained experts.

Fortunately many of the haphazard and excessive applications of the early post-war years have already given way, or are giving way, to more moderate application and concepts of integrating biological, cultural and other methods with lowered but continued use of chemicals in the control of pest populations. Nevertheless, the total world production

and consumption of pesticides continue to increase. The rate of increase is greatest amongst developing countries and this trend seems likely to continue for many years to come, in spite of a widening recognition of the disadvantages of excessive reliance on chemicals.

The above-mentioned benefits can be adequately assessed only if considered alongside the adverse effects. These guidelines have been prepared to draw attention to the environmental problems that have been encountered in the use of pesticides with particular emphasis on "industrial crops" (those produced for trade or commerce, rather than those produced for consumption by the producers or persons in their immediate localities).

ENVIRONMENTAL IMPACTS

Effect on the pest

If correctly chosen and applied in accordance with the manufacturers instructions and in sufficient quantities, the effect of the pesticide will be to bring about a reduction in the pest population so that the losses it causes are economically insignificant.

In general there is no need to attempt to eradicate the pest, although this has been recognized as a valid approach in the case of organisms which have been accidentally or recently introduced into a continent, and have not become very widely established.

Direct effect on man, domestic animals and other life

At the outset it must be recognized that pesticides have properties that are potentially harmful to man and to many beneficial species. Nevertheless as indicated in the WHO "Recommended Classification of Pesticides by Hazard" only a very small proportion of commonly available agricultural pesticides falls into the "highly" or "extremely" hazardous categories.

In assessing the hazards to man the most important considerations are the toxicology of the pesticide, its physical and chemical properties (volatility, solubility, stability, etc.) and the routes by which humans and animals may be exposed to it. These routes may include exposure of third parties or workers following spillages or other accidents, from exposure during spraying, or contact with used containers. Most poisoning and similar incidents have followed gross misuses due to

inexperience in the application of the compound in question and/or failure to provide adequate supervision as recommended by both governments and the original manufacturers. For instance, in attempts to control cotton pests in Central America substitution of relatively transient organo-phosphorous for organo-chlorine compounds subsequently produced casualties amongst operatives and some domestic animals due to the higher acute toxicities of the compounds.

Unintended or unsuspected distribution into the environment

Much of the public attention and disquiet concerning pesticides during recent years falls into this category.

RESIDUES IN THE CROP BEING PROTECTED

Poisoning directly via this route is very rare, but the presence of residues at any level is of great economic significance to food producers, particularly of foods produced on an industrial scale for sale in foreign markets. All major food importing countries have restrictions on the presence of alien substances in particular marketed foods and most specify maximum permissible levels for named pesticides if the produce is not to be rejected.

RESIDUES ELSEWHERE

Residues may occur in other food products, farm animals and wildlife outside the area designated for the application of the pesticide. This can occur as the result of either:

a) *Contamination of the aquatic environment:* Pesticides may make their way into the river system, borne directly by rain or irrigation waters, through absorption into the soil and its subsequent erosion, or through inadequate provision for disposal of cattle dips or spray run residues. This can cause contamination of fish, or of the drinking water for humans, farm animals or wildlife. Under a regime of heavy irrigation a significant amount of residual pesticide may reach the ground water system and hence be recycled in the drinking water; or

b) *Inefficient application:* Application by land-based workers in windy or turbulent conditions or aerial spraying can result in a significant proportion of the pesticide falling outside the designated area. For instance, during aerial spraying of cotton in Central America, it was estimated that less than 50 per cent of the dose applied actually fell within the target area. Some of the drifting insecticides fell on

neighbouring cattle pastures and found its way into the meat and milk products.

Diminishing returns from excessive and uncritical use

DESTRUCTION OF NATURAL ENEMIES OF PESTS

The role of their natural enemies in keeping pests under control can be considerable, and the importance of these predators is often underestimated. The total number of insect species is approximately one and a half million. Of these only some five thousand cause significant damage to crops, domestic animals or man, either directly or indirectly by transmission of disease. However, many of the parasites and predators of pests are as susceptible to pesticides as their prey, and there are few types of pesticides selective enough to kill only specific pests. Furthermore pesticides sometimes kill not only enemies of existing pests but also those of relatively innocuous plant-feeding species, which, released from predator/parasite pressure, may multiply rapidly and become pests. An example of this is the fruit tree red spider mite which prior to the advent of DDT was not a pest; the species was kept in check by various predatory mites which were very susceptible to the large quantities of DDT that were used in orchards. With these enemies removed, the red spider mite which is not susceptible to DDT became a major pest. On a similar basis, in some cotton-producing regions the number of pests increased from one or two to as many as 15 species with the advent of pesticides. This has sometimes led to heavier spraying regimes. These effects are particularly important in the developing countries where pesticides are only just beginning to be used on a large scale, and where the introduction and extended use of a new pesticide may bring with it the dangers of creating a new pest problem. Although the appearance of all new pests amongst industrial crops cannot be explained by suppression of natural enemies, many similar instances could be cited.

RESISTANCE OF PESTS TO PESTICIDES

When populations of some pests, particularly of insects or fungi, are continually treated with the same pesticide, it becomes necessary to gradually increase the dose applied each year. Eventually the pest may become almost immune so that even increased doses are no longer effective. This development is due to the natural selection of resistant individuals from the population in each succeeding generation and the

gradual genetic development of resistant strains. Sometimes resistance to a single pesticide may develop but, more commonly, cross-resistance develops so that resistance to one substance is accompanied by resistance to one or several others. Although only a small proportion of the known arthropod pests have developed such resistance, unfortunately this includes some of the most important species which infest crops and which transmit human and animal diseases. Resistance develops most commonly after continued exposure to persistent insecticides. Excessive applications can therefore greatly accentuate this problem.

WHAT CAN BE DONE

A variety of measures can be taken to eliminate or reduce the environmental damage associated with the use of pesticides. The list of measures given below should be considered as something at which to aim, rather than as a prerequisite standard to be reached before any projects can be accepted. The extent to which these measures can be omitted from the project design must inevitably be left to the discretion of the agency whose approval is sought. However this will largely depend on the size of the project, the damage that may result due to their omission, the availability of manpower qualified to carry them out, and the urgency of the need for the use of pesticides.

One general method of helping to reduce the adverse environmental impacts of pesticides is to ensure that suitably trained personnel are available to assist in the implementation of pest management practices. If the project is large, arrangements for the training of such personnel should be made.

Alternative or supplementary methods of attaching the pest problem: "integrated pest management"

Pesticides are not the only method by which the pest population may be reduced. As the result of increasing awareness of the potentially damaging side effects of the use of chemical pesticides there has been growing emphasis in recent years on what is known as "integrated pest management".

Integrated pest management looks at the whole ecosystem and requires an adequate knowledge of the population ecology of the pest to be controlled and the other relevant organisms, especially its natural enemies, in the same environment. By using a combination of intelli-

gent crop management practices and mechanical, biological and, if necessary, chemical controls, integrated pest management can lead to a dramatic drop in the intensity of pesticide use. It has been estimated by the Office of Technology Assessment (US) that this approach could cut pesticide use in the USA by up to 75 per cent on some crops, reduce preharvest losses by 50 per cent and result in significant savings in pest control.

Crop management practices: due to the fact that the reproduction cycles of many pests are attuned to the growth of plants, if crops can be planted a few weeks before or after the normal time, it may be possible to bypass that stage of the insect that causes most damage to the crop. Intercropping and polyculture can also reduce the spread of pests and disease organisms by interspersing unsusceptible crops with the host crop in the same field.

Mechanical control practices: Sometimes the easiest, and the most environmentally sound, means of controlling pests on agricultural lands is by using mechanical control methods such as burning the field prior to planting, and flooding the field. Such methods not only avoid the chemical side effects of pesticides but also may be far more cost effective—especially in countries where manual labour is plentiful.

Biological control methods: Pests can be controlled by assisting the propagation of their natural predators, or by other biological means such as the use of sex attractants, insect growth regulators, sterilized male insects, and insect pathogens, all of which may prove effective in reducing the pest population.

Obviously all the above methods will not be feasible in every single project due to constraints on scientific back-up and appropriately trained manpower. However every effort should be made to ensure that the project design incorporates those methods that can be applied, thereby reducing dependence on the use of chemical pesticides.

Minimization of the direct effect on man, domesticated animals, and other life

Due to their toxicity many pesticides represent a potential danger to man and other animals, and in some circumstances can prove fatal. However if proper safeguards are used the number of serious accidents can be greatly reduced or even eliminated.

At all stages of the operation, i.e. packaging, transport, storage, distribution and application, it must be ensured that those involved

have adequate knowledge of the proper safety procedures applicable to the pesticide concerned. Furthermore responsibility for following these procedures must be clearly allocated at each stage of the operation. An indication as to how these responsibilities are to be allocated between governments, individual supervisors, and managers is given in the Occupational Safety and Health pamphlet of the ILO on "Safe Use of Pesticides". The adoption and efficient implementation of official control schemes is recommended wherever possible. Such schemes include government-sponsored registration schemes for the introduction and use of pesticides, and those recommended by WHO and FAO.

For increased safety in handling and application, it is essential that provision is made within the project for the appropriate language to be used on the pesticide containers and/or for suitable instruction to be given to all operatives. In circumstances where the pesticides are used in an emergency by workers unfamiliar with them, supervision should be provided by someone with the requisite knowledge or experience.

Minimizing the unintended or unanticipated distribution into the environment

Residues in the crop being protected: Even if pests are causing economically significant damage to the crop, and alternative methods of control cannot eliminate the problem, it is sometimes better to allow the damage to take place than to run the risk of making the crop unsaleable due to the excessively high levels of pesticide residues in it. The acceptable levels differ according to national legislation; however, there is some uniformity since many are derived from the recommendations of the FAO/WHO Codex Alimentarius Commission. To avoid the indiscriminate use of pesticides which results in the crop being unsaleable on the international market for which it was intended (or of becoming a health hazard at home), it is essential that the farmers involved in the project have access to, and make use of, facilities for monitoring these residues. These facilities are provided by various authorities in different countries, including government departments, trade associations, and other organizations. A number of such facilities have been established or assisted with UN funds and FAO technical help. In assessing a project involving the use of pesticides it is essential that the problem of residues is considered and that adequate facilities are made available to check that the recommended limits are not being exceeded.

MINIMIZATION OF RESIDUES ELSEWHERE

a) Due to seepage into the aquatic environment it is desirable to minimize the amount of pesticide entering the aquatic environment, especially if the contamination of fish or of the drinking of man or other animals may result. A well-prepared project will therefore make allowance for this, and make appropriate adjustments, where possible, to avoid the use of pesticides during the rainy season, or before heavy irrigation or leaching of the soil. It is also possible, through the careful construction of drainage ditches, to reduce the erosion, and subsequent entry into the aquatic system, of soils in which pesticides may have been absorbed.

b) Due to inefficient application—Certain methods in the application of pesticides are less efficient than others in terms of the proportion of the chemical landing on the appropriate crop. The use of aerial spraying has proved to be particularly problematic. Thus if the project calls for the use of such measures they must be justified not just in purely commercial terms, but also within the wider context related to this environmental damage. Even when applied using hand-held sprays, a significant proportion of the pesticides may fall outside the target area if they are dispersed in the wrong conditions. Pesticides should be applied when the air is still; often this is in the early morning or early evening, and to minimize environmental damage it is important that the project ensures that operatives are made aware of this.

Avoiding excessive and uncritical usage

Destruction of the natural enemies of pests: As indicated above, the encouragement of pests' natural parasites and predators is one of the least environmentally damaging methods of dealing with the problem. Therefore if the use of chemical pesticides is found to be necessary, an attempt should be made to gauge the possible impact on the pest's predators and, where a choice exists, the pesticide used should be such which will cause the least damage to them.

Resistance of pests to pesticides: In the application of pesticides the dictum that "if a little is good then a lot is better" is rarely applicable. Pesticides should only be applied as and when they are needed. Practices such as the contracting of firms to provide aerial crops spraying at fixed intervals should not be encouraged, and those who are to imple-

ment the project should be aware of this. If pesticides need to be applied regularly then the best method for avoiding the development of resistant strains of the pest may be to avoid using the same pesticide all the time. This may involve becoming acquainted with new safety procedures, etc., but it is a method well worth considering if retraining of operatives is not a major problem.

SUMMARY AND CONCLUSIONS

The use of pesticides in the right circumstances brings about a dramatic increase in agricultural production and, therefore, in the context of widespread malnutrition in many developing countries should always be considered seriously.

However the use of pesticides is not without its environmental hazards and in all circumstances every effort should be made to reduce these as far as the prevailing circumstances allow. In assessing a project involving the use of pesticides three main questions should be asked:

1) Have the alternatives been considered?
2) Has every effort been made to estimate the possible environmental damage?
3) As far as the circumstances allow have steps taken to reduce this damage?

In the light of the information derived from the answers to these questions, and essentially with reference to the foregoing text, it is expected that the evaluator will find it possible to make a reasoned evaluation of the project at the level required.

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