ronmental Management Guidelines, No. 12

ENVIRONMENTAL GUIDELINES FOR

Farming Systems Research

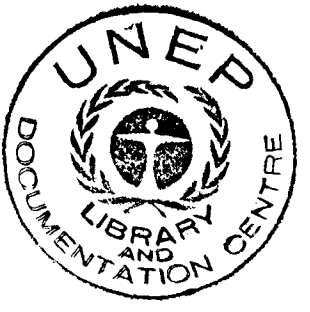
UNITED NATIONS ENVIRONMENT PROGRAMME

FARMING SYSTEMS RESEARCH

Environmental Management 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
7. Formulation of National Soils Policies
8. The Restoration and Rehabilitation of Land and Soils after Mining Activities
9. Afforestation Projects
10. Agricultural Mechanization
11. Agroforestry Projects
12. Farming Systems Research
13. Rural Roads.

FARMING SYSTEMS RESEARCH



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FOREWORD

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

There are many pitfalls to be avoided in initiating development activities and many opportunities that can be availed of without much additional cost. Experience during the last ten years has shown that remedial measures must be incorporated, if they are to be effective, in the conceptual and design stages of projects. The same applies to planning procedures. Later attempts may prove to be only cosmetic, as ecosystems are fragile and complex and may not recover from the stresses to which they are exposed.

Prepared by UNEP, in close consultation with the United Nations specialized agencies concerned, the first six guidelines were jointly financed by UNEP and UNDP. They were adopted by UNDP and distributed to the UNDP Resident Representatives. The remaining guidelines in the series have been prepared by UNEP to cover important areas of emerging concern.

The remedial or preventive measures outlined are meant to be illustrative rather than exhaustive in nature: there is no substitute for local experience, foresight and prudence. We have only attempted to draw attention to the kind of considerations which must be kept centrally in mind in undertaking development activities.

The objectives for which we strive in these guidelines are numerous and interrelated, requiring a formidable array of diverse technologies and disciplines. Although the guidelines 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 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 UN specialized agencies, UNDP and other multilateral and bilateral development financing institutions, as appropriate, taking fully into consideration comments and advice which we expect to receive regarding this set of guidelines.

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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 UN specialized agencies, the preparation of environmental operational guidelines to assess and minimize the possible adverse environmental impacts 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 universities and 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 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, parameters and 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 in manuals of implementation".

In the event, the 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 guidelines in this series are not intended to be prescriptions for corrective action or constraints on the methods, nature and scope of development activities. 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 circumstances permit, to contain or reduce them. It is necessary to take early steps, because later attempts at remedial action may be illusory, more costly than preventive action taken at the outset, and in some cases, may be so costly as to bring into question the overall economic viability of the project.

We acknowledge with gratitude the contributions received from the UN specialized agencies, particularly the Food and Agriculture Organization (FAO), for preparing the guidelines. Without financial assistance from UNDP, the operational guidelines could not have been completed effectively within the time available. We are also dependent upon the assessment of the Resident Representatives and the Headquarters staff of UNDP on whether the 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. Nay Htun (for the guidelines on the pulp and paper industry and on the hides and skins industry) and Mr. Mohamed Tangi (for the guidelines on coastal tourism). Ms. Merran Van der Tak, Ms. Shahida Chaudhary and Mr. Mark Aeron-Thomas assisted in the research and editing of the first six guidelines in the series; the latest guidelines have benefited from the sustained efforts of Ms. Sophie Schlingemann and Ms. Gill Mayers.

UNEP's decision, to produce further guidelines, on issues currently on the international agenda for environmental action, has resulted in subsequent guidelines in the series. The first six have been complemented by the following:

1. formulation of national soil policies
2. the restoration and rehabilitation of land and soils after mining activities
3. afforestation projects
4. agricultural mechanization

The three latest ones are on:

1. agroforestry
2. farming systems research
3. environmental considerations in rural roads projects

On the basis of reports received additional guidelines are under editorial consideration.

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INTRODUCTION

Farming Systems Research (FSR) has increased in popularity recently both in academic circles and among administrators of national and international agricultural development programmes. In the expectation that FSR programmes will continue to demonstrate their effectiveness in developing and promoting new technologies which will be acceptable to small-holder or low-resource farmers, and, therefore, widely adopted by them, it is important to examine the impact which FSR programmes could have on the environment.

The natural environment is the source of a large part of the productive inputs of any farming system. These guidelines have been written to provide policy makers and their advisers with a clear description of the environmental impact FSR programmes might have and the ways and means of designing and administering a research programme which adequately ensures the long term sustainability of the natural resource base.

For the purposes of this guideline the word environment is taken to mean the natural and physical environment which provides resources under which agricultural production occurs and which is altered, in turn, by agricultural production. The FSR literature is particularly concerned with the socio-economic context of agricultural production and hence environment is often meant to refer to the socio-economic and natural environment combined rather than the physical or geographical conditions alone. The guideline addresses, however, the interactions of the farming system with the physical environment.

The next Chapter will briefly describe what FSR is and how it differs from more traditional agricultural research programmes. Chapter Three discusses both the positive and negative potential impacts of FSR upon the environment. Chapter Four provides guidelines for an FSR research programme which emphasizes the positive potential impacts of FSR upon the environment and attempts to identify measures that could minimize the negative.

FARMING SYSTEMS RESEARCH

Farming Systems Research can most easily be understood as a response to difficulties encountered in the extension of research results developed on experimental research stations. In the wake of the successes in irrigated wheat and rice in the 1960s, the so-called "green revolution", several attempts to develop new varieties for other crops under different conditions showed considerable promise on experimental plots. However their adoption by farmers, particularly small-holder or low-resource farmers was poor. Failure at the farm-level prompted researchers to consider the perspective of individual farmers and to involve farmers earlier in the setting of the research agenda.

FSR has two main features which distinguish the process from ordinary research: (1) the opening of a dialogue with the farmer before research begins to determine research priorities; and (2) the treatment of the farm as a productive system with wide ranging objectives and interacting production activities. We describe each feature in turn.

Improved dialogue with farmers: FSR is an approach to research which begins with discussions with the farmer to determine their priorities and the constraints to production which they identify and determine to be worthy of research effort [1]. FSR attempts in this way to build a bond of trust between the researcher and the farmer. Once this bond is established researchers may employ their greater experience in other parts of the world to discuss with the farmer alternative goals and thereby adjust the farmer's priorities to reflect national or other researcher-determined goals.

This contrasts with earlier crop or discipline specific research in that research priorities were generally applied from the top down, a practice often referred to as "downstream" research as opposed to "upstream" research. Researchers' experience in other parts of the world would, in this case, prejudice them towards technologies with which they are

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1. The reader may wish to refer to one particular methodology associated with FSR in

2. Collinson, in an appendix to the 1980 edition of Ruthenberg states this idea in a slightly different way: "It is the task of FSR to assess the worthwhileness of innovations in the context of the total farm unit. FSR is thus a major tool to close the 'gap' between agricultural research and the performance in actual farms." p. 382.

familiar and lead them to apply them under conditions to which they are not suited.

A second, although related, aspect of FSR, is improved interaction and communication, not only between farmers and researchers, but also between what is often called "on-farm research" and experimental station research. Thus FSR has a role to play in determining areas and disciplines for new formal research which takes place on experimental plots. It has the potential of bringing farmer objectives and researcher objectives closer together [2]. On farm research also serves an extension function providing farmers with first hand experience with new technologies. Farmers can communicate their response to particular innovations in the course of FSR. Their input is part of an iterative research process.

The treatment of the farm as a productive system: It is now a generally held premise that small-holders run their farms as a system, balancing a number of different objectives, and allocating finite resources to several interacting production activities to meet those objectives. Developing a thorough understanding of these interacting production activities and the objectives towards which they are applied is a distinguishing feature of FSR. Ordinary crop or discipline specific research was formerly undertaken solely on experimental research stations with little regard for conditions, particularly socio-economic conditions, that faced the farmer. This often led to the recommendation of technologies that were ill-suited to small-holder systems.

An understanding of the interactions within the farming system opens up the possibility of meeting the objectives of farmers by alternative means thereby removing the constraint to the adoption of a particular technology. For example, most small-holder farmers practice mixed cropping, combining several different crops on one field rather than producing one crop (sole cropping) for sale in the market. This is because in certain developing countries the marketing system is often unreliable, either as a source of purchased food, or as a place to sell goods to earn the cash to pay for food. If markets, one element of the "system", were improved it might make sole-cropping technologies acceptable to farmers. Whether or not sole-cropping is preferable to mixed-cropping is one of the issues to be discussed in the next chapter on the environmental impacts of FSR.

ENVIRONMENTAL IMPACTS OF FARMING SYSTEMS RESEARCH PROGRAMMES

Positive Impacts

The positive impacts of FSR derive chiefly from the two characteristics described above which distinguish it from more traditional research programmes. These are the initial dialogue with the farmer and the treatment of the farm as a system.

The initial discussion with the farmer and the setting of the research agenda according to farmer priorities is more likely to address the issue of the long-term sustainability of the resources upon which farmers depend for inputs. Research indicates (Norman, 1978) that farmers are keenly aware of the long-term effects upon the environment of their activities. Concern for the future livelihood of their children translates directly into concern for the quality of environmental inputs. Solutions to problems such as deteriorating soil quality, reduced quality or availability of ground water resources, and increasingly scarce fuelwood for cooking are likely to be at or near the top of the research agenda because farmers' needs are given priority.

The treatment of the farm as a system and the thorough understanding by the researcher of the farming system as currently operated by the farmer ensures that traditional technologies are not prematurely and incorrectly discarded. Many traditional technologies, including mixed cropping and staggered planting schedules, both aimed at providing a constant food supply throughout the year, are, in fact, better at preserving soil quality than sole-cropping. Continuous cover helps prevent erosion and the mixture of crops on one field may maintain a better balance of soil nutrients, especially where fertilizer inputs are too expensive or not available. Not all traditional technologies are necessarily the best possible. However, FSR avoids the mistake of discounting the experience and expertise of the farmer in favour of modern technologies which have uncertain long-term consequences for the environment.

A "system" perspective is also beneficial to the environment when environmental inputs are explicitly considered as part of the system rather than as fixed. It is clear that the rate and means of use of environmental inputs have direct consequences for their long term availability for sustained production. Likewise the combined effect of many farmers adopting the same recommended technology will have effects upon the availability of resources both for other farming systems and other pro-

ductive systems. As long as the "system" is defined broadly enough to take into account the effect of productive activities upon environmental inputs as well as any by-products of production which have effects upon the environment, then FSR programmes can be expected to have a positive impact.

Negative Impacts

Negative impacts derive, firstly, from the financial, manpower and time constraints which typically face research programmes as implemented in practice. Secondly, researcher goals may also differ from farmer goals. Researchers are usually more oriented to output maximization than small-holder farmers and may recommend new technologies on that basis which are unsuited to the environment under consideration.

It is emphasized in the literature (Byerlee, et. al., 1980 and Collinson, 1980) that the system under consideration should be as narrowly defined as possible in order that the complex system interactions be fully understood for a particular set of farmers (a particular "recommendation domain")[3]. This often requires that farmer circumstances, including the physical environment, be taken as given. Otherwise, it is argued, the research task becomes too difficult and expensive to manage[4]. In this context, the long term sustainability of environmental inputs cannot be adequately addressed. Furthermore, if researchers are limited to consideration of the individual farmer they will not fully take into account the effects upon the resource base that their recommended technologies will have if all farmers adopt them collectively. This is the classic externalities problem, whereby, because an individual farmer is not required to pay his share of the full cost to the society or community incurred by his actions, he may over-use a collective resource such as soils or water.

There seem to be, therefore, two aspects of FSR as applied in

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[3] "Recommendation domain" is defined loosely as a subset of farming systems which share production conditions and objectives enough in common such that recommendations of particular technologies will have valid applications and enjoy adoption by all farmers in the domain.

[4] "an efficient research strategy should focus on a very few—perhaps two to four research opportunities that offer potential to increase resource productivity in a way acceptable to farmers", Byerlee, et. al., 1982, p. 899.

practice which have negative implications for environmental management: (1) the environment is larger than any individual production system so that recommendations for one domain (set of farming systems) may have adverse effects on other domains or on the environment in general which sustains more than one complex system of production. (2) The definition of recommendation domain implies that the researcher is making recommendations for a class or set of individual farms to help them achieve their goals. He/She is not oriented towards investigating the implications of all farms collectively following his/her advice and the consequences this may have on the resource base.

Researchers must be expected to adhere to their own objectives defined loosely in terms of national research programme goals or personal ambition. In fact, FSR programmes typically encourage researchers to employ their greater world-wide experience and expertise in discussions with the farmer after a bond of trust has been established. Researcher objectives may or may not include the long term sustainability of natural resources.

National research programmes are often oriented towards aggregate output objectives, which may, in turn, reflect trade, foreign exchange or revenue enhancement imperatives. Researchers are often rewarded on their contribution to national goals. New technologies which increase the output of a particular crop, may, in fact, be the objective of a particular FSR programme and researchers would be rewarded for their degree of success in their development. While output maximization and sound environmental management do not necessarily conflict there is the danger that environmental concerns will be muted or entirely ignored in deference to other shorter-term objectives.

GUIDELINES FOR AN FSR RESEARCH PROGRAMME

The nature and orientation of a research programme is a policy issue which should be addressed at the planning level. Effective planning must take into account the longest possible time frame and must, therefore, reflect concern for the long-term sustainability of a country's natural resources. An agricultural research programme which builds upon the precepts of FSR can be designed and administered in such a way that environmental resources are not jeopardized.

The following set of guidelines is indicative of the kind of issues that must be raised at the planning level so that researchers develop with farmers new agricultural technologies which are sustainable over the long-term.

The positive impacts of an FSR programme, as described in Chapter Three, must be emphasized to ensure that they are fully incorporated in the research methodology. For example:

It is essential that researchers make a genuine effort to enter into a dialogue with the farmers to appreciate fully the constraints they face in the attainment of their objectives. Traditional technologies must be thoroughly examined, understood and evaluated in terms of these objectives. In particular, researchers must be sensitive to the long-term and inter-generational needs and objectives of farmers, especially the maintainance of their livelihood for future generations. New technologies must not be introduced and are unlikely to meet with widespread adoption unless they meet farmer objectives. Wherever possible, it is necessary to incorporate the superior environmental aspects of traditional technologies and adapt rather than replace them.

In the latter stages of farmer-researcher dialogue, once a bond of trust has been established, the researcher must undertake to educate the farmer in those cases where current practices are detrimental to the long-term sustainability of environmental resources. A researcher, by virtue of his/her world-wide experience, superior resources and education, may be aware of a decline in the stock of agricultural inputs which may not otherwise be obvious to the farmer such as the loss of ground water resources or the deterioration of soil quality. He/She should help the farmer come to terms with these long-term trends and should work to provide new technologies for their halt of reversal.

The "system perspective" must be expanded to include the level and state of environmental inputs as an integral and interactive component. The tendency to take environmental inputs as given and, therefore, unchanging must be resisted. Similarly the scope of an FSR programme must be wide enough to allow for creative solutions to environmental crises. A research programme which focusses merely on output maximization will fail to appreciate the longer term consequences of over production and consumption in the near term. A broadly defined "system" may allow for solutions which involve alternative productive enterprises for rural communities, thereby reducing the pressure of large populations on agricultural resources

We have described in Chapter Three the negative impacts of FSR programmes especially with respect to the constraints which face a research programme in practice. The following suggests ways to minimize these impacts:

Financial and manpower constraints must not be allowed to affect adversely the degree to which environmental effects of recommended technologies are taken into account. Researchers must be encouraged to take explicit precautions against recommending new technologies which ignore the long term consequences upon the natural resource base. While the focus of a research programme may be upon an individual crop or a narrowly defined farming system, it is essential that broader perspectives be employed to analyze the wider ramifications of new technologies for other farming systems, other "recommendation domains", and other productive systems which share scarce environmental inputs.

Researchers must balance farmer goals, including the sustainability of their resource base, against nationally determined research goals which often include the expansion of output. Policy makers must be made aware of the potential conflict of farmer and researcher goals and set the basis upon which these conflicts can be resolved. This is best achieved through an FSR programme which emphasizes communication with the farmer. However, it must be further emphasized that the conservation benefits of some traditional technologies should be fully respected and new technologies fully tested against a similar standard of conservation before they are recommended as improvements. Likewise researchers must emphasize the development of new technologies which improve upon current farmer practices with respect to the long-term sustainability of the natural resource base.

CONCLUSIONS

Policy makers and planners are responsible for establishing the focus and orientation of national agricultural research programmes. FSR represents a major improvement over earlier research programmes on small-holder agriculture in that it ensures the adoption of new technologies by entering into a dialogue with the farmer and setting the research agenda according to his/her priorities. It also helps to avoid the mistake of applying new technologies on the basis of researcher experience on experimental plots indiscriminately and without regard to small-holder circumstances. In this respect FSR is a highly recommended kind of research programme which has the potential for adequate consideration of the impacts of recommended technologies on the environment.

However, further measures are required on the part of planners and policy makers to ensure that FSR programmes develop and maintain a broader and longer-term perspective than is typically the case. A programme must be designed which adequately motivates researchers to develop technologies which address national goals such as expanded output but not at the expense of the long-term sustainability of the resource base. A too-narrowly defined research task mitigates against the development of creative solutions to production constraints. A broader definition of the "system" under consideration is required and must be encouraged by programme administrators. Such an orientation can only be established and provided for at the policy and planning levels. It is hoped that these guidelines have assisted those responsible for this task by pointing out the positive and negative potential impacts upon the environment and recommending policy actions which will build upon the advantages of an FSR programme and minimize the potential drawbacks.

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