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ON-FARM RESEARCH IN AN INTEGRATED AGRICULTURAL TECHNOLOGY DEVELOPMENT SYSTEM: CASE STUDY OF TRITICALE FOR THE HIMALAYAN HILLS

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by

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SUMMARY

This paper discussed the central role of an on-farm research program in an integrated agricultural technology development system. The dynamic relationships between program justification, on-farm research, implications analysis, policy making, on-station research and technologies for extension promotion are described in the context of an overall research and development system.

The methods for conducting an on-farm research program are suggested. These include initial surveys and other information gathering activities, diagnosis of farmers' problems, on-farm experiments and the monitoring and feed-back systems. Parts of this approach are illustrated by examples from a current research program for developing triticale for the people of the Himalayan hills. The paper concludes with a list of suggestions of what might be considered when the workshop participants draw out the implications of their observations in the field and their discussions and write up the workshop's recommendations.

INTRODUCTION

Over the last few years increasing attention has been given to the development of cost effective methods for helping research programs focus scarce research resources on diagnosing farmers problems and in finding suitable technologies to help address those problems.

In this paper some principles and guidelines are described which arise out of experiences of biological scientists and economists working together in national and subnational research programs as well as from CIMMYT programs in Mexico. Some of these methods are described in greater detail in two forthcoming publications (Byerlee et al and CIMMYT) and in CIMMYT training materials (e.g. CIMMYT 1978).

As our concern here is with the development of triticale for farmers and consumers in the Himalayan hills, the methodology is illustrated using that crop, although it is felt that the guidelines may be used - with appropriate judgement - for other biological, chemical and mechanical technologies.

OVERVIEW OF AN INTEGRATED TECHNOLOGY RESEARCH PROGRAM

Figure 1 shows an overview of an integrated technology research system. It can be seen that there are five major components:

1. Program Justification

In the macro planning context every applied research and development (R&D) program must have an underpinning of adequate analysis as regards whether or not the program can be justified against future optimal land use patterns, national development objectives, available resources and expectations about future utilization patterns and the distribution of benefits.

It seems unfortunate if scarce national research talents of intuition and perseverance, not to mention financial and other inputs, are diverted to research activities when it could have been seen from the start of the endeavour that a certain crop should not be encouraged or there would be no effective demand for the products of the technology once it was developed. Alternatively, as sometimes in the case of foodgrains, there may be a national need for carbohydrates but, because of a lack of effective purchasing power on the part of the poorest groups in the society, these consumers are unable to obtain the grain. In this case foodgrain prices may decline unless there are government foodgrain subsidies and/or attention is directed to promoting labour intensive technologies for increasing the productivity of scarce national resources, which at the same time also provides people with jobs and effective purchasing power.

In the case of triticale for the Himalayan hills we need not spend too much time on justification because:

a) Countries in this region have a national commitment to the poorest groups in rural areas and the people of the Himalayas must be some of the poorest people in Asia.

b) Triticale is a crop which can be grown in the winter (rabi) season and apparently has a yield, as well as a risk reducing, advantage over competitive crops such as wheat.

c) The benefits of triticale production are more likely to go to those people who most need them, because most grain in the hills is consumed on the farm where it is grown. This also means that there is, and there will continue to be for a considerable time, an effective demand for triticale grain.

d) From the national point of view, the widespread adoption of triticale in the hills would reduce a major source of disease infection for wheat grown on the plains.

There is though at least one other major development objective which should be taken into account as regards the promotion of triticale or any other field crop in the Himalayan hills: Long term national goals may be better met if programs of re-forestation are undertaken in the hills and land is taken out of field crops. However, even if this development objective is implemented there is still a justification for a triticale program on the grounds that it will be a better crop for that land which is still left under cereal cultivation.

2. On-farm Research

Once an P&D program has been justified against national objectives the second, and central part of the overall system, is the on-farm research program. This covers such issues as gathering information on basic agro-climatic and socio-economic conditions, the diagnosis of key farmer problems, drawing down on currently known technologies and setting up on-farm experiments, developing extension recommendations for specified groups of farmers and introducing monitoring methods to keep up with farmer innovations and experiences with new technologies. We shall come back to this topic shortly.

3. Implications Analysis

The third component of the research system is the implications analysis which is conducted and completed during each cycle of an on-farm research program. The important thing to note here is that the on-farm research program must be "tailor made" to allow for a rapid analysis of results each season as the whole essence of this farmer orientated approach to research is that collaborative groups of scientists are involved in a

dynamic process by which information is collected for a specific purpose, and the implications from the analysis are drawn out quickly for the next year's cycle of on-farm experiments, special purpose surveys, on-station research, extension recommendations as well as for key policy issues. This means that surveys and on-farm experiments must all be reduced in scope and size so as to only focus on priority issues and must be feasible within the bounds of available manpower and other research resources. This generally calls for intuition, resourcefulness, ingenuity and perseverance on the part of researchers.

4. Experiment Station Research

This is seen as a back-up to the on-farm research program. No applied research on an experiment station in a national or a subnational program can be justified unless there is a clearly defined target zone of agro-climatic conditions and socio-economic environments for which such activities as plant breeding research are orientated. As key information on agro-climatic and socio-economic conditions comes from the local on-farm research program, it can be seen that a good experiment station research program is dependent upon a strong local on-farm research program.

5. Policy Making

There are many ways in which policy issues which affect farmers and consumers may be identified and addressed. As those familiar with crop improvement programs know, there is no lack of "possible" policy issues which need addressing for the promotion of a specific crop. High support prices, subsidized inputs, land consolidation, reduced taxes are frequently called for. By placing the identification of key policy making issues

dependent upon the implications analysis of an on-farm research program we are letting careful micro analysis of technical and socio-economic phenomenon in the real world environments of farmers direct us to the one or two priority policy issues which may be open to change by government Of course, policy decisions are influenced by many factors beyond that of a good diagnosis of farmers circumstances. For example, land reform measures and price support policies, however, we would argue that policy analysis which uses the results of good on-farm research programs can contribute to sound policy decision-making.

GENERAL METHODOLOGY FOR AN ON-FARM RESEARCH PROGRAM

Figure 2 gives greater detail of the techniques that may be used in an on-farm research program. Three elements are inextricably woven together. These are:

- surveys and observational techniques
- on-farm experiments
- on-going implications analysis of data and information.

In Figure 2 we have separated out some of these components, however, it is recognized that in rare research projects these things may frequently be going on simultaneously in the mind of a researcher. For example, a really exceptional agronomist or agricultural economist may be able to go straight from an exploratory survey where he (she) has travelled in a specific region with his (her) eyes open and has talked to farmers, to identifying a specific package of practices which is appropriate for a target group of farmers. However, we are notably short of agricultural economists and agronomists with this type of farm level experience and whose minds automatically have a subconscious "check list" which ensures that they at least

take into account the information they absorb in the field, the knowledge they have about varieties and technical response functions from other sources, knowledge and projections about the opportunity costs of inputs, and also the likely benefits gained from the new technology. If these factors have not been implicitly "ticked off" then its quite likely that quick answers on recommendations will not be appropriate to farmer's circumstances and not adopted.

In recognition that there are few really exceptional technical or social scientists of the type described above, Figure 2 describes a number of steps which we hope will help in diagnosing farmer problems and coming up with technologies which are useful in meeting these problems. Hopefully the results will be no different (although a little later) from the recommendations of the exceptional scientists. If they are then at least we have a framework of analysis in which we can identify the specific causes of the differences and thereby improve on the methodology.

ILLUSTRATIONS FROM A TRITICALE ON-FARM RESEARCH PROGRAM

In this section we describe a few examples from the current triticale research program at the G.B. Pant University of Agriculture and Technology. Although some of the information and analysis was not collected and analysed with the framework of Figure 2 in mind, it is useful to use our experiences to test this approach and to see if the framework is useful.

1. Background data

This includes data on rainfall, soil types, area under crops, prevalence of cereal diseases, size of holdings, fragmentation, and other socio-economic information from existing reports and documents. A review of this

background information describes an agricultural setting which is scarce in resources, extremely harsh, unpredictable, very complex and where most of the agricultural work and decision-making is done by women. Developing a crop for a flat consolidated irrigated holding with access to inputs on the plains would seem a relatively easy task compared to the problems faced by farmers and scientists working in the hills. The very fact that there is a scarcity of background information only highlights that these difficult problems have been little worked on before. Of course, much of this background data is also necessary for justifying the overall crop improvement program and is not just related to the on-farm research program.

2. Exploratory Survey

This normally takes about 2 or 3 weeks with a technical scientist (generally an agronomist or plant breeder) travelling together with a social scientist (generally an economist) in the region, talking to farmers in an informal unstructured way and all the time discussing a whole range of technical and economic issues. In this process, a lot of possible solutions and technologies are "screened out" by the comments of ones colleagues or by the common sense of the farmer. An example of the type of feed-back from an exploratory survey came from some discussions last year with farmers who told us that the current generation of triticale seeds which were red and rather shrivelled did not worry them as it looked little different from their own local wheat grain. As regards its eating value, they said they either made chappatis directly out of it or mixed it with wheat or other grains. For them yield was more important than grain type or colour.

Possible implications for the triticale breeding program from this was that:

a) new crosses for white seeds and plump grains are less important than breeding for yield and yield stability and

b) for promoting triticale it should be seen as a type of wheat, rather than a new crop, as farmers already look upon triticale as a variety of wheat, and they are used to different varieties of wheat.

3. Formal Survey

From the exploratory work it became clear that a formal cultivator survey was necessary to diagnose the problems and constraints of farmers for whom triticale was being developed. The Formal survey uses random sampling techniques for the identification of farmers and a carefully designed and pre-tested questionnaire. Because triticale is so like wheat, questions are focussed on current wheat production practices, its place and comparative advantage/disadvantage in the cultivator's farming system and on household wheat consumption and utilization practices. The data and its analysis should be available soon.

4. Monitoring Survey

Triticale has been promoted through the local extension system and by mini-kits and demonstrations for several years. However, the monitoring of this new technology by means of feed-back from the extension service and by post-cards which were sent out with the mini-kits has not been too effective. Recently it was hypothesized that many farmers are in fact adopting triticale and a monitoring survey was started this year as an integral part of the research system. By means of this survey all farmers in 3 locations

who had ever grown triticale were to be interviewed to find out, for example, why or why not they were continuing to grow it, how they used it, whether they mix it with other grain to make chappatis, was the straw an important product etc. Early reports on the progress of this survey seem to indicate that triticale is less widely grown than previously thought, as only five farmers have been found in the three major locations of this year's on-farm research program.

Another critical side of the monitoring system is that the information from the on-going experiences of the field staff who are managing plots and surveys is fed back to the coordinator of the project throughout the season. It should be recognized that a coordinator cannot spend all his time in the field however, on-going feed-back and visits to the field are essential experiences and these often have as much impact on the future design of research, recommendations etc. as the results and data which are presented in reports at the end of each year. For example, this year some trials were looking in a very bad state in January, probably due to frost damage. The field staff were worried that the trials would fail and sent an urgent message to the coordinator. On visiting the plots he did indeed find them in a bad state however, the farmers' alternative crop, the local wheat and sonalika, were also looking in a poor condition. Nothing could or should have been done as on-farm experiments are not that type of experiment which should be done under the controlled conditions of experiment stations. What has happened is that we now know that certain conditions will affect all crops and it appears from more recent reports that the triticale is indeed showing the comparative advantages it is thought to have over

alternative crops and is recovering far better than the wheats.

5. Innovator Survey

This survey is designed to help keep scientists abreast of new technologies and management methods coming out of the informal research system of farmers and other village people. For example, along the Gangetic plain, many of the improved new agronomy and agriculture engineering practices for water use etc. which are most appropriate to the efficient use of scarce resources have been developed by farmers themselves (Biggs).

Because farmers are researchers innovator surveys are seen as an essential part of an on-going crop improvement program, Innovative farmers (who are frequently not the richer farmers) can contribute by:

a) providing verified technologies for extension promotion,

b) indicating new directions where applied research in the formal research system might be helpful to farmers, i.e. changing relative prices of crops and inputs may induce some farmers to change cropping patterns or start new inter-cropping practices. Sometimes, these trial by error methods could be improved on by the knowledge and experience of scientists and finally,

c) enabling us to learn a good bit from rural innovators about cost effective research methods.

In the case of triticale, in the exploratory survey, we found that some innovative farmers are already experimenting in using triticale and wheat in different proportions in order to get different types of chappatis. No separate innovator survey was started this year as we hoped that the new monitoring survey would catch some of these new innovations.

6. Diagnosis and Description

Out of the exploratory survey and discussions involving economists and biological scientists, it became evident that we did not know what was causing sterility in some triticale plots. Was it altitude? Was it temperature? Was it the differences of north or south facing terraces? In addition we found that we did not know enough about the technical fertilizer response functions for triticales on farmers' fields or how important the date of planting was to triticale yields. These were thought to be fundamental questions which needed answers from experiments on farmers' field trials before drawing up verification trials which combines various components into possible packages which might be recommended to farmers. At this exploratory stage we also "screened out" such experiments as forage cutting trials, irrigated triticale experiments (because there is virtually no irrigated land in the hills and there is not likely to be any in the future), planting under orchard trials etc. Although these are all possible trials and, under certain circumstances, they may be relevant, it was thought that at this stage more basic and fundamental questions needed answering and the results monitored and the implications drawn before we could go ahead. Accordingly, 36 varietal, 15 fertilizer and 11 time of planting trials were set up in three major locations: Narendranagar, Ranichuri and Ramgarh. The trials were set up at different altitudes, and characteristics such as the plot aspect and cropping pattern were noted.

CURRENT TRITICALE RESEARCH AND THIS WORKSHOP

The purpose of this workshop is to enable scientists to interact, argue and discuss different ways and methods to most effectively develop

triticales for the current and future farmers of the Himalayan hills. The workshop is centered around the on-station and on-farm research programs of the multi-disciplinary triticale group at the G.B. Pant University of Agriculture and Technology. This gives us a specific program against which we can discuss in concrete terms the breeding objectives, methods and site locations of a specific on-station program and the way in which the on-farm research of surveys, trials and talking to farmers ties in and influences the direction of that program. However, beyond this I would request that we also give attention to:

a) whether the type of overall program described in this paper is desirable and feasible, in other triticale programs, to this Himalayan region, and

b) how communications can be strengthened between scientists who can contribute to national or subnational triticale programs which are well focussed as regards their target group of cultivators and are using cost-effective methods to achieve those objectives. This, of course, does not restrict us to a dialogue between people within the region, as knowledgeable outsiders can often make a significant contribution by constructively questionning objectives and methods and also by suggesting relevant and viable alternatives. The encouragement and support for those doing difficult work is also generally appreciated.

CONCLUSIONS AND IMPLICATIONS

In the spirit of this paper and the thrust of this action orientated workshop, it is hoped that we can, by the end of the workshop, distil our observations and discussions and draw out the implications for recommendations on the following points:

1. Justification for Developing Triticales for the Himalayan Hills

There are still some people who feel that the benefits may not be adequate to cover the costs involved. Have we done enough to adequately describe and justify the case for triticale development for the hills?

2. Policy-Making

a) Technology Research and Development (R&D) Policy: Should there be an increase in the allocation of funds to on-farm research? Should there be increases in the rewards, incentives and logistical support for those scientists who are working in close contact with farmers and their problems?

b) Input Policies and Prices: Which of the many factors such as the supply and price of fertilizers, credit, seed, etc. are the critical bottlenecks at this stage to the spread of triticale, or is the development of technology the major constraint?

3. On-Station Research

At a regional workshop such as this it would appear useful for plant breeders and other scientists to be asking and answering such questions as the following:

Are we breeding for the right grain characteristics for consumption by the people of the Himalayas? Are we screening material at the right locations for the farmers of the Himalayas? Are we ensuring that we get the most relevant materials for our purposes from international and other plant breeding programs? Are we using the most cost effective breeding methods to achieve our objectives?

4, On-Farm Research

Is it worth it? Do we really need exploratory surveys, formal surveys,

monitoring and feed-back systems? Should top scientists spend a significant amount of their valuable time in villages talking to farmers, setting up and looking at on-farm trials, and in analysing each cycle the implications of the results of an on-farm research program? Do we really need to think each year about changing the techniques, components and levels used in on-farm research programs?

5. Technologies for Extension Promotion

Are we confident that we have developed varieties and recommended agronomy practices that are appropriate to farmers' circumstances? What can we say about the current generation of lines and their suitability for hill farmers? Have we spent enough time and research resources on ensuring that there is an effective, creative and on-going feed-back to the research system from village level extension personnel and farmers?

6. Regional and International Communications and Collaboration

While we frequently agree that good communications are an excellent idea, have we put in enough thought to methods by which we can keep up our good intentions? Journal articles are frequently not the most efficient and timely way of transmitting the type of information which is useful to scientists who are working on the problems of hill people. What are the alternatives? A regional quarterly Newsletter? Regional workshops? Regional study tours? There is certainly a set of common problems here which would make regional collaboration worthwhile for some of the poorest rural households in Asia.

7. Collaborative research between Technical (e.g. plant breeders) and Social Scientists (e.g. economists)

This workshop is made up mainly of technical scientists.

Generally, in the past, agricultural economists have not been involved at the planning stage (ex-ante stage) of developing agricultural technologies. They have often kept themselves to themselves or have come along after the event and merely described what has happened or criticized the decision of the technical scientist. If it is seen that there is a constructive role for social scientists at the macro (policy) level of crop planning, price policy etc. and at the micro level of diagnosing farmers' problems and developing technologies which are technically, and economically viable, then funds and positions within crop improvement programs have to be found.

Are we convinced that the economist can play a useful role within technical programs? If we are convinced then considerable effort has to be put into developing suitable methods for callaborative research because most of our techniques and professional rewards are orientated towards the demands of our separate disciplines and not towards working together on farmers' problems.

This paper and techniques and guidelines of the on-farm research methods we are developing with national programs are a step in the direction of evolving suitable collaborative research methods.

Bibliography

Biggs, Stephen D.

"On-farm and Village Level Research: An Approach to the Development of Agricultural and Rural Technologies," Paper prepared for the Symposium of Economic Problems in Transfer of New Technology, Indian Agricultural Research Institute, New Delhi, August, 1978 (Also CIMMYT Asian Report Number 6).

Byerlee, Derek, Stephen D. Biggs, Michael Collinson, Larry Harrington, Juan Carlos Martinez, Edgardo Moscardi and Donald Winkelmann.

"Towards a Methodology for Developing Technologies Appropriate to Farmers". Paper prepared for a conference of the International Association of Agricultural Economists, Bauff, Canada, September 1979 (forthcoming).

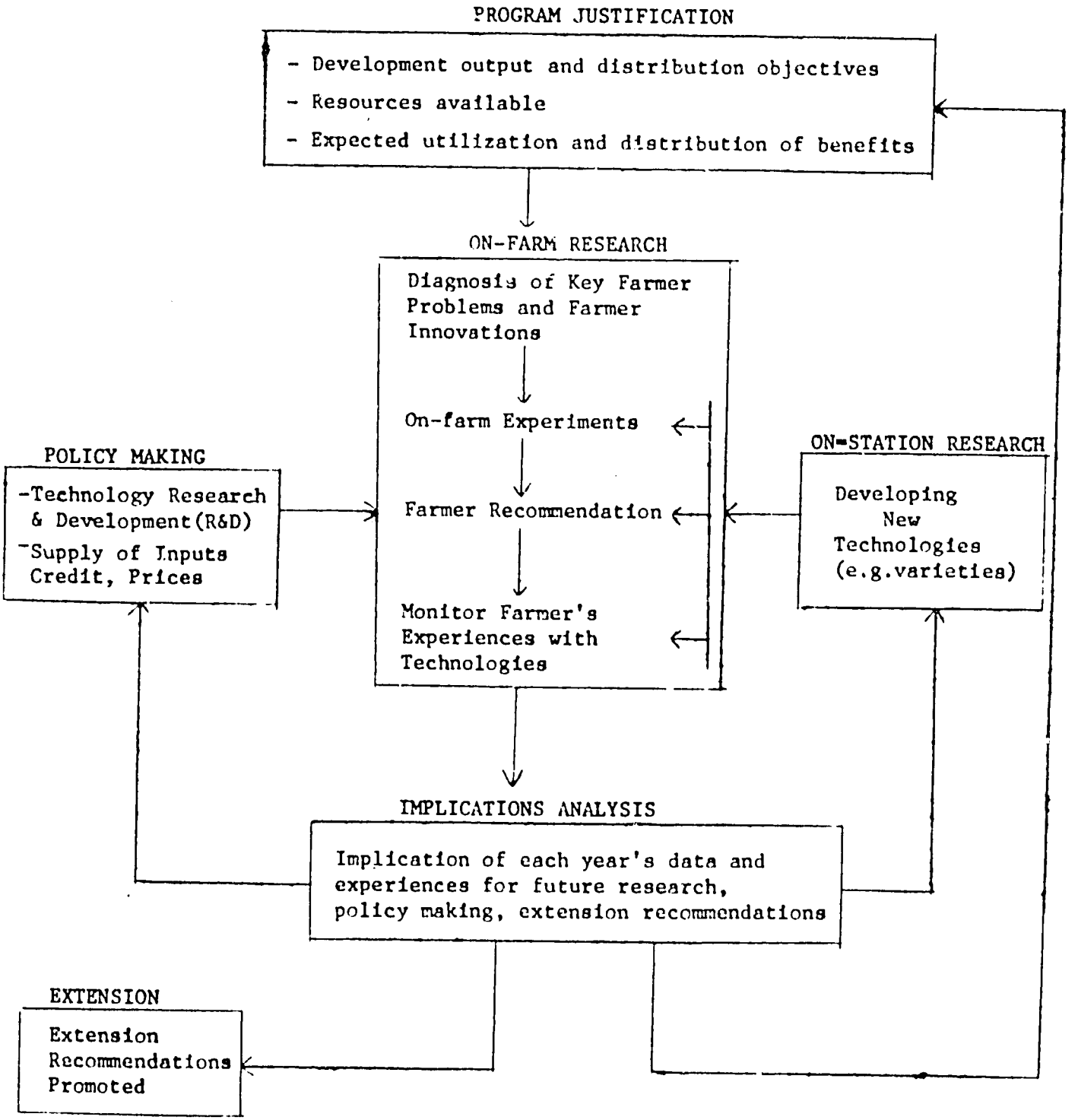
CIMMYT, 1978

CIMMYT Training, CIMMYT Today, Number 9, Mexico, CIMMYT 1978.

CIMMYT,

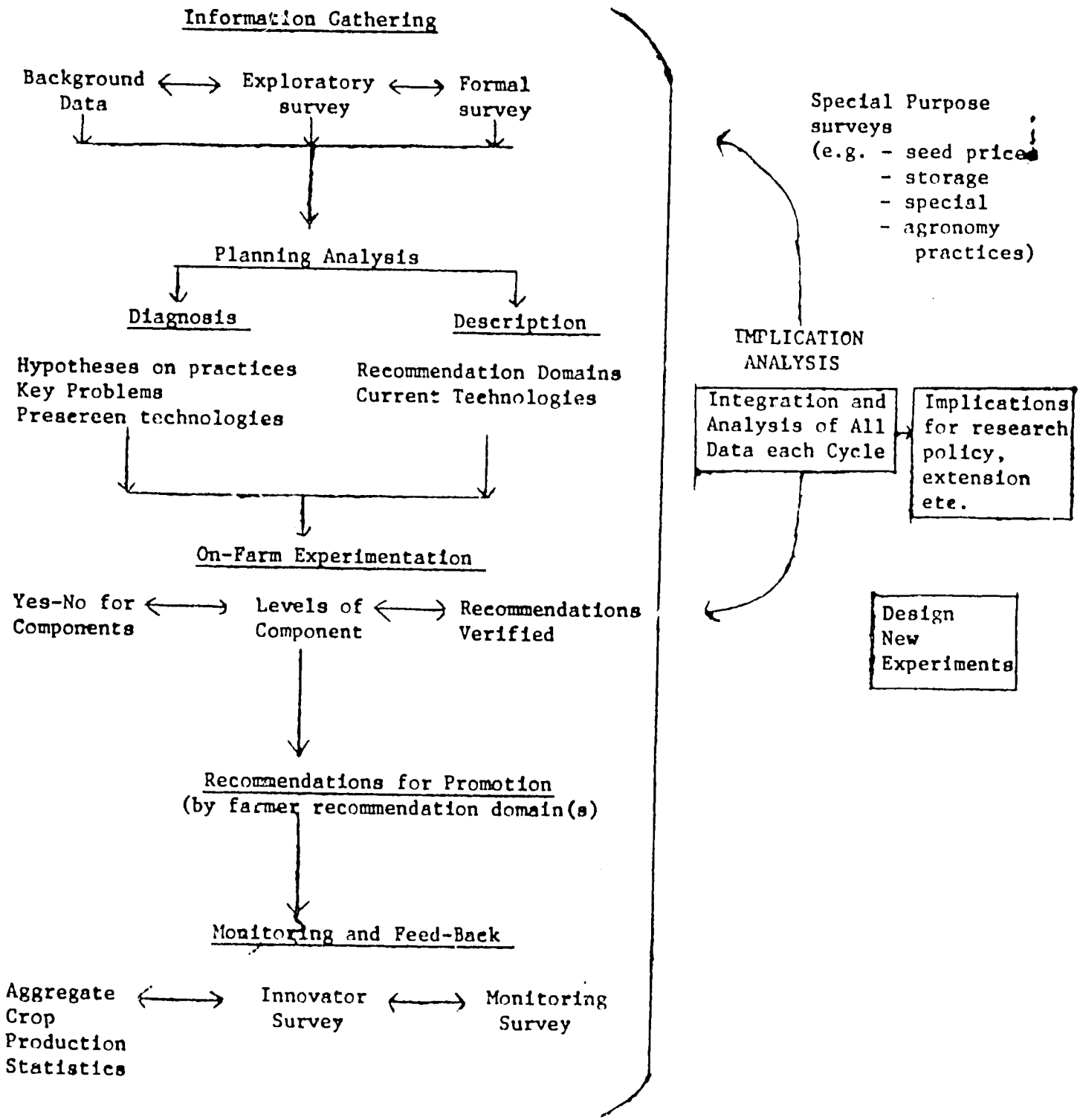
"Planning Technologies Appropriate to Farmers' Circumstances: A Manual of Procedures" Economics Program, CIMMYT, Mexico (forthcoming).

Figure 1: Overview of an Integrated Technology Research System



Source: Based on a figure from Byerlee et. al.

Figure 2 : Suggested Methodology for an On-Farm Research Program



Source: Based on a figure from Byerlee et. al.

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Integration of the Agricultural Production System in Planning and Executing a Production Program by Ernest W. Sprague, May 1978.

Developing an On-Farm Testing Program for Maize in India by Takumi Izuno, May 1978.

Planning Rural Technologies in the Context of Social Structures and Reward Systems by Stephen D. Biggs, May 1978.

An On-Farm Research System: Two Papers on Maize Research in Pakistan by A.F.E. Palmer, July 1978.

Social Science Training for Regional Agricultural Development by Robert Werge, July 1978.

On-farm and Village Level Research: An Approach to the Development of Agricultural and Rural Technologies by Stephen D. Biggs, July 1978.

Wheat Production with Employment: Priorities for Wheat Research in Bangladesh by Stephen D. Biggs, September 1978.

Generating Technology for Traditional Farmers: A Multi-disciplinary Methodology by Peter E. Hildebrand, October, 1978.

Maize in Asian Cropping Systems: Historical Review and Considerations for the Future by Takumi Izuno, January, 1979.

Technology Generation, Verification and Dissemination in Corn by Antonio Mercado, January, 1979.

Proposed Strategy for the East Java Maize Development Program 1979-1985 by Takumi Izuno, February, 1979.

On-farm Research in an Integrated Agricultural Technology Development System: Case Study of Triticale for the Himalayan Hills by Stephen D. Biggs, April 1979.

Maize On-Farm Research Project (1978 Report) by G.B. Pant University of Agriculture & Technology, Pantnagar - 263145 (Distt. Nainital), U.P., India. December, 1978.

The Present and Future for Maize in India by P.G. Ramachandran, February, 1979.

CIMMYT's Asian Regional Economics Program by S.D. Biggs, January, 1979.

The Rural Poor: Obstacles Which Prevent the Development of Agricultural Technologies for Their Benefit - A Discussion note by S.D. Biggs, February, 1979.

Maize Cultivator Survey (Exploratory Questionnaire)

Barley Exploratory Survey

*From Agronomic Data to Farmer Recommendations: An Economics Training Manual by Richard K. Perrin, Donald L. Winkelmann, Edgardo R. Moscardi and Jock R. Anderson.

*Maize Training in the International Maize & Wheat Improvement Center (CIMMYT) by A. Violic, F. Kocher, T. Stilwell and E. Moscardi.

*Field Manual of Common Wheat Diseases and Pests, 1977 (IB 29).

*Maize Disease: A Guide for Field Identification, 1978 (IB 11) 2nd ed.

*Current List of Publications from CIMMYT, Mexico.

*This is CIMMYT 1978.

*CIMMYT Review (Current Issue).

*CIMMYT Training (CIMMYT Today/No. 9).