Adept at adapting

Contributions of sociology to agricultural research for small farmers in developing countries: the case of rice in the Dominican Republic

Frans Doorman

STELLINGEN

1. Sociologie en antropologie kunnen een belangrijke bijdrage aan toegepast landbouwkundig onderzoek leveren op het gebied van methoden en technieken voor het verzamelen van informatie bij kleine boeren. (Dit proefschrift)

2. De in Farming Systems Research meest gangbare kombinatie van diagnostische onderzoeksmethoden – de "snelle verkenning" ("Rapid Rural Appraisal") en de enquête – zullen in de meeste gevallen onvoldoende inzicht geven in de gekompliceerde verbanden tussen agro-ekologische, socio-ekonomische en kulturele faktoren in kleine boerenbedrijfssystemen. Zij moeten daarom worden aangevuld met een meer kwalitatieve, diepgaande en participatieve onderzoeksmethode: de diagnostische case studie. (Dit proefschrift)

3. De sociaal wetenschappelijke onderzoeksmethoden case studies en enquête lenen zich goed voor kombinatie met agronomisch proefonderzoek voor het verschaffen van informatie over de frekwentie van het vóórkomen van bepaalde problemen, de effekten van die problemen op produktieresultaten, en de mate waarin boerenadapties, in de vorm van door boeren ontwikkelde remedies, bijdragen aan het beperken van produktieverliezen. (Dit proefschrift)

4. Sociale wetenschappers die in interdisciplinaire teams in toegepast landbouwkundig onderzoek werkzaam zijn zullen in diagnostisch onderzoek hun akademische integriteit gedeeltelijk moeten prijsgeven om binnen door andere teamleden gestelde tijdslimieten onderzoeksresultaten te kunnen presenteren op basis waarvan agronomen kunnen beginnen met technologieontwikkeling. (Dit proefschrift)

5. Simmonds' mening dat als er al een rol is voor antropologen in Farming Systems Research, deze zeer beperkt is, berust op een karikatuur van "de antropoloog", wordt niet gefundeerd en is daarom, zoals Simmonds zelf aangeeft, een "geloof". (N. Simmonds, *Farming Systems Research: A review.* The World Bank, 1985.)

6. In de meeste gevallen handelen Dominicaanse rijstboeren rationeel wanneer zij tegen de adviezen van onderzoekers en voorlichters in zaailingen gebruiken die langer dan de aanbevolen maximum periode van 45 dagen in het zaaibed hebben gestaan. (Dit proefschrift)

7. Het ontwikkelen van aangepaste technologie voor oogsten ingezaaid "buiten het seizoen", bijvoorbeeld door het ontwikkelen van rijstvariëteiten die goed bestand zijn tegen lage doses zonnestraling en temperaturen, kan een relevante bijdrage leveren aan produktieverhoging in de Dominicaanse rijstverbouw. (Dit proefschrift)

8. Het pessimistische standpunt van Richards ten aanzien van de (on)mogelijkheden van succesvolle kommunikatie tussen kleine boeren en onderzoekers moet gerelativeerd worden voor de situatie in de Dominicaanse Republiek, waar in principe geringere kulturele verschillen tussen funktionarissen en kleine rijstboeren de perspektieven op succesvolle interaktie vergroten. (P. Richards, *Agriculture as a performance.* In: R. Chambers et al., eds., 1989), Farmer first: farmer innovation and agricultural research).

9. De landbouwvoorlichter in ontwikkelingslanden moet worden omgeschoold van overbrenger van een exogene technologische boodschap tot, enerzijds, een veldonderzoeker die onder supervisie van landbouwkundig onderzoekers en lokale kennis inventariseert en samen met boeren onderzoek doet, en anderzijds, een promotor van de verspreiding van kennis via informele netwerken, door boeren benut voor de uitwisseling van informatie.

10. De kortzichtigheid van politici die korte termijn ekonomische overwegingen laten prevaleren boven lange termijn ekologische overwegingen wordt enkel overtroffen door het gebrek aan visie van de kiezers die op die politici stemmen.

11. Ondanks publikatie in de reeks "Literaire Reuzenpockets" van de Bezige Bij krijgt Maarten Toonder's werk over Olivier B. Bommel nog steeds niet de literaire erkenning die het verdient.

12. Als het de rijke landen ernst is met het behoud van het regenwoud, dan moet men bereid zijn de ontwikkelingslanden die deze wereldhulpbron nog bezitten voor de geleverde produkten – zuurstof en water – te vergoeden op een schaal die vergelijkbaar is met de werkelijke waarde.

13. Het gebruik van STOP borden voor het aangeven van voorrang op alle verkeerskruisingen, zoals onder andere in de Verenigde Staten en Costa Rica het geval is, zou de verkeersveiligheid in Nederland aanzienlijk vergroten.

Frans Doorman
Adept at adapting
Contributions of sociology to agricultural research for small farmers in developing countries: the case of rice cultivation in the Dominican Republic
Wageningen, 29 mei 1991

Adept at Adapting

Contributions of sociology to agricultural research for small farmers in developing countries: the case of rice in the Dominican Republic

Promotor: dr. ir. D. B. W. M. van Dusseldorp
hoogleraar in de Sociologische Aspecten
van de Ontwikkelingsplanning in niet-westerse gebieden

Co-promotor: dr. L. de la Rive Box
universitair hoofddocent in de
Agrarische Ontwikkelingssociologie

Frans Doorman

Adept at adapting

Contributions of sociology to agricultural research for small farmers in developing countries: the case of rice in the Dominican Republic

Proefschrift
ter verkrijging van de graad van
doctor in de landbouw- en milieuwetenschappen,
op gezag van de rector magnificus,
dr. H. C. van der Plas,
in het openbaar te verdedigen
op woensdag 29 mei 1991
des namiddags te vier uur in de aula
van de Landbouwuniversiteit te Wageningen.

CIP-DATA KONINKLIJKE BIBLIOTHEEK, DEN HAAG

Doorman, Frans

Adept at adapting: contributions of sociology to agricultural research for small farmers in developing countries: the case of rice in the Dominican Republic / Frans Doorman. – Wageningen: Landbouw-universiteit. – Fig., tab. – (Wageningen studies in sociology, ISSN 0923-4365; 31).
Also published as thesis Wageningen, 1991. – With ref. – With summary in Dutch.
ISBN 90-6754-189-3
Subject headings: agricultural sociology / farmers; Dominican Republic.

Deze CIP-gegevens alleen afdrukken in handelseditie.

Printed in the Netherlands

CONTENTS

TABLES

DIAGRAMS

SUMMARY

This book discusses possible contributions of sociology and anthropology to agricultural research. It is based on investigations carried out from 1981 to 1985 in the Dominican Republic in the Adaptive Agricultural Research (AAR) project, a cooperative effort between the Agricultural University of Wageningen and the Dominican Ministry of Agriculture. The origins of this project can be found in the growing interest, during the last decade, in the potential benefits of the participation of sociologists and anthropologists in interdisciplinary research teams involved in applied agricultural research.

Chapter 1 reviews the state of the art of sociology and anthropology in agricultural research. On the basis of the literature, a number of roles for the non-economic social scientists are discussed, as well as various topics for sociological and anthropological research. Also, some of the problems of interdisciplinary research involving biological scientists, economists and non-economic social scientists are examined.

In Chapter 2 the methodology of the AAR rice research is presented, and related to the diagnostic research methodology of the most well-known approach to small farm development: Farming Systems Research. Particular attention is paid to the introduction of the diagnostic case study in the research process, as a means to obtain, in a cost-effective way, a wealth of information on the how's and why's of farmer decision making.

In Chapter 3, background information is given on the Dominican Republic, Dominican rice cultivation and the three areas where the AAR rice research took place.

In Chapter 4, the linkages between Dominican rice researchers, extension agents and farmers are analyzed. It is shown that small Dominican rice farmers lack ways of indicating their needs for new technology to rice researchers, and therefore do not participate in the setting of research priorities. The virtual absence of an information flow from the small farm to the research level is described as a result of institutional constraints and the prevalence among officials of the stereotype of the small farmer as uneducated, traditional and backward. A result of the lack of communication is that an important part of

the technology generated at the research station is not or only partly applicable in small farm production conditions.

Chapter 5 presents an example of the effectiveness of small farmer practices in obtaining good production results with limited resources. The case presented is that of the growing of a ratoon crop, i.e., obtaining a second rice crop from the stubble of the first - sown - crop. It is demonstrated that both from a micro and a macro point of view ratooning is an efficient way of producing rice, particularly in production systems that face constraints in access to irrigation water and machinery for land preparation.

Chapters 6 to 9 elaborate on the central argument of this thesis, which is that an important contribution of sociology and anthropology to applied agricultural research for small farmers can be made in the area of diagnostic methodology. Chapter 6 contends that in the first phase of diagnostic research, the reconnaissance, all potentially relevant factors should be appraised with the purpose of selecting for further analysis those that are found to have the strongest impact on farmer decision making. A framework for such an appraisal is presented, together with the results of its application to the three areas where AAR rice research took place. It is concluded that the principal factors influencing the decision making of the farmers investigated are of an agro-infrastructural and economic nature: access to irrigation water, machinery for land preparation and credit, and plot levelling and drainage.

In Chapter 7, the weaknesses are discussed of the currently predominant diagnostic research methods in applied agricultural research: Rapid Rural Appraisal and the formal survey. It is argued that in most instances the combination of these two techniques is unlikely to yield the thorough understanding of complex small farm systems that is needed to establish guidelines for the development of adapted technology. Therefore, it is suggested to add a more qualitative and in-depth research method, the diagnostic case study. The inclusion of case studies in diagnostic research methodology also permits a more participatory approach to the development of technology for small farmers by incorporating the latter's perspective in setting research priorities and orienting research programmes.

In Chapter 8, it is argued that the fact that agronomists and economists are neither trained in qualitative research nor in the analysis of farmer perceptions, ambitions, goals and perceived needs, justifies the participation of sociologists and anthropologists in interdisciplinary teams involved in technology development. However, to function properly in such teams, the social scientist must be able to produce rapid results that can be used as a basis for technology design. Since the time available for diagnostic research is usually quite limited, this may mean that the social scientist will have to trade some scientific thoroughness for speed.

In Chapter 9, it is shown how the social science methods of case study and survey can be combined with agronomic trial research to create a more complete picture of specific small farm problems. The case presented is that of the late transplant of rice seedlings. Case studies provided information on the causes of the problem and the way farmers coped with it by adapting certain management practices; survey research yielded estimates of the number of farmers affected by the problem; and trial research resulted in quantitative estimates on yield losses and the effectiveness of farmer adaptations.

In Chapter 10, the categorization is discussed of the farmers of the three research areas according to the aforementioned five factors of plot levelling, drainage, and access to irrigation water, machinery and credit. It is demonstrated that for the overall research population, as well as two of the three research areas, the used method of categorization is effective in differentiating farmers on three important indicators for technology development: yields, cropping intensity and income earned from rice production. On the basis of these results, two general recommendation domains with "good" and "poor" production conditions are established and recommendations for the development of appropriate technology are made for each.

The conclusions of this book, presented in Chapter 11, start with a review of the research topics and roles of the social scientist, discussed in Chapter 1, that were taken into account in the AAR rice research. It is concluded that a mayor sociological contribution was made in the area of research methodology, by supplementing the information gathered through the "traditional" diagnostic methods of rapid appraisal and survey with the qualitative, in-depth knowledge generated by the case studies. Other important roles fulfilled by the AAR sociologist were that of an ex-post evaluator of the adoption and adaptation of new rice technology, that of a two-way translator and broker who fosters communication between biological scientists and farmers, and that of an indicator of needs for new agricultural technology. Of the topics for research mentioned in Chapter 1 particular attention was paid to the analysis of farmer decision making, motivation and perceptions, and to the analysis of local knowledge on rice cultivation. Other important research foci were household composition and organization, the linkages between farmers and officials, and farmer organization.

After a brief review of the conclusions regarding the desirability of the incorporation of local knowledge in technology development, some comments are made on the specific characteristics of the local knowledge of the investigated rice farmers. It is argued that in spite of the short history of rice farming in the research areas, a considerable body of local knowledge had already been developed, based for an important part on adaptations to constraints in production conditions. However, due to the fact that the research population consisted of a socially heterogeneous and atomized group of settlers with a western-Latin background, for whom rice was a relatively new crop, the influence of social and cultural factors on decision making in rice cultivation was relatively limited. In other situations, where specific cropping systems have formed the basis of existence for farming families for centuries, social and cultural factors will be likely to determine farmer practices and decision making to a much greater extent. Consequently, in development oriented research such factors will need more attention than was the case in the research reported here.

PREFACE AND ACKNOWLEDGMENTS

In 1981, having just obtained my MSc. degree at the Department of Rural Sociology of the Tropics and Subtropics at the Agricultural University of Wageningen, I was invited to participate in the Adaptive Agricultural Research (AAR) project, due to start that same year in the Dominican Republic. The main objective of the AAR project was to define what and how sociology can contribute to agricultural research. The project leader, Dr. Louk Box, had earlier supervised my graduate work on the social and economic aspects of cassava cultivation in the north coast area of Colombia, in 1977-78, and in Surinam in 1980. In the intervening years, his interest in what he called "agrosociology", the borderline area of the biological-agricultural and the social sciences, had stimulated mine, and I gladly accepted the assignment. My participation in the project was originally planned for eight months, but was extended several times so as to last a total of three-and-a-half years.

The AAR project formed part of a larger undertaking, financed by the Dutch Ministry of Development Cooperation and aimed at establishing what and how sociology can contribute to agricultural research for the small farm sector in developing countries. The origins of this project can be found in the growing interest, during the last decade, in the potential benefits of the participation of sociologists and anthropologists in interdisciplinary research teams involved in applied agricultural research. The AAR project in the Dominican Republic formed one component of this larger project; the other component was established at the International Rice Research Institute (IRRI) in the Philippines. Formally, the AAR project consisted of a cooperative effort of the Agricultural University of Wageningen and the Dominican Ministry of Agriculture; charged with the actual execution of the project were the Department of Rural Sociology of the Tropics and Subtropics of Wageningen University, and the Dominican research institute Centro de Desarrollo Agropecuario de la Zona Norte (CENDA), where the project had its offices. Other important Dominican counterpart institutions were the agricultural faculty of the Universidad Católica Madre y Maestra, the Instituto Superior de Agricultura (ISA), the Dominican rice research institute, Centro de

Investigaciones Arroceros (CEDIA), and the Dominican land reform institute, the Instituto Agrario de Desarrollo (IAD).

To provide an answer to the AAR project's central question, the project initiators chose to study the generation and transfer of technology in two crops, cassava (*Manihot esculenta Cr.*) and rice (*Oryza sativa*). In cassava, the influence of institutional research and extension on production technology had hitherto been minimal, whereas in rice, the generation and transfer of new technology had influenced cultivation significantly, to the point where a majority of rice farmers had adopted at least part of the modern technology developed at CEDIA. For both crops, a diagnostic research programme was carried out, with the purpose of providing biological scientists with guidelines for the development of technology adapted to small farm production conditions. The resulting new technology was intended to be in accordance with both farmer needs and goals and nationally defined objectives for cassava and rice production (Box 1981b).

The choice to focus on specific crops rather than the study of complete farming systems was an accommodation to the way standard agricultural research is organized, that is, through the division of research programmes according to crops or groups of crops. However, the research approach differed from standard agricultural research in that it was interdisciplinary. The project team consisted of one full time and several part time agronomists, an agricultural economist, an extension specialist, all from the Dominican Republic, and two sociologists, Louk Box and myself. In addition, a considerable proportion of particularly field research was done by Dutch and Dominican students of both the natural and the social sciences. The project personnel was divided into two teams, with Louk Box in charge of the cassava component of the Project, and myself coordinating the research on rice. However, between the two teams there was a continuous coordination and feedback, particulary with regard to the planning and methodological aspects of the different research phases.

This thesis discusses the results of the rice research component of the AAR project. As a result of the context in which the project was carried out, the reported research has several features that make it somewhat uncharacteristic for a PhD thesis. The first is that it is interdisciplinary, in the sense of trying to bridge a gap between the agricultural and social sciences by incorporating relevant elements of the latter into the former. The second is that the introductory chapters were elaborated in detail only after actual field research had been completed and the results had been analyzed. The third is that as a result of the overall objectives of the AAR project, the research reported here has a practical-methodological rather than a theoretical orientation, aimed as it is at generating concrete suggestions as to what and how sociology can contribute to agricultural research.

As envisioned by Box, the central question of the AAR project would have to be answered through the experiences generated by the execution of a three stage research process. This process, which will be described in detail in Chapter 3, started out with a limited number of case studies with farmer informants, directed at obtaining in depth information on the farming systems being studied and farmer decision making therein. In the second stage, the principal case study findings were to be evaluated quantitatively through the execution of a formal survey, and in the third, a selection of agronomical problems that had been identified in the previous stages were to be further examined in agronomic trial research, both on-station and on-farm. As survey and trial research, in different forms, have constituted the mainstay of interdisciplinary agricultural research as it has been executed over the last two decades by agronomists and (agricultural) economists, the most interesting methodological question was what, and how, a typical social science method such as the case study could contribute to agricultural research. The answer to that question is, in fact, the principal question that I attempt to answer in this book.

The fact that the aims of the AAR project were practical rather than theoretical has not only determined the contents of this book, but also its form. Since generating a PhD thesis was not originally one of those aims, I did not find the time to work on this book during my stay in the Dominican Republic. An additional eight months' contract at Wageningen University, in 1985, was spent largely on data analysis that, for various reasons, had not been possible in the Dominican Republic, and on the drafting of a final report of AAR project results. When in 1986 I was offered an assignment in Costa Rica, I decided, in consultation with Louk Box and Dr. Dirk van Dusseldorp, the coordinator of the overall research project of which the AAR project formed part, to write a series of articles on my work in the Dominican Republic, and combine these to serve as a PhD thesis. I could make some progress on the articles in 1986, but when I started my new assignment at the beginning of 1987, the pace of progress slowed considerably. Nevertheless, in the course of the following four years, I was able to finish the seven articles that make up Chapters 5 through 11 of this book and to prepare the introductory and concluding chapters.

The fact that this thesis is built around six articles has the unfortunate consequence that there is considerable redundancy in this book. Since each article needed an, albeit brief, description of the research methodology and setting, the information on these topics is repeated several times in the text. Therefore, the reader that has examined Chapters 2 and 3 is advised to skip the sections in Chapters 4 through 10 that refer to AAR methodology and research areas. On the other hand, an advantage of the used format is that each chapter can be read independently from the others.

Apart from serving as a PhD thesis, the purpose of this book, as indicated above, is to help define what and how sociology can contribute to agricultural research. As such, the book is meant to be of interest to all those involved in agricultural research directed at the development of small scale agriculture in Third World countries. In practice, this means that it is more directed at policy makers, agronomists and economists than at sociologists or anthropologists proper, since the latter still form a small minority among those involved in agricultural development. As will become clear further on, the case in favour of a greater role of sociology and anthropology in agricultural research is stated both to biological scientists and economists currently involved in small farm development, and to sociologists and anthropologists who might be interested in getting involved. This dual orientation is reflected in the choice of the journals to which the different papers have been submitted. Three of these, the Netherlands Journal of Agricultural Science, Tropical Agriculture and Exploratory Agriculture, are primarily technical. The fourth journal, Agricultural Systems, which in 1989 was merged with Agricultural Administration and Extension, is the most interdisciplinary, directed as it is at biological scientists and policy makers as well as social scientists. Only the fifth and sixth journals, Sociologia Ruralis and Human Organization, are actual social science journals.

Terminology

Small farmers

The terminology used in this book corresponds, wherever possible, with the terminology most commonly used in the literature on agricultural development. The term "farmer" is used to indicate a person engaged in the management of crop production, that is, a person who takes the principal decisions regarding the cultivation of a specific crop. As such, the concept is equivalent to that of "cultivator", a term which, were it not for its less frequent usage, would have been preferable because of its lesser ambiguity. Thus, as used in this book, the term "farmer" is not associated with aspects such as the reasons for crop production - subsistence or commercial - or the relative importance of the husbandry of crops and/or animals for the household's economy. The term "small", where mentioned in conjunction with "farmer", can be considered equivalent to "low resource". That is, a "small farmer" is a cultivator who produces at a small scale, at low levels of investment, due to constraints in the access to the production factors land and capital.

Interdisciplinarity

The terms "multidisciplinary" and "interdisciplinary" are at times used interchangeably, and at other moments, used to indicate different levels of intercommunication and exchange between disciplines. In this book, the definition as given by Shaner et al. (1982) will be used, who describe interdisciplinarity in terms of the productive interaction between different disciplines. The synthesis of knowledge that is a result of such productive interaction, also called synergism, is larger than the sum of the individual parts - the individual disciplines - and generates new ideas, concepts and solutions. Shaner et al. distinguish interdisciplinary, which necessarily involves a combination of disciplines with frequent and significant interaction, and multidisciplinary, which is used simply to indicate a combination of disciplines (1982: 185).

Agronomists and social scientists

In the remainder of this book, three categories of professionals involved in applied agricultural research are distinguished. The terms "agronomist" and "biological scientist" will be used intermittently to indicate professionals of the group that forms the mainstream of agricultural research: the "natural scientists" involved in the study of plants, such as breeders, entomologists, pathologists, and agronomists. A second type of professional, the economist, has played an increasingly important role in agricultural research over the last two decades, and will, for the purpose of this book, be placed in a separate category. And thirdly, there is a still small group which only the last ten or so years has established itself rather precariously on the margins of the agricultural research complex. This group is formed by the non-economic social scientists, i.e., sociologists and particularly anthropologists. In the following, a professional from this group will be indicated with the term "social scientist".

The above implies the exclusion of economists from the category of social scientists, even though economics is usually included in the social sciences. The purpose of this separation is to bring to the fore the potential of specifically sociological and anthropological contributions to agricultural research. Thereby, anthropological is identified with the somewhat more qualitative, holistic approach to research, and sociological to the more quantitative analysis of specific aspects of (agricultural) reality. Yet, although some divergence between sociology and anthropology continues to exist, over the years the two disciplines have overlapped to such extent that it is virtually impossible to indicate separate fields of interest for each discipline. At the same time, it appears necessary that a good social scientist - sociologist or anthropologist - working in a interdisciplinary team with natural scientists and economists, is proficient in qualitative as well as quantitative research approaches.

Contents of the remainder of this book

In Chapter 1, an overview is given of the state of the art of sociology and anthropology in agricultural research. In Chapter 2, the methodology used to obtain the results presented in the remainder of this book is discussed and compared with the diagnostic methodology normally used in applied research for the small farm sector. Background information on the Dominican Republic, Dominican rice cultivation and the three areas where the AAR rice research was executed is given in Chapter 3. In Chapter 4, the linkages between Dominican researchers, extension agents and farmers will be analyzed. In Chapter 5, the discussion of Dominican rice cropping systems will serve as an example of the rationality of small farmer decision making, and of the fact that in some instances the goals of the state and those of small farmers coincide, even though officials perceive them as conflictive.

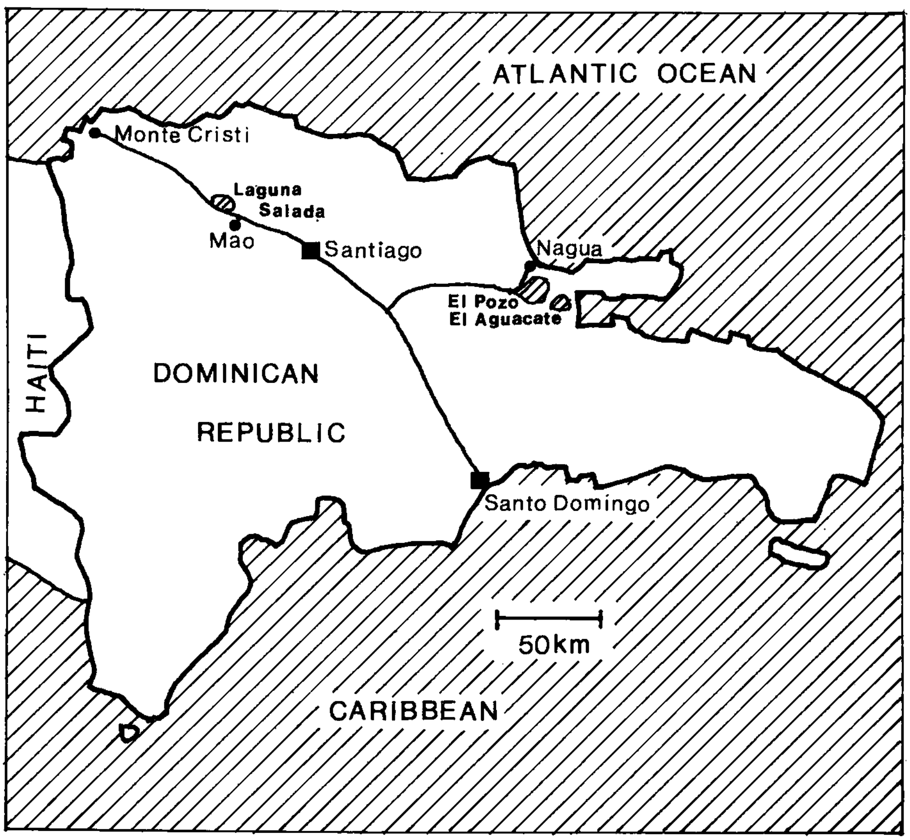
In Chapters 6 through 9, the main argument of this book, i.e., that a major social science contribution to agricultural research can be made in the area of diagnostic research methodology, is substantiated. In Chapter 6, a framework is presented for orienting the diagnostic research process through an initial rapid qualitative appraisal of the factors that potentially influence farmer decision making, with the purpose of selecting for further analysis those that are considered to have the strongest impact on technology adoption. Chapter 7 discusses the shortcomings of current diagnostic research methods, and suggest the inclusion of an additional technique, the diagnostic case study, to generate essential information on the how's and why's of farmer decision making. In Chapter 8, the participation of sociologists and anthropologists in interdisciplinary teams engaged in diagnostic research is discussed, as well as the conditions that should be met, particularly by the social scientist, for such participation to be successful. Chapter 9 illustrates how a specific agronomic problem can be analyzed using complementary social science and natural science methods, i.e., case studies, survey and trial research. In Chapter 10, a method will be discussed for the categorization of a heterogeneous population of farmers according to their needs for agricultural technology. As conclusions are presented at the end of each chapter of this book, the conclusions presented in Chapter 11 will focus on general issues that, due to the more specific character of the other chapters, did not receive sufficient attention.

Acknowledgements

I am indebted to many people for the completion of this book. First of all, I would like to express my gratitude to Louk Box, who gave me the opportunity to get involved in "agrosociology", with whom many of the initial ideas on which this book is based originated, and who has been a continuing source of support and encouragement over the last nine years. My second debt is to the Dominican rice farmers and fellow researchers, with whom I worked from 1981 to 1985, for their sharing of knowledge, their patience in helping me understand the intricacies of Dominican rice farming, and their friendship. In particular, I would like to mention Francisco Mendez, who was my research partner during most of the three and a half years I spent in the Dominican Republic; Federico Cuevas of ISA, whose knowledge of rice cultivation and incisive comments contributed greatly in shaping my research; and Doña Bienvenida Grullón, of Los Limones de Nagua, who not only was a living counter-argument to the widespread fallacy that Dominican women do not farm, but also offered room and board to Francisco and myself during our periods of fieldwork. Also, I would like to express my gratitude to the scientific personnel of CENDA, ISA and CEDIA, including, at the latter institute, the members of the Mission of the Republic of Taiwan; to the personnel of the Computer Department of the Dominican Ministry of Agriculture, particularly Nita Adames, who did an outstanding job in initial survey data processing and analysis; and to the extension agents and land reform officials stationed in the AAR research areas, who provided friendship as well as information. Much is owed also to the Dutch and Dominican students who cooperated with our research; of them, I would particularly like to mention Paul Hagens. In The Netherlands, my gratitude goes in the first place to Dirk van Dusseldorp, who stimulated my work through his insightful observations, helpful suggestions and general encouragement, and to Hans Postma, who with patient determination managed to wrestle from the University's computer most of the quantitative data and analysis presented in this book. Furthermore, I thank the members of the

Department of Sociology of Rural Development of the Wageningen University for valuable suggestions and comments made over the years; and particularly, Barbara de la Rive Box-Lasocki for her assistance in preparing for print two of the papers that make up this book, for the revision of the introductory and concluding chapters as well as the bibliographical references, and for her help in facilitating my contacts with the Department during my stay in Costa Rica. I am also greatly indebted to Jos Michel of the Department, who prepared the final manuscript of this book. Piet Holleman (WAU) who drew the map and completed the diagrams.

I owe the Agricultural University for providing several extensions of my contracts, even in a time of considerable budgetary constraints, and the VASO foundation, for contributing to the cost of making this book publishable. Furthermore, I would like to thank the anonymous referees and the editors of the journals to which I submitted the articles, for greatly contributing to making their contents more focussed and concise. In Costa Rica I owe many thanks to Marinus Gisolf, who revised all sections of this book, pointing out both shortcomings in my English and flaws or ambiguities in my arguments. Finally, I would like to express my gratitude to my parents, who have quietly supported me through all these years, and made possible the extended stays in Colombia and Surinam which set me off on the road that culminated in this book; and my wife Cristina, who during these last five years has put up, with only a minimum of protest, with my crawling behind my word processor on evenings, weekends and holidays, leaving her to deal with our children and the household.


ATLANTIC OCEAN
Monte Cristi
Laguna
Salada
Mao
Santiago
Nagua
El Pozo
El Aguacate
HAITI
DOMINICAN
REPUBLIC
Santo Domingo
50km
CARIBBEAN

I. SOCIOLOGY AND ANTHROPOLOGY IN AGRICULTURAL RESEARCH: STATE OF THE ART

1.1. Introduction

Until the mid 1960's, agricultural research institutes were the exclusive domain of biological scientists. However, in the aftermath of what is commonly known as the Green Revolution - the development and widespread introduction and application, since the 1950's, of high input, high yield technology developed at the chain of international research institutes, particularly the International Rice Research Institute (IRRI) and the International Maize and Wheat Improvement Center (CIMMYT) - the last two decades have shown a growing awareness of the fact that the generation and transfer of new agricultural technology, especially in developing countries, is influenced not only by technical and biological, but also by social, economic and cultural factors. This has led to the incorporation of particularly economists in development oriented agricultural research. In the network of international agricultural research centers, the first economist to be appointed in a staff position was Vernon Ruttan, at the International Rice Research Institute in 1963. The Agricultural Economics Department developed by Ruttan and his successors has served as a model for other agricultural research institutes, and all international and many national research institutes now employ economists. In some institutes, particularly those with strong interdisciplinary programmes directed at applied research for the small farm sector, agricultural economists have contributed significantly to agricultural research through the conduction of ex-post studies on farmer adoption and the impact of new technologies, farm management studies, and the identification of production problems (Bartlett & Fajemisin 1981, Horton 1984, Simmonds 1985). However, in other instances the integration of agricultural economics into overall research programmes has been less successful (Bartlett & Fajemisin 1981:373, Horton 1984:15), and questions are still being raised as to the exact role economists should play in the agricultural research institute.

In comparison with the growing role of economists the contribution to agricultural research of other social scientists, i.e. sociologists and anthropologists, has hitherto been minimal. Van Dusseldorp (1977) estimated that in 1976 there was only one permanently assigned sociologist or anthropologist for every thousand biological and other scientists working in research institutes. Although that ratio may have increased somewhat, overall participation is still limited. A good indicator of the marginal position of non-economic social scientists is the fact that in most cases where anthropologists or sociologists have joined research programmes their incorporation has been temporary; in only one or two cases they have been appointed in staff positions on a permanent basis.

It appears that there is still considerable doubt among policy makers and biological scientists as well as economists whether sociologists and anthropologists can contribute significantly to agricultural research in a cost effective way. A good, though perhaps extreme example of a negative judgement appears in Simmonds' 1984 review of the state-of-the-art of applied agricultural research for the small farm sector, prepared for the World Bank. Simmonds justifies his rejection of an anthropological contribution with the following argument: "One recalls the not altogether unfair stereotype of an anthropologist living in a village for years and emerging at the end with the view that the villagers are all splendid chaps, who ought to be allowed to get on with agriculture in their own way regardless of the fact that the world around them will not allow them to do so". Simmonds goes on to conclude that "if there is a place for anthropology at all, it would be for economic anthropologists rather than the strictly social kind". Even so, Simmonds considers that this kind of anthropologist will probably also be superfluous, since "... there might be little to distinguish him from the economist with well developed social perceptions" (Simmonds, 1985:51).

Even though Simmonds' argument is based on a very narrow, stereotypical view of anthropology and shows a notable lack of familiarity with the many fields and broad range of topics, some of them directly relevant to agricultural research, in which anthropologists have involved themselves over the last decades, his comments do point to the need to define clearly what and how anthropology and sociology can contribute to agricultural research. Biological scientists and economists working in interdisciplinary agricultural research appear to have a hard time to provide answers to this question. Although lip service is paid to the importance of social customs, values, and preferences (see a.o. Gilbert et al. 1980, Zandstra et al. 1981), there are generally few concrete indications that these aspects are taken into consideration in technology development. This is understandable to a certain extent, since it is often difficult to translate this kind of information into recommendations that can be acted upon by agricultural researchers. What, for instance, must an agronomist do in terms of technology design with the information that, in a traditional Asian village, money generated by selling surpluses of a certain commodity will be used for ceremonial and social purposes rather than private consumption? This goes to illustrate that, although it is somehow felt that socio-cultural factors may be important in the adoption of new technology, it is not clear how they should be taken into account in technology design.

In the last decade, a small body of literature has appeared in which social scientists try to provide answers to the above question. Sociologists and anthropologists like Whyte (1983), Horton (1984), Gladwin (1983), Garrett (1984), DeWalt (1985), Tripp (1985) and Dusseldorp & Box (1989) have suggested where sociological and anthropological contributions can be relevant for and useful to agricultural research, particularly to applied research directed at the development of adapted technology for small farmers. Also, workshops have been held on the topic (IRRI 1982, Sutherland 1987), and experiences of interdisciplinary research involving anthropologists and sociologists have been documented. In the corresponding literature, four approaches can be distinguished. The first adresses what the role of social scientists should be in interdisciplinary research teams. The second tries to provide answers to the question as to what topics sociologists and anthropologists should investigate. The third approach deals with contributions of social science to interdisciplinary agricultural research in the areas of methodology and theory, including the contribution of new perspectives and approaches to agricultural development in the small farm sector. The fourth contemplates the problems involved in interdisciplinary research involving biological scientists, economists and social scientists. In the following, a review of the literature on the role of sociology and anthropology in agricultural research, ordered according to the four above mentioned approaches, will be presented.

1.2. The role of social scientists in interdisciplinary research teams

This first approach to defining sociological and anthropological contributions to agricultural research establishes seven roles for the non-economic social scientist: accommodator of new technology, ex-post and ex-ante evaluator of the impact of new technology, indicator of the needs for new technology, translator of farmer's perceptions, broker-sensitizer, adviser in on-farm research, and trainer of team members from other disciplines.

Accommodator of new technology

The role ascribed to the first social scientists that were linked to agricultural research is that of an accommodator of the technology developed by biological scientists. This role consists both of screening new technology for cultural and economic viability, and of diffusion and communication studies (Dusseldorp 1977, Ruttan 1982). Sutherland (1987) adds to these two tasks the development of extension methods appropriate to farmers, as well as research on the relationship between technology adoption and effective local cooperation. Dusseldorp & Box (1989) also emphasize the analysis of forms of farmer cooperation required to make new technology function.

Particularly in Ruttan's suggestions, the role of the social scientist is reminiscent of, and can to a certain extent be seen as an extension of the work of social scientists in the diffusion of innovations approach, dominant throughout the 1950's and 60's. Diffusion research focussed on the nature and attributes - perceptions, values and motivations - of the adopter, starting from the premise that such traits as illiteracy, fatalism, rural values and lack of media exposure were the major obstacles in the innovation diffusion process. The main fallacy in this approach, particularly within the context of small farm development in the Third World, was that technology was assumed to be available and relevant for all targeted farmers, and that the infrastructure necessary to support the innovation - markets, inputs, credit, transportation, storage - was in all cases available. In fact, as a result of later studies, it became generally accepted that the adoption process was limited more by technological and institutional factors than by the individual or collective traits of small farmers (Saint & Coward 1977, Barker & Whyte 1983).

The role of the behavioural scientist in the diffusion of innovations approach is that of a "facilitator", responsible for the rapid and widespread adoption of innovative practices, the contents of which is not under discussion. This makes it comparable to the "accommodator" role, since in both instances the social scientist is presented with a product in the development of which he or she has not participated. This implies that the basic characteristics of the developed technology are not open to discussion - at least not to the social scientist. Even though in principle the social scientist can conclude, on the basis of his or her "accommodating" research, that, to be able to offer a feasible alternative, the technology to be introduced should be adjusted, the fact remains that the social scientist is only called in when the product, developed by biological scientists, is ready for delivery.

Ex-ante and ex-post evaluator: the social scientist as an analyst of the possible consequences and impact of new technology

The consequences of the Green Revolution raised questions regarding many of the tenets of the diffusion paradigm (Saint & Coward 1977: 743). Even the staunchest supporters of the Green Revolution started recognizing that the corresponding new technology had a tendency to increase social and economic inequality along with agricultural productivity, particularly in social settings where such inequality was already present. This called for a readjustment of the diffusionist focus on the role of individuals in the communication process, as well as of the premise that information and therefore technological change would trickle down from more innovative to less innovative farmers. The evidence that, as a result of the introduction of Green Revolution technology, small farmers had suffered in many instances both a relative and an absolute decline in living conditions resulted in growing pressure from donor agencies to include, as a goal of technological development, the raising of the living standard of the rural poor through a more equitable distribution of benefits. Social scientists, in the forefront of pointing out the negative consequences of the Green Revolution, could be assigned a role in assessing the impact of new technology on the social environment, and to help formulate measures to assure a more equitable distribution of benefits.

In accordance with the above, the participants of the workshop on the role of anthropologists in interdisciplinary agricultural research, held at IRRI in 1981, indicate as one role for social scientists the assessment of the social consequences of introducing new technology for food production and consumption systems, and the definition of potential as well as actual beneficiary groups (IRRI 1982: 93,94). Similarly, Dusseldorp (1977) and Dusseldorp & Box (1989) show the importance of ascertaining in advance what effects the development and introduction of new crops and crop technologies can have on the existing economic and social structure of the societies involved, with particular attention for different categories of producers and the rural poor. Garrett (1984, 1986), taking a more structural perspective, indicates how social scientists, by pointing out class differences and their consequences for programming, can help policy makers adopt a comprehensive picture of both positive effects for beneficiaries and negative consequences for other strata of rural society. Janvry & Crouch (1981) and Oasa (1985) go further, referring not only to predicting the negative consequences of proposed technological improvements, but also to the task of guaranteeing, to the extent possible, that the benefits of new technology accrue to the small farmer. DeWalt (1985) considers that the historical and holistic perspective of the anthropologist facilitates the assessment, not only of productivity and profit, but also of the cultural impact and the health and nutritional effects of agricultural change.

Indicator of needs for new technology

This role can be considered as a logical consequence of the two roles discussed in the above. The finding in an ex-post evaluation that newly introduced technology will have to be adapted to fit the needs of farmers, or the ex-ante assessment that new technology may have unacceptable detrimental effects on certain groups in society, both imply the notion of the social scientist indicating technological alternatives. Correspondingly, the role of the social scientist experiences a shift in focus, from "accommodating" developed technology to "steering" programmes of technology yet to be developed (Dusseldorp 1977).

It should be recognized that the step from ex-post to ex-ante evaluation is a major one, as it implies a direct influence of social scientists in the formulation of research policies, a terrain that until quite recently was - and in many instances still is - the exclusive domain of the biological scientist. Only since the late 1970's has it been suggested that social scientists could "steer" agricultural research - initially, by social scientists working outside agricultural research institutes (Dusseldorp 1977, Saint & Coward 1977). Saint & Coward, in their important 1977 article in *Science*, ascertain that basic information on traditional agricultural systems, gathered in a joint effort by biological and social scientists, should be "fed forward" to the research center as an essential first step in technology development. The role of the social scientist consists in the identification of systematic patterns in topics such as the provision of labour and sources of and responses to risk. These patterns should be related to environmental resources and restraints, physical requirements of the agricultural production system, technology employed, and the broader institutional context with regard to land tenure, marketing systems and the local political structure. From these patterns, problem specific typologies can be constructed, which should be related to research objectives and agricultural policy goals (Saint & Coward 1977: 735,736).

Social scientists directly involved in agricultural research institutes suggest more specific tasks in establishing needs for new technology. Participants in the 1981 IRRI workshop refer to "steering" agricultural research when emphasizing the importance of the social science contribution to diagnostic research focused on the isolation and description of production problems (IRRI 1982:98,99). Gladwin (1983), on the basis of her work at a national Guatemalan research institute (ICTA), suggests introducing decision-tree models to predict the actual choices of individuals in FSR programmes, so as to provide recommendations to a team of biological scientists for the design of technological alternatives to be tested in on-farm trials. Tripp (1985), on the basis of his experiences as an anthropologist at CIMMYT, indicates a major role for anthropologists in the identification of recommendation domains, i.e., categories of farms with differing needs for agricultural technology.

The most well documented experiences of social science participation in applied agricultural research derive from the International Potato Center (CIP), another of the international agriculture research centers, where anthropologists have been involved since 1977 in the diagnostic research that forms the basis for technology development. Specific anthropological contributions at CIP in "steering" agricultural research are described as identifying indigenous technology management patterns, providing an understanding of the food systems of which potatoes are a part, identifying shape and colour preferences of potato consumers, and establishing how farmers identify, select and distribute potato varieties and seed tubers - information important for planning genetic conservation. Also, the CIP anthropologists played significant roles in the delimitation of agro-ecological zones, the classification of farm types, the design of appropriate post harvest technology, and in cross cultural comparison and technology extrapolation in a worldwide potato study (Rhoades 1984, Horton 1984, Rhoades et al. 1985 b, Brush 1986).

Translator of farmer's perceptions

The social scientists' role as a translator of farmer's perceptions covers various topics. The identification of household priorities is indicated by Keller (1985), while anthropologist Brush (1986), on the basis of his experiences at CIP, mentions the examination of how farmers identify, select and distribute crop varieties - potato varieties and seed tubers. Tripp (1985) refers to assigning a value to family labour and subsistence production in the farmer's own terms, as well as to identifying the farmer's own evaluation criteria for agricultural technology, and the assessment of farmer reactions to official recommendations. Likewise, IRRI (1982) mentions as a role for social scientists the analysis of farmer perceptions of new technology, while Wallace & Jones (1985), in a more general sense, emphasize the need to understand the motivations of farmers in the management of their farms.

The role of sensitizer/broker

Rhoades et al. 1982, Rhoades 1984, and DeWalt 1985 point to a primary role for anthropologists as a broker who links researchers with farmers. Although social scientists may consider this to be a rather limited perspective of the potential social science contribution to agricultural research, biological scientists appear to consider that communication between scientist and farmers is an art, requiring an expertise which many biological scientists do not have (Rhoades et al. 1982). Barker & Whyte (1983) also point to the tendency to see social scientists as being sensitive to the needs and interests of small farmers, coupled with an ability to relate well with them in the field.

Box (1989a) describes the broker role of the social scientist in terms of the linking of different knowledge networks - those of researchers, extension agents and different groups of farmers. Sociologists can contribute to a better information flow between these different networks through "interfacing" (the terminology is derived from Long (1984:10): the creation of contacts between members of different networks, i.e., researchers and farmers, extension agents and farmers, researchers and extension agents, and farmers and farmers. Through interfacing, the articulation between different networks can be strengthened, stimulating the communication and interaction between parties normally separated by different life-worlds, values, norms and interests (Box 1989a:167).

IRRI (1982) indicates the importance of the anthropologist in sensitizing other members of an interdisciplinary team to the nature of farmer practices, and to the implications of those practices for other research disciplines. In addition, the role of the social scientist in providing feedback from farmers to researchers, extension agents and policy makers is mentioned. Keller (1985) refers to the role of sensitizing biological researchers to be receptive to the needs and productive potential of farm family members other than the farmer.

Some authors consider that social scientists can contribute to changing ingrained attitudes among their biological counterparts. Thus, Keller (1985) sees the contribution of anthropology as a correction to the patronizing or parental attitude toward local communities by agricultural scientists, developers and other change agents. She suggests anthropologists can create respect and understanding for the knowledge and capacity of small farmer families for sustainable production under difficult circumstances, as a basis for creating an attitude of partnership and collaboration among farmers and officials. As such, she presents examples from Western Sudan and Burkina Faso, where anthropologists sensitized biological scientists to the fact that non-adoption of certain parts of technological packages should be considered not so much as failures of the research programmes involved, but rather as adaptations to the environment and, as such, as improvements of the original packages.

In a more general sense, Rhoades et al. (1982) indicate that anthropologists comply with an important role in pointing out to biological scientists the essential rationality of human adaptation to the immediate and wider social and physical environments (1982:7,8). Whyte (1983) speaks in this respect of "the rediscovery of peasant rationality", indicating that the desire to learn from farmers, and thus the implicit recognition of farmer rationality and knowledge, was generally recognized in the late 19th and early 20th century. However, as agricultural research moved more and more to the experimental station and the laboratory, researchers were increasingly separated from farmers; a separation that lasted until the 1970's with the advent of farmer oriented approaches such as Cropping and Farming Systems Research. Still, the transfer of part of the agricultural research process from the experimental station to the farm - one of the main characteristics of these approaches - does not automatically mean that biological scientists take farmer experience and knowledge more seriously. Therefore, a relevant role for anthropologists is the sensitizing of agricultural researchers to what McCorkle (1989:6) describes as the foolishness of ignoring the wealth of local knowledge.

Social scientists can also sensitize their colleagues from the biological sciences to the importance for agricultural development of factors whose analysis pertains to the domain of the social sciences. Dusseldorp and Box (1989:8,9), rather generally, mention the social aspects influencing agricultural processes; Garrett (1984), more specifically, indicates the sensitizing of FSR teams to land holding and land use patterns, landlord-tenant relations, and the significance of the combination of agricultural production with rural wage labour as a survival strategy for low resource rural households.

Sutherland (1987), in his discussion of the role of sociology (in which he includes anthropology) in agricultural research, states that the area most in need of attention of sociologists is on-farm experimentation and technology testing. He regrets that the social scientific involvement usually stops with the completion of diagnostic surveys, with the danger that experiment station methods and attitudes will be taken onto the fields of the small farmer. IRRI (1982) also sees a role for social scientists in the on-farm evaluation of technology. However, neither Sutherland or the participants to the IRRI Workshop specify exactly which tasks social scientists could fulfill in this respect. Tripp (1985) suggests a contribution in the selection of farmers for on-farm research, although this appears to be a role of relevance only at the start of the technology development process. Similarly, Merrill-Sands et al. (1989:18), in an ISNAR review of experiences with on-farm research in nine national agricultural research systems, indicate that although social scientists usually play important roles in initiating on-farm, client oriented research programmes, these same programmes face difficulties in institutionalizing a continuing role for the social scientists throughout the research process. In this respect they mention as important roles, in addition to the development of appropriate methods for selecting farmer cooperators for on-farm research also mentioned by Tripp, the monitoring of adoption, and the development of innovative mechanisms for farmer participation in on-farm trials. An example of the latter is presented by Ashby (1986:17), an anthropologist stationed at the International Center for Tropical Agriculture (CIAT) in Colombia, who demonstrates how the role of farmer values and goals in technology development can be strengthened through farmer participation in defining objectives, experimental designs and evaluation criteria for technology testing. Similarly, Box (1989b) describes the role of the sociologist as a two-way translator in adaptive trial research, with the purpose of making trial design, execution and analysis acceptable and relevant to both researchers and farmers.

DeWalt (1985) describes as one of the unique contributions social scientists can make to agricultural research the training of interdisciplinary teams in methodologies that can be used to effectively provide reliable and useful information as a basis for technology development. Dusseldorp & Box (1989:8,9) and Merrill-Sands et al. (1989) point to the fact that due to budgetary constraints of particularly national research institutes, hiring social scientists as contributors to interdisciplinary research may not always be possible. Therefore, they suggest that social scientists could train agricultural scientists in some of the social science methods relevant for agricultural research. Even so, Merrill-Sands et al. (ibidem:19) indicate that without strong leadership from a senior social scientist, the effective and creative application of social science methods and concepts has proven to be difficult to sustain, and conclude that such training is not an effective substitute for the continued involvement of trained social scientists.

1.3. Research topics for social scientists

In addition to the definition of the roles of social scientists in agricultural research, several authors list specific areas of research. Dusseldorp (1977) points out that agricultural practices are embedded in a social and economic structure, and that the analysis of that structure, i.e., the study of the existing pattern of leadership, power structure, marketing patterns at local and regional levels, the calendar of social and cultural events, food habits, and ergonomic aspects of agricultural activities are needed to indicate the properties that new crops and technologies should have. Barker & Whyte (1983) suggest as relevant topics for socio-economic studies the influence of local society and culture on the productive and consumptive activities of the family. Dusseldorp (1977), Barker & Whyte (1983) and Keller (1985) add to this the importance of household composition and organization, particularly in relationship with (changes in) management practices. Topics to be studied in this area are size and structure of families, the (customary) division of labour according to sex and age, and the objectives of household members of different age and gender.

Barker & Whyte (1983) and Sutherland (1987) advocate the study of land tenure and the local organizations relevant to agricultural support, such as cooperatives, communal work groups, credit groups, and farmers' and women's clubs. The study of land tenure and landlord-tenant relations is also mentioned by Tripp (1985) and Garrett (1984); in addition, Garrett suggests that the sociologist should incorporate into the research agenda the socio-economic characteristics of different social strata among small farmers: petty commodity producers, peasants, and semi-proletarians. DeWalt (1985) proposes as an important topic of research the analysis of the impact of governmental policies at the micro level of farming systems.

The study of decision making processes

Since decisions regarding the adoption, adaptation or rejection of new technology are ultimately made by the farmer, the analysis of farmer decision making is an important research topic. In this regard, Gladwin (1980) stresses the need to understand the logic behind production decisions that comprise "traditional" agriculture. Citing the experiences of the Puebla project in Mexico, Gladwin points out that if, at the start of the project, planners had analyzed farmers' decision criteria and strategies to grow corn, a series of recommendations for variety use and fertilization would not have been made. In a 1983 paper, Gladwin introduces the decision-tree model to analyze and predict farmer choices. She indicates how the results of decision tree analysis can be used to provide recommendations to a team of biological scientists designing on-farm trials; by showing biological scientists how farmers make agricultural decisions, the use of the trees can contribute to more effective, farmer oriented programme policies.

Tripp (1985) suggests that many critical issues affecting farmer decision making are in the realm of anthropology: the nature of land distribution, the allocation of labour to various household tasks, the organization of marketing, strategies for off-farm income generation, food preferences, and the management of the household food supply. Barker & Whyte (1983), in their presentation of a social science framework for agricultural research and development, emphasize the study of the social and cultural factors - family, community and organizational memberships and relationships - that influence the motivation of small farmers in agricultural decision making, and put special emphasis on the analysis of farmer conceptions of risk.

The study and analysis of research institutes and other government institutions

Dusseldorp & Box (1989) indicate as a relevant topic for analysis the organization of and communication in research institutes and agricultural research in general. However, they point out that, for obvious reasons, such analysis is difficult to combine with cooperating with biological scientists in interdisciplinary research. This implies that such organizational research should be executed by social scientists from outside the research institute involved.

Barker & Whyte (1983) advocate in a more general sense the study of the nature of agricultural development projects and change processes, so as to establish the organizational requirements for the successful implementation of such projects. They also recommend the analysis of the structure and functioning of local government and the distribution of power, and of bureaucratic organizational structures and social processes relevant for agricultural development in general, pointing out that the contributions of social scientists to the study of agricultural bureaucracies has hitherto been very limited.

The analysis of local knowledge

The terms "indigenous" and "local" knowledge are used interchangeably to indicate the body of theories, beliefs, practices and technologies that people have elaborated without direct inputs from the modern, formal scientific establishment (McCorkle 1989, IDS 1979, Brokensha et al. 1980, Chambers et al. 1989). Anthropologists have been studying indigenous knowledge systems for more than a century, however, only in the late 1950's anthropologists began to give explicit attention to rural people's knowledge pertaining to agriculture and ecology (McCorkle 1989:4), and only recently there have been efforts to integrate the results of this research into the development of agricultural technology.

A number of authors, such as Brokensha & Riley (1977:23), Howes (1979:13) and Chambers (1980:21) denote the depth and range of local knowledge, based as it is on generations and, in some cases, centuries of experience. As Chambers (1980:21) puts it: "there is a parallel system of knowledge ... which is complementary, usually valid and in some respects superior to scientific knowledge ... rural people have their own categories and fine discriminations, they often have much detailed knowledge of soils, of plant indicators of fertility, of weather patterns and the like" (1980:21). IDS (1979), Brokensha et al. (1980), Chambers (1983), McCorkle (1989) and Chambers et al. (1989) all point to the necessity for development planners and agricultural researchers to take into account the accumulated knowledge and traditional skills and technology of the people among whom they work. Howes (1979) notes the depth and breadth of local knowledge, and urges investigation of the principles on which it is organized as well as of the methods used for its accumulation and transmission. Johnson (1972), Swift (1979), Box (1989b) and Chambers et al. (1989) allude to the fact that resource poor farmers continuously experiment, adapt and innovate, and that the knowledge generated by this indigenous research is relevant for agricultural development.

Swift (1979:43) and Richards (cited in Howes 1979:17) further strengthen the argument for incorporating local knowledge in agricultural development by arguing that rural people are more likely to successfully adopt new technology if it incorporates elements of their own indigenous knowledge. In addition, Swift contends that rural people have a good moral claim to participate in deciding their own future on the basis of their own experience, while Chambers (1978:7) indicates that the negation of indigenous knowledge is likely to result in a growing dependence on the larger society and a loss of cultural identity; elements that may lead to growing passivity and the disappearance of local initiatives to improve the own situation.

IRRI (1982), Rhoades (1984) and Dusseldorp & Box (1989) mention the analysis of indigenous knowledge as a specific task for the social scientist, particularly the anthropologist. This assertion is based on the observation that local knowledge may be structured according to principles that differ from those of scientific knowledge, making it difficult for natural scientists to integrate the two. For example, Levy-Strauss (discussed in Cole et al. 1971:8) suggests that local classification systems categorize objects and phenomena according to their external qualities, while science categorizes on the basis of fundamental, structural properties. IDS Workshop (1989:31) proposes, in a similar vein, that indigenous classification systems are functional, that is, related to use, as opposed to the standardized categorization criteria derived from the physical sciences. An example of local classification principles is presented by Van der Ploeg (1989), who discusses the use of "folk taxonomies" by Andean farmers for the identification and naming of potato varieties in relation to, among other factors, soil conditions and planting patterns. Box et al. (1987) and Box (1989b) show how research among cassava cultivators coordinated by a sociologist led to the description and official classification of local cassava cultivars previously unknown to cassava researchers, as well as to the identification of different forms of cassava root deterioration. Another concrete example of the potential value of the analysis of local knowledge systems is given by Brush (1986), who indicates how his study of the local potato taxonomies in Andean agriculture contributed to genetic conservation efforts by CIP geneticists.

IDS (1979) addresses the problem of why so little use is made of local knowledge in development programmes. Swift (1979:42) argues that the authority of officials over farmers rests on the control of knowledge; consequently, every acknowledgment of the value of local knowledge is a threat to the official position of dominance. Chambers (1980) indicates that the problem is also one of communication: officials, particularly those in higher, decision making positions, are seldom in contact with farmers, whereas the entire reward structure in developing countries is biased towards urban areas with better living and working facilities and better chances of professional advancement. This lack of communication with their rural clientele, in combination with the above mentioned interest in maintaining official supremacy, leads not only to a lack of appreciation of small farmer knowledge, but is also conducive to the formation and maintenance of the well known stereo type of the backward, traditional, resistant-to-change rural poor. The only possible way to overcome the official reluctance to incorporate indigenous knowledge in development programmes, suggests Chambers, is a change of mentality: the attitude characterized by superiority and authority will have to be exchanged for one of openness, empathy and modesty (1980:22). Accordingly, the above mentioned "sensitizing" role of social scientists, of pointing out to agricultural researchers and other officials involved in agricultural development the value and relevance of local knowledge, takes on new significance.

1.4. Theoretical and methodological contributions

The development of relevant theory: contributing to the understanding of agriculture

Since the late 1970's, a number of authors have indicated how social scientists can contribute to the generation of theory regarding the role of agricultural technology and research in agricultural development. Saint & Coward (1977) assert that technology should be considered as a social product: invention and discovery are processes that occur in all agricultural systems and are determined by particular organizational patterns, group values and available resources. Thus, the focus of development oriented research should not only be on the impact of technology on society, but also on the influence of social organization on the generation and utilization of new agricultural technology. Following up on Saint and Coward, Box (1981a) advocates a sociology of agriculture to study the complex relations between crop cultivation and social organization, the results of which could provide biological scientists with insights into the values and interests of small farmers.

Basic social science contributions in the development of theory and method are also suggested by Ruttan (1982), while according to Sutherland (1987) sociology - more than any other discipline - is relevant to developing applied social theories and methods (55). Wallace & Jones (1985) suggest that the need to understand the motivations of farmers and constraints on agricultural technology poses questions which can best be answered from within the theoretical framework of cultural ecology, through studying the interaction of cultural and biological factors. Barker & Whyte (1983) submit the need for a theory of socio-economic man which requires placing the individual in the context of family, community and organizational memberships and relationships.

Rhoades (1984) sees a specific anthropological contribution to agricultural research by bringing in a holistic perspective, in which the understanding of agriculture is broadened by tracing linkages between the farm household or unit, the environment, technology, crops and animals, and the larger socio-economic milieu. This holistic perspective also implies the perception that all manifestations of human behaviour are interrelated parts of cultural systems, and should be studied within a historical framework.

Methodological contributions

Although various authors suggest the potential importance of social science contributions to the methodology of applied agricultural research, the literature is often short on specifics. For example, DeWalt (1985) indicates a major role for social science in the diagnostic research that precedes technology development, and suggests that more attention needs to be paid to developing and testing time-effective, reliable methods. According to Rhoades et al. (1982) and Rhoades et al. (1985 b), the most positive outcome of the involvement of social scientists in applied interdisciplinary agricultural research programmes has been the development of more incisive problem foci and methodologies in the analysis of topics such as marketing, land tenure, farmer motivation, attitudes, management decisions and decision making criteria. Anthropological expertise permits tracing the connection between mundane farming activities and beliefs, religion, kinship, social institutions, material culture and even ecology and economy. In addition, the general anthropological orientation of direct, sustained contact, to understand how people perceive the world and their problems, contributes to a total view of farming and social activities that can yield a special holistic understanding of farmer decision making. Tripp (1985) points out that the issue in the analysis of such topics as the use of labour, marketing, land tenure, risk and decision making is more methodological than conceptual: the question is not if they are in the domain of economics or anthropology, but how they can best be studied. Anthropological experience on how to elicit opinions from farmers, how to make and record observations informally, and how to utilize different types of data by cross-referencing them is of major importance in this respect.

A few authors give more concrete indications as to the social science methods most relevant for agricultural research. Rhoades (1984) specifies these as participant observation, informal surveys, ethnographic eliciting techniques, and controlled cross-cultural comparison. Tripp (1985) similarly suggests contributions in the form of participant observation and informal interviewing, and also sampling. He points to the importance of selecting data collection techniques - informal interviews and observation, with different levels of rigour, and formal surveys - according to their appropriateness for the analysis of different sets of problems.

On the other hand, Tripp considers that where social scientists are involved in agricultural research, too much time and resources are spent in the diagnostic phase. He points out that in applied agricultural research approaches such as Farming Systems Research the typical diagnostic phase lasts only a few months, while experimentation may continue for several years before results are produced. He suggests that it is therefore in the experimentation phase that anthropological fieldwork techniques have their largest potential for generating relevant information. Consequently, as Sutherland (1987), Tripp advocates continuing participation of social scientists in this phase of the research process.

Like Rhoades (1984) and Tripp (1985), the participants in the 1981 IRRI workshop mention participant observation as a relevant research tool for applied agricultural research, both in diagnostic research and on-farm testing. In addition, they suggest an important role for social scientists in improving the conduct and content of the survey research that is the mainstay of most diagnostic research, as well as the analysis of secondary sources so as to make anthropological data produced elsewhere accessible for the purposes of the agricultural research institute (IRRI 1982).

Box (1989b) argues for complementing standard agricultural research practices with three techniques: biographical analysis, adaptive trials and knowledge network transformation. On the basis of his work on cassava cultivation in the Dominican Republic, he suggests that through biographical analysis, social scientists can reconstruct cultivator biographies with respect to a particular crop, so as to learn about farmer adaptations to changing circumstances and the local improvement of available technology. In adaptive trial research, social scientists can contribute by helping to translate cultivator experiments into scientific designs, and adapting scientific trials to local conditions. And in knowledge network transformation, social scientists transform local knowledge about a crop into more general statements, and articulate local knowledge networks with more general ones through the construction of interfaces.

The literature on indigenous or local knowledge is the most specific in defining appropriate social science methods and techniques. Howes (1979) notes that ethnoscience methodology and cognitive anthropology, i.e., the systematic study of farmer perceptions, are essential for eliciting indigenous knowledge. Also, both Howes and Werner & Begishe (1980) indicate that the use of ethnoscience to understand indigenous technical terms is a necessary element for improving the accuracy and reliability of translations, as well as the working with interpreters. Richards (1980) suggests a need for methods for eliciting what the farmer knows, for analyzing what he knows, and for elucidating the process by which the farmer comes to know what he knows. He proposes a multi-instrument approach - survey research, observation and participation - in which the initiative in interviews is given to the respondent, who should have the opportunity to clarify the connections between data, symbols and values. Richards also adresses the fact that participant observation is often impracticable from the point of view of time and research support available, and proposes a strategy of combining the direct observation of the interplay of language, symbols, ideas and action, with a "gaming approach". In the latter, a series of "let's imagine" situations are set up by the researcher, and respondents are asked to act out or talk out the likely responses in real life. To that purpose, he suggests the use of pictorial stimulus material, sentence completion tests, thematic apperception tests, triads tests, and telling or completing stories.

1.5. Problems involved in interdisciplinary cooperation between biological and social scientists

Several authors discuss not only the potential contributions of social scientists to agricultural research, but also obstacles to the incorporation of economists, sociologists and anthropologists in interdisciplinary teams dominated by biological scientists (Dusseldorp 1977, Rhoades 1984, Horton 1984, Keller 1985, Rhoades 1986, Rhoades et al. 1985 b, Maxwell 1986 b, Sutherland 1987, and Dusseldorp & Box 1989). Since this discussion does not concern the potential contributions of social scientists to agricultural research as such, it will only be touched upon briefly here, as a point of reference for the discussions that follow in the rest of this book.

Dusseldorp (1977), in one of the first papers to discuss the role of non-economic social scientists, particularly sociologists, in agricultural research institutes, mentions several reasons why social sciences are not easily accepted. Biological scientists consider it to be a major problem that the social sciences do not produce hard facts and universal laws, that they are too close to politics, and that their practitioners take too much time in coming up with results. Ruttan (1982:303), who in his discussion on the role of social scientists in agricultural research focusses on agricultural economists, also treats the relationship between the latter and non-economic social scientists, i.e., sociologists and anthropologists. He indicates an uneasy relationship between economics and sociology - although, as he puts it, the reasons remain to him a mystery - and notes that the same uneasiness does not seem to exist between economists and anthropologists. Ruttan continues to affirm that anthropologists have established highly complementary working relationships with both the biological agricultural disciplines and economists at several of the international agricultural research institutes. Although this contention may hold true, to a certain extent, for CIP (Rhoades et al. 1985), one should also juxtapose it with the comments of Goodell (in Goodell et al. 1982), who worked as an anthropologist at IRRI. Goodell arrives at considerably less positive conclusions regarding the relationship anthropologist-economist, indicating that during her stay at IRRI the most serious communication problems did not occur with biological scientists, but with her economist colleagues. A particular point of friction, she reports, is related to the economists' intellectual hostility towards the use of qualitative research methodology and analysis (Goodell et al. 1982:40).

On the basis of the most well documented experience with the integration of social scientists in interdisciplinary agricultural research, at CIP in Peru, Rhoades (1984) makes several recommendations on how to increase anthropological contributions to agricultural research. He suggests that anthropology needs to "shake" the stereotypes that follow the discipline, particularly that regarding the "noble savage living in permanent harmony with nature" (1984:48). Rhoades also urges anthropologists to report on their contributions to successful interdisciplinary work, and advocates a better explanation of anthropological research methods and analysis, as well as a need to create a formal framework for agricultural anthropology.

In a 1985 paper, Rhoades and two CIP colleagues, economist Douglas Horton and plant pathologist Robert Booth, discuss anew the problems involved in interdisciplinary collaboration, pointing to the professional and institutional barriers that increase the chances of failure in interdisciplinary research. Like Goodell et al. (1982), they suggest that despite common bonds and even the same department-administrative affiliation, anthropologists and economists seem to have had greater difficulty working together than either of them with biological scientists (Rhoades et al. 1985b:24). To counter this tendency, Rhoades et al. recommend to involve economists and anthropologists in the whole research process, instead of only in initial surveys or after-the-fact evaluations. They also suggest engagement in "constructive conflict", to develop disciplinary understanding and respect between individual team members (ibidem, 35).

On the basis of her review of the role of anthropologists in renewable resource management, Keller (1985) discusses problems in the professional make-up of anthropologists that complicate their participation in interdisciplinary agricultural research. She comments that most anthropologists are not accustomed to team work, and that many of them are frequently more tolerant of other cultures than of other research approaches. On the other hand, she argues that the gap of understanding and lack of professional communication between the "soft" and "hard" sciences complicates the acceptance by biological scientists of particularly anthropologists, more so than that of more quantitatively oriented sociologists and economists (1985:59). Citing IRRI 1982 (1985:54), Keller also identifies as a limitation of the anthropological approach to agricultural research that it has focussed too much on explaining the rationale of individual and social activity, in an attempt to promote understanding and respect for the logic and soundness of local management practices. However, anthropologists have been too reluctant to see intervention as their role, and have not developed models or predictors of agricultural change.

1.6. Sociology in the adaptive agricultural research project: prologue

In the above, a wide range of - potential - contributions of social science to agricultural research, as well as roles for social scientists in interdisciplinary research teams have been indicated. In the following chapters it will become clear that in the AAR project attention was paid to a majority of the topics mentioned and that the sociologist engaged in most of the described roles. However, the focus of this book will be on the contributions made to the development of methodology in the first stage of the applied agricultural research process: diagnostic research for problem identification and the formulation of guidelines for technology development. In Chapter 2, a brief overview will be given of the currently dominant methodology in this area, and the alternative approach used in the AAR project will be outlined. However, before entering into this matter, a discussion will be presented of an issue which is fundamental to the concept of agricultural development with some measure of participation by small farmers and their families. This issue concerns the theoretical and practical possibilities of and problems with the integration of scientific knowledge on the one hand, and the local or indigenous knowledge of the groups targeted for agricultural development on the other.

II. METHODOLOGY

2.1. Current diagnostic research methodology

In the last two decades, the creation of technology adapted to the production conditions of the small farm sector has become an important focus in agricultural research. This has led to the development of several interdisciplinary approaches to technology design, the most well-known of which is Farming Systems Research (FSR). The objective of FSR, as described by Gilbert et al. (1980), is "to increase productivity of farming systems given their constraints and potential and taking into account the farm household's private goals". The core of FSR is its systems perspective: rather than focussing on a single crop or an aspect of its cultivation, agricultural activity is studied within the context of the physical, biological and socio-economic conditions that determine the farm families' goals, access to resources and decision-making (Shaner et al. 1982).

FSR diagnostic research normally starts with a rapid rural appraisal (RRA), and is followed by a formal survey. In RRA - also called sondeo (Hildebrand 1981), informal agricultural survey (Rhoades 1982), reconnaissance survey (Shaner et al. 1982) and exploratory survey (Collinson 1981) - an interdisciplinary team, using mostly informal methods such as unstructured interviews and ad-hoc observation, makes an inventory of the local situation in a one to three weeks period. Usually, the recollected information is then quantified and verified through the execution of a formal survey. In some instances, a single visit survey serves as the basis for a multiple visit survey, in which detailed agro-economic information is gathered in a series of visits made at regular intervals to a limited number of usually preselected farms (Shaner et al. 1982, Fresco 1984, Maxwell 1986a).

As will be discussed in detail in Chapters 7, 8, and 9, the predominance of agronomists and economists in FSR teams has led, on the one hand, to a strong emphasis on the study of agro-ecological and economic factors influencing small scale farming. Although FSR specialists pay lip service to the importance of social and cultural factors in farmer decision making (Shaner et al. 1982, Gilbert et al. 1980), there is little evidence that these factors are seriously analyzed in diagnostic research. On the other hand, in the area of diagnostic methodology, the agro-economic predominance in FSR has resulted in a strong emphasis on survey research; however, little attention is paid to systematic, in-depth, qualitative analysis of the complex interrelationships between agro-ecological and human factors that characterize small farm systems. Considering the expertise of social scientists in this kind of analysis, the basic premise of this book is that a major social science contribution to FSR and similar approaches can be made in diagnostic research, when a thorough assessment of the factors that influence the adoption and impact of new technology must be made.

Essentially, the form of adaptive agricultural research (AAR) described in this book combines the focus of FSR with methodological and conceptual elements of the non-economic social sciences. Important aspects that are added are the analysis of the influence of social, cultural and political factors on the farming system, and a historical perspective on small farm development and farmer decision-making. Also, AAR strives to increase farmer participation in technology development. On the one hand, this is attained by emphasizing the farmer's perspective on the needs for new technology in defining research policies. On the other hand, the use of local technical knowledge in actual technology development is stressed, as well as the importance of the direct involvement of farmers in on-farm trial research (Box 1981b).

In the area of method, as will be discussed more elaborately in Chapters 7 and 8, the shortcomings of FSR diagnostic methodology, particularly with regard to the analysis of farmer decision-making and the motivations, perceptions and aspirations that underlie it, implies a need to add qualitative research methods to the rapid appraisal and surveys on which FSR is based. This book focuses on the potential of case study research, which can be used not only for studying topics that are usually considered to belong to the domain of the social sciences, but also for analyzing specifically "technical" problems.

2.2. Case studies as a research tool

Casley & Lury (1982:62) describe the case study as a detailed study of a small number of units, selected as representative for the group or groups relevant to which the issue under consideration pertains, but not necessarily representative of the population as a whole. They indicate the usefulness of the case study as a research tool in situations where it is necessary to probe deeply into the relationships between people and their environment, to explain current attitudes and beliefs, and to show why certain behaviour occurs. Yin (1986) defines the case study as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used".

The definitions of Yin and Casley & Lury imply that case studies are directed at obtaining information on the "how" and "why" of a certain phenomenon from a dynamic perspective. The objective is to understand the processes that give shape to a phenomenon, not just its state of being at a certain point in time and place. In the case of research on small farming systems, the above implies that case studies are eminently suited for learning about and comprehending the rationale behind farmer decision-making, that is, for obtaining a thorough understanding of the farming system being studied and the way it came into being.

The potential of case studies for FSR has been indicated by Maxwell (1986a), who recommends extensive studies of at most 10 farms during at least one production cycle to analyze in detail the physical, biological and socio-economic characteristics of small farms. Maxwell stresses the need for an on-going case study programme, first to provide diagnoses of constraints and opportunities in the FSR diagnostic stage, and then as an instrument for consultation, monitoring and feed-back in the remainder of the FSR process (ibid.:154). In addition, he emphasizes the importance of case studies as an instrument to develop close relationships between researchers and farmers. In advocating case studies to analyze small farming systems, Maxwell proposes a duration of one year.

Unfortunately, the time available to social scientists working in interdisciplinary teams involved in technology development is usually quite limited. Thus, there is a need for case studies that can yield the information needed to understand small farm systems in a much shorter period of time than is taken for the sort of case studies described by Yin and Maxwell. The description, in the following section, of adaptive agricultural research methodology as used in the AAR project, will show one possible way of incorporating such case studies in the diagnostic research process.

2.3. Adaptive Agricultural Research methodology

The AAR research methodology, in both cassava and rice, consisted of four main components: a reconnaissance, case studies, a survey and trial research, executed both at the research station and on-farm. The combination of case studies and survey was intended to provide an alternative to the standard FSR diagnostic research procedure of a rapid appraisal followed by a formal survey. With in mind on the one hand, the superficiality of rapid appraisal studies, and on the other, the need for a thorough understanding of the local situation before relevant questions for survey research could be formulated, the execution of case studies was proposed as a first step in the research process (Box 1981b). In practice, case study research had to be preceded by a phase in which the identification of case study informants was combined with generating a first impression of the actual situation and history of the research areas: in other words, a reconnaissance. However, in the original research proposal this phase was not identified as such, but considered implicitly as the first step in the case study research phase.

Through the combination of case study and survey research, qualitative and quantitative methods were combined to arrive at a thorough and detailed analysis of crop production. As will be described in more detail hereafter, research focussed on the identification of the principal production conditions, defined as the factors that influence crop production but cannot be altered by individual farmers, and farmer adaptation to changes in those conditions. Particular attention was paid to the identification of problems resulting from constraints in those - changing - conditions, and the ways farmer adapt their practices to counteract the negative effects of those problems (adapted from Box 1981b).

The emphasis on the above three topics can be explained as follows. Problem identification was aimed at giving biological researchers concrete guidelines for defining research priorities for technology development. Information on small farm production conditions was to provide a framework for the development of technology by indicating which characteristics new technology should have to be successfully adopted by farmers. Thirdly, providing biological researchers with information on farmer adaptations, in the form of local technology developed as a response to specific problems, was aimed at helping to focus research on solutions that, on the one hand, would be well adapted to prevailing production conditions. On the other hand, it was hypothesized that new technology that incorporated elements of local technology would be more likely to be accepted by farmers, since it would contain elements that farmers already were familiar with.

Reconnaissance

In each of the three research areas - which will be described in detail in Chapter 3 - the research process was initiated with an extended reconnaissance, executed by the team sociologist over a several-week period. In all three areas, general information was gathered on the history, the agro-ecological characteristics and the social and economic situation, with a focus on rice cultivation. This information was obtained through the study of the available literature and interviews with key informants - land reform officials, extension agents, personnel of the local rice research station, and formal and informal farmer leaders. For more specific information on rice cultivation, a total of 67 open-ended, half-hour interviews were conducted with farmers on the principal production decisions in rice cultivation. Some of these farmers were encountered haphazardly, i.e., in their fields, in local government offices, or on the road. Others were found by asking already interviewed farmers and officials for the names and addresses of farmers known for their experience and knowledge of rice cultivation.

The 67 reconnaissance interviews not only served for gathering basic information on rice cultivation, but also for the identification of farmer-informants for the next research phase, the case studies. Possible candidates for the case studies were located by asking farmers and officials about farmers especially knowledgeable on cassava and rice cultivation. In the above mentioned half-hour interview their knowledge of the crop, their capacity to verbalize that knowledge, and their willingness to cooperate in the case studies were evaluated. Special attention was paid to the respondents' capacity to explain the "why" of their actions and decisions, as well as their memory for certain crucial quantitative data such as yields, use of labour, production costs and income generated by both on-farm and off-farm activities. Also, the representativeness of the informants for specific groups of farmers who were expected to face different production conditions and problems was taken into account in the selection process. For example, both cases who cultivated modern semi-dwarf varieties and cases who preferred traditional, tall varieties were included. A distinction was also made between farmers who were able to sow two crops a year and those who were not, and between farm households with or without major sources of income apart from rice cultivation.

Case studies

On the basis of the selection interviews, a total of 42 case study informants were selected and interviewed twice, for two to four hour periods, by the team sociologist and a junior agronomist with training in agricultural economics. In the first interview, the life story of the informant, decision making in rice cultivation, and obtained and expected yields were discussed. Questions were directed at the identification of discrepancies between real practices (the practices actually realized in the two last harvests), preferred practices (what the farmer would have liked to do), practices recommended by extension agents, and practices executed in the past. By establishing, in dialogue with the farmer, the causes for those discrepancies, information was acquired on production conditions, constraints therein and the agronomical problems resulting from these constraints. Whenever possible and practical, a visit to the farmer's field was made, which often resulted in important additional and clarifying information. Farmers were generally found to be quite willing and even enthusiastic to converse about the above described topics; the long duration of some of the interviews at times proved to be more demanding for the researchers than for the farmer.

The second interview was directed at obtaining socio-economic data, with as main topics the availability and use of the production factors labour, water, capital and land, the costs and benefits of rice production, household composition and consumption, attitudes towards farmers' organizations and government institutions operating in the area, and expectations for the future. Because of the confidence established in the first case study interview and the selection interview, farmers were, without exception, well inclined to providing this kind of data.

The interviews were executed with the help of a list of open ended questions. These only served as a guide for the interviewer, and whenever necessary or relevant, further questioning and probing took place. It was usually in this further questioning that the most interesting information on farmer production conditions and adaptations was obtained.

Together, the two interviews and field visit resulted in a detailed inventory of farmer production conditions, agronomical problems resulting from constraints in those conditions, and adaptations to those problems in the form of local technology developed by farmers to limit yield losses. The information on agronomical problems and resulting farmer adaptations was reviewed and analyzed with senior agronomists at the rice research institute.

Survey

The two other research components, the survey and the trials, were based on the results of the case studies. In the survey, quantitative estimates were obtained of variables that in the case studies were identified as crucial for establishing priorities for technology development. Representative samples of rice farmers from the 3 research areas, 242 respondents in all, were subjected to a one to one-and-a-half-hour interview with the use of a structured questionnaire. This yielded quantitative estimates of a number of key indicators for the characterization of the predominant cultivation systems agronomically (a.o. cropping intensity, sowing system, yields, fertilizer and pesticide use), economically (use of land, labour and capital, and income) and socially (participation in farmer organizations, information exchange with other farmers and contacts with extension agents). In addition, the survey supplied information on the frequency of occurrence of the problems and adaptations identified in the case studies. These served to provide rice researchers with estimates on the relative importance of the problems identified in the case studies, both in terms of the frequency of occurrence and the number of farmers affected, and in terms of the effects on yields. In addition, as will be indicated in Chapters 6 and 10, survey data provided the opportunity to test for statistical significance a series of hypothesis on the relationships between production conditions, production results and technology adoption.

Adaptive trials

At the same time that preparations for the survey went underway, a trial research programme was initiated to investigate some of the problems identified in the case studies. The aim of these trials was to evaluate, in close collaboration with farmers, the impact on yields of problems identified in the case studies as resulting from constraints in specific production conditions, and the effectiveness of farmer adaptations in counteracting yield losses as a result of those problems. By combining survey data on the percentage of crops affected by a specific problem with trial data on the impact of that problem in the form of yield losses and the effectiveness of farmer adaptations in counteracting those losses, guidelines could be established for setting research priorities and the selection of possible technological alternatives.

2.4. Presentation of the obtained results

In the following chapters, the results obtained with the above described research process will be presented. In addition, Chapters 6 through 9 will discuss methodological issues involved in the execution of the research. Chapter 6 will focus on the reconnaissance, while Chapters 7 and 8 will emphasize the role of the case studies. Chapter 9 will show how case studies, survey and trial research were successfully integrated. Chapter 10 will discuss a method for classifying farmers according to their needs for new technology, developed on the basis of the case study results and applied to the survey population of farmers. However, before entering into detail in these matters, the following chapter will provide background information on the Dominican Republic, Dominican rice cultivation and the three research areas selected for AAR rice research.

III. RICE AND THE DOMINICAN REPUBLIC

3.1. Introduction: the country

Geography and climate

Sharing the island of Hispaniola with the Republic of Haiti, the Dominican Republic covers some 48,279 square kilometers, bordered in the North by the Atlantic Ocean and in the South by the Caribbean. The country is split in two by a mountain range, the Cordillera Central, running from the northwest to the south, with a length of 550 km. The fertile Cibao Valley, located between the Cordillera Central and the lesser northern range Cordillera Septentrional, is the major centre of agricultural activity.

The Republic's climate is tropical but mild, with lowland temperatures varying between 20 to 32 degrees Celsius. A dry season, coinciding with trade winds, is predominant from December to March. Except for arid regions in the northwest and southwest, precipitation is plentiful, particularly in the April-May and September-November periods. However, considerable yearly variations occur in both the amount and distribution of precipitation. Particularly in the central plains water shortages occur due to irregular rainfall in combination with high levels of evaporation (source: OMNIDATA-EFE 1986).

A brief history

Before the arrival of the Spaniards in 1493, Hispaniola appears to have supported a fairly dense population of Arawak Indians, whose subsistence was centered around the cultivation of cassava. At the end of the fifteenth century, this peaceful people suffered increasingly from attacks of the more belligerent Carib indians, a situation which the Spaniards managed to use to their advantage in establishing the first settlements. As Spanish colonization intensified, the indigenous population was wiped out completely through disease and maltreatment, a process which took less than a century to complete. As the first colony in the new world, Santo Domingo became for a few decades the centre of Spanish activity in the Americas; however, with the discovery of Mexico and Peru interest in Hispaniola declined. In the seventeenth and eighteenth century, France and Spain shared the island for some 130 years, reaping the riches of the sugar boom. For 1785, a population of 125,000 is reported, 14,000 of which were slaves (OMNIDATA-EFE 1986). In 1795, a weakened Spanish government ceded its colony to the French. The plantation slaves of what was then called Saint Domingue revolted in 1801 and overran the entire colony, including the formerly Spanish part of the island. They were driven out the year after by Napoleons troops, and Spanish rule was re-established in 1809 over the eastern part of the island. In 1821 a revolt took place that aimed at the integration of Santo Domingo in Bolivar's Republic of Colombia, but before that had been realized a Haitian army invaded the country, in 1822. Haiti governed all of Hispaniola until 1844, when a revolt successful led by Juan Pablo Duarte established the Dominican Republic.

For the first 85 years of its existence the new republic suffered long periods of internal turmoil in which weak semi-democratic governments alternated with corrupt and brutal dictatorships. The disarray was such that in 1860 Spanish rule was reestablished on the request of the Dominican government. This rule lasted only three years, and, after the Spaniards had been forced to leave, another period of instability followed. The inability to pay foreign debts led to foreign intervention, in 1903 by a joint force of the United Sates, Germany, Britain and several other countries, and again in 1916 by the United States.

The first prolonged period of peace came about under Rafael Leonidas Trujillo, who ruled the country directly or via figureheads from 1930 to 1961. In this period, some economic and social progress was made through the development, with American aid, of infrastructure such as roads and railways, and through the establishment of a relatively well developed education system. However, Trujillo's government was marked by brutal repression of political opponents, and by institutionalized corruption and nepotism that led to the amassing of huge estates and wealth by the dictator and his family. In 1961, Trujillo was murdered, and in 1962, after elections, Juan Bosch was installed as President. The latter's progressive policies brought him into conflict with the traditional land-owning elite and the military, and after 6 months Bosch was deposed of by a military coup. A popular movement to reinstate Bosch gained momentum in the following year, leading to an armed uprising in 1965 and the ousting of the conservative forces from the government. The warring of rival military factions supporting and opposing Bosch ended with US intervention, ostensibly to protect and evacuate American citizens. After mediation of the Organization of American States, peace was established with the help of an Interamerican peace force. New elections brought to power Joaquín Balaguer, a former aide to Trujillo and interim president in the period between Trujillo's death and the elections of 1961. Balaguer and his party, the Partido Reformista, remained in power until 1978, when in free elections Antonio Guzmán of the nominally social-democratic Partido Revolucionario Dominicano (PRD) defeated him. In 1982 the PRD prolonged its mandate by winning the presidential elections, with its candidate Salvador Jorge Blanco (sources: OMNIDATA-EFE 1986, Almanáque Mundial 1988).

Although the rhetoric of the PRD governments has been more progressive than that of their predecessors, actual social and economic policies have not differed greatly. Progressive taxation such as income, corporate and property taxes have remained among the lowest in the western hemisphere (World Bank, 1983:13). In 1984, in a worsening economic situation as a result of the international economic crisis of the early eighties and a tremendous decline in the price of the Republic's main export, sugar, a number of unpopular measures to cut back government expenditure were taken. The brunt of the burden of the effects of cutting subsidies on food and medicine came to bear on the poorest layers of the population, while the already difficult situation of those dependent on government services, such as small farmers in land reform projects, became even more precarious.

Population, economy and agriculture

In 1983, the Dominican Republic had a population of 5,953,300, with an annual growth rate of 2.6 % (OMNIDATA-EFE:1986). In that same year, 45 % of the population was living in the countryside, down from 70 % in 1960. Estimates are that the massive migration from the countryside to urban areas will result in a further decline of this proportion to 40 % in 1990, and 30 % in the year 2000 (World Bank 1977, in ISNAR 1983: 12).

The agricultural sector employed 41.3 % of the economically active population in 1983. However, the percentage of national GNP produced in this sector amounted to only 17 in 1983, down from 30 in the 1960-1962 period. The discrepancy between percentage of GNP and percentage of employment denotes low productivity, which is reflected in rural wages. Data from 1976-77 indicate that the average annual per capita income of the rural sector was RD $ 340 (in 1976, 1 RD$ was equivalent to 1 US$), a little over half of the national per capita income of RD $ 662. Calculations on the basis of the above presented data for 1983, and a GNP of US 7,292,400 million for that year (Almanaque Mundial 1987), put the national per capita GNP at US $ 1225, and that of the agricultural sector at US $ 504,-. An indicator of the poverty in the agricultural sector for the 1976-1977 period is that in those years, according to Central Bank statistics, protein and calory consumption of the rural population were only 73% and 71% respectively of the minimum requirements recommended by the World Health Organization (Fletcher et.al. 1980, in ISNAR 1983:11-13).

In the nineteen seventies, farms occupied approximately 27,350,000 has., some 57% of the total expanse of the Dominican Republic. Of this area, 43% (11,870,000 has.) was used as pasture, while 45% (1,206,000 has.) was dedicated to growing crops. Of the latter, 45.6 % (550,000 hectares) were used for the cultivation of the export crops sugar cane, coffee, cocoa and tobacco (ISNAR 1983:15). In 1980, 260,000 has of sugarcane were grown, 150,000 has of coffee, 69,000 of cocoa, and 30,000 of tobacco (OMNIDATA-EFE 1986).

3.2. Rice in the Dominican Republic

In the late nineteen seventies rice was the Dominican Republic's most important food crop. After sugarcane, it was also the most important crop in terms of gross value of production, labour employed and capital invested. In 1980, the area sown was approximately 112.000 has., a figure that includes doublecropped land. Cordero (1978:1) indicates, for 1977, a physical rice area of a little over 75,000 hectares, 98 % of which was officially classified as irrigated. However, due to the deficiencies in the irrigation and drainage infra-structure in about

25 % of this area, the rice grown there would, according to Cordero, be more aptly classified as "upland rice grown under favourable conditions" ("arroz de secano favorecido").

A short history

Although some authors claim that rice existed in Hispaniola before the arrival of the Spaniards, in undomesticated form in low, swampy areas, most sources state that the crop was introduced by Christopher Columbus on his first visit to the island (Checo & Azcona, 1982:5). Araujo Rivera (op.cit. in Checo & Azcona 1982:5) puts rice in fifth place on a list of the most important crops in the 17th century, after plantains, maize, cassava and sugar cane. Until the 20th century, almost all rice was cultivated in small areas under rainfed conditions. The crop was generally sown "al pugón", a method in which the grains are deposited in holes made with planting sticks. The first irrigated rice is reported around the year 1905 in the south of the country, but larger scale production under irrigation was not undertaken until 1924. That year, the Bogaert family in the province of Valverde Mao, in the dry north west of the country, started large scale commercial production using irrigation water from the river Mao. In 1930, the Bogaerts are reported to have cultivated some 440 hectares with irrigated rice. For that period, major extensions of irrigated rice are also reported in Villa Riva, in the northeast of the country, and San Juan de la Maguana, in the southwest (Checo & Azcona 1982:6).

By combining figures on local production and imports, an apparent per capita rice consumption in the range of 18 to 25 kgs. per year can be calculated for the 1930-1940 decade (Checo & Azcona, 1982: 13). Of the period before 1930, no production figures are available, but imports are reported from as far back as 1900. In 1930, shortly after the rise to power of Trujillo, a major campaign was started to increase the national production of foodstuffs, particularly rice. Through the improvement and expansion of the irrigation infrastructure - the area watered by state canals increased from some 3,000 hectares in 1930 to 14,000 in 1941 - and the stimulation of modern production methods - by providing incentives for the use of machinery and modern inputs, and for investment in rice mills - self sufficiency in rice was obtained in 1940.

In the 1941-1946 period the Dominican Republic even exported rice, while per capita consumption rose from 23 to about 32 kgs. After that, production and per capita consumption diminished somewhat. In most years, with the exception of 1963, 1964 and 1968, imports were minimal until well into the seventies (Checo & Azcona 1981: 9-11).

Production and consumption after 1970

The nineteen seventies brought, as Table 3.1 shows, a strong increase in per capita consumption: from 28.4 kgs for the early sixties, to over 48 kgs. in the early eighties. In 1977, a study of the Central Bank resulted in estimates that, with a per capita consumption of 50 kgs per year, about 10% of the Dominican family budget was spent on rice. For the lowest income group, gaining between RD$ 600 and RD$ 1,200 per year, this figure was as high as 16.3%, about one third of the 50.3% of the budget spent on food. This group, which accounted for almost 50% of the population, was found to obtain approximately 25% of its total calorie intake from rice (Banco Central 1977).

Even though rice production increased strongly in the nineteen seventies, the increase in consumption resulted in mayor rice imports becoming the rule rather than the exception. Peaks were reached in 1974, 1975, 1977 and 1981 with imports of some 73,500, 50,200, 65,400 and 63,900 tons respectively. Thus, rice imports put a heavy strain on the country's foreign currency reserves, accounting for as much as 6% of the country's imports in 1974 and 3% in 1973 and 1977 (INESPRE 1981a, 1981b).

The high cost of rice imports, particularly those of 1974 and 1975, propelled the objective of obtaining self sufficiency in rice production to the forefront of Dominican agricultural policy. In September 1977, the government announced the launching of a "Programa de Arroz" - rice program - directed at procuring self-sufficiency through four main strategies:

1.- The improvement of existing irrigation and drainage systems, and their expansion into hitherto unirrigated areas;
2.- The improvement of extension and training by gearing these services more effectively towards problems affecting production levels;

3.- The development of seed programs so as to extend the availability and use of modern semi-dwarf varieties;

4.- The installation of a coordinating agency, the Comisión Nacional de Arroz (National Rice Commission), and its executive branch, the Departamento de Fomento Arrocero (Department of Rice Promotion), charged with the execution of the Programa Nacional de Arroz.

Table 3.1. Rice production, consumption and imports in the Dominican Republic, 1962-1983

Year	Production (thousands of metric tons)	Imports (thousands of metrics tons)	Population (thousands)	Apparent per capita consumption (Kgs/year)
1970	138.4	0	4,067	33.6
1971	154.6	0	4,188	36.5
1972	164.9	8.7	4,312	39.8
1973	180.1	30.1	4,440	46.8
1974	171.1	73.5	4,571	52.9
1975	144.1	50.2	4,697	40.1
1976	192.7	32.4	4,835	46.0
1977	189.3	65.5	4,978	50.6
1978	216.7	10.6	5,124	43.8
1979	248.4	0	5,275	46.5
1980	265.9	41.2	5,431	55.2
1981	262.5	63.9	5,622	48.5
1982	265.1	0	5,785	44.5
1983	286.6	0	5,953	48.6

Source: adapted from INESPRE 1981a, 1981b, and data from the Unidad de Programación y Estadísticas of the Departamento de Fomento Arrocero, the Estadísticas Oficiales de Arroz, and the Secretaría de Estado de Agricultura

Although substantial rice imports were still necessary in 1980 and 1981, the data presented in Table 3.1 appear to indicate that the state's efforts to obtain self-sufficiency have met with considerable success. Average annual production for the 1974-1978 and 1979-1983 periods shows an increase of 45 % (from 182.8 to 265.8 thousand tons respectively), while for the same periods average annual imports display a 55 % decline (from 46.4 to 21.0 thousand tons respectively). Personal interviews during a visit to the Dominican Republic in 1986 learned that no rice had to be imported in 1984 either, but in 1985 rice imports were necessary once again, mainly as a result of a decline in the area sown. One cause of the lesser area sown was said to be a reduction of farmers profit margins, due to rises in input prices with which the rice price paid by the central marketing agency INESPRE did not keep up. Another major problem reported by these informants was the lack of funds at the state run Agricultural Bank. This left particularly the small and medium sized farmers no alternative but to leave their land idle since the credit needed for crop production could not be obtained. In addition, the rice crops that had been sown were affected by drought.

Rice and land reform

Land tenancy in the Dominican Republic is marked by a skewed distribution of arable land. Agricultural Census data from 1981 (in ISNAR 1983: 16) show that in that year the 82 % of farms with less than 5 hectares occupied only 13% of the total area of farm land, while on the other end of the scale the 2 % of farms covering more than 200 hectares covered 64%. These data are fairly similar to those of the Agricultural Census of 1971, according to which the 77 % of farms with less than 5 hectares occupied the same 13 % of the total farm area, against 67 % of the then 3 % of farms larger than 50 hectares.

As in most of the rest of Latin America, "latifundismo" and "minifundismo" are embedded in the social, economic and political history of the continent. Efforts at restructuring the land tenancy pattern only date from the last three decades, although some efforts at providing the rural poor with land were made before 1960, during the reign of Trujillo. Particularly in the nineteen fifties settlements called "colonias" were established along the Haitian border, to prevent the influx and occupation of land by Haitian immigrants. Since these "colonias" were established on government land, for political and strategic rather than social reasons, the terminology "land reform" is in fact hardly applicable. In addition, the impact of the "colonias" on the development of the border regions and the improvement of the living conditions of the settlers was minimal. Due to the absence of services, unfavorable ecological conditions (low precipitation, unfertile, often eroded, rocky soils) and isolation as a result of poor access roads, many beneficiaries left within a few years after having been settled (Gutiérrez 1983:1).

Actual land reform in the Dominican Republic did not start until 1962, with the creation of the Instituto Agrario Dominicano, IAD. Law 5879 charges the institute with the acquisition and distribution of land to the landless and smallholders with less than 1 hectare of arable land. In addition, IAD must assume responsibility for the provision of the necessary production facilities and living conditions for the beneficiaries and their families: credit, machinery, inputs, irrigation and roads, and elementary services such as housing, utilities and education.

In spite of the objectives of Law 5879, actual restructuring of the Dominican land tenancy pattern has not taken place, particularly not during the first 10 years of the existence of IAD. Law 5879 did not provide for the expropriation or purchase of privately owned land. As a result, almost all of the land that came under IAD control had already been state owned, in the form of uncultivated "baldios", the above mentioned "colonias", and the extensive estates of Trujillo and his family, expropriated immediately after his death (Gutiérrez 1983:2).

The land reform process received a new impetus in the years from 1972 to 1974, under the second Balaguer government, with the declaration of several new laws. Laws 282 and 290 of March 1972 gave IAD the possibility to expropriate unused and abandoned privately owned land, and terrains over 500 tareas (31 hectares) that were irrigated by canals constructed by the State. Law 314 of April 1972 made possible the expropriation of land belonging to "latifundios". A "latifundio" was defined as a private holding larger than a specified area, which varied according to the quality of the land (for example, the maximum area for first rate land was 1599 tareas, 94 hectares, while of

7th class land it was permitted to have extensions of as much as 45000 tareas, about 2830 hectares, before expropriation became legally possible). The new laws excluded land dedicated to the cultivation of sugarcane (Gutiérrez 1983:2,3).

The purpose of accelerating the land reform process was both economic and political. On the one hand, the state wanted to assure selfsufficiency in rice production without having to raise the price of the crop, as private producers had been demanding since 1970. Since the land reform sector could be controlled much better than the private sector, growing a major proportion of the nation's rice on IAD land would facilitate price control. Furthermore, the Balaguer government sought to relieve the social tensions that had been growing in the countryside as a result of the lack of access to land of large sections of the rural poor.

As a result of the new laws, the Land Reform process gained considerable momentum: in only three years, from 1972 to 1974, the number of "asentamientos" (literally, settlement, in practice, a Land Reform administrative unit) more than doubled from 127 to 260, the number of "beneficiarios" - families that received land - increased with 115% from 14488 to 31148, and the area distributed expanded with 113% from 77334 to 164675 hectares. However, after the peak years 1972 and 1973, the annual number of newly settled families gradually decreased to an average of a little over 2000 for the 1979-1982 period (IAD 1982, Bravo 1983).

In spite of the surge in land distribution during the 1972-1974 period, land reform has not greatly altered the structure of land tenancy in the Dominican Republic. The census data presented in the above indicate that between 1971 and 1981 the share of the total arable area of farms smaller than 5 has. on the one hand, and farms over 50 has. on the other, did not change significantly. IAD statistics from 1983 also demonstrate that the laws of 1972 did not have much impact: in the 1970-1981 period, only 0.6 % of the total distributed area was expropriated using Law 341 (pertaining to latifundio's), and 2.9% applying Law 282 (involving "baldio" land). About 10.6 % of the land acquired in this period was donated and 23.2 % purchased; the remainder involved land that had already been state owned.

As far as the social and economic impact of Dominican land reform is concerned, although part of the beneficiaries of the IAD projects have seen improvement in their living conditions, many others have not. One of the principal causes of this phenomenon is that large tracts of the distributed land have very limited agricultural potential, because of poor quality soils, difficult access, or both. Stanfield (1985:3), reports that in 1978 about 75% of the 170.000 hectares distributed by IAD could be considered marginal, as substantial investments in infrastructure would be needed to make production commercially attractive. Gutiérrez (1983:4), reports somewhat more positive figures: of the 371,000 hectares at the disposal of IAD in 1981, 36 %, some 133,000 has., were appraised as apt for agricultural use, as a result of the presence of water, access roads and sufficient soil quality. However, only about 64 % of this area, amounting to some 85.000 hectares, was actually being cultivated at that time. Both Gutiérrez (1983:5) and Stanfield (1985:3) report as the principal drawbacks for the development of IAD projects the lack of state funds for infra-structural development and agricultural credit, a lack of technology adapted to the prevailing agro-ecological and socio-economic conditions, and low prices for agricultural products, particularly after 1975.

In spite of the above mentioned problems, the land reform sector produces an important proportion of Dominican foodstuffs. For 1978, the World Bank estimated that about 27 % of the total value of agricultural production was generated in IAD projects, including 31% of national rice production, 21 % of maize, 20 % of peanuts (important for the production of cooking oil), and 17 % of beans and root and tuber crops such as cassava and sweet potato (ISNAR 1983:15,16). For 1981, these figures were 37, 16, 22, 9 and 16 % respectively, as well as 23 % of the national sorghum crop (Moquete Ortíz 1983, in Gutiérrez 1983, Annex 9). In Table 3.2 the IAD contributions to national rice production for the years 1975-1982 are presented.

Table 3.2 indicates the important role of the land reform sector in rice production: between 30 and 40 % of national production originates in IAD projects. Only 1979 was an exceptional year, with a relatively low proportion of 25.3 %, possibly as a result of hurricane David. This high proportion of national rice production grown on land reform projects is partly a heritage from the reign of Trujillo. As a consequence of the personal interest Trujillo had in the crop, a number of large mechanized farms in his name or that of relatives were created, while other terrains were prepared for irrigated agriculture. In the early nineteen sixties, after their transfer to IAD, this land constituted an important part of the total Dominican rice area. In later years, efforts of the successive Balaguer governments to keep a major proportion of rice production under government control resulted in important extensions of land being added to the IAD domains. In 1980, about 50% of the total physical rice area was administrated by the Land Reform Agency, while data from IAD and SEA show that in 1982, 1983 and 1984, respectively 42.5, 46.2 and 43.3 % of the total area sown involved IAD land. Another indicator of the importance given by the state to rice production is that in 1984 credit for rice cultivation amounted to approximately 83% of the total amount of credit extended to Land Reform projects (data obtained from the División de Crédito and the Sección de Estadísticas of IAD).

Table 3.2. The contribution of the land reform sector to rice production in the Dominican Republic, 1976-1984 (metric tons of milled rice)

Year	National rice production	IAD rice production	% of total contributed by IAD
1976	192,740	60,122	31.2
1977	189,336	72,910	38.5
1978	216,660	71,898	33.2
1979	248,400	62,744	25.3
1980	265,926	80,637	30.3
1981	262,545	95,725	36.5
1982	257,623	96,900	37.6
1983	290,834	119,568	41.1
1984	329,014	104,490	31.8

Sources: for the years 1976-1981: IAD 1983; for 1982-1984: data obtained at the Sección de Estadística of IAD and the Secretaría de Estado de Agricultura)

An aspect that has influenced strongly the Dominican land reform process is the organization of production in IAD projects. In the settlements formed before 1972, land was distributed to individual households in "family sized" parcels, with an average size of about 3 hectares. Each "parcelero" received a "provisional title" to the land, which gave him or her the right of usufruct, whereas the sale of the land itself or its exploitation for other purposes was prohibited. The state, through IAD, had the final say on the use of the land, i.e., the crops to be grown on it. In principle, the right of usufruct was hereditary, as the parcelero's family had the right to keep cultivating the plot after his death.

With Law 391 of november 1972 the creation of collectively operated rice farms became official policy. The provisional title received by beneficiaries of such a settlement established his or her membership in the collective, but did not specify rights to a particular piece of land. Every beneficiary was obliged to contribute to all activities involved in crop cultivation, under the management of the "Consejo Administrativo", the executive board responsible for all major decision making. The "Consejo" was presided over by the IAD project administrator and counted two members, a representative of the Presidency and a representative of the members of the collective. The income generated from the sale of the collectively produced crops was, after subtraction of the debts due to bank loans, distributed among its members according to the number of work days put into the production process. Usually, due to social pressures among collective members not to report on those that did not show up for work or otherwise performed poorly, the income was distributed equally among all members of the collective (Stanfield 1985:6).

Collectivization was directed particularly at the rice growing IAD projects. The primary objective was to have a larger proportion of the national rice crop grown on government owned land, so as to become less dependent on the private sector, which had been demanding price increases since 1970. Collectivization offered the opportunity for economies of scale, particularly in irrigation, input application (by air) and mechanized harvesting. Also, the organization of the collectives permitted a much stricter control over rice production than was possible in settlements where production was individually organized. Thus, the collectives were considered to provide better opportunities to increase rice production without having to increase consumer prices. In 1974, the collectivization law was extended to other crops, and in following years, ever increasing proportions of distributed land went to collectives. In the 1979 to 1982 period, no individual projects were created at all (Gutiérrez 1983, Stanfield 1985).

The equal distribution of benefits, and consequently, the absence of a clear relationship between payment and the amount and quality of the work done, and the overriding control of IAD officials over farm management, created dissatisfaction among the members of the collectives (Stanfield 1985:6). From the very start of the collectivization process, beneficiaries pleaded for more clearly relating performance in production to the benefits received, and for more influence in management and decision making. Opposition to the collective form of production was so strong that in a few instances military force was necessary to establish them (ibid.:8). As a response to these problems, IAD studied possible alternatives and introduced some minor changes, such as dividing the collective farms up in smaller units and payment of beneficiaries according to their labour input. However, under pressure of IAD technicians the principles of the collective system were maintained. Officials felt that by carving the collectives up into individual plots not only economies of scale would be lost, but also the control over production that was considered necessary to avoid a fall back to "traditional" low input and low yield farming. This divergence between farmer and official viewpoints led to frequent strains in the relationships between the IAD officials in charge of the settlements and land reform beneficiaries.

After the change of government in 1978, in which a more liberal political climate was established, the pressure for changing the collective model increased. IAD responded by executing studies, holding seminars and appointing commissions, but kept holding on to the collective system. In 1982, organizations of land reform beneficiaries took their requests for modifications in the collective system directly to the president and other top government officials. Suggestions were made to establish associative projects, in which the economies of scale could be maintained by arranging for credit, land preparation, irrigation and inputs at group level, but work, product sale and payment was to take place on the basis of the assignation of individual plots. In 1982 and 1983, the leadership of several organizations of collective beneficiaries initiated attempts to convert their collectives into associative projects, in defiance of IAD's apparent unwillingness to change the system. Continuing pressure led to concessions from the government, which culminated in march 1985 in the passage of Law 269. This law permitted the creation of "asentamientos asociativos", in which individual income would be linked directly to the production derived from individually assigned plots (Stanfield 1985:12). As such, it gave legal backing to a process which in effect had already been taking place since 1980, when the first associations had been formed in individually organized IAD projects. With the new law, the boards of associations formed in collective projects could obtain the legal status necessary for the procurement of credit and farm machinery and the selling of produce.

In terms of area, collectives covered, at the end of 1982, about 60.590 hectares, approximately 26% of the total area distributed since 1961. No data were available on the proportion of total rice production rendered by the collectives. However, IAD data from 1984 on the supply of credit indicate that some 56% of all credit went to the collective sector, and about 44 % to the individually organized projects. Taking into account that collectives received somewhat higher disbursements per tarea than individual farmers, it may be assumed that, roughly estimated, about half of the rice production on IAD land takes place on collectives, and half in individual projects.

Other institutions involved in rice production

Apart from IAD, several other government institutions exercise important influence on rice production. The Instituto de Estabilización de Precios (INESPRE) was founded in 1969, with the objective of establishing control over the prices of agricultural products, especially non-perishable foodstuffs such as rice and beans, so as to assure reasonable prices for both producer and consumer. In rice, this control was obtained by establishing INESPRE as the central marketing agency, through which all produce must pass on its way to the consumer. Middlemen still have a role in the marketing process: wholesalers buy rice from INESPRE and sell it to retailers, or retailers buy directly from INESPRE. Also, middlemen still buy rice from farmers, mill it, and sell it to

INESPRE. Since their profit is in the milling process, these "intermediarios" never buy milled rice from farmers.

Of great importance for rice production is also the state run agricultural credit bank, the Banco Agrícola. This bank supplies virtually all credit for the land reform sector, and a fair share of that for the private sector, particularly for small and medium sized farms. Most of the credit is short term, to finance the production costs of one cropping cycle, but some medium term credit is supplied to finance the purchase of farm equipment such as machinery for land preparation. Production credit, especially that of IAD farmers, is closely supervised. The amount allotted for a cropping cycle is as much as possible supplied in kind, for instance in the form of vouchers for the purchase of seed, fertilizer, and pesticides. For costs which have to be paid in cash, such as the wages of labour hired for seedbed preparation, transplanting, weeding and harvesting, payments are made separately, just before each activity is executed. Usually, credit agents of the Bank and field officials of IAD cooperate in the verification of the correct use of the allotted funds, while after the harvest the Bank recovers the loan and the interest due directly from INESPRE or the private rice millers. Thus, the farmer only receives the balance that is left after his total debt has been subtracted from the proceeds of his crop.

The Instituto Nacional de Recursos Hidráulicos, INDHRI, is responsible for the development and maintenance of the irrigation infrastructure, particularly the primary and secondary canals for irrigation and drainage. Institutional responsibilities at the level of tertiary irrigation works in IAD projects do not appear to be very well defined; in practice they are usually a shared responsibility with IAD.

The Secretaría de Estado de Agricultura, SEA, intervenes in rice production in several ways. The sub-secretariat of Research, Extension and Training is charged with the coordination of the generation and transfer of new technology. Actual rice research is executed at the Centro de Investigaciones Arroceras, CEDIA. Established in 1963 with aid of the Nationalist Republic of China, its main efforts have been directed at breeding and introducing improved varieties, seed purification and production, and improving management practices, including the use of modern inputs. SEA's extension agents are responsible for the transfer of the new technology to farmers.

SEA also supports rice production through the Department of Fomento Arrocero and the Programa de Servicios de Maquinarias Agrícolas, PROSEMA. Fomento Arrocero is in charge of seed production and distribution, cooperates with CEDIA and the Centro Nacional de Capacitación, CENACA, in the dissemination of new technology and general training of extension agents and farmers, and helps coordinate the supply of essential services and inputs to farmers. PROSEMA provides for the needs for agricultural machinery, particularly tractors and the accompanying equipment for land preparation.

Institutional problems

In theory, irrigated rice cultivation should be promoted through smooth cooperation between the Banco Agrícola, IAD, INESPRE, INDRHI and SEA. In practice, the coordination of the different services leaves much to be desired. One of the principal problems is that, although at the local level cooperation does occur, coordination at the higher levels, where all major decision making takes place, is deficient. At the time the AAR research took place, another major problem was a lack of funds, which inhibited or slowed the various agencies in the realization of their tasks. Particularly the Banco Agrícola was frequently short of cash, as a result of which less operational credit was allotted to farmers than originally approved. Also, on many occasions credit was allotted too late, with devastating consequences for crop production when critical time limits, such as those for pesticide applications, were exceeded. Similarly, the lack of resources inhibited INDHRI to maintain the existing irrigation infrastructure, and did not permit its expansion into the considerable areas of IAD projects that had not yet been prepared for rice cultivation.

As indicated in the above, IAD was found to have to cope with similar problems as INDHRI, both with regard to the upkeep and construction of tertiary canals, sluices, roads and bridges, and, in shared responsibility with PROSEMA, the supply of machinery for land preparation. Because of its highly centralized structure, it was not uncommon that local IAD agencies, and consequently farmers, had to wait for weeks for spare parts for machinery and water pumps, or even lubricants or fuel, or for the authorization to acquire these materials locally. For SEA's extension agents, the lack of funds resulted in the absence of means of transportation, or, for those who were lucky enough to have been assigned a motor cycle, to spend days and even weeks in idleness because there were no vouchers for fuel.

3.3. The research areas

Description of the Nagua region

The areas originally selected for the rice research component of the AAR project were two IAD projects ("Asentamientos" or settlements) in the Nagua region, in the north-east of the Dominican Republic. The region has a tropical lowland climate, with an average annual precipitation of over 2000 mm, with peaks in May and November. Although low in phosphate, in overall terms soils are fertile, with high organic matter and potassium contents.

The AC-09 project, named El Pozo after the village where the IAD offices are established, about 15 kilometers south of Nagua, covers sòme 10,000 hectares. The AC 101 project "El Aguacate", with its central office in the village of the same name, 25 km. southeast of Nagua, comprises about 5600 hectares. Both areas are almost exclusively dedicated to irrigated rice cultivation. In isolated parts of the projects some other crops, mainly coconut (Cocos nucifera) and the root crop "yautia" (tannias, Xanthosoma spp.) are grown commercially. Due to an insufficient water management infra-structure, large zones in both projects have problems with irrigation, especially during the dry spells of February and March, or with drainage in the rainy season. In addition, large parts of the two settlements have never been distributed, or have been abandoned by the beneficiaries and their families due to a lack of water management and transportation infrastructure. In 1981, for example, only some 3700 hectares of rice were sown in the El Pozo project, and approximately 2100 in the El Aguacate settlement. Since these numbers include land that was doublecropped, the actual area used for rice cultivation is considerably less, particularly in El Pozo. Parting from local estimates that in El Pozo and El Aguacate respectively about one half and one third of the physical rice area is doublecropped, a crude approximation would put the latter at 2400 hectares for El Pozo, less than 25 % of the total area, and 1600 hectares, or about 28 % of the total area for El Aguacate. Correspondingly, preparations for AAR survey research in 1982 and 1983 learned that the number of commercially producing rice farmers in El Pozo and El Aguacate amounted to about 1200 and 600; with average plot sizes of 2.5 and 3 hectares respectively, the areas developed for rice cultivation can be estimated at approximately 2500 for El Pozo and 1800 for El Aguacate.

A brief history of the region

In the first half of this century the Nagua area was sparsely populated, and, due to a lack of all-weather roads, relatively isolated from the major political and economic decision making centers of the country: the capital of Santo Domingo to the south, and the central Cibao valley, with Santiago as its major urban centre, to the south-west and west. The area now occupied by the El Pozo and El Aguacate settlements was split up in small and medium sized holdings with areas from 30 to 90 hectares, in which small scale cultivation of cocoa (Theobroma cacao), upland rice, cassava (Manihot esculenta Cr.), sweet potato (Ipomoea batatas), maize (Zea maiz) and plantains (Musa spp) took place. Towards the end of the nineteen forties, Trujillo confiscated large extensions of land in the El Pozo area to initiate irrigated, mechanized rice farming. The expropriated owners received minimal compensation if they cooperated; several who did not ended up as forced labour on the farms, as did political prisoners as well as common criminals from other parts of the country. After Trujillo's death, groups of these workers occupied the farms and divided the land among themselves. A year after, through the intervention of the then newly founded IAD, this situation was normalized with the formation of the AC- 09 settlement. Originally, the land was split up in individual plots varying from 3 to 6 hectares, but in later years, when the influx of new immigrants in the area and the coming of age of the sons of the initial settlers increased the demand for land, smaller plots were created. Particularly the larger plots with relatively good infra-structural conditions were split up, as a result of which at the time AAR research was initiated most plots varied in size from 2 to 3 has.

Halfway the third presidential term of Joaquín Balaguer, in 1976, an attempt was made by IAD to transform the oldest AC-09 zone, which roughly coincided with the former farm of Trujillo and had the best access roads and water management infrastructure, into a collective. After strong opposition of the beneficiaries involved, this plan was put on hold, and finally cancelled after the presidential elections of 1978. However, IAD did successfully push the formation of associations, which initially consisted of 15 to 25 beneficiaries with adjacent plots. As described in the above, the land of the members was cultivated individually, but with credit, land preparation and supply of inputs arranged at group level. The preferential treatment associated farmers received stimulated individual farmers elsewhere in the settlement to form their own associations, and in 1981, about half of the 1200 beneficiaries registered as rice producers were incorporated in some 30 associations, with several more in the process of formation.

In contrast to the El Pozo area, where in the first half of the century most of the land was privately owned, the terrains in the El Aguacate area were mostly "baldio's", government owned land without any infrastructure, where a few settlers grew subsistence crops on small plots of cleared land. In some areas rice was grown, with farmers obtaining two crops a year: upland varieties were sown in the spring months (March through May), at the beginning of the rainy season, while in the wettest months, from August onwards, a second crop of swamp rice was sown in inundated areas. Towards the end of the nineteen fifties the Trujillo government initiated land reform in the state owned terrains, with the division and assignation of plots from 6 to 9 hectares and the construction of some minor irrigation and drainage infra-structure. Unlike El Pozo, the area did not receive much government attention after Trujillo's fall. Only in 1969 did the first Balaguer government incorporate El Aguacate in the land reform process with the formation of the AC-101 settlement. The land was redistributed in plots of about 4 hectares, and irrigation and drainage was improved, although infrastructural production conditions never came close to those in the associative area of the El Pozo project.

The Mao region

In 1983, work was started in the third rice research area of the AAR project: two small IAD projects north of the city of Mao. The area is located in the arid north-west of the Dominican Republic, with an average annual precipitation of about 600 mm. (as compared to 2000 mm. in the Nagua area). The area around Mao has a long history of rice cultivation, and, as was indicated in the above, is reported as the first area where the crop is grown on a large scale under irrigation. Several important innovations in rice cultivation also appear to originate in this area, such as the tall local varieties Toño Brea and Mingolo, both selected by the local farmers who gave them their names, and widely grown throughout the country. A widespread practice which is most successfully executed in the Mao region is the ratooning of a rice crop, amply discussed in Chapter 6, in which a second crop is obtained from the stubble of an already harvested crop.

The IAD intervened at an early stage in the Mao area: the first official settlement in the country was the AC 01, named after the village of Laguna Salada, situated about 10 km north of Mao. This project, consisting of some 180 "parcelas" with an average size of 3 hectares, is situated on both sides of the main road that connects Santiago, to the southeast, to the town of Monte Cristi, in the extreme northwest of the country. Infrastructural conditions are good in the plots situated closer along the road, but deteriorate in the plots situated further away, where some parts of the settlement are unfit for rice cultivation due to saline soils.

The La Guajaca project is located a little further to the northwest, also on both sides of the Santiago - Monte Cristi highway. This project, with about 120 beneficiaries, is similar to the lesser developed parts of the Laguna Salada projects: the supply of irrigation water is less secure, and deficient drainage has resulted in salinization in various parts of the project.

Both the La Guajaca and the Laguna Salada projects are individually organized, however, when AAR research was initiated the first associations were in the process of being formed. Since, apart from the variations in infrastructural development, there were no major differences between the La Guajaca and Laguna Salada projects, both projects were considered as a single research area, which will be indicated as Laguna Salada in the rest of this report.

IV. LINKAGES BETWEEN RESEARCH, EXTENSION AND FARMERS: THE CASE OF RICE IN THE DOMINICAN REPUBLIC*)

Abstract

Linkages between rice researchers, extension agents and farmers in the Dominican Republic are weakly developed. Due to institutional constraints and attitudes prevalent among most officials, farmers lack ways of indicating their needs and priorities to rice researchers. As a result, the new technology developed and transferred consists of a technological package that in many cases is not, or only partly, applicable in small farm production conditions. The case used to illustrate this predicament is that of the sowing of a second rice crop out of season. It is concluded that by starting the generation of new technology with the analysis of production conditions, and resulting problems at farm level, the role of farmers in setting research policies can be increased. This should lead to the development of new technology that is better adapted to small farm production conditions.

Introduction

In many developing countries, the generation and transfer of new agricultural technology is marked by a top-down approach (Chambers 1983, Rhoades et al. 1985a, Simmonds 1988). Recommendations are developed at research level, passed on to the extension service, and then transferred to selected groups of farmers. Research policies are determined by policy makers and researchers with little or no farmer participation. Technology development is focused on those areas where production potential is highest, as a result of which the technological packages are only partly relevant for the sub-optimal production

---

*) To be published in: Agricultural Systems (1991)

conditions that characterize most of the small farm sector. If small farmers adopt at all, they tend to modify recommendations to a considerable extent, to the chagrin of most officials.

In this paper, the generation and transfer of modern rice technology in the Dominican Republic will be analyzed within the context of the linkages between the Dominican rice research institute, extension agencies and small farmers. It will be shown that the above described situation is characterisic for the Dominican system of generation and transfer of agricultural technology, as a result of which practices and problems that are of importance to farmers have been overlooked by national rice research. On the basis of the discussion of one such problem, the sowing of a second rice crop "out of season", the feasibility of directing research programmes towards the development of adapted technology will be indicated.

Research context and methodology

Research was conducted within the framework of the Adaptive Agricultural Research (AAR) project. Executed from 1981 to 1985, the project involved a interdisciplinary team effort directed at the identification of constraints in small farm production conditions, problems resulting from those constraints, and farmer adaptations to those problems in the form of indigenous technological solutions. Research for problem identification at the farm level was initiated with a reconnaissance of the three research areas, the El Pozo and El Aguacate land reform projects near the town of Nagua in the north-east of the Dominican Republic, and the Laguna Salada project, close to the city of Mao, in the north-west. In addition to the collection of general information on the research areas and rice cultivation, the reconnaissance served to select 42 case study informants, with whom a detailed qualitative inventory was made of how's and why's of farmer decision making in rice cultivation. Subsequently, a number of key variables were evaluated quantitatively through the execution of a survey among a 10 % sample of the research population, while two of the problems encountered in the case studies were evaluated in on-station and on-farm trial research, with the objective of obtaining reliable estimates of yield reductions and the effectiveness of farmer adaptations.

At the official level, a total of 34 open-ended interviews were conducted with rice researchers and extension agents. Fourteen were with researchers, accounting for two-thirds of the total population of 21. The remaining interviews were conducted with 20 of the total of 24 extension agents that operated in the Mao and Nagua regions.

Dominican rice policy and institutions

Rice is the most important staple food in the Dominican Republic. In area sown, production value and labour and capital invested it is second only to sugarcane (SEA 1981). In the years 1975-1982, an average of about 35% of total national rice production was grown in Land Reform projects (Cuevas Pérez 1983), indicating that an important proportion of Dominican rice production takes place on small farms.

The priorities for the generation and transfer of new rice technology are set in accordance with one of the principal objectives of Dominican agricultural policy: the attainment of self sufficiency in rice production. As a consequence, research and extension policies have been directed at raising production levels as rapidly as possible, through the introduction of a high-input technological package based on the doublecropping of modern semi-dwarf varieties.

The generation and transfer of new agricultural technology is the responsibility of the Ministry of Agriculture (Secretaría de Estado de Agricultura); for rice, four dependencies of the Ministry are involved. The Centro de Investigaciones Arroceras (CEDIA), founded in 1963, is charged with research. The institute counts with 17 national researchers, and receives technical assistance from 4 Taiwanese experts. Fomento Arrocero, the department commisioned with the implementation of rice production policies, plays a major role in the production and distribution of seed of the modern semi-dwarf varieties developed by CEDIA, and in the allotment of other resources such as chemical inputs and farm machinery. The department also counts with a small but elite team of extension specialists, who concentrate their efforts on a limited number of areas that function as models of the successful application of new rice technology.

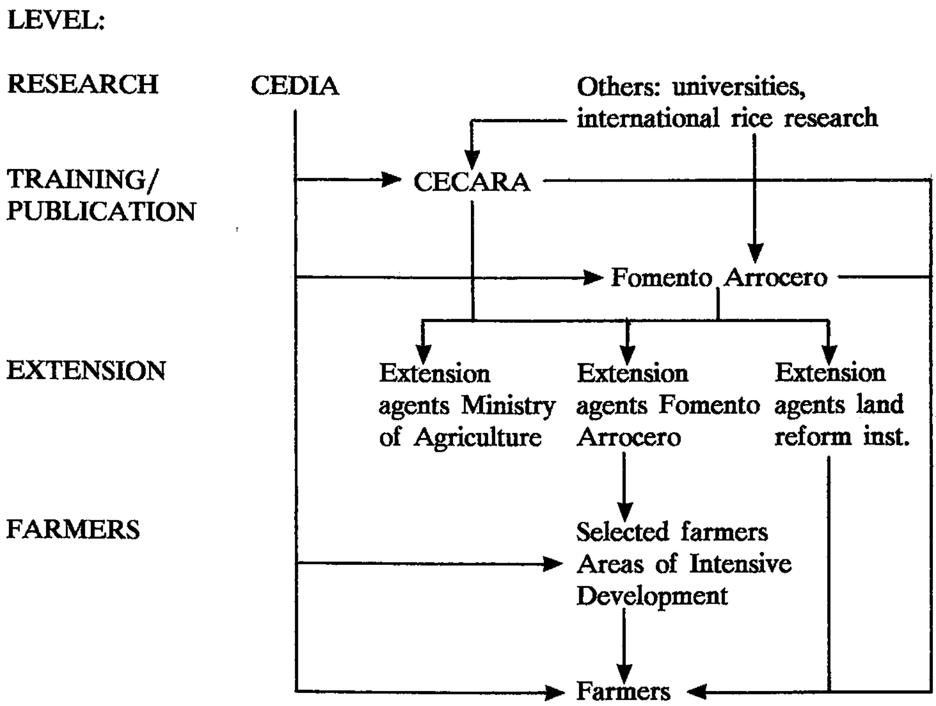
Outside the areas covered by Fomento Arrocero's agents, technical assistance and the transfer of modern rice technology is the responsibility of the extension agents of the Department of Extension of the Ministry of Agriculture, and of the officials of the land reform institute. The training of these agents is the responsibility of the Centro Nacional de Capacitación Arrocera (CECARA), which depends primarily on CEDIA researchers for teaching the courses it organizes.

ISNAR's study about the Dominican system of generation and transfer of agricultural technology reports the lack of financial resources and the unpredictability of their disbursement as the primary impediment to increasing the systems effectiveness (1983). In the interviews conducted for this study, this finding was confirmed: both researchers and extension agents considered the lack of material resources as an important or the principal limiting factor in the execution of their work. Researchers reported a lack of funding for conducting research outside the central experimental station in Bonao. Extension agents, particularly those of the Department of Extension, recounted that for prolonged periods of time they had been unable to visit farmers due to a lack of means of transportation and fuel. In addition, they complained about the shortage of documentation and teaching material, and of not being able to make use of demonstration plots for the transfer of new technology.

Linkages between researchers, extension agents and farmers

An ideal representation of the flow of information regarding new rice technology is depicted in Diagram 4.1. Technology generated at CEDIA and information derived from the international rice literature and research at Dominican universities is passed on to extension agents through personal contacts, CECARA's training courses or via the publications department of Fomento Arrocero. Farmers receive the corresponding recommendations in face-to-face interaction with extension agents, through participation in field days, in leaflets distributed to farmers, or through courses organized by CECARA. Of particular importance for wider dissemination is the transfer from farmer to farmer on which the Training and Visit extension model - adopted in the late nineteenseventies - is based.

Diagram 4.1. Flowchart of information on (new) rice technology in the Dominican Republic



In reality, the linkages between researchers, extension agents and farmers are weak. Only 3 of the 11 interviewed researchers claimed to be in contact with extension agents more often than once a month; three others stated to have such contacts only once a year or less. Similarly, 6 out of 10 of the extension agents interviewed in the Nagua region said they had been in contact with researchers only once or twice in the year before the interview, while 2 more reported not having met with researchers at all.

Researchers reported to be in contact with farmers somewhat more frequently than with extension agents. In most cases, however, it concerned informal contacts with large farmers who visited the research institute looking for solutions to specific problems. Otherwise, direct contacts between farmers and researchers were infrequent, and took place almost exclusively on field days in which new technology was demonstrated to audiences of extension agents and farmers.

As for the frequency of contacts between extension agents and farmers, about half of the 242 farmer respondents reported to have been in touch with an extension agent at least once during the last three months. Of the others, almost 20 % said they had not seen an extension agent for a year or more, and another 9 % claimed never to have been visited by one.

The contents of the exchange of information

Apart from the infrequent contacts between the three parties involved, another deficiency of Dominican rice research and extension concerned the messages that were exchanged. The problems started at the level of the translation of research results into recommendations to be transferred by extension agents. Only a very minor proportion (at the most 10%) of all executed research projects was found to be published in any form at all, the remaining 90 % did not get further than the desk of the responsible researcher. In this respect, a major impediment was that CEDIA had no publications department of its own. Fomento Arrocero did, but the responsible official stated that over the last year no material had been produced for lack of funds.

Even in those instances where manuals for extension agents or leaflets for farmers were published, their contents often did not contain the results of CEDIA research, but appeared to be based on internationally available rice production manuals or other sources. As a result, extension agents made recommendations on the basis of a standard technology package that had not systematically been adapted to regional and local agro-ecological or socio-economic conditions. In fact, none of the interviewed officials knew the origins of several important and nationally used recommendations. A good example of this phenomenon was the standard fertilization formula for irrigated rice, used since the early nineteenseventies by extension agents all over the Dominican Republic. From the interviews with the officials involved, it became clear that this recommendation did not include a wealth of knowledge generated by more than 200 fertility trials, conducted mainly by the experts of the Taiwanese mission.

Small farmers were found to have little interest in the official technological package, and in general, in recommendations for new technology. Table 4.1 shows that, of the 242 farmers from the Nagua and Mao regions interviewed in the AAR survey, only one mentioned learning about new technology as a reason for desiring technical assistance. The interviewed farmers were much more interested in problem solving extension; more than 70 % of the reasons for looking for technical assistance involved production problems and the use of pesticides.

Table 4.1. Topics for which technical assistance is desired, as reported by a sample of 242 farmers from the Mao and Nagua regions of the Dominican Republic

Topic	Frequency, % *)
Pest and disease control	38.2
Identification of production problems	27.2
Use of herbicides	15.5
Use of fertilizer	13.7
New production techniques	0.3
Others	5.1
Total	100.0

*) % of the total number of topics mentioned, n=393

Source: Doorman 1986a

The role of farmers in technology generation

The infrequent contacts between researchers and farmers, and the emphasis on technology transfer in the communication between farmers and extension agents, leaves little opportunity for the feedback of information from the farm to the research level. A problem that compounds this phenomenon are official's attitudes towards farmers, particularly on the part of extension agents. Small farmers are considered traditional and resistent to change. When the interviewed extension agents were asked which they considered a more logical explanation for the non-adoption of new technology, "farmer rationality" (i.e., limitations of the technology itself) or "farmer traditionalism" (i.e. attitudinal problems of the potential adopter, such as resistance to change), 11 out of 12 extension agents working in the Nagua region opted for the latter alternative (the question was not put to Mao region agents). Similarly, of 24 reasons extension agents gave for the partial adoption or adaptation of recommendations, only one alluded to the possibility that the farmers' alternative might be more economical, while 14 again referred to "traditionalism" (Table 4.2).

Among researchers, a somewhat more positive view was taken of farmer rationality. When asked the same question on the reasons for non-adoption of new technology that was put to the Nagua extension agents, 8 out of 12 researchers considered farmers have valid reasons for non-adoption. Also, both researchers and extension agents recognized that in some instances a lack of production conditions could impede adoption of new technology. However, neither researchers nor extension agents considered that local technology employed by farmers could, in specific conditions, be more feasible than the recommended technology.

The low esteem officials hold for farmers is reflected in their opinion on the influence the latter should have in setting priorities for rice research. Only one out of 14 agents to whom the question was put considered farmer participation important, as compared to 4 out of 14 researchers. All the other interviewed officials were of the opinion that researchers, by themselves or together with extension agents and Fomento Arrocero officials, should set priorities.

Table 4.2. Opinion of 17 extension agents from the Mao and Nagua regions of the Dominican Republic on the reasons for farmers' adaptation of official recommendations, in percentage of the total number of reasons given

Reasons for adaptation	% of total
Tradition / resistance to changing existing practices	58.3
Lack of production conditions	25.0
Farmer practices are more economical	4.2
Farmer not convinced by benefits of recommendation	4.2
Other	8.3
Total	100.0 (n = 24)

Source: Doorman 1986b

The case: sowing out of season

The lack of feedback of information from the farm to the research level has resulted in a failure to incorporate small farmers' needs for new technology, in the form of solutions to problems resulting from sub-optimal production conditions, into research programmes. However, as will be indicated in this section for the case of the sowing of a rice crop "out of season", providing researchers with the necessary feedback can lead to the taking into account of such problems and conditions in technology development.

The recommendation for sowing dates for the doublecropping of a rice plot is to initiate the first cropping cycle in December or January, and the second in June or July. The rationale of this advice is that crops sown "out of season", after mid-August, can suffer significant yield reductions due to the low temperatures, low levels of solar radiation and strong winds in the December-February period. Although farmers recognize this risk, at the time of research sowing out of season was a widely encountered practice in the Nagua region.

According to AAR survey data, some 60% of all second cropping cycles of 1981 and 1982 were sown out of season (Doorman 1986a). As for the losses caused by this practice, AAR trial research executed in 1982 (Rikken et al. 1985) showed yield reductions averaging some 20% for the four varieties most widely used in the Nagua region. However, rice specialists and farmers claimed that in 1982 climatic conditions had been favorable, and that every three or four years unfavorable weather caused yield losses of up to 50 %.

In spite of the official recommendation, it was found that Nagua farmers had few alternatives to sowing out of season. Due to major shortages of irrigation water in the months of February and March, following the official recommendation of sowing the first crop in December or January meant that the crop would almost certainly be affected by drought in its most vulnerable growing stages. Consequently, the preferred practice was to establish the seed-bed for the first cropping cycle in March, and transplant in April, with the coming of the rains. Theoretically, transplanting a first crop in April would still make it possible to establish the second one in the beginning of August, "in season". However, because of delays in land preparation and transplanting, both in the first and second cropping cycle, the second crop could often not be established before september.

Although the standard technological package specified planting dates, it did not contain any recommendations on what to do when production conditions resulted in delays. In practice, officials recommended not to sow the second cropping cycle at all, so that the first cropping cycle of the new season could be initiated on time, in December or January. However, as indicated above, farmers, rather than foregoing a complete cropping cycle, were found to take their chances and sow anyway, particularly in late August and September. In addition, although lower yields were accepted as inevitable, they were found to adapt their practices to limit yield reductions as much as possible. One of these adaptations was the use of varieties more tolerant to the unfavorable climatic conditions of the winter months. A local, photo-sensitive tall variety that matures in the month of January was preferred by some farmers, while several semi-dwarf cultivars with medium length growing cycles were used by others. Both the local variety and the semi-dwarfs, when sown before mid-september, flowered before the January/February windy season. Also, farmers were found to vary some cultural practices for a crop sown out of season. To compensate for reduced tillering, some farmers increased plant density and fertilizer application, or planted seedlings in an inclined position (Doorman 1983).

Generating topics for agricultural research

Initially, the problem of sowing out of season was not identified as such. In the case studies, farmers from the Nagua region consistently reported that yields in the second cropping cycle were lower than in the first, a fact which was later confirmed in the survey. However, farmers did not distinguish between sowing the second crop "in" or "out" of season in terms of the official recommendation, before or after the 15th of August. A probable explanation is that Nagua farmers, because of the above described practice of sowing the first crop in the March-April period, almost always sowed either out of season or just barely in season, in the first two weeks of August. Therefore, they had little opportunity to compare second cropping cycles sown late and on time. As a result, the AAR team did not at first describe the problem as sowing "in" or "out" of season either, but rather as a general reduction in yields in the second cropping cycle. Only after corroboration with rice officials was the problem formulated as "sowing out of season".

The above indicates that problem identification at the farm level is not simply a matter of asking what the farmer's problems are. Once certain problems are described in farmers' terms, they have to be "translated" to match the definitions and concepts used by researchers. This implies that sufficient knowledge of both the farmers' and the researchers' perceptions is necessary to translate the identified problems into topics for research. In this case, it was recommended that rice researchers investigate ways to diminish the negative effects of sowing out of season. As a basis for such research it was suggested to take into account farmers' adaptations to the problem: the use of tolerant varieties, and the increase of plant density and fertilizer application to compensate for lesser tillering and panicle formation. As a result, in a cooperative effort between CEDIA and the AAR project, the above discussed trial research on sowing out of season was initiated, while CEDIA's researchers included tolerance to low temperatures and solar radiation in breeding programs.

Conclusions

The case of sowing out of season points to a fundamental shortcoming in Dominican rice research and extension: the failure to address problems that ensue from constraints in production conditions faced by small farmers. This deficiency results from two fundamental characteristics of the system. The first is that, as a result of the national policy objective of attaining self-sufficiency in rice production, priority has been given to the formulation of a technological package geared to high input cultivation under favorable production conditions. The second characteristic has been the lack of communication between the three principal parties involved: researchers, extension agents and small farmers, as a result of which there has not been a systematic feedback of information from the farm to the research level. For an important part, the latter problem can be traced to the way officials viewed their clientele. Particularly extension agents considered most small farmers as too uneducated and resistant to change to adopt their recommendations. And neither researchers nor extension agents considered that farmers should be given a role in defining research priorities.

The result is that farmer influence and participation in the generation of new technology have been minimal, and that topics which are of interest to small farmers working in sub-optimal conditions have virtually been excluded from research programmes. This tendency has been reinforced by the prevalent viewpoint among officials that production conditions should be adapted to the demands of the new technology rather than the other way around. Consequently, in the case discussed in this paper, the sowing out of season of a rice crop, no other advice was avaible than to forego an entire cropping cycle. The paradox is that this solution ran counter to the main objective of rice policy, namely the maximization of production in order to fulfill the national demand for rice.

In conclusion, it appears that at least in some instances, optimising production under less favourable production conditions corresponds with both national and farmers' interests. The institutionalized analysis of farmer production conditions, problems and adaptations should make officials more aware of the problems specific to the small farm sector, and thus stimulate the search for adapted solutions.

V. FARMER'S ADAPTATIONS TO PRODUCTION CONSTRAINTS AND ITS IMPLICATIONS FOR AGRICULTURAL POLICY: THE CASE OF RICE CROPPING SYSTEMS IN THE DOMINICAN REPUBLIC[*)]

Abstract

To obtain national self sufficiency in rice production, rice officials in the Dominican Republic strongly favour doublecropping over other cropping systems, particularly those where a second crop is substituted for a ratoon. This paper aims to show that the ratoon and other local rice cropping systems employed by small farmers are well adapted to the production conditions in which they are practiced. It is suggested that under most conditions a ratoon is more cost effective, both at micro and macro level, than doublecropping. Therefore, a re-examination of the official view on rice cropping systems is recommended, as well as the incorporation of the ratoon in programs directed at the development of new rice technology.

Introduction

Various studies have indicated that small farmers are quite skilled in the development and use of technology adapted to the specific production conditions of their farms (see for example IDS 1979, Chambers 1983, Chambers et al. 1989). The indigenous knowledge on which these skills are based does not usually result in very high yields in absolute terms. Nevertheless, it helps farmers to obtain optimum results in terms of fulfilling their production goals, with the limited resources available in their particular farming system (Butler Flora 1988).

---

*) To be published in: Tropical Agriculture (1991)

This low-input, low-yielding local technology starkly contrasts with the high yielding, high-input technology developed at research stations and promoted by government agencies. In many instances, the contradictions between local and recommended technology have led to low adoption rates of the latter, in spite of government policies combining positive incentives (for example, providing subsidies on modern inputs) with negative ones (such as withholding credit).

The argument underlying this paper is that it may well be more feasible to adapt government policies to existing farming practices than to impose policies on unwilling farmers that are incompatible with their goals and production conditions. In the following, rice cropping systems in the Dominican Republic are analyzed in relationship, first, with the production conditions that have generated them, and secondly, with government policies directed at increasing production.

Rice in the Dominican Republic

Rice is the most important staple food in the Dominican Republic. In the early nineteeneighties, in terms of area sown, total production value and the labour and capital invested it was second only to sugarcane (SEA 1981, p.5). In 1983, 99733 hectares were sown with rice, with an average production of 3.6 tons of paddy per hectare (Cuevas Pérez 1983).

Since the nineteenseventies, national self sufficiency in rice production has been one of the major objectives of government agricultural policy. In the last decade an important part of government resources for agricultural development has been aimed at achieving that goal. For example, according to data from the Dominican Land Reform Institute (Instituto Agrario Dominicano), of the total of the agricultural credit provided by the state for land reform projects in 1984, approximately 58 % was destined for rice production, considerably more than all other crops combined. Research and extension has also received major attention, and the rice research institute Centro de Investigaciones Arroceras (CEDIA) has played an important role in developing technologies aimed at increasing yields per hectare. Rice breeding has been the most successful component: the use of the CEDIA varieties Juma 57, Juma 58 and

Juma 60 - also known as Tanioka - has been widespread since the latter half of the nineteen seventies. For example, in 1984, according to estimates by Lora and Persia (1985), 61.2 % of the total Dominican rice area was sown with certified seed of semi dwarf varieties; in about 70 % of this area the Juma cultivars developed by CEDIA had been used.

To obtain maximum benefits with the semi-dwarf varieties, a package of recommendations was developed based on doublecropping, careful water management and seedbed preparation, and the use of modern inputs such as certified seed, NPK fertilizer, systemic insecticides, fungicides - particularly against *Pyricularia oryzae* - and pre-emergent and post-emergent herbicides.

Research areas and methodology

Research was carried out within the framework of the Adaptive Agricultural Research (AAR) project, a cooperative Dutch-Dominican effort carried out from 1981 to 1985. One of the project's main objectives was to find out why many small Dominican rice farmers rejected or only partially adopted the technological package developed by CEDIA. Three research areas were selected, all settlement projects of the Dominican land reform agency. Two of the projects, El Pozo de Nagua, with about 1200 settlers and their families, and El Aguacate de Arenoso, with about 600 settlers, are located to the south of the town of Nagua, in the northeastern part of the Dominican Republic. The third research area, Laguna Salada, consisting of two adjacent Land Reform projects with a total of about 300 settlers, is situated near the town of Mao, in the north-west of the country.

Diagnostic research was initiated with a reconnaissance, in which basic information on the research areas in general and rice cultivation in particular was compiled. Also, the reconnaissance served to select informants for the second step in the research process, the case studies. In the six to eight hour case study interviews, an in-depth analysis was made of all aspects of rice production, with particular attention for the reasons underlying specific production decisions. A total of 42 case studies was executed in the three research areas.

The third step of the diagnostic research process was the quantitative evaluation of a series of key variables, identified in the reconnaissance and particularly the case studies, through the execution of a survey among 242 respondents. This total consisted of random 10 % samples of the El Pozo and El Aguacate projects, and a 20 % random sample from the Laguna Salada area.

Production conditions in the research areas

In the reconnaissance and case studies the three research areas were found to have widely varying production conditions. Most of Laguna Salada and about one third of the El Pozo area counted with fairly good access to the essential inputs irrigation water, credit and machinery for land preparation, and farms located in those zones, with sizes from 2 to 3 hectares, were usually well drained and levelled. In the rest of the El Pozo area and the entire El Aguacate project, with plots of up to 4 hectares, production was negatively influenced by insufficient access to credit and machinery for land preparation, frequent shortages of irrigation water in the dry season, drainage problems in the rainy season, and poorly levelled plots. Comparison of the survey data on average annual rice production per hectare - a function of cropping intensity and yields - obtained in the three research areas is illustrative. For Laguna Salada, average annual production amounted to 5.7 tons/ha., for El Pozo, 4.4 tons/ha. and for El Aguacate, 1.3 tons/ha.; analysis of variance showed the differences to be significant at the 0.005 level. The remarkable differences in production conditions, not only between, but also within the three investigated Land Reform projects, resulted in a classification of farmers into four groups, with good, fair, poor and very poor conditions. This classification was based on the above mentioned five factors; access to irrigation water, credit and machinery for land preparation, and plot levelling and drainage.

Rice cropping systems

Doublecropping

Doublecropping with CEDIA's semi-dwarf varieties has been considered a prerequisite for obtaining national self sufficiency in rice production, ever since, in 1978, the latter was officially designated as a major goal of agricultural policy. In El Pozo and El Aguacate, it is also the cropping system preferred by most farmers: of the 185 surveyed farmers in these two projects, 92.1 and 91.5 % respectively preferred it over the alternative of sowing a crop and a ratoon. On the other hand, in Laguna Salada only 42.1 % of the 57 surveyed farmers favored doublecropping over ratooning (Table 5.1).

Table 5.1. Farmers' preference for doublecropping or ratooning in three land reform projects in the Dominican Republic

Project	Total no. respondents	Prefer doublecrop		Prefer ratoon	
		No.	%	No.	%
Laguna Salada	57	24	42.1	33	57.9
El Pozo	126	116	92.1	10	7.9
El Aguacate	59	54	91.5	5	8.5

Source: Doorman 1986a (p.29)

The surveyed farmers mentioned as the principal reason for preferring doublecropping over a ratoon, higher production and benefits (in 65 % of the 343 reasons given; respondents were allowed to give up to three reasons). Also, 32 % of the farmers preferring doublecropping mentioned the problem of excessive weed development in ratoon crops, and 21 % indicated the problems involved in receiving financing for a ratoon from the principal source of credit for Dominican land reform farmers, the state run Agricultural Bank.

Due to the above described problems with irrigation and land preparation, the actual frequency with which farmers doublecrop was found to be much less than the expressed preferences would have led to expect. In El Aguacate doublecropping was only practiced in 15.4 % of the inventoried annual cropping cycles; in El Pozo this percentage amounted to 53, and in Laguna Salada, to 36.

Directly related to the promotion of doublecropping are CEDIA's recommendations on sowing dates. These include establishing the first crop in December or January, and the second in June or July. Sowing the second crop after mid August, "out of season", is discouraged, since unfavourable climatic conditions - low temperatures, lack of solar radiation and strong winds, causing a high percentage of unfilled spikelets in the flowering stage of the rice plant - may result in significant yield reductions.

Reconnaissance and case study information indicated that the sowing dates in Laguna Salada coincided rather well with CEDIA's recommendations. However, because of frequent water shortages in February and March, El Pozo and El Aguacate farmers were found to establish their first crop much later than recommended by CEDIA, at the beginning of the rainy season in April. Consequently, the second crop was rarely established before August, and sowing out of season was frequent. According to the survey data, in El Pozo fully 63.3 % of the crops sown in the second half of the year was sown out of season (Doorman 1986a, p.74). In El Aguacate this percentage was 47.2, however, due to the fact that delays in land preparation and transplanting frequently inhibited sowing in the first cropping cycle, many of the crops sown in the second cropping cycle, in season, were actually the first - and only - crop of the year.

Crop and ratoon

A ratoon or *retoño* is a crop produced by tillers regenerated from the rice stubble after harvesting. A ratoon can be considered as an alternative to sowing a second cropping cycle, since after the original - first - crop is harvested, the regrowth can be managed as a second crop. The growing cycle of a ratoon is only three months, as compared to 4.5 to 5.5 months for a sown crop.

Not all rice varieties yield a good ratoon. In the Laguna Salada area, ratoons were almost exclusively practiced with the local variety Mingolo, while in El Pozo and El Aguacate the semi-dwarf Tanioka (Juma 60) was used. Cultivation practices were also found to vary according to region and production conditions. Case study farmers reported to cut back the plant parts remaining after the harvest to heights varying between 3 and 7 cm, depending on plot conditions. In poorly levelled and drained plots stalks were cut at greater height, to avoid the rotting of the stubble in parts subject to inundation. In well levelled plots stalks were cut lower, which was claimed to result in the formation of a larger number of new shoots and consequently, higher yields.

Ratoon yields were found to vary considerably per research area. Two of the Laguna Salada case study farmers, working in very well leveled plots with good drainage and access to irrigation water, reported that, with careful water management and nitrogen fertilizer application of up to 120 kgs. per hectare - about equal to that of a sown crop - they had obtained yields of up to 5 tons of paddy per hectare. Case study informants from El Pozo and El Aguacate reported considerably lower maximum yields, of 3.5 tons/ha (with applications totalling some 105 kgs. of nitrogen per ha.) and 2 tons/ha (with an application of 5 kgs. of nitrogen per ha.) respectively.

The average yields reported in the survey were found to be much lower than the above presented maximum, ranging from 2.5 tons/ha in Laguna Salada to 1.3 tons/ha. in El Pozo and 0.8 tons in El Aguacate (Table 5.2). Analysis of variance showed these differences to be significant at the 0.0001 level.

The information on ratooning gathered in the case studies permitted the identification of three different perspectives among those who prefer and/or engage in the practice. A first category of farmers, with good plot conditions, encountered primarily in Laguna Salada, ratooned a first crop because they preferred it to doublecropping. Case study farmers belonging to this category explained that because of lower production costs, a ratoon leaves higher net benefits than a second crop. It also requires less work, reduces the need for credit and obviates the use of machinery for land preparation. Among the surveyed farmers, the arguments of higher net benefits and less work were the most frequently mentioned (Table 5.3).

Table 5.2. Frequency, maximum and average yields of ratooning in three land reform projects in the Dominican Republic

Project	Frequency of ratooning as % of total no. of years that:		Yields (tons/ha)	
	At least one crop was harvested 1)	Two or more crops were harvested 2)	Maximum case studies	Average survey 3)
Laguna Salada	49.7 (n=151)	56.0 (n=134)	5.0	2.6 (n=43)
El Pozo	11.4 (n=377)	17.0 (n=241)	3.5	1.3 (n=28)
El Aguacate	9.3 (n=175)	34.1 (n=44)	2.0	0.9 (n=9)

1) n = the total number of annual cropping cycles in the 1981-1983 period that survey respondents grew at least one rice crop
2) n = the total number of annual cropping cycles in the 1981-1983 period that respondents practiced either doublecropping or a ratoon
3) n = the total number of ratoons in the 1981-1983 period.

Sources: AAR case studies, AAR survey, Doorman 1983 (p.127,128), Doorman 1986a (p.27,48)

The second perspective on ratooning was found among Laguna Salada farmers with good access to credit and machinery for land preparation, but plots not yet sufficiently well levelled and drained to make a ratoon an attractive alternative for a second crop. However, in principle they preferred ratooning, and would ratoon instead of doublecrop as soon as they could make the necessary improvements in plot conditions.

A third category of farmers, which included case study informants from El Pozo and particularly El Aguacate working in poor production conditions, were found to practice a ratoon because they could not doublecrop for lack of water, machinery and/or credit. These farmers grew a ratoon so as to obtain some additional rice - and income - at minimum cost; usually only that of the cutting of the stalks, some weeding and the harvest. Because yield expectations were low as a result of deficient water management conditions, no major investments were made in fertilizer application or pesticides.

Table 5.3. Reasons for preference for ratooning in the Laguna Salada land reform project, Dominican Republic

Reason*)	No. times mentioned	%
Higher profits/lower production costs	23	33.8
Less work	20	29.4
No need for credit	9	13.2
No need for land preparation	8	11.8
Other	8	11.8
Total	68	100.0

*) Each respondent was given the opportunity to give two reasons for the expressed preference

Source: Adapted from Doorman 1986a (p.30)

To evaluate the argument of the first category of farmers that a ratoon in good production conditions yields higher net benefits than a second crop, a cost-benefit model was elaborated on the basis of the case study and survey data (Table 5.4). Production costs are based on data acquired in the Laguna Salada case studies; for yields the survey averages for Laguna Salada and El Pozo farmers working in good production conditions are used.

The data in Table 5.4 show that, for farmers working in good production conditions, ratooning is almost two times more profitable than sowing a second crop. Even with ratoon yields of only 2.2 tons/ha benefits would still equal those of a second crop.

Table 5.4. Model of costs and benefits of a second crop and a ratoon, based on case study and survey data obtained from farmers working in good production conditions

		Second crop	Ratoon
Production costs, (RD$/ha)	(1)	RD$ 800.00	RD$ 380.00
Yields (tons/ha)	(2)	3.7	2.8
Production value per ton (RD$)	(1)	RD$ 273.50	RD$ 273.50
Gross production value (RD$/ha)		RD$ 1012.95	RD$ 765.80
Net production value (RD$/ha)		RD$ 212.95	RD$ 385.80

1 RD$ = 0.50 US $

Sources: (1) AAR case study data, Mendez & Doorman 1984 (p.46,80)

(2) AAR survey data, Doorman 1986a (p.48,78). For ratoon yields n = 29, for second crop yields n = 57

Crop, first and second ratoon

After harvesting the ratoon crop, it is possible to ratoon the stubble a second time. This *bitoño* or second ratoon has a growing cycle of about three months, equal to that of a first ratoon. Neither in the case studies nor in the survey were any farmers encountered who practiced a second ratoon as a rule, although some had experimented with it. Four case study farmers from El Pozo reported yields from 0.5 to 1.7 tons/ha. obtained form *bitoños*. As a reason for not continuing the practice they mentioned very aggressive weed development during the second ratoon (Doorman 1983, p.138). The farmers involved also explained that higher yields and better weed control were possible with improved levelling and water control, but that the required conditions did not - yet - exist in the El Pozo project. However, the potential of the practice is indicated by the fact that farmers from the private sector, in other rice producing regions in the Dominican Republic, have obtained yields of up to 2.4 tons/hectare from a second ratoon (De Groot 1983, p.18).

Crop and riso

Only practiced in the Nagua area, the *riso* is a type of ratoon, in which the rice plants are left to sprout anew after the first harvest without being cut close to the ground. As a consequence, new shoots appear from the upper nodes, and not from the basal parts of the rice plant. This results in the rapid development of a second crop, with, according to case study informants, yields of up to 1.5 tons per hectare. A riso can be practiced with any rice variety. Usually no inputs are used, although some case study farmers reported the application of two to three one hundred pound bags of urea fertilizer (45 % nitrogen) for a three to four hectare plot. Production expenses are minimal, and sometimes nil, as weeding is not necessary and harvesting is mostly paid in kind rather than cash.

Farmers practice a *riso* if there is no need or possibility for land preparation in a period for up to two months after the harvest - the time it will take for a riso to mature. Thus, in a period that would otherwise be unproductive, some additional rice is produced at minimum cost. Farmers do not consider the *riso* to be an alternative to the growing of a second crop, or to ratooning in good production conditions. However, in poor production conditions, in which ratooning is not likely to result in reasonable yields and doublecropping is impossible, a *riso* is practiced as a substitute.

As is to be expected from the above, *risos* are most common in El Aguacate, among farmers who only sow one crop a year. The survey data of El Pozo and El Aguacate indicated that a *riso* had been grown in 39 % of the 118 inventoried annual production cycles in which farmers had only been able to sow one crop. Cropping systems including a *riso* accounted for about 26 % of the total of annual production cycles, as against only 8 % for cropping systems involving a ratoon.

Crop and mateo

Another way of obtaining a second crop, found only in El Pozo, is the *mateo*. A *mateo* is obtained through letting seed of the local tall variety Inglés germinate and develop in an already established semi-dwarf crop. In some cases, farmers broadcast Inglés seed in the established crop when it is about 3 months old. In others, they simply depend on seed that was spilled in the field during the harvest of previous Inglés crops. In both cases the very strong germinating capacity of Inglés assures that seedlings will start developing, in spite of the competition from the rice plants of the already established crop. After the harvest of the latter, the Inglés plants have the chance to develop fully and yield a second crop. Since Inglés is a photosensitive variety maturing in January and February, the duration of the "mateo" depends on the time the first crop is established and the Inglés seed is broadcast.

Four of the sixteen El Pozo case study informants claimed to have practiced a *mateo* at one time or another, usually when the first crop was established very late in the first cropping cycle, i.e., in the month of July. This late date would make doublecropping impossible, particularly if the farmer wanted to start the first cropping cycle of the following year on time, in March or April. Since in less favorable production conditions a ratoon would not have been feasible either, the farmers opted for a *mateo* - in some cases followed by a *riso*. Yields from a *mateo* were reported to be slightly higher than those from a *riso*: in the case studies yield estimates ranging from 0.7 to 2.0 tons per hectare were obtained (Doorman 1983, p.135). In the survey, only three cases of a *mateo* were encountered, which was less than expected on the basis of the results of the case studies. This may be related to the fact that many farmers refrain from the practice to avoid the problem, reported by several case study informants, of the germination of Inglés seed in crops sown after the *mateo*. Due to competition of the resulting hardy Inglés rice plants with the sown crop, the yields of the latter are negatively affected, particularly when semi-dwarf varieties are used.

Rice cropping systems and agricultural policy

The above mentioned official promotion of doublecropping is particularly strong in those land reform projects where access to water, machinery and credit make the use of this cropping system possible. Since on the one hand, the *riso* and *mateo* are practiced under marginal conditions when doublecropping is not possible, and on the other, farmers who grow a *riso* or *mateo* would generally agree with officials that the growing of a second crop is preferable, there is no conflict between official and farmer viewpoints on these practices. Such a conflict of interest is, however, quite apparent in the case of a ratoon practiced in good production conditions. The average ratoon in these conditions yields less rice, but more profits than a second crop. Thus, farmers are more interested in ratooning, while officials want them to doublecrop. Indeed, in the late seventies officials began to see ratooning as a major impediment in their bid to raise national rice production. As a result, everything possible was done to prevent ratooning. No official credit was given for a ratoon, nor technical assistance. In some instances overzealous officials in collective Land Reform rice farms had ratoons plowed under, obviously against the will of the tenants. In later years, perhaps partly under the influence of papers pointing out the positive sides of ratooning (Cuevas Pérez & Núñez Jiménez 1980; De Groot 1983) some officials took a milder stance towards this practice. For instance, in the Laguna Salada area the Agricultural Bank resumed credits for ratooning in the early eighties. Nevertheless, as recently as August 1984, one of the leading Dominican rice officials still proclaimed that as long as there was a risk of rice shortages in the country, Dominican government institutions could not afford to permit farmers to grow a ratoon instead of a second crop (personal communication).

The information presented in the above provides sufficient grounds for a thorough reexamination of the prevailing official viewpoint. In the first place, ratooning can be considered as an adaptation to specific constraints in production conditions, such as overall shortages of water and machinery for land preparation. For example, it can be looked upon as an attractive alternative to a second crop, sown out of season as a result of those constraints. A second consideration is that, particularly in small scale farming, capital is a scarce resource. This is valid both for farmers' own resources and for credit extended by the state-run Agricultural Bank. Since, as Table 5.4 showed, the average production costs of a ratoon are only some 40% of those of a sown second crop, while yields amount to more than 75%, it can be concluded that credit is more efficiently used in case of a ratoon. And, because of the lesser investment in the latter, financial losses resulting from lower-than-expected production are also reduced considerably. This argument becomes particularly valid when ratooning is considered as an alternative for a second crop sown out of season.

A third consideration favoring ratooning concerns another scarce resource in rice production: machinery for land preparation. In comparison with doublecropping there is not only a reduction by half of the need for machinery, but the shorter total cropping cycle also allows for much more flexibility in sowing dates. While in doublecropping CEDIA's recommended sowing dates should be adhered to fairly strictly to avoid sowing out of season, a cropping system based on the ratooning of the first crop can in principle be established at any date between December and May. This flexibility implies that the peak demand for machinery is spread over a four to five months' rather than a two months' period, theoretically reducing the need for machinery by some 60 %.

Finally, as Cuevas Pérez (1980) and De Groot (1983) have already indicated, at the macro level ratooning should not only be considered in terms of overall production. The savings in land preparation and to a lesser extent chemical inputs should also be taken into account, since in the Dominican Republic all machinery, fuel, lubricants, pesticides and components of fertilizer have to be imported. Since the main argument against ratooning is that lower production levels cause rice shortages, resulting in the need for imports which have to be paid for with scarce foreign currency, a comparison between the cost of the rice imports to compensate for lower ratoon yields and the import of the extra inputs to produce a second crop is valid. In Table 5.5 such a comparison is presented. The average yields of 3.7 and 2.8 tons/ha of paddy for second crops and ratoons are the same that were used in Table 5.4, and are based on survey data on Laguna Salada and El Pozo farmers working in good production conditions. At an international rice price in august 1983 of RD$ 345.- per metric ton, the 0.9 ton difference in paddy, or about 0.55 tons in milled rice, would have cost RD$ 189.75 to import.

Case study data indicate that about 60 % of the production costs presented in Table 5.4 for second crop and ratoon account for imported inputs (Mendez & Doorman 1984, p.46). This figure coincides with estimates of De Groot, who arrived at 65 and 60 % respectively for a second crop and a ratoon (1983, p.16). The estimate of 60 % for both leads to a total value of imports of RD$

480,- for a second crop (all for inputs), and RD$ 417,75 for a ratoon (RD$ 228,- for inputs and RD$ 189,75 for rice). These data indicate that the real costs of ratooning in terms of imports are even less than those of doublecropping, thus invalidating the principal official argument against ratooning.

Table 5.5. Comparison of costs in foreign currency of a second crop and a ratoon, based on the model of costs and benefits of a second crop and a ratoon presented in Table 5.4

	Second crop	Ratoon
Yields, tons/ha (1)	3.7	2.8
Production costs, RD$ (2)	800.00	380.00
% Imported (2)	60%	60%
Production costs to be paid for in foreign currency, RD$	480.00	228.00
Value rice imports (3)	----	189.75
Total value of imports, RD$	480.00	417.75

Sources:

(1) AAR survey data, Doorman 1986a (p.48,78). For ratoon yields n = 29, for second crop yields n = 57

(2) AAR case study data, Mendez & Doorman 1984 (p.46,80).

(3) Milled rice, conversion factor paddy-milled rice=5/8 Price in RD$ is based on August 1983, world market price for Thai SWR Grade B, average CIF quotation at Rotterdam in US $ at the equivalent of RD $ 345.00 per metric ton

A final consideration to be taken into account in the above comparison is the already mentioned fact that in very good production conditions, a *bitoño* or second ratoon can yield as much as 50% of a second sown or transplanted crop (De Groot 1983, p.19). This would put total production of a cropping system involving a double ratoon some 15% above that of doublecropping, while still reducing the need for imported inputs.

Conclusions

In this paper, four rice cropping systems used by Dominican farmers were discussed in relation to the production conditions in which they occur. When given the choice, farmers prefer either doublecropping or ratooning, while the *mateo* and the *riso* are only used to obtain some extra rice and income if a second crop or ratoon cannot be practiced. The official stance on rice cropping systems is that maximum production should be obtained through doublecropping. From this perspective, a ratoon is considered anathema, even though considerable groups of farmers prefer ratooning over doublecropping because of higher net benefits, lower production costs and less work. At the macro level, ratooning economizes on scarce resources such as irrigation water and capital - particularly credit from the state-run Agricultural Bank - and imported mechanical and chemical inputs. The savings in foreign currency in the latter two commodities were shown to more than compensate for the rice imports needed to make up production differences between a ratoon and a sown crop.

The objective of this paper is not to advocate overall replacement of doublecropping by ratooning. In many farms with less than optimal water management conditions, doublecropping will be a more feasible alternative than ratooning. However, it is suggested that ratooning is taken into consideration in rice research activities. Ratooning capacity could be included as a selection criteria in rice breeding. Also, agronomic research could be executed on such topics as water management, weed control and fertilization. Considering farmer experience and obtained results in ratooning, it would be advisable to base this further development of ratooning technology on an inventory of already existing local knowledge.

VI. A FRAMEWORK FOR THE RAPID APPRAISAL OF FACTORS THAT INFLUENCE THE ADOPTION AND IMPACT OF NEW AGRICULTURAL TECHNOLOGY*)

Abstract

The number of variables that influence farmer decision making is enormous. Theoretically, in diagnostic research for small farm development all these factors should be considered so as to determine their relative importance. In practice, many, particularly those of a socio-cultural or political nature, are not taken into account at all. The central argument of this paper is that in the initial stage of diagnostic research a rapid appraisal of all factors must be made, to select for further research those that seem to have the greatest potential impact on decision-making. A framework for this appraisal is presented, together with its application in adaptive research on rice cultivation in the Dominican Republic.

Introduction

Over the last two decades, the number of variables that has been considered in the analysis of farmer decision making on the adoption of new agricultural technology has steadily grown. With the growing role of social scientists, particularly in the problem identification stage of the technology development, more attention has been paid to factors such as norms and values, belief systems, formal and informal leadership and organization, and vertical and horizontal social relations (IRRI 1982, Garrett 1984, DeWalt 1985, Horton 1986). The time available to analyze this complex array of variables is usually quite limited. In the diagnostic stage of the research process, under pressure from biological colleagues to present information on which technology development can be based, social scientists have at best a few months, and

*) To be published in: Human Organization (1991)

sometimes only weeks, to appraise the importance of agro-ecological, economic and socio-cultural factors. Even within that period much time will be taken up by survey research focusing on agronomic and economic variables, limiting the available time even further. Consequently, at a very early stage in the research process the social scientist is forced to delimit the number of variables to be analyzed in detail, by selecting for further research those factors that, after a rapid appraisal, are considered to have the greatest potential impact on farmer decision making. The central argument of this paper is that the reasoning underlying that selection must be made explicit. In the following, a framework is presented for such rapid appraisal, as well as its application to the case of small scale rice cultivation in the Dominican Republic. The results obtained are combined with those of subsequent diagnostic research in the form of case studies, to elaborate a simple causal model of the relationships between explanatory and dependent variables. In addition, some results of the last step of the diagnostic research process, a survey applied to a representative sample of the research population, are used to illustrate the validity of the approach. In conclusion, it is argued that because of the holistic approach of anthropology to the study of human reality, anthropologists can play an important role in rapid appraisal, even in those situations where the principal factors to influence farmer decision making are of an agro-ecological or economic rather than of a social or cultural nature.

The study of factors influencing farmer decision making: state of the art

In general terms, farmer decision making on agricultural technology has been analyzed from three broad perspectives, which in the following shall be identified as diffusion of innovations research, Farming Systems Research, and the anthropological approach.

In diffusion of innovations research, the analysis of decision making has focused on a series of personal characteristics that are considered to influence farmers' receptiveness to change, and thus, the adoption of new agricultural technology. Research therefore concentrates on variables such as education and literacy, frequency of contact with (extension) officials, exposure to the media, participation in organizations, and such social- psychological concepts as progressiveness, cosmopolitanism and rationality (see for example Galjart 1968, Rogers 1969, and more recently Pérez Luna 1979, Nweke 1981, Voh 1982 and again Rogers 1983).

Implicit in the traditional diffusion of innovation studies is the assumption that the adoption of the new technology is, in all cases, the small farmers' best alternative. However, in the aftermath of the negative consequences of the Green Revolution, the rationality of the unquestioned adoption of the packages of modern technology has been increasingly challenged. In many instances, it has been shown that technology developed at the research station was not adapted to specific production conditions, especially those marked by constraints typical of the small farm sector. The assumption that the small farmer is a rational decision maker has led to the conclusion that the causes of non-adoption of new technology are not primarily related to a series of social, cultural and psychological characteristics of the potential adopter, but are for an important part a result of the characteristics of the technology itself. This recognition forms the basis of the approach of Farming Systems Research (FSR), which consists in taking the existing farming system, with its constraints and technology, as a basis for technology development and transfer (Gilbert et al. 1980, Shaner et al. 1982). In addition, this acknowledgement of farmer rationality has led to the appreciation of traditional farming practices as adaptations to specific ecological and socio-economic circumstances (IDS 1979, Brokensha et al. 1980, Chambers 1983: 82-92).

The dominance of agronomists and agricultural economists in FSR has resulted in a strong emphasis on the study of factors of an agro-ecological nature, such as climatological conditions, soils, topography and hydrology; economic factors such as access to land, labour and capital, prices of inputs and produce and market structure; and geographical and infrastructural conditions, such as distance to regional and national markets, availability of services, and physical infrastructure. As for the social and cultural factors that may influence farmer decision making, although FSR specialists usually pay lip service to their importance, the literature on the subject contains few indications that they have been systematically analyzed. The recognition of this weakness has resulted in the extension of traditional FSR with an anthropological perspective. Recent years have shown an increasing participation of non-economic social scientists, particularly anthropologists, in agricultural research projects (IRRI 1982, Gladwin 1983, Tripp 1985, Ashby 1986, Horton 1986 and Rhoades 1986). This third tendency implies, on the one hand, the study of social and cultural factors that influence the need for, adoption, and impact of new technology. These factors include formal and informal farmer organization, the exchange of commodities and information through formal and informal networks, the social, economic and political ties of small farmers to other social groups (middlemen, government officials, large farmers, the landless) and cognitive aspects of farmer decision making. On the other hand, the growing involvement of non-economic social scientists has resulted in a stronger emphasis on the use of qualitative research instruments such as informal interviewing, participant observation and case studies, which are particularly useful in the analysis of the farmers' perspective on the need for new agricultural technology.

A framework for the rapid appraisal of factors influencing farmer decision making

This paper is based on the premise that all three perspectives, i.e., the diffusion of innovations theory, Farming Systems Research, and the sociological and anthropological contribution thereto, have their intrinsic value, and that the appraisal of the factors influencing farmer decision making and needs for new agricultural technology should, in principle, take into consideration the focal points of all three approaches. In Table 6.1, the principal corresponding variables are presented, subsumed under three headings. The first, personal, refers to traits inherent in the farmer as an individual. The second type of factor, situational, refers to the interaction between the farmer and his immediate environment. To a certain extent, these factors can be manipulated by the farmer, and as such create the space that gives meaning to decision making: the choice between alternatives of action. The third type of factor is external, and refers to those elements that are outside the sphere of influence of individual farmers, and can therefore not be manipulated. External factors can also be indicated with the term production conditions, and represent the independent variables that, collectively, determine the scope of individual production decisions.

Table 6.1. Factors influencing farmer decision making and needs for new agricultural technology

	Personal	Situational	External
Physical/ ecological		. Agro-ecol. production conditions on farm: - soils - topography - hydrology - flora and fauna (including weeds pests, diseases) . Farm families health, nutrition	. Production conditions in the region: - climate - topography, soils - hydrology . flora and fauna . landscape . demography . human health, nutrition
Infrastructural/ geographical		. Agro-infrastructural production conditions on farm: - water control - access (roads,bridges) . Access to services: - credit - supplies/inputs - (agricult.) machinery - extension - health, education . Access to local market and processing facilities . Access to local centers of economic/political decision making	. Agro-infrastr. production conditions of the region: - irrigation, drainage - roads, bridges . Availability of services: - credit - supplies, inputs - agricultural machinery - extension - health and education - transportation . Access to markets: regional, national, international . Access to centers of economic and political decision making
Land use		. Crops/cropping systems/ livestock, hunting, gathering, fishing . power (i.e.traction) . energy (i.e. fuel)	. Crops/cropping systems/ livestock . Natural resources
Economic		. Resource availability: . Land: - tenurial status - farm size - fragmentation	. Prices of: - inputs - services - land (rent) - labour (wages)

Table 6.1. Factors influencing farmer decision making and needs for new agricultural technology (cont.)

	Personal	Situational	External
		. Labour: - availability and skills - family and hired - exchange of labour - (seasonal) migration - (off farm) employment . Capital/wealth: - cash/cash flow - assets (incl.machinery, means of traction, etc. . Consumption: - household size - consumption patterns	- capital (interest) - transport - machinery . Prices of produce: - local, regional, - national/international - stability/fluctuations . Marketing: - role of government - role of cooperatives - role of intermediaries
Educational	. Education/literacy	. Local possibilities for: . Knowledge of modern agricultural technology services: frequency of contacts with officials	- education - training via extension
Cultural/ psychological	. Managerial capacities/ skills/knowledge/experience . Attitudes towards: - farming and risk - tradition and innovation - officials and government intervention - other social groups . Aspirations and expectations . (Opinion) leadership		
Socio-cultural and political	. Ethnicity . Indigenous technical knowledge . Tastes and preferences . Perceived needs . Norms and values . Goals/orientation of production: - subsistence - commercial . Goals/aspirations (e.g.towards income, spare time, occupation) . Religion . Belief systems . Aesthetics	. Social structure: - kinship - patronage - formal and informal leadership - factions . Mutual obligations and assistance . Formal and informal organization . Other horizontal and vertical social relationships . Household structure and functions: - division of labour - decision making patterns - control of returns from production	. Government policy on: - land tenure - local leadership - local organization - agriculture: . research/extension . subsidies and taxes . Regional and national social structure: ethnic groups,castes,clans,etc. . Regional/national socio-political structure: political institutions and government

Sources: Galjart 1968, Rogers 1969, Nweke 1981, Shaner et al. 1982, Doorman 1983, Mendez & Doorman 1984

In very general terms, it can be said that traditionally, the diffusion of innovations approach has focused on personal factors. On the other hand, agro-economic approaches such as FSR have concentrated on the external factors of an agro-ecological, geographical, economic and infrastructural nature, while the emphasis on situational factors, particularly those of a socio-economic, socio-cultural and "agro-cultural" character is typical of the contribution of non-economic social science.

Obviously, a thorough analysis of all factors presented in Table 6.1 is impossible to realize in the short time that is usually available for diagnostic research for agricultural development. This implies the need for a rapid, qualitative appraisal, with the objective of selecting for further research those factors that are concluded, provisionally, to have the greatest influence on farmer decision making. The following sections will describe the results of the application of the framework presented in Table 6.1 to the case of small-scale irrigated rice farming in the Dominican Republic.

The case: irrigated rice farming in two rice producing regions in the Dominican Republic

The research on which this paper is based took place within the framework of the Adaptive Agricultural Research project (AAR), carried out from 1981 to 1985 by an interdisciplinary team in the Dominican Republic. One of the main research questions put to the AAR research team by biological scientists of the national rice research center CEDIA (Centro de Investigaciones Arroceras) was to establish why large groups of small farmers had not or only partially adopted CEDIA's technology package, based on the doublecropping of semi-dwarf varieties and an intensive use of chemical inputs.

On the suggestion of CEDIA's researchers two projects of the Dominican land reform agency, AC-09 El Pozo and AC-101 El Aguacate, in the rice producing region around the town of Nagua in the northeast of the Dominican Republic, were chosen as research areas. In the El Pozo project, administrated by the Land Reform Agency from a village with the same name, some 1300 beneficiaries cultivated rice on irrigated plots with an average size of some three hectares. El Aguacate, situated to the east of the El Pozo project, served some 770 families with plots that, with an average size of four hectares., were slightly larger than those in El Pozo.

In general terms, the El Pozo project was considered by rice officials to be a fairly successful project in terms of production levels and the adoption of the technology package advocated by CEDIA. Yields of up to five tons of paddy per hectare per crop were reached by farmers following CEDIA's recommendations to double crop modern semi-dwarf varieties. This was particularly true for an area comprising about 600 farming families around the El Pozo village; in the following, when alluding to El Pozo, reference is made to this particular area. The El Aguacate project, on the other hand, was considered to be a failure, with low production levels and adoption rates. Many farmers still grew traditional, tall varieties and only sowed one crop a year. Yields were reported to reach three tons of paddy per hectare of at the most, and average repayment rates on the loans extended by the state run Agricultural Credit Bank were said to be as low as 20 %.

Research methodology

Research started with an extended reconnaissance, executed by the team sociologist over a period of several weeks, in which general information was gathered on the history and present situation of the research areas, with a focus on rice cultivation. The general information on the region and its historical development was obtained through the study of the available literature and interviews with key informants - land reform officials, extension agents, personnel of the local rice research station, and formal and informal farmer leaders. For more specific information on rice cultivation, a total of 67 open-ended, half hour interviews were conducted with farmers on the principal production decisions in rice cultivation. Some of these farmers were encountered haphazardly, i.e., in their fields, in local government offices, or on the road, while others were found by asking already interviewed farmers and officials for the names and addresses of farmers known for their experience and knowledge of rice cultivation.

The 67 reconnaissance interviews not only served for gathering basic information on rice cultivation, but also for the identification of farmer-informants for the next research phase, the case studies. A total of 32 case study informants, 18 in the El Pozo and 14 in the El Aguacate project, were selected and interviewed twice for two to four hour periods by the team sociologist and a junior agronomist with training in agricultural economics. The first interview treated agronomical aspects of farmer decision making, and the information gathered was reviewed and analyzed with senior agronomists at the rice research institute. The second interview was directed at the social and economic aspects of rice cultivation, and served among others to obtain the necessary data for a cost-benefit analysis of rice cultivation under specific production conditions. In combination, these two interviews resulted in a detailed inventory of farmer production conditions, agronomical problems resulting from constraints in those conditions, and adaptations to those problems in the form of local technology developed by farmers to limit yield losses.

The third step of the diagnostic research process consisted of the quantification of the main findings of the case studies through the execution of a survey among 185 farmers, a 10 % sample of the research population. Apart from supplying quantitative estimates of a number of key indicators for characterizing the predominant cultivation systems agronomically (cropping intensity, sowing system, yields, fertilizer and pesticide use), economically (use of land, labour and capital, and income) and socially (participation in farmer organizations, information exchange with other farmers and contacts with extension agents), the survey also yielded information on the frequency of occurrence of the problems and adaptations identified in the case studies.

The preliminary identification of the causes of the differentiation in the successful adoption of new rice technology, in terms of a rapid appraisal of the factors presented in Table 6.1, took place in the reconnaissance. This appraisal consisted, first, in taking inventory of and assessing the explanations that local key informants and farmers gave for those differences. In the second place, it included the assessment, in a rather quick-and-dirty but nevertheless systematic manner, of the variables of Table 6.1 that had not been suggested as possible causes for the differentiation between El Pozo and El Aguacate. Since this differentiation was assumed to be a result of variations in one or more of the factors presented in Table 6.1, the analysis was directed at establishing for all factors, individually or in groups, if differences between El Pozo and El Aguacate indeed existed.

The results of the extensive analysis of farmer decision making conducted in the next step of the research process, the case studies, helped to specify the relative importance of the factors that had been identified provisionally as causes of farmer differentiation. Also, this analysis helped to substantiate the results of the rapid appraisal by providing detailed explanations of the reasons for the variations in production levels and the adoption, adaptation or rejection of the recommendations of CEDIA's technological package. The result was a comprehensive picture of the relationships among production conditions, agronomical problems, and farmer adaptations which, in combination with the corresponding survey data, provided the basis for recommendations for the development of adapted agricultural technology. In addition to supplying the quantitative parameters needed for defining research priorities, the survey data also permitted the testing of some of the conclusions drawn in the reconnaissance and case studies regarding the causes of the differential adoption of modern rice technology. Pearson correlation coefficients were determined for the relationships between the indicators for possible causal factors and indicators for successful adoption, while analysis of variance was used to test these relationships for statistical significance.

Appraisal of factors influencing farmer decision making: similarities between the El Pozo and El Aguacate projects

Personal characteristics

The very first key informant interviews with rice officials at CEDIA and in the Nagua region yielded a clear indication of the official viewpoint on the differences between El Pozo and El Aguacate. In the opinion of most officials it was the farmers' personal characteristics that were the main factor in determining decision making, and more specifically, the rate of adoption of the new technology and production levels. In general terms, El Pozo farmers were considered serious, responsible, hard working, open to advice and honest. They followed the recommendations of officials, used their credit "productively", that is, applied the inputs supplied by the Agricultural Credit Bank on their crops, and repaid their loans. As a consequence, so it was reasoned, they reached quite satisfactory production levels, and made a decent living of rice cultivation.

In contrast, El Aguacate farmers were said to be traditional, uneducated, unwilling to listen to good advice and irresponsible. The farmers' lack of responsibility and their dishonesty were illustrated by the contention that frequently farmers sold the inputs delivered in kind by bank officials, instead of applying them to their crops. Also, many farmers using credit from the state run Agricultural Bank were said to sell part of their crop without the Bank's knowledge. At the time of repayment, after the harvest, the farmers in question would claim that they could not repay the loans because of a crop failure. It was these practices - although admittedly not engaged in by all farmers - that prompted one official to suggest that it would be better to transform the entire El Aguacate project into one large state or privately run farm, where the current farmers could be employed as day laborers.

Thus, the official explanation of the differences between El Pozo and El Aguacate farmers was based on the premise that the behaviour of both groups was determined by distinctive personal characteristics. However, there was little objective reason to hold this view. Analysis of the available literature and key informant interviewing led to the conclusion that the histories of the two areas were similar. Until the 1950's, both were isolated areas thinly populated by subsistence farmers. In the early 1950's, the dictator Trujillo expropriated lands in both El Pozo and El Aguacate, to start large scale mechanized rice farming in the region. After his fall in 1961, the land and its infrastructure became state property, and in the following years the large mechanized farms were divided by the Land Reform Agency in three hectare plots that were distributed among landless farmers, including the owners expropriated by Trujillo or their offspring. Much of the current population of both the El Pozo and El Aguacate projects immigrated to the region at the time the actual land reform took place, in El Pozo in 1961 and El Aguacate in 1967, or shortly thereafter.

Both the immigrant populations of El Pozo and El Aguacate could, to a certain extent, be considered as samples of specific socio-economic strata in Dominican society: younger, lower class, mobile, mostly single males with few economic opportunities in their home regions. Although in the 1950's El Pozo, much more so than El Aguacate, was used as a prison camp for real or alleged political opponents of Trujillo, and therefore in that period could have had a fairly large population of people from socio-economic strata that do not usually yield migrants, most of these political prisoners left the region following Trujillo's fall. Thus, there is little reason to assume that, in general terms, people going to the El Aguacate project differed from those going to El Pozo in terms of the socio-cultural and cultural-psychological personal traits presented in Table 6.1. The two populations can be assumed to be similar wit regard to education, management capacity, knowledge and experience in farming, tastes and preferences, religion and belief systems, values and norms, aspirations and expectations, and attitudes towards and perceptions of the agro-economic and social environment: farming, risk, innovation, and social categories such as other farmers, middlemen and government officials.

The 67 reconnaissance interviews did not indicate significant differences between farmers of the two areas either. In general, the mentality and attitudes of both El Pozo and El Aguacate farmers appeared quite conducive to fostering agricultural innovation. Although there were, of course, differences among individuals, most farmers were found to be quite willing to experiment with new agricultural technology - if they had the necessary resources and perceived a reasonable chance of success, that is, of raising income derived from rice cultivation. A clear indicator of this attitude was the fact that farmers were almost unanimous in mentioning high yields as the primary reason for the choice of a specific rice variety. The exchange of old varieties for new ones that were perceived to have higher yield potential was a practice reported by almost all farmers. This willingness to change in order to increase the benefits obtained from rice production is not only indicative of a general desire to improve the living conditions of the household, but also points to aspirations for upward social and economic mobility. Another indicator of these ambitions was the importance farmers gave to sending their children to school (rather than keep them on the farm) and the expressed desire to have their children follow professional careers rather than continue as farmers.

The above leads to the conclusion that in general, the cultural-psychological characteristics of farmers in both the El Pozo and El Aguacate projects were conducive to adopting new technology directed at raising production. However, a prerequisite for such adoption is the farmers' perception that such technology will indeed work in their particular production conditions, that is, will raise yields and net benefits. With respect to these expectations, a considerable difference between the two projects was established. Generally, El Aguacate farmers appeared to discern fewer opportunities than El Pozo farmers. This phenomenon is related to differences in certain situational factors, as will be explained below.

Situational and external factors

The study of geographical, topographical and climatological maps and interviews with CEDIA's informants indicated that the agro-ecological production conditions of El Pozo and El Aguacate are virtually identical. Both areas are plain, with an annual rainfall of some 2000 mm with peaks in May and October, an average temperature of 27°C, and fertile soils with a high organic matter content. Land use reflected these conditions: both areas depended almost completely on rice cultivation.

The El Pozo and El Aguacate projects were also quite similar with regard to most of the other situational and external factors presented in Table 6.1. Resource availability was about equal for both areas as far as land and labour were concerned, and the state run Agricultural Bank provided credit in both areas. Prices of inputs and end products, as well as marketing, were controlled by the national government; both projects had rice mills in the vicinity, and the prices farmers received for their produce were identical. And, although the El Aguacate project is somewhat further removed from the main urban centres than El Pozo, access was good since roads in both areas were in fairly good condition.

Following the same reasoning as with the appraisal of personal factors, there was also little reason to assume there would be major differences between the two projects as far as social structure and social relations - mutual obligations, informal organization, division of labour, decision making and inheritance patterns within the household - were concerned. In general, the communities in both the El Pozo and El Aguacate projects showed the lack of social cohesion typical of most settlement projects. Villages consisted of independent nuclear households whose strongest claim to the epithet "community" was that they were grouped together in a geographical sense. There was little social stratification and, although some degree of both formal and informal leadership existed, its influence could not be considered an important determinent of the decision making of individual farmers to a major degree. Thus, social and leadership factors did not appear to play a role in technology adoption either: there were no indications of social barriers to the adoption of new practices, in the form of social pressures on the individual to conform to community norms and to refrain from actions that would distinguish a person from other community members in terms of wealth or status.

Differences between the El Pozo and El Aguacate projects

The principal argument for concluding that the personal, situational and external factors discussed up till now were of little or no importance as explanatory factors has been that for none significant differences were encountered between the El Pozo and El Aguacate projects. However, four situational/external factors from Table 6.1 were identified as variables on which El Pozo and El Aguacate diverged considerably. These were wealth, farmer organization, contacts with extension officials, and the infrastructural production conditions essential for irrigated rice cultivation, i.e., water management infrastructure - canals, reservoirs, pumps, sluices - and access to capital and machinery for land preparation.

As for wealth, El Pozo farmers were found to be significantly more prosperous than their colleagues from El Aguacate, a factor manifested most clearly in better housing and the possession of durable consumer goods such as motorcycles, (colour) television sets, and refrigerators. The differences in farmer organization, contacts with extension officials and infrastructural production conditions, all were found to be a consequence of an overall difference in the quantity and quality of services bestowed upon El Pozo and

El Aguacate by government agencies. El Pozo was considered to be a showcase for successful government land reform policy, and as such was visited regularly by high officials. Therefore, all government institutions involved gave favourable treatment to El Pozo farmers by lavishing, a disproportionately large amount of scarce resources on the project, while neglecting other settlements such as El Aguacate. This practice resulted in a better rice farming infrastructure in the El Pozo region, particularly with regard to the construction and maintenance of the canals, sluices and pumps needed for water management. Also, the El Pozo land reform agency had much more land preparation equipment at its disposal than did the El Aguacate office. And, although agricultural credit was available in both areas, the amount of credit given by the El Pozo branch of the state run Agricultural Bank for growing one hectare of rice was some 50 % higher than that lent by the branch of El Aguacate.

More government attention for El Pozo also resulted in a much more intensive extension program, with more and better trained agents serving fewer farmers. And finally, El Pozo had more active and better functioning farmers' organizations, which were actively promoted and supported by officials of the land reform institute and other development agencies. These cooperatives, consisting of some 15 to 30 members, were seen by officials as a means to cut overhead costs in supplying credit, and as a way to stimulate mutual control among farmers so as to assure the correct use of the allocated credit. To stimulate their formation, machinery for land preparation and the maintenance of the local infrastructure, credit, and technical assistance were supplied with priority to what may be dubbed the "elite" of organized El Pozo farmers.

Explanatory value of the identified factors

After identifying the above described factors as divergent for El Pozo and El Aguacate, and therefore as potential explanations for the differences in production levels and technology adoption, the relative importance of each was established on the basis of both reconnaissance and case study results. The detailed analysis of farmer decision making in the case studies yielded strong indications of the primary importance of the above described infrastructural production conditions. Informants from El Aguacate mentioned time and again five constraints as the causes of low yields and non-adoption of new technology. These factors were: lack of irrigation water, excessive flooding, poor levelling of plots, shortages of machinery for land preparation, and credit that was disbursed late and proved insufficient to cover all production costs (Doorman 1983, Mendez & Doorman 1984). The deficient water management infrastructure was reported to result in water shortages during dry spells and flooding in the rainy season, causing yield losses or even crop failures. Lack of machinery caused delays in land preparation, making doublecropping impossible or, in less serious cases, causing the second crop to be sown "out of season", in unfavorable climatic conditions. Lack of proper equipment, or the resources to hire it, inhibited farmers from levelling their terrains sufficiently, with the result that in higher parts of the plot the crop would suffer from lack of water, and in lower areas from water excess, both of which resulted in yield reductions. Insufficient credit that was disbursed late hampered the application of the necessary inputs and labour, and frustrated the contracting of privately owned machinery for land preparation; several crop failures were reported as a result of the inability to apply herbicides on time. Summarizing, the water, levelling and credit problems were found to lead to diminished yields per hectare per harvest, while the constraints in irrigation and land preparation resulted in a lower cropping intensity of the rice plots, thus lowering production per hectare per year.

The same infrastructural constraints also clarified the reasons for the limited adoption of CEDIA technology. The case study informants from El Aguacate explained that those who had tried CEDIA's semi-dwarf varieties - at times voluntarily, but more often because the allotment of credit had been coupled to the use of modern varieties and chemical inputs - had found out that in spite of their higher yield potential, these short stature varieties were more susceptible to the frequent droughts and flooding in the region than the tall, local cultivars. On the other hand, in these unfavorable conditions the local varieties, in spite of their lower yield potential, required fewer chemical inputs and labour to produce what were considered acceptable yields. Consequently, the results of the use of the new technology had often been doubly negative: production costs had been high and yields had been low, sometimes even lower than those of low-input crops in which local varieties had been used, and often too low to pay back the debts incurred.

The experiences with CEDIA's semi-dwarfs also explained the non-adoption or adaptation of most of the technological package accompanying CEDIA's varieties. For example, recommendations on seedbed preparation, fertilizer application, and the use of certain expensive pesticides, such as fungicides and pre-emergent herbicides, all involved considerable cost. On the other hand, the effects of such inputs were limited in poorly levelled terrains, and were minimal in crops affected by drought or flooding. As a result, high input use was not considered feasible by farmers working in poor production conditions.

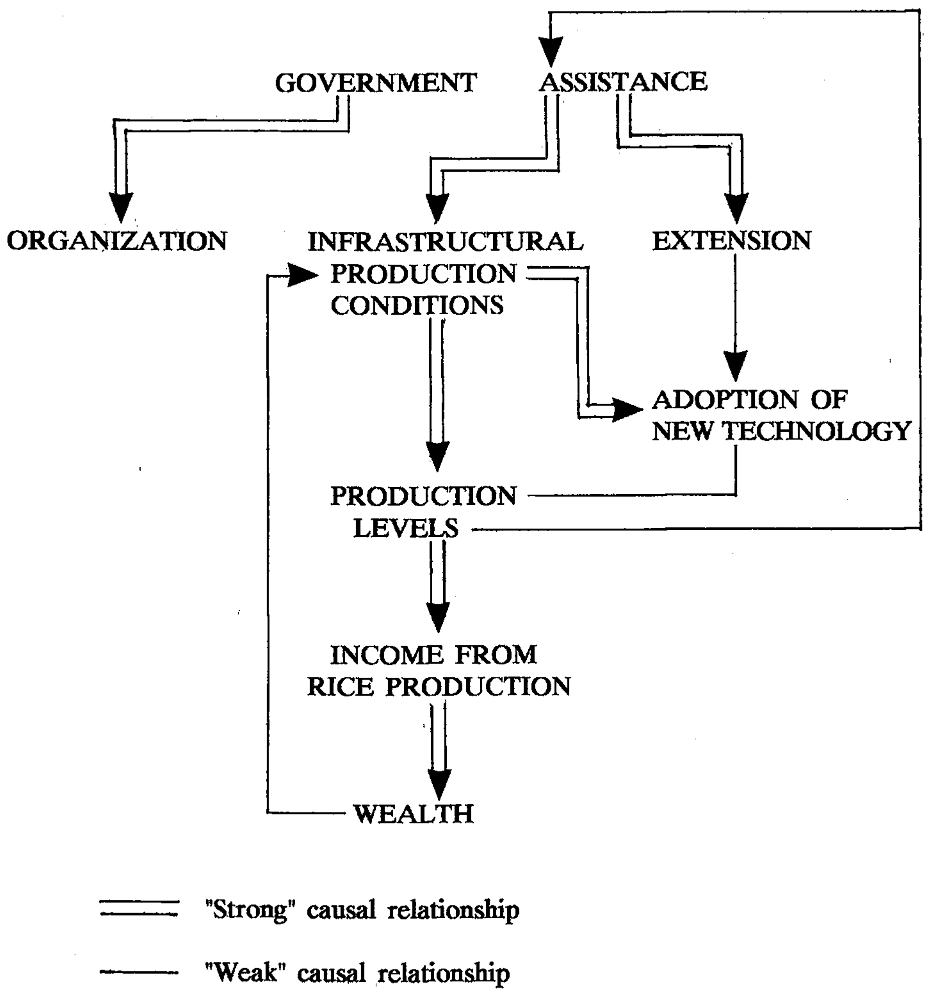
The case studies also yielded insight into the importance of the explanatory value of another of the four above mentioned factors, farmer wealth. The obvious hypothesis is that wealth implies access to capital, and hence results in higher investment capacity in rice production. However, case study information indicated that the inverse relationship, i.e., wealth as a consequence rather than a cause of successful rice production, was more important. In correspondence with reconnaissance findings that in both projects the starting point had been the same - i.e., immigrants and locals with few or no resources, who had started cultivating rice as land reform beneficiaries in the 1960's - the richer El Pozo informants explained that they had started poor, and had derived their relative wealth primarily from rice cultivation. At the time of research, they were found to rely on credit rather than spend their own capital in rice production, preferring to invest accumulated capital outside the agricultural sector, usually in small businesses. Still, a two-way interaction between production conditions and wealth was confirmed by informants who used private capital for the purchase of inputs and the hiring of labour and machinery when credit was insufficient or late. Also, several farmers were found to have invested surplus income in improving plot conditions. However, particularly in El Aguacate this type of investment was rare, since acceptable returns - in terms of significantly higher production levels - were unlikely if production conditions at the project or even regional level were not improved. On the basis of these findings it was concluded that, although the effect was to a certain extent reciprocal, farmer wealth was a consequence rather than a cause of successful technology adoption.

Reconnaissance and particularly case study findings also led to the conclusion that the other two factors mentioned above, organization and extension, were of minor importance in explaining the differences between El Pozo and El Aguacate. The main argument to support this contention is that in the El Pozo project considerable groups of non-associated farmers were encountered who received little or no technical assistance, but nevertheless had the same high production levels and adoption rates as El Pozo's "elite" farmers. The plots of these farmers were generally situated in areas adjacent to those of the associated farmers, and had similar infrastructural production conditions. Another argument against organization as an explanatory factor was that farmers' organizations had only become important since 1980, at a time when, according to informants, the differentiation among the two projects and within the El Pozo project already existed. It was therefore concluded that the importance of organization as a direct causal factor of differing adoption rates and production levels was minimal. However, since the priority given to organized farmers in the rendering of government services did result in improved infrastructural production conditions - a better water management infrastructure, and better access to machinery for land preparation and credit - a fairly strong indirect relationship was concluded to exist.

With regard to extension, farmers interviewed in the reconnaissance as well as case study informants, claimed that they had adopted certain components of CEDIA's technology package not so much on the advice of extension agents, but because they had seen the advantages on other farms. Still, some farmers did confirm to have adopted certain practices on the instigation of officials, and claimed that other farmers had taken up some of those practices after having observed the results. There was thus a probable causal relationship between extension and adoption, albeit not a particularly strong one.

The above can be summarized as follows. An overall independent variable, the level of government assistance, generates three specific independent variables: the level of infrastructural production conditions, organization and technical assistance. Of these, infrastructural production conditions seems to be the main causal factor of the dependent variables, production levels and adoption rates. There is some reciprocity in this relationship, since high production levels and adoption rates lead to more government assistance, as officials are interested in maintaining or even strengthening the showcase character of the region involved. Extension and participation in farmer organizations are not found strongly to influence adoption and production levels.

Diagram 6.1. Schematic representation of factors explaining production levels and adoption rates in two rice producing regions in the Dominican Republic



The income derived from rice production, which to a major extent determines the wealth of the farming family, is a result rather than a cause of high production levels. Nevertheless, the access to capital enjoyed by wealthier farmers does help to alleviate the problems caused by constraints in two of the five infrastructural production conditions, access to credit and machinery for land preparation. As for the two dependent variables, adoption of specific elements of the technology package is concluded to positively affect production levels when infrastructural production conditions are favorable, but not when they are poor. A schematic representation of the described causal relationships is presented in Diagram 6.1.

Quantitative analysis: survey results

Quantitative data gathered in the third step of the diagnostic research process, the survey, allowed for the testing of some of the relationships of the causal model presented in the above. In Table 6.2, correlations are presented among several of the above described variables or their indicators. For the explanatory variable infrastructural production conditions, an indicator was developed that incorporates scores for the five factors mentioned in the above, i.e., plot levelling and drainage, and access to irrigation water, capital and machinery for land preparation. The influence of extension is indicated with the frequency of contact with extension officials, and wealth is represented by an indicator that includes total income, possession of durable consumer goods, and the importance of protein in the household's diet (the latter variable was operationalized as the frequency of meat or fish consumption). Average yield per crop per hectare and average annual production per hectare are taken as indicators for production levels, and the amount of fertilizer applied and the number of pesticide applications per harvest as indicators for the adoption of modern technology. It must be emphasized that the latter two represent only a minor part of CEDIA's technology package; however, other variables, such as variety use or recommendations on levelling or seedbed preparation, are not included in the Table since they cannot be measured at ratio level.

Table 6.2. Pearson correlation coefficients for the independent variables infrastructural production conditions, contact with extension officials and wealth, and dependent variables fertilizer application, pesticide use and average yields per harvest per hectare, for rice farmers of the El Pozo and El Aguacate Land Reform projects, Nagua, Dominican Republic

	Infrastr. product. condit.	Freq.cont. extension agents	Annual income rice	Estim. wealth	Fertil. applic.	Pestic. applic.	Yields per ha.
Infrastructural production conditions	1.0000						
Frequency of contact with extension agents	0.0935 (n=91) p=0.378	1.0000					
Annual income rice cultivation	0.4309 (n=174) p=0.000	0.1195 (n=89) p=0.265	1.0000				
Estimated wealth	0.2911 (n=185) p=0.000	0.0236 (n=91) p=0.824	0.2719 (n=176) p=0.000	1.000			
Fertilization per crop per ha.	0.3973 (n=150) p=0.000	-0.0835 (n=88) p=0.439	0.2486 (n=145) p=0.003	0.2745 (n=150) p=0.001	1.000		
Number pesticide applications	0.2350 (n=123) p=0.009	-0.2694 (n=64) p=0.031	0.1116 (n=119) p=0.227	0.0244 (n=123) p=0.789	0.1933 (n=102) p=0.052	1.000	
Average yield per crop per ha.	0.4665 (n=181) p=0.000	-0.0617 (n=90) p=0.563	0.4309 (n=174) p=0.000	0.4567 (n=181) p=0.000	0.5181 (n=149) p=0.000	0.2608 (n=121) p=0.004	1.000
Annual production per ha.	0.5488 (n=181) p=0.000	-0.1249 (n=90) p=0.241	0.4390 (n=174) p=0.000	0.5376 (n=181) p=0.000	0.5887 (n=181) p=0.000	0.3411 (n=121) p=0.000	0.6992 (n=181) p=0.000

In accordance with Diagram 6.1, Table 6.2 shows a high correlation between infrastructural production conditions, production levels, income from rice production, and one of the indicators for technology adoption, fertilizer application. The correlation with the other indicator, pesticide use, which in the Nagua region corresponds primarily with the spraying of insecticides, is considerably lower, though still significant. An explanation for this finding is that the number of pesticide applications is not only correlated with access to the capital needed for buying the inputs, but also with the occurrence of pests. Several case study and key informants stated that the growing of rice the year round on better levelled and prepared plots could reduce the incidence of at least some insect pests, which would to a certain extent neutralize the positive correlation between access to capital and pesticide use.

In Diagram 6.1 a weak causal relationship was depicted between the frequency of contacts with extension agents on the one hand, and technology adoption and production levels on the other. Since Table 6.2 shows the absence of any relationship, the general conclusion that extension is not a major determinant of production levels and technology adoption appears to be confirmed.

Three other predicted relationships, among production levels, income from rice cultivation, and wealth, are also confirmed by Table 6.2. The correlation between income from rice production and wealth is somewhat lower than expected; however, this finding does appear to vindicate the argument that farmers invest surplus profits outside rice cultivation, in the longer run diminishing the importance of rice cultivation as a primary source of income. On the other hand, it should be remembered that data on income, particularly when gathered in a survey, are notably unreliable, a weakness that is also recognized for the present study.

Table 6.2 shows a high correlation between the indicators for production levels (average yields per hectare and annual production) and fertilizer use, and a somewhat lower, but still significant correlation between these indicators and pesticide use. However, the relationship suggested by these correlations is not necessarily causal. In Diagram 6.1, infrastructural production conditions are depicted as a common causal factor for the two dependent variables technology adoption and production levels, and as such, as the cause of the computed correlation between the latter two. As indicated above, case study information led to the conclusion that a causal relationship between technology adoption and production levels does exist in favorable production conditions, but not in poor conditions. To test this affirmation the correlation between fertilizer use and average yields per hectare was calculated separately for El Pozo (representing favorable conditions) and El Aguacate (poor conditions). For El Pozo, a significant positive correlation of 0.3117 (n=124, p=0.000) between the two variables was found, while for El Aguacate a negative, but not statistically significant correlation of -0.2053 (n=57, p=0.126) was determined, results that appear to confirm the above hypothesis.

The survey data also presented the opportunity to verify the case study informants' comments on the relationship between production conditions and the performance of CEDIA's semi-dwarf varieties. Survey data showed that in El Aguacate local varieties were sown in almost 60 % of the harvests taken into account - much more frequently than in El Pozo, where the same varieties accounted for less than 20 % of all harvests. In El Pozo the average yield of the semi-dwarfs was found to be almost 45 % higher than that of the local varieties (3.60 tons/ha. against 2.49 tons/ha.) - a difference statistically significant at the 0.0001 level. On the other hand, in El Aguacate average yields of the local varieties were found to be slightly higher (8 %) than those of the semi-dwarfs (2.01 tons/ha. against 1.84 tons/ha.). Although the difference is not statistically significant (tested at the 0.1 level), these data do confirm the conclusion of the case studies that CEDIA's semidwarf varieties do not realize their production potential in less favourable production conditions.

So as to obtain an indication of the effects on production levels of each of the five variables that constitute the factor infrastructural production conditions, correlations with average yields and annual production were computed for each separately. The variables representing access to irrigation water, access to machinery for land preparation, drainage and plot levelling all showed correlations between 0.2002 and 0.2434 with average yields, and between 0.2343 and 0.2790 with annual production. The correlation with the fifth factor, access to capital, was stronger, at 0.3904 and 0.4713 respectively. However, these higher correlations do not necessarily indicate that access to capital has a stronger causal effect on production levels than the other four factors, since in accordance with the explanations given in the above, a reciprocal relationship can be assumed to exist between production levels and wealth. Thus, the similarity between the correlations can be concluded to indicate that each of the five separate variables has significant importance in explaining production levels. Also, the correlations found point to the fact that combining the five factors yields a better explanatory variable than treating them separately, suggesting that in most instances, low production levels are caused by varying combinations of constraints.

Impact of the findings on rice research

Feedback of the above presented conclusions to rice researchers, in combination with concrete suggestions for technology development, led to an increased measure of recognition of the intrinsic logic and rationality in farmer decision making. Several topics related to the problems and adaptations identified in the case studies were included in research programs; for example, trial research was conducted on the tolerance of different rice varieties to late transplanting, that is, the transplant of seedlings that have remained too long in the seedbed as a result of shortages of irrigation water or machinery for land preparation. Similarly, tolerance to low temperatures and levels of solar radiation were included as desirable traits in breeding programs, in response to the widespread practice of sowing a rice crop "out of season", another problem caused by delays in land preparation and transplanting. In general, these results marked a first step in turning around one of the basic tenets of Dominican rice research, namely the conviction that in cases where the new technology does not generate the expected effects, deficiencies in production conditions should be corrected so that it does. By arguing that the corresponding improvements could be a long time in coming, and that as a result in the short run small farmers were unlikely to be able to apply CEDIA's high input - high yield technology successfully, a conscience was created for adapting technology to production conditions rather than the other way around.

Conclusions

Over the last three decades, agricultural development has been analyzed from different perspectives. In this paper, the basic elements of three of the principal approaches, diffusion of innovations theory, Farming Systems Research, and the anthropological approach added to the latter in recent years, have been used to construct a framework for the selection of those factors that appear to be of primary importance in farmer decision making. The use of this framework makes explicit a process that is always engaged in, but only very rarely specified in the first stage of diagnostic agricultural research for small farm development: the selection, from a wide array of factors that may influence small farmer decision making, of those that should be analyzed in more detail in subsequent research. To that purpose, the use of rapid qualitative appraisal was presented which, in combination with detailed information on farmer decision making obtained in case studies, was used for the elaboration of a simple causal model with which differential adoption rates and production levels among small Dominican rice farmers were explained. For the research population, infrastructural production conditions - access to water, machinery for land preparation and capital, and plot levelling and drainage - were found to be the main determinants of technology adoption and production levels. This conclusion was confirmed by the quantitative analysis of survey data.

The outcome of the analysis appears to vindicate the approach followed by Farming Systems Research, which starts from the premise that technological packages such as the one offered to Dominican rice farmers should take into account and be adapted to constraints in local production conditions. It also appears to justify, at least to a certain extent, the negligence of the Farming Systems approach as regards the analysis of social, cultural, political and psychological variables in explaining farmer decision making. However, it should be noted that the results reported in this paper refer to a specific situation: that of a recently established and therefore socially atomized population, with a culture that can be characterized as predominantly Latin, for whom rice is a fairly new crop. It is to be expected that social and cultural-psychological factors will play a much more important role in situations where new technology is introduced into indigenous non-western populations, living in close-knit communities that have depended for centuries or millennia on the cultivation of a specific crop or crops.

A final question to be addressed concerns the role of the social scientist in the sort of analysis described in this paper. In this respect, there appears to be good reason to argue that the professional most qualified for executing the quick and rather dirty, but nevertheless systematic kind of analysis presented is the non-economic social scientist. Because of the holistic perspective the anthropologist brings to the analysis of human reality, he or she could offer a major contribution to the type of diagnostic research for agricultural development that is part and parcel of approaches such as Farming Systems Research. A prerequisite for the realization of this contribution is the disposition to work in interdisciplinary teams, and a certain amount of willingness to compromise academic standards in exchange for the quick results on which particularly biological scientists, eager to start with technology development, will insist.

VII. A SOCIAL SCIENCE CONTRIBUTION TO APPLIED AGRICULTURAL RESEARCH FOR THE SMALL FARM SECTOR: THE DIAGNOSTIC CASE STUDY AS A TOOL FOR PROBLEM IDENTIFICATION[*)]

Abstract

Currently, the social science methods mostly used in the diagnostic stage of Farming Systems Research are Rapid Rural Appraisal and formal surveys. In this article it is argued that the sole dependence on these methods may be insufficient to obtain the thorough understanding of small scale farming systems needed to engage successfully in technology development. Therefore, it is suggested to add a more qualitative, in-depth and participatory research method to the FSR tool kit: the diagnostic case study. Research on small scale rice cultivation in the Dominican Republic is used to illustrate how this type of case study can yield a host of valuable information in a relatively short period of time.

Introduction

In the aftermath of the Green Revolution there has been a growing awareness of the fact that the generation and transfer of new agricultural technology is influenced not only by technical and biological, but also by social and economic factors. This has led to the creation of interdisciplinary methodologies aimed at the development of technology adapted to small farming conditions in the Third World. The most well known approach of this kind is Farming Systems Research (FSR). The objective of FSR is to increase productivity of farming systems, given their constraints and potential and taking into account the farm

---

[*)] Published in: Agricultural systems (29): 250-264 (1989)

household's private goals (Gilbert et al. 1980:23). The FSR process consists of several phases. In the diagnostic stage, information is gathered on the principal constraints and opportunities of the different farming systems in the study area. Then, on the basis of the information gathered, strategies are designed to overcome those constraints. Subsequently, the new technologies are tested in farmers' fields and, if successful, disseminated to other farmers in the on-farm research and extension stages of the FSR process (Shaner et al. 1982, Fresco 1984, Maxwell 1986a).

Hitherto, the dominant tools used in the diagnostic stage of FSR are Rapid Rural Appraisal (RRA) and the formal survey. RRA is defined as "a study used as a starting point for understanding a local situation, lasting at least four days but no more than three weeks, and based on information collected in advance, direct observation and interviews, where it is assumed that all relevant questions cannot be identified in advance" (Beebe 1985:2). The formal survey consists of the application of a pre-formulated questionnaire to a representative sample of farmers. This may entail either a single visit to the selected farm, or a series of visits made at regular intervals. In both instances the objectives of the survey are to test, verify and quantify the findings of the RRA, and to obtain additional information on topics of specific interest (Shaner et al., 1982).

In this article it is argued that, given particular methodological weaknesses of the RRA and the formal survey, there is a need for the inclusion of an additional instrument in the diagnostic methodology of FSR. Most promising, both in terms of the wealth of information generated and cost-effectiveness, is what will be designated as the diagnostic case study. Used in addition to RRA and formal survey, this kind of case study can yield essential information on the how's and why's of farmer decision making. At the same time, diagnostic case studies offer the possibility for a more participatory approach to problem identification in the small farm sector.

The remainder of this article consists of three sections. In the first, a description will be given of the characteristics and shortcomings of the diagnostic methodology currently used in FSR. This will be followed by a discussion of how the case study, as a complementary diagnostic research tool, can compensate for these shortcomings. And in the third and final part, some results will be presented of experiences with the use of case studies in adaptive research among rice farmers in the Dominican Republic.

State of the art in the diagnostic stage of Farming Systems Research

A logical first step in assessing the need for adding the case study to the FSR tool kit is to examine the instruments currently used in the diagnostic stage: RRA and the formal survey. In the next sections, a closer look will be taken at the characteristics of both methods as practiced in FSR. Then, the argument for including case studies as an additional diagnostic instrument will be presented.

Rapid rural appraisal

RRA, also called "sondeo" (Hildebrand, 1981), "exploratory survey" (Collinson, 1981), "reconnaissance survey" (Shaner et al. 1982) or "informal agricultural survey" (Rhoades, 1982) is the first step in obtaining an understanding of the context in which agricultural development is to take place. Carried out by a interdisciplinary team in a time span of at most three weeks, its primary objective is to generate relevant questions for further research, in the form of trials, or, if more diagnostic information is needed, a formal survey.

In practice RRA is becoming more and more important. Some prominent authors on FSR, notably Chambers and Collinson, indicate that a well executed rigorous exploratory survey may even make the formal survey superfluous (Chambers, 1983:68,69). According to Collinson's experiences, the findings of the formal survey never resulted in major contradictions with those of rigorously executed exploratory surveys. However, the "hard figures" furnished by the formal survey were extremely important in convincing "the Establishment" officials, policy makers and biological scientists of already drawn conclusions (Collinson 1981:444).

Given the need for cost-effectiveness and speed in agricultural development programmes, the replacement of more formal methods by a thorough RRA is obviously attractive. Nevertheless, there are several reasons for not relying on RRA as the sole means for problem identification, or even as the sole preparation for formal survey research. Many authors, not in the least the ones mentioned, have pointed out the complexity of small scale farming systems. On the one hand, there are the intricate interrelationships between the different parts of the farming system and between the farming system and its environment. On the other, there is the influence of such multi-faceted variables as the goals and motivations of the farm household members, and the agro-ecological, socio-economic and cultural-political factors that determine them. A thorough understanding of all these elements can be essential in avoiding costly mistakes in technology development.

Yet, it is hard to imagine how a group of up to ten scientists of different disciplines can obtain sufficient insight into these complex interrelationships in a one to three week period, especially when part of that time is spent on plenary sessions, discussions among team members, and drafting reports. Thus, a period of 7 to 10 days, as proposed for RRA by Hildebrand (1981) and Collinson (1981), must be considered to be too short to obtain a thorough understanding of the small farm systems under investigation. This is especially true when researchers have little or no previous knowledge of the local situation, and when research takes place in a cultural setting very different from the one the members of the research team are accustomed to.

In conclusion, there is no doubt that RRA is a useful instrument for obtaining a first impression of the research area and its farming systems, and of some of the problems that affect them. Particularly, RRA can serve as a means for generating relevant questions for further diagnostic research. Due to the time limits imposed, however, RRA will necessarily remain fairly superficial. Its informal and exploratory character hampers the systematic in-depth analysis necessary to obtain a real understanding of the farming systems under investigation. This argument is supported by some social scientists who have participated in FSR projects. For example, Gladwin (1983:155) signals the superficiality of the sondeo as it was practiced during her stay at what can be considered its cradle, ICTA in Guatemala.

The formal survey

The most common method for information gathering at the farm level, be it in FSR, in more 'conventional' agro-economic investigations, or in integrated rural development programmes that include attention for such aspects as health and education, is still the formal survey (Chambers, 1983:49,50). This dominance can be explained as follows. Formal surveys provide data that can be statistically analyzed, and as such seem to provide the kind of hard data that especially biological scientists and policy makers ask for. To justify their participation in agricultural research, social scientists obviously feel the necessity to come up with studies that are taken seriously. More often than not, a precondition for this is that data are obtained from a representative sample and are accompanied by the necessary alfa's, chi-squares and other statistical measures, while the recollection of descriptive and analytical information through the use of non-quantitative methods is at best considered to be preparatory for survey research.

In spite of the obvious preferences of many agricultural scientists for survey research, the method has several serious drawbacks. The problems involved with the execution of a survey within the framework of FSR are both of a practical and of a methodological nature. On the practical side, surveys are expensive, requiring huge resources in manpower, equipment, and time. The difficulties involved in executing, processing and analyzing surveys, particularly in rural settings in developing countries, and the many cases in which the results never became available or became available too late, are discussed among others by Chambers (1983,1984) and Horton (1986). On the methodological side, the drawbacks of survey research are twofold. The first is related to the truthfulness of the respondents answers. Because of the brief duration of the interview and the usually limited training the interviewers have received, it is difficult to create enough confidence with the respondent to obtain sensitive information. Also, it is usually very hard or impossible to judge if the information given is indeed correct, since the researcher does not usually execute the interviews him- or herself (for examples see Chambers 1983:55-57). Thus, a validity problem is created by the fact that interviewing is usually done by field assistants, usually hired for the occasion, and not by the researcher who drew up the questionnaire.

The second methodological problem has to do with the validity of survey questions. Here, the point is if the questions that are formulated to obtain estimates of the variables under investigation really measure what they are supposed to. To formulate valid questions for a formal survey, to be carried out among a population of small farmers, a precise knowledge of the farmer's terminology, way of thinking and production conditions is necessary. In this respect, the argument made by Stone and Campbell (1984) in a paper on the validity of fertility surveys in Nepal, is also valid for the analysis of small farming systems. They affirm that when survey research is not based on preparatory qualitative research, it is highly questionable if one measures what one wants to: questions may be misunderstood, misinterpreted, or irrelevant to the respondent's circumstances. A similar argument is made by Chambers (1983:55-57), who cites 5 examples of misleading data given in survey research in Third World settings, two of them related to the use of labour and land in small scale agriculture.

Diagnostic case studies: a complementary method to RRA and survey

The need for case studies

Two conclusions can be drawn from the above description of current FSR diagnostic methodology. The first is, that RRA by itself will usually be too "quick and dirty" to serve as a solid base for problem identification in smallholder agriculture, particularly when maintained within the time limits that most authors indicate. The second is that it is doubtful if the information gathered in RRA is of the depth and reliability needed to generate sufficiently relevant and valid questions for a formal survey. This doubt is particularly appropriate in settings about which little is known before the initiation of RRA field work, and in those areas where major cultural differences between farmers and researchers can be expected.

On the basis of the above considerations, the argument can be made that there is a need for an additional diagnostic method in FSR and similar approaches. This method, in combination with RRA and formal survey, should provide the sort of in-depth qualitative and quantitative information that can serve as a solid and reliable basis for successful technology development in the post-diagnostic stages of FSR. Given the need for speed in the problem identification stage of the research process, this method should be, to use the terms of Chambers and Collinson, "fairly quick and fairly clean". The method, proposed in this paper, which complies with these requirements is a special form of an approach widely used in the social sciences: the case study.

Case studies as a research tool

Casley and Lury (1982:62) describe the case study as a detailed study of a small number of units, selected as representative of the group or groups relevant to the issue under consideration, but not necessarily representative of the population as a whole. They indicate the usefulness of the case study as a research tool in situations where it is necessary to probe deeply into the relationships between people and their environment, to explain current attitudes and beliefs, and to show why certain behaviour occurs. Yin (1986) defines the case study as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used". With this definition, Yin aims at distinguishing the case study from other "research strategies": the experiment, the history and the survey. In an experiment a phenomenon is deliberately separated from its context by conducting it in a controlled environment. A history does deal with the entangled situation between context and phenomenon, but focuses on non-contemporary events. Surveys, on the other hand, offer only limited opportunity to deal with the context, due to the need to limit and define the number of independent variables (Yin 1986:23). Strangely, Yin does not explicitly discuss another, perhaps even more important characteristic in which a survey differs from a case study. This is the fact that a survey uses only one source of evidence: the data provided by the respondents.

The potential of case studies for FSR has been indicated in part by Maxwell (1986a), who recommends extensive studies of at most 10 farms during at least one production cycle to analyze in detail the physical, biological and socio-economic characteristics of small farms. Maxwell stresses the need for an on-going case study programme, first to provide diagnoses of constraints and opportunities in the FSR diagnostic stage, and then as an instrument for consultation, monitoring and feed-back in the remainder of the FSR process (ibid.:154). In addition, he emphasizes the importance of case studies as an instrument to develop close relationships between researchers and farmers.

The types of case studies discussed by the above mentioned authors have two things in common. The first is that they are directed at obtaining information on the "how" and "why" of a certain phenomenon. In the case of research on small farming systems, that means that case studies are used for learning about and comprehending the rationale behind farmer decision-making, that is, for obtaining a thorough understanding of the farming system being studied. The second aspect that the discussed case studies have in common is that they are all of fairly large duration. Although Yin and Casley and Lury do not specify, their guidelines point to a minimum of several weeks. Maxwell, in advocating case studies to analyze small farming systems, proposes a duration of one year, which in most cases will be equivalent to a complete production cycle. Obviously, a minimum duration of several weeks does not concur with the search for "fairly quick and fairly clean" methods that are advocated by authors such as Chambers. Thus, there is a need for an adapted form of the case studies hitherto described, a kind of case study that can yield the same type of information but in a much shorter period of time.

The diagnostic case study as a tool for problem identification

The diagnostic case study proposed in this paper differs from the types of case study mentioned in the above in that it aims at obtaining the necessary in-depth and contextual information on small farming systems in a period of days rather than weeks. The actual length of a diagnostic case study depends on the complexity of the farming system being studied. For example, the study of a system based on only one crop could be done in only one day, while more complex systems could take up to three days. This short time span - relative to other types of case studies - has several implications, both of a methodological and a practical nature. The first and most important one is that, in comparison with other case studies, the diagnostic case study relies very strongly on a single research instrument: the informant interview. A several days' period offers only limited opportunity for observation and direct measurement, not only because of the available time, but also because most of the phenomena to be analyzed simply do not occur during the period reserved for data collection. Thus, there is an almost total dependence on the informants memory, since it is impossible to obtain the data on such variables as cultural practices, yields, cash flow or use of labour through the more direct means of observation, measurement, or supervised data taking by farmers themselves. Obviously, this means that to a certain extent exactness and reliability are sacrificed for time. To minimize this loss - that is to say, to obtain, in spite of the limits imposed by the short time available, information as reliable and exact as possible - the quality of the farmer as an informant is of crucial importance. Thus, it is imperative to select, among the population of decision makers from the farming systems under study, those farmers which are most able and willing to provide detailed information on all aspects of their particular farming system.

Apart from the time factor, there are two additional advantages to the almost exclusive reliance on "high quality" informants as a source of information. One is that estimates of important quantitative data such as labour use, cash flow and yields can be obtained in a more relevant and cost-effective manner than in a multiple visit survey. The data are more relevant because they can be related to a host of other, more qualitative information on the farming system being studied. As such they can be presented as "typical" of a certain category of farmers, which obviates the need for the much more costly recollection and analysis of "representative" data by means of a multiple visit survey. In this case, statistical representativeness is sacrificed for a "lower" level of extrapolation, i.e., generalization to the category of farmers to which the informant belongs, and speed, particularly in the analysis of data. This trade-off may be all the more attractive taking into account the methodological and practical problems of survey research discussed in the above.

The second advantage of the reliance on high quality informants is that it creates the conditions for developing a meaningful dialogue between researcher and farmer. In the intensive interviewing of the diagnostic case study the potential for obtaining a clearer view of the farmers' perspective on their situation, problems and possible solutions is considerably greater than in the more formalized multiple visit survey or the short and fairly superficial interchange of the RRA. Thus, the diagnostic case study offers a more participatory approach to problem identification.

The experience: adaptive research among rice farmers in the Dominican Republic

This section is based on the results of interdisciplinary research executed in the Dominican Republic from 1981 to 1985 within the framework of the Adaptive Agricultural Research Project. In the project, two sociologists worked with agronomists, an economist and an extension specialist to study the generation and transfer of agricultural technology in two crops, rice and cassava. Most of the argument that follows is based on the rice research in the project. Only a brief overview is given of the results that relate to the argument made in this paper; for more extensive information see a.o. Doorman 1983 and 1984, Mendez & Doorman 1984, and Box & Doorman 1985.

Adaptive research methodology

The project's research process consisted of four main components: a reconnaissance, case studies, a survey and trials. The reconnaissance phase served three purposes. The first was to acquire a preliminary impression of the focus of our research: small scale rice and cassava cultivation. The second purpose was to obtain general information on the five selected research areas and its farming population. And thirdly, this first phase was used for the selection of informants for the case studies. The case studies were executed as the second phase of the project, with the purpose of obtaining a comprehensive, in-depth view of farmers' decision-making and the factors that influence it. All in all, some 33 cassava growers and 42 rice farmers were extensively interviewed for periods lasting from three to seven hours; the longer interviews being spread over two visits.

The execution of the other two research components, the survey and trial research, was based on the results of the case studies. In the survey, quantitative estimates were obtained of variables that in the case studies were identified as crucial for establishing priorities for technology development. Representative samples of rice and cassava farmers from the 5 research areas, about 500 respondents in all, were subjected to a one to one-and-a-half hour interview with the use of a structured questionnaire. Also, at the same time that preparations for the survey went underway, a trial research programme was initiated to investigate some of the problems identified in the case studies. The aim of these trials was to evaluate, in close collaboration with farmers, the impact of and possible solutions for agronomic problems resulting from constraints in small farm production conditions. By combining survey data on the extent of those problems (such as the percentage of crops affected) with trial data on their impact (yield loss per crop), the relative importance of these problems could be established.

Execution of the case studies

During the reconnaissance, possible candidates for the case studies were located by asking farmers and officials about farmers especially knowledgeable on cassava and rice cultivation. These candidates were subjected to a short selection interview, in which their knowledge of the crop, their capacity to verbalize that knowledge, and their willingness to cooperate in the case studies were evaluated. Special attention was paid to the respondents' capacity to explain the "why" of their actions and decisions, as well as their memory for certain crucial quantitative data such as yields, use of labour, production costs and income generated by both on-farm and off-farm activities.

On the basis of the selection interviews, 12 to 20 case study informants were selected for each research area, the final number depending on the homogeneity or heterogeneity of the farming systems encountered. For instance, in the case studies on rice cultivation, both cases who cultivated modern semi-dwarf varieties and cases who preferred traditional, tall varieties were included. A distinction was also made between farmers who were able to sow two crops a year and those who were not, and between farm households with or without major sources of income apart from rice cultivation.

For the actual execution of the rice case studies the selected farmers were visited twice, each time for a three to four hour interview. The main topics treated were the life story of the informant, decision making in crop cultivation, production costs, yields, availability and use of labour, water, capital and land, household composition and consumption, attitudes towards farmers' organizations and government institutions operating in the area, and expectations for the future. In the first interview, all aspects of crop cultivation were discussed and some biographical data were taken. Whenever possible and practical, a visit to the farmers field was made, which often resulted in important additional or clarifying information. Farmers were generally found to be quite willing and even enthusiastic to converse about these topics: the long duration of some of the interviews often proved more demanding for the researcher than the farmer. The second interview was directed at obtaining socio-economic data, including the more sensitive information on such topics as income and land tenure. Because of the confidence established in the first case study interview and the selection interview, farmers were, without exception, well inclined to providing this kind of data.

The interviews were executed with the help of a list of open ended questions. These only served as a guide for the interviewer, and whenever necessary or relevant, further questioning and probing took place. It was usually out of this further questioning that the most interesting information was obtained. By directing questions at discrepancies between past and present practices or preferred and real practices, information was acquired on production conditions, constraints therein and the agronomical problems resulting from these constraints.

Some results of case study research among Dominican rice farmers: variety use, late transplanting and sowing out of season

In the following, a brief overview is given of three major topics analyzed in the case studies on Dominican rice farming: farmers' choice of rice varieties, the late transplant of rice seedlings, and the sowing of rice crops "out of season". Emphasis is put on the description of specific problems, the production conditions that were found to be the causes of those problems, and the way farmers, in their decision making and cultivating practices, adapted to those conditions.

Use of rice varieties

One of the principal questions put to the AAR team by Dominican rice researchers was why, despite the existence of "modern" semi-dwarf rice varieties developed at the national rice research institute CEDIA, many farmers kept on cultivating "traditional" tall varieties. Information gathered in the case studies revealed that particular groups of farmers had quite valid reasons for doing so. It was found that farmers working in unfavorable production conditions - i.e., with insufficiently leveled plots and with little control over irrigation and drainage - preferred the tall varieties because these were more tolerant to drought or flooding than the semi-dwarfs. Thus, although almost all farmers recognized that the yield potential of the semi-dwarfs was higher than that of the tall varieties in favorable conditions, actual yield differences under unfavorable conditions were minimal. Since production costs of the tall varieties were lower than those of the semi-dwarfs, equal benefits resulted in higher profits. In very unfavorable circumstances, particularly in areas prone to flooding, case study informants even indicated that the sowing of the semi-dwarf varieties had led to crop failures, while in those conditions some tall varieties still gave sufficiently high yields to turn a profit.

Somewhat surprisingly it was found that in one particular area farmers working in favorable production conditions preferred growing a specific tall variety named "Mingolo". Here, the reason was that farmers with very well-leveled terrains and good irrigation and drainage conditions practiced a "ratoon" after harvesting their first crop, that is, they cut off the stalks close to the ground and harvested a second crop from the newly emerged shoots. This practice saved them the costs of land preparation and sowing. Although the yields of a ratoon were lower than that of a sown crop, net benefits were found to be higher because of greatly reduced production costs (Box &

Doorman 1985, Doorman 1983).

Late transplanting of rice seedlings

A problem encountered in the case studies that rice technicians hitherto had hardly paid attention to was that of the late transplant of rice seedlings. The cause of the problem was that the lack of machinery and periodic shortages of irrigation water led to delays in both land preparation and the flooding of the land prior to transplanting. These delays resulted in farmers having to transplant seedlings at ages older than the recommended maximum of 45 days. This was strongly discouraged by extension agents and other rice technicians, who claimed that the use of old seedlings led to unacceptable yield losses. Instead, they advocated direct seeding, preparing a new seedbed, or buying seedlings of the right age elsewhere. Neither of these three alternatives was particularly viable for the farmers involved. Plot conditions usually did not allow direct seeding, or their owners would have done so in the first place. Making a new seedbed was too costly and usually took too much time. Buying seedlings elsewhere was another expensive solution, apart from the fact that seedlings of the right age whose owners were willing to sell them were usually hard to find. Thus, many farmers transplanted seedlings older than 45 days, in spite of the extension agents' recommendations not to do so. In quite a few cases, the use of seedlings of 60, 70 and even up to 90 days old was encountered. Farmers engaging in late transplanting claimed that specific measures such as increasing plant density and fertilizer application could diminish yield losses to an acceptable level (Doorman 1984).

Sowing out of season

For those farmers who grew two crops a year, the same problems of delays in land preparation and shortages of irrigation water were found to result in the problem of sowing the second crop "out of season". Officials actively discouraged initiating a crop after mid August, because unfavorable climatic conditions (low temperatures and solar radiation, strong winds) were liable to reduce yields significantly or even to result in outright crop failures. However, many farmers were not able to sow their second crop before mid August, because of delays in establishing their first crop earlier in the year. Thus, they were faced with the unenviable choice between sowing and risking reduced yields or skipping an entire cropping cycle. Many were found to opt for the former, while resorting to a series of measures with which they hoped to limit yield losses as much as possible. These measures consisted, on the one hand, of the use of varieties, both semi-dwarf and tall, of which experience had taught that they were more tolerant to the adverse climatological conditions of the winter months. On the other hand, in the same vein as with the late transplanting problem, increased plant densities and fertilizer application were used to offset the supposedly lesser tillering of plants sown out of season (Box & Doorman 1985, Doorman 1983).

The importance of the case studies

In the examples given, the case studies proved to be essential for the detailed analysis of small farm production problems, the constraints underlying those problems, and farmers' adaptations to those constraints. In a more general sense, case study research provided insight into the context of farmer decision making by presenting an overall view of the investigated farming system, its components, the interrelationships between those components, the systems historical development, and its linkages with the agro-ecological and socio-economic environment. The corresponding analysis of the factors that influence decision making led to the conclusion that, in this particular case, social, cultural and political factors did not have major influence on farmer decision making: farmers explained their practices almost exclusively in terms of responses to constraints in agro-ecological, economic and infra-structural production conditions. It must be noted that the farming families involved have social and cultural characteristics that are common in Latin American settlement projects: relatively few and loosely structured social relations, limited uniformity in cultural and religious beliefs and weak political ties at the local and regional level. Consequently, in daily life and work, and particularly in farming, there was much less influence of social, political and cultural factors than has been reported for older, socially and culturally more homogeneous communities (for some examples see Shaner et al., 1982).

Follow-up to problem identification: technology development

The examples given do not imply that late transplanting and sowing out of season are the most important problems Dominican rice farmers face. Rather, they serve to illustrate that, through the use of the case study method, the occurrence of a specific problem could be linked to its causes, i.e. a series of serious constraints in production conditions typical of small rice farms. Thus, the problems were set in a context that had hitherto not been recognized by Dominican rice researchers, a failure that had resulted in substantial discrepancies in official recommendations and farmers' practices. In addition, the information on adaptations developed and employed by farmers as a response to specific production problems served as a basis for the development of new technology directed at diminishing yield losses caused by those problems.

The qualitative information on production conditions, problems and farmer adaptations generated in the case studies was supported by quantitative estimates obtained in the survey. Analysis of the survey data made it possible to indicate the frequency with which specific problems occurred, give very rough estimates of resulting yield losses, and quantify the use of different adaptations made by farmers to diminish those losses. The combination of qualitative and quantitative information from case studies and survey enabled the research team to recommend research topics to Dominican agronomists. These recommendations were based on the premise that, since it did not seem probable that the infra-structural limitations underlying the problems were going to be solved in the short run, research would have to be directed at developing technology adapted to the prevailing production conditions. As a result, the traits of tolerance to droughts, flooding and adverse climatological conditions were incorporated into the rice research institute's breeding programmes. At the same time, work was started on devising agronomical measures to limit production losses caused by late transplanting and sowing out of season. As a first step to formulating potentially viable practices, the above described farmers' adaptations to these two problems - increasing plant density and fertilizer application - were evaluated in trial research (for results see Hagens & Doorman 1985).

Time and resources involved in case study execution

The experiences obtained indicate that it should be possible to execute a reconnaissance and case studies in a minimum of 6 and a maximum of 18 weeks. Counting with six half to one hour interviews a day, with a total of 30 to 60 interviews depending on the heterogeneity of the farming systems encountered, reconnaissance and informant selection can be done in one to two weeks. From these 30 to 60 candidates it should be possible to select fifteen to thirty case study informants, each of whom will be interviewed twice for half a day. In case of more complex farming systems, it may be necessary to double or triple this interview time. Thus, for case study interviewing by one interviewer or interview team three to six weeks should suffice for one-day case studies, and six to eighteen weeks for two- to three-day interviews. Analysis, cross checking of data and reporting can then be done in a two to four weeks period. It would be advisable to spend some more time on the reconnaissance if little is known of the research area before the field work is initiated. Also, a one week break after the execution of a first series of case studies is useful for some preliminary analysis and to adjust the question list by including new questions and reformulating or eliminating existing ones.

In terms of manpower, a small interdisciplinary team consisting of an agronomist and a social scientist, both with ample experience in field research at the small farm level, would be optimal. In those cases where it is impossible to assign two experienced researchers, one could opt for a interdisciplinary team formed by an experienced researcher and a lesser trained assistant. Since skillful interviewing is essential for obtaining relevant and reliable information, the experienced member of the team should either be an agronomist with a basic knowledge of the social sciences and ample training in interviewing techniques, or a social scientist with some sound agronomical training. A point to consider in the choice between agronomist and social scientist is that the AAR project agronomists, who had little previous training and experience in interviewing, were usually uncomfortable with case study interviews lasting more than two to three hours. Therefore, a more feasible working method could be to have a social scientist do the interviewing and preliminary analysis. After discussing the results with a team agronomist, both could make an additional visit to the farmer and his fields so as to obtain extra information on and clarification of the more specific and complex agronomical questions.

Conclusions

The aim of this paper is to propose the addition of case studies as a diagnostic instrument to the existing tool kit of FSR and related approaches. The by now generally accepted argument underlying this proposal is that for the development of agricultural technology adapted to small farm conditions, a thorough knowledge of the farming systems concerned is essential. However, as was illustrated in this paper, insufficient attention has been given to the systematic gathering of this in-depth knowledge. The prevalent diagnostic methods of FSR, Rapid Rural Appraisal and the formal survey, cannot provide the kind of qualitative, in-depth insights into small farming systems that are needed to engage in successful technology development. The type of case studies discussed in this paper can, and their inclusion in FSR diagnostic methodology could overcome many of the deficiencies that currently exist in the problem identification stage of FSR. Obviously, the argument is not to replace the "traditional" FSR diagnostic instruments of rapid rural appraisal and survey with case studies. Rather, it is to complement these two methods with a "fairly quick and fairly clean" method of gathering the in-depth and contextual information that is considered essential for the development of technology adapted to small farm conditions.

As a "fairly quick and fairly clean" method, diagnostic case studies offer an additional advantage, namely that of reducing the amount of information that ordinarily is collected through survey research. Particularly when estimates of complex quantitative variables such as labour use, use of capital and income are gathered in case studies rather than survey research, many of the practical and methodological pitfalls involved in executing formal surveys in Third World rural settings can be avoided.

Perhaps the most important gain of including the case study in diagnostic research is that it increases farmer participation in the overall research process. In problem identification the dialogue between farmer and researcher should boost the influence of the farmers' perspective in the definition of major production problems. In technology development, making use of farmers' adaptations identified in the case studies can increase the chances that new technologies will be adapted to small farm production conditions and respond to farmer priorities.

A final benefit of diagnostic case studies is that they can be used for the identification of candidates for participation in on-farm trials and for the kind of extensive, longer lasting case studies advocated by Maxwell (1986a). Using plots of case study informants for trial research has the advantage that an extensive description of the farmer's production conditions is readily available. In addition, the execution of the trials can be combined with further information gathering and for maintaining a continuous dialogue between farmers and scientists. Thus, trial research can be combined in a cost effective way with multiple visit survey methodology, both for crosschecking data obtained in the case studies and for the gathering of new, more exact quantitative estimates of such key variables as yields, production costs, labour use, cash flow and income.

VIII. STRENGTHENING QUALITATIVE METHODOLOGY IN AGRICULTURAL RESEARCH: THE SOCIAL SCIENTISTS' CONTRIBUTION[*]

Abstract

In this paper it is argued that sociologists and anthropologists can contribute significantly to agricultural research directed at small farm development. In the area of method, qualitative social science methods such as case studies are needed to yield insight into the complex interrelationships between agro-ecological, socio-economic and cultural factors in small farm systems. At the same time, the application of these methods permits a more participatory approach to developing relevant technology for small farming systems. To function properly in interdisciplinary teams usually dominated by biological scientists, social scientists should be willing to make compromises in two areas. First, scientific thoroughness must, to a certain extent, be traded off for speed. Secondly, social scientists must be disposed to focus on topics directly relevant for technology development, even if this implies putting less emphasis on sociologically more interesting phenomena.

Introduction

What can sociology and anthropology contribute to agricultural research in and for developing countries? This is a question that various biological scientists, policy makers and social scientists working in agricultural research have considered over the last 10 years (Van Dusseldorp 1977, Box 1981 and IRRI 1982, and more recently Simmonds 1984, Rhoades 1986, DeWalt 1985, Tripp 1985 and Horton 1986). Box (1981), focussing on the contribution of sociology,

---

[*] Published in: Sociologia Ruralis (29): 250-264 (1989)

recommends that

sociologists should study the manifold relations between men and their agricultural environment and, for that purpose, create a sociology of agriculture.

Many other authors define the role of sociologists and anthropologists (hereafter to be called "social scientists") more specifically in terms of the topics they should study: the social and cultural factors that influence the need for, adoption and impact of new technology (Van Dusseldorp 1977, Gladwin 1983, Garrett 1984, DeWalt 1985, Tripp 1985 and Horton 1986). In the field of methodology, the discussion has focussed mainly on the contribution of anthropologists in rapid informal survey methods (Horton 1986) and in generating in-depth understanding of farm-level circumstances through participant observation (IRRI 1982: 93).

The present paper aims to add to the discussion by arguing that rapid but systematic qualitative research methods are needed in the problem identification stage of research directed at small farm development. These methods are essential for a thorough assessment of the factors that influence the adoption of new technology, particularly with regard to the farmer's perspective on his or her needs and goals. Adding these methods to the research instruments currently used could compensate for a number of weaknesses inherent in the methods used at present, and provide for a more participatory approach to small farm development. Since sociologists and anthropologists, because of their training, may be considered to be more effective in the application of these methods than agronomists or economists, it is argued that they be incorporated in interdisciplinary teams involved in technology development for small farmers. The conditions for successful participation in such teams are, first, that social scientists should propose recommendations that can be incorporated into technology design, and secondly, that results must become available quickly. Experiences obtained in an inter-disciplinary research project in the Dominican Republic will be used to substantiate the above propositions.

Social scientists in agricultural research: pride and prejudice

Since the Green Revolution, there has been a growing awareness of the fact that the generation and transfer of new agricultural technology is influenced not only by agronomic, but also by social and economic factors. As a result, there has been increasing participation of agricultural economists in agricultural research, particularly in projects directed at developing technology adapted to small farm conditions in the Third World (Bartlett & Fajemisin 1981; IRRI 1982). However, in spite of the lip service agricultural scientists pay to the importance of social and cultural factors in farmer decision making (Shaner et al. 1982, Gilbert et al. 1980 and Zandstra et al. 1980), participation in agricultural research of non-economic social scientists, i.e. sociologists and anthropologists, has hitherto been minimal. Van Dusseldorp (1977) estimated that in 1976 there was only one permanently assigned sociologist or anthropologist for every thousand biological and other scientists working in research institutes. Although that ratio has increased in later years, participation is still limited almost exclusively to temporary stays in externally financed projects (IRRI 1982, Gladwin 1983, Ashby 1986, Horton 1986 and Rhoades 1986).

The reasons for the limited participation of sociologists and anthropologists in agricultural research are several. To begin with, a prerequisite for interdisciplinary cooperation with biological scientists is that social science research yields information that can be acted upon by biological scientists (Van Dusseldorp 1977). The problem is that although social scientists have been on the forefront in criticizing the negative social and economic consequences of the Green Revolution, there has been little experience in actual cooperation with agricultural researchers in the development of agricultural technology.

A second reason for the marginal role of social scientists is the notion that other scientists, particularly economists, can analyze those social and cultural aspects that are considered most relevant for technology development, such as taste preferences or the division of labour within small farm households. Consequently, there seems to be no convincing argument for adding social scientists to a research team already containing an economist or even an agronomist with some social science training (Simmonds 1985).

A third important drawback for social scientists lies in their image, both among biological scientists and economists. There exists a certain distrust as to the sociologist's or anthropologist's approach to both agricultural development and development oriented research. Many biological scientists feel unfairly criticized by those sociologists and anthropologists who have highlighted the negative effects of the Green Revolution while ignoring its benefits. In research, it is perceived that social scientists, especially anthropologists, take too long before presenting the results of their work - at a time when, both in agricultural and other development oriented research, results are needed quickly (Chambers 1983, Simmonds 1984). In addition, anthropologists are sometimes seen to identify themselves with the locals in an unrealistic and romantic way (Rhoades 1986: 65). A clear example of this stereotype is to be found in Simmond's review of the state of the art of research for the small farm sector, prepared for the World Bank: "One recalls the not altogether unfair stereotype of an anthropologist living in a village for years and emerging at the end with the view that the villagers are all splendid chaps who ought to be allowed to get on with agriculture in their own way regardless of the fact that the world around them will not allow them to do so" (Simmonds 1985: 51).

As far as research methodology is concerned, the prevalent perception among natural scientists is that social scientists present their conclusions on the basis of scant, 'soft' evidence, rather than the quantitative, statistically analyzed data that are considered scientific. Qualitative research methods in particular give rise to many misconceptions among non-social scientists. A good example can be found in an article by Anderson & Hardaker (1979) on economic analysis in the design of new technologies for small farmers. Quoting Zeleny (1975), they distinguish between "intuitive thinking", which has "implicit, non sequential and non-recoverable attributes" and relies on "holistic impressions, impulsive synthesis and lateral reasoning", and "analytical thinking', which has "explicit, sequential and recoverable attributes" and relies on "logical, reductionist and vertical reasoning". In other words, research that does not yield results in terms of quantified relationships between variables and cannot be verified through statistical analysis, is considered "unscientific". In this view the only remotely acceptable social science instrument is the formal survey, the results of which are accompanied by such essentials as standard deviations, confidence intervals and correlations. No survey, no scientifically based conclusions, and no applicable results. This attitude towards social research is best exemplified by the oft repeated question put to an anthropologist working at one of the major International Agricultural Research centers: "How long does an anthropologist need before he or she can start making a survey?" (IRRI 1982: 41).

Applied agricultural research for small farmers: Farming Systems Research

In the last two decades, the creation of technology adapted to production conditions specific to the small farm sector has become an important focus in agricultural research. This has led to the development of several interdisciplinary approaches to technology design, the most well-known of which is Farming Systems Research (FSR). The objective of FSR is to increase the productivity of farming systems, given their constraints and potential and taking into account the farm household's private goals (Gilbert et al. 1980:2,3). The FSR process starts with a diagnostic stage, in which information is gathered on the principal constraints and opportunities of the different farming systems in the study area. On the basis of this information a strategy, in the form of a "package" of agricultural technology, is designed to overcome those constraints. Subsequently, in the on-farm research phase the new technology is tested in farmers' fields and, if successful, disseminated to other farmers in the extension stage of the FSR process (Shaner et al. 1982, Fresco 1984, Maxwell 1986a).

The potential for a social science contribution to FSR is greatest in the diagnostic stage, when a thorough assessment of the factors that influence the adoption and impact of new technology must be made. At present, the dominant tools used in the diagnostic stage of FSR are rapid rural appraisal (RRA) and the formal survey. In RRA, also called sondeo (Hildebrand 1981), informal agricultural survey (Rhoades 1982), reconnaissance survey (Shaner et al. 1982) and exploratory survey (Collinson 1981), a interdisciplinary team, using mostly informal methods such as unstructured interviews and ad-hoc observation, makes an inventory of the local situation in a one to three weeks period. The recollected information is then quantified and verified through the execution of a formal survey. In some instances, a single visit survey serves as the basis for a multiple visit survey, in which detailed agro-economic information is gathered in a series of visits made at regular intervals to a limited number of usually preselected farms (Shaner et al. 1982, Fresco 1984, Maxwell 1986a).

Shortcomings in current diagnostic methodology

The current diagnostic methodology of FSR assumes that the information generated by RRA and survey provides a sufficiently secure basis for the development of technology adapted to small farm production conditions. Two arguments can be brought against this assumption. The first is that formal survey research, with its use of highly structured instruments, is unfit, by definition, for obtaining in-depth insights in situations with which the researcher is unfamiliar. That means that the detailed qualitative knowledge of the research setting which is needed as a preparation for both survey research and technology development must be generated by RRA. That leads to the second argument: RRA by itself cannot generate an adequate understanding of complex small farm systems. It is difficult to conceive how in a period of at the most three weeks, part of which is used for plenary sessions and group discussions among team members and for the drafting of reports, sufficient insight can be obtained into what FSR experts themselves describe as "the complex arrangements of soils, water sources, crops, livestock, labour and other resources and characteristics within an environmental setting that the farm family manages in accordance with its preferences, capabilities and available technologies" (Shaner et al. 1982: 3). The superficiality in RRA data collection and analysis is noted, among others, by Gladwin (1983), an anthropologist who participated in an interdisciplinary research team in one of the cradles of FSR, ICTA in Guatemala.

Some FSR specialists appear to recognize the dangers of taking RRA as the sole basis for understanding farming systems. Beebe (1985: 1), for example, indicates that RRA can be quite harmful when the results are taken as "truth" and emphasizes the need for a continuous process of collecting and systematically organizing information. In terms of most FSR researchers, that would be through the execution of single and multiple visit surveys. However, the reliability and validity problems involved in doing survey research, although widely documented in textbooks and articles on social science methodology, are phenomena FSR researchers appear to be unfamiliar with. As a result there is little or no recognition of the fact that, particularly in settings that are little known and where important cultural differences between the local population and researchers may be expected, a "quick and dirty" method like RRA is unlikely to provide an adequate basis for the elaboration of a survey instrument that yields relevant, valid and reliable information.

A social science contribution: diagnostic case studies

The conclusion to be drawn from the above is that the current diagnostic methodology of FSR does not offer the valid, reliable and in-depth information that agricultural development experts themselves consider necessary for engaging succesfully in technology development. Considering the sort of information required, the inclusion of qualitative social research methods in the FSR diagnostic tool kit could compensate for present shortcomings. Since in most agricultural research projects the time available for diagnostic research is limited, these qualitative methods should yield workable results within a relatively short time span of, at the most, two to three months. In the following, some experiences will be presented with a method that meets these conditions: the diagnostic case study.

The use of diagnostic case studies in rice research in the Dominican Republic

From 1981 to 1985, an interdisciplinary team consisting of a sociologist, an agricultural economist, an agronomist and an extension specialist studied the generation, transfer and adoption of new rice technology in the Dominican

Republic, The team functioned within the framework of the Adaptive Agricultural Research (AAR) project, a Dutch-Dominican cooperative effort with the general objective of defining what and how sociology can contribute to agricultural research. The AAR rice team collaborated closely with biological scientists from the national rice research institute CEDIA (Centro de Investigaciones Arroceras). The institute's main interest was to obtain answers to the question as to why there were such differential adoption rates of new CEDIA technologies among small and medium sized Dominican rice farms. Since the late sixties, the institute has been promoting a technological package based on the use of modern, semi-dwarf rice varieties. However, by the time the AAR project started in 1981, some 10 years after the introduction of the new varieties, CEDIA researchers estimated that large groups of farmers, probably accounting for as much as 40 % of the total rice area, still grew the local, tall varieties (personal communication to the author). Other parts of the package, such as the use of modern inputs (fertilizers and pesticides), sowing dates and seedbed preparation and seedling age for transplanting were also reported to be only partially adopted. Dominican rice researchers wanted to know why some farmers did make the proposed changes in their rice cultivation practices, while others did not, or only partially so.

The research process consisted of four components: a reconnaissance, diagnostic case studies, a structured survey and agronomic trial research. The reconnaissance served to obtain an overview of the three selected research areas and its rice farming population, and a first impression of the factors that influence farmers' decision-making in rice cultivation. Equally important, it was used for the selection of farmer informants for the second phase of the research process: the case studies.

The case studies formed the core of research process, aimed as they were at obtaining a comprehensive, in-depth view of farmer's decision-making and the factors that influence it. On the basis of the information gathered in the reconnaissance, a list of open ended questions and topics was formulated. From the farmers interviewed in the reconnaissance, a total of 42 - 12 to 18 per research area - was selected on the basis of their knowledge of rice cultivation, their capacity to verbalize that knowledge, and their willingness to participate in the elaborate case study interviews. In these, informants were extensively interviewed for periods ranging from 5 to 8 hours, distributed over two visits. In the first interview, some biographical data were collected, and an extensive analysis of decision-making regarding rice cultivation was made. Emphasis was placed on the analysis of the "why" of certain decisions, particularly if these deviated from CEDIA's recommendations on such topics as the use of varieties, fertilizers, pesticides and sowing or planting dates. Wherever possible and feasible, the interview was combined with a visit to the farmer's fields. In the second interview, socio-economic data on the use of land, labour and capital, household consumption, income, and attitudes towards farming and farmer organizations were collected. Obtaining the more sensitive data on such variables as income and land tenure proved to be relatively easy in this second case study interview, as enough confidence between informant and researcher had been built up in the reconnaissance and first case study interviews.

The other two components of the AAR research process, the survey and the agronomic trials, were both based on the results of the case studies. In the survey, quantitative estimates were obtained of variables that in the case studies were identified as important for technology development. From each of the three research areas a representative sample of rice farmers was drawn, which led to a total of 242 respondents. Each respondent was interviewed with a structured questionnaire, which took one to one-and-a-half hours to complete. The survey data were processed in the computer department of the Dominican Ministry of Agriculture.

By the time the survey was executed, some of the problems identified in the case studies were already being investigated in a first series of agronomic trials. In these, both the impact of each problem, in terms of production losses, and the effect of farmer adaptations or practices directed at counteracting those losses, were measured. The evaluation of production losses helped in establishing research priorities, while the results of assessing the effects of farmer adaptations helped to provide a basis for technology design. The trial research was executed both on CEDIA's experimental station, so as to obtain exact estimates of losses in controlled circumstances, and on-farm, for measurement under small farm conditions. By executing the on-farm trials in close collaboration with farmers they served as a basis for a continuing dialogue with the farmer on his cropping decisions.

Some results: production conditions, problems and adaptations

The diagnostic research executed by the AAR team resulted in detailed information on the reasons for the limited adoption of CEDIA's technology. It was found that in many instances farmers did not follow CEDIA's recommendations because of serious constraints in production conditions. The most important of these were due to defects in the regional rice production infra-structure, i.e. deficient water management and lack of access to credit and machinery for land preparation. In turn, these limitations resulted in unfavorable conditions in individual rice plots, particularly as regards plot drainage and levelling (Doorman 1983). For example, insufficiently levelled plots, drainage problems and difficulties in the distribution of irrigation water led farmers to opt for the hardier tall varieties rather than CEDIA's semi-dwarfs. Under those unfavorable conditions the tall varieties were reported to yield equal or better, at a lower production cost, than CEDIA's varieties.

Small farm production conditions were also found to result in two other problems in rice cultivation: the sowing "out of seasón" of a second rice crop and the "late transplant" of rice seedlings from the seedbed to the field. In both instances two major constraints, the lack of access to irrigation water and to machinery for land preparation, impeded farmers from following CEDIA's advice. In the first case, delays in starting a new cropping cycle caused farmers who double cropped their land to sow their second crop later than the recommended date of the 15th of August. Due to unfavorable climatic conditions, a crop sown after this date often results in considerable yield losses or even outright crop failures.

On the other hand, waiting for irrigation water or machinery for land preparation often forced farmers who transplanted their rice to transplant "late", after the seedlings in the seedbed had passed the recommended age of 30 to 40 days. Rice researchers and extension agents discouraged the use of seedlings over 45 days old, since their use was thought to lead to severe reductions in yields. Nevertheless, it was found in the case studies that farmers used seedlings that had spent up to 90 days in the seedbed - with only minor yield reductions. In addition, the case studies showed that farmers adapted their practices to sowing out of season or a late transplant by selecting tolerant varieties and increasing plant density and fertilizer application.

Survey data showed that both sowing out of season and late transplanting were common problems: in the two largest research areas, 54 % of the number of second crops were sown out of season, while in 35 % of the transplanted crops seedlings older than 45 days were used (Doorman 1986a).

Contributions to Dominican rice research

Although the reconnaissance yielded some preliminary information, it was the case studies that resulted in detailed insights on the causes of the limited adoption of new CEDIA technology. Of particular value was the information the in-depth interviews provided on the links between specific problems in rice cultivation, the constraints in production conditions that cause them, and the ways farmers cope with those problems by adapting farming practices. Although the specifically agronomical problems identified in the case studies were usually known to some extension agents and a few researchers, in general rice scientists were found to have little understanding of the context of those problems, and no knowledge at all of the local technology employed by farmers to counteract their negative impact. In addition, the case studies provided an empirical justification of one of the basic tenets of the adaptive research approach, namely that in many instances it may well be more feasible to adapt technology to production conditions than the other way around. This tenet was based on the finding that, on the one hand, large segments of Dominican rice farmers worked under suboptimal conditions, and on the other, that for the time being the Dominican Republic did not have the resources to create the infrastructure needed to improve these conditions. Since it appeared unlikely that the shortages of irrigation water and machinery for land preparation would be solved in the short run, sowing out of season and late transplanting would be realities with which, for the time being, one would have to cope. Moreover, the argument was made that, even in the long run, adapting technology to existing production conditions could well be a more economical solution to Dominican rice production problems than adjusting production conditions to existing technology. In the particular case of sowing out of season, the AAR team argued that spreading sowing dates over the year would result in a more economic use of water and machinery for land preparation than the concentration of sowing in a four month period - December and January for the first crop, and June and July for the second - that would result from avoiding sowing out of season.

The above findings were translated into a number of concrete suggestions for agronomic research. Trial research on late transplanting and sowing out of season was executed by agronomy students within the AAR project, under the supervision of the team agronomist and CEDIA researchers (see Hagens & Doorman 1985, and Rikken & Doorman 1984). Even more significant was that on the basis of the team's findings CEDIA initiated several research projects on its own initiative, or included AAR suggestions in existing research programs. Thus, a CEDIA agronomist executed a trial on late transplanting (Perez Rodríguez, 1983), while tolerance to low temperatures and lack of solar radiation were included as desired characteristics for new rice varieties to be developed in CEDIA's breeding programs. The latter was a direct result from an AAR recommendation to develop technology adapted to the unfavorable climatic conditions of sowing out of season, and reflected the implicit adoption of the previously described tenet that technology should be adopted to production conditions rather than the other way around.

Acceptance of adaptive research findings

The principle of adapting technology to production conditions rather than the other way around did not find acceptance among all rice researchers. The same was true for the AAR team's general conclusion that the limited adoption of CEDIA's technology by many farmers was due principally to CEDIA's failure to adapt its' recommendations to the unfavorable production conditions faced by large groups of Dominican rice farmers. Informal interviews with rice researchers and extension agents showed an unfailing belief in the superiority of CEDIA's technology and recommendations over traditional farming practices, even in the face of data to the contrary. And in those cases where the limited success of CEDIA's technology was undeniable, the opinion prevailed that conditions would have to be adapted to the technology rather than the other way around. CEDIA, so it was reasoned, should supply the technology , while other government institutions had to provide the infrastructure.

This rejection of some of the AAR findings and recommendations was to be expected. In particular the notion that the technology developed by biological scientists on research stations is not always applicable in small farm circumstances, and therefore, is not in all cases superior to farmer practices, was contrary to the most basic beliefs of many biological scientists. In addition, the heavy reliance in AAR methodology on farmers as informants, particularly in the case studies, was bound to create skepticism. Over the years, most officials have been well indoctrinated with the image of the small farmer as a backward, illiterate, traditional, stubborn individual who prefers his own easy-going ways over the sound, scientific advice of well educated professionals.

The adjustment of such ingrained views as the ones described will take time as well as a direct involvement of research institute personnel in interdisciplinary research efforts at field level. Both because of the AAR projects' limited duration and the context of its execution, under foreign auspices in the margin of established research institutes, it would have been unrealistic to expect it to result in a major turnaround in existing ideas. Nevertheless, an important start was made. Apart from the incorporation of several of the AAR teams' suggestions in CEDIA's research programs, a definite interest was created in the potential of social science as a component of agricultural research. This was reflected in that towards the end of the AAR project CEDIA pledged full support, in the form of material and human resources, to a proposal for a follow-up to the AAR project.

Time limits for diagnostic research: some lessons from the Dominican experience

The diagnostic stage of the AAR research process, i.e. the reconnaissance, case studies and a preliminary analysis of survey data, took about 2 years. To that period another year had be added for the more detailed analysis of the survey data. That may seem a long time; however, in those three years diagnostic rice research was executed in three regions, and the research team spent considerable time on activities and projects that were not an essential part of the diagnostic stage. Also, since the main objective of the AAR project was to develop a methodology for incorporating sociology into agricultural research, the research process itself was a learning experience with, to a certain extent, a trial and error character. However, as the project progressed, the methodology applied was streamlined and data gathering and analysis improved both in quality and speed. While in the first two research areas data collection and analysis in reconnaissance and case studies took about six months, that of the third region took only six weeks. The latter time conforms to what should be considered as a reasonable time span for diagnostic research consisting of RRA, case studies and survey: a three to four months period, depending on the size and heterogeneity of the research area. A shorter period does not allow for a sufficiently thorough investigation, while a longer duration is liable to meet objections from biological scientists eager to start with technology development. In fact, many biological scientists might consider even three months of diagnostic research as exaggerated: in that case it will be up to the social scientist to present arguments to justify this period.

To stay within the above mentioned time limits, special care should be taken to avoid the pitfalls of survey research in Third World settings documented among others by Chambers (1983). Chambers reports the many problems involved in the gathering, processing and analysis (particularly computerized) of survey data, and indicates many instances in which final results became available much too late or not at all. A comparable experience resulted in the AAR project, where the main bottleneck in the diagnostic stage was the processing and analysis of survey data. Anticipating the problems involved in the analysis of survey data in the computing department of the Dominican Ministry of Agriculture, with limited capacity and a large workload, the AAR rice team decided to ask only for quantitative estimates of those variables considered essential to determine the needs for new technology. Even so, a considerable delay in processing and analysis was incurred, owing to the relative complex character of many survey variables and the inexperience of both the research team and the computer operators in managing the kind of data involved. This shows the importance of limiting to a minimum the number and complexity of the variables to be investigated in the diagnostic survey, incorporating only those for which quantitative estimates are essential. Although a number of socio-cultural and other more complex variables may be included in a diagnostic survey questionnaire, both their analysis and the running of more complex tests and associations between simpler agro-economic variables, should be undertaken only after quantitative information essential for decision-making on research priorities has become available.

The division of tasks in interdisciplinary research

In all three forms of diagnostic research discussed, i.e., reconnaissance, case studies and survey, the principal tool for data gathering is the interview. Since this is a typical instrument of the social sciences, it stands to reason that social scientists have a central role to play in diagnostic research, particularly in the area of methodology. This is especially valid in the case of the diagnostic case study. Since case study research is primarily qualitative in character, the usefulness and quality of the information obtained depend on the skills, experience and insight of the researcher. Since anthropologists and sociologists are trained in qualitative research, it seems logical to leave the execution of case studies to them. In the AAR project some case study interviews were carried out by a small interdisciplinary team consisting of a sociologist and an agronomist. However, it was found that the latter did not feel comfortable with interviews that lasted longer than two hours. Thus, although the full-fledged participation of non-social scientists is quite feasible in the execution of RRA and, to a certain extent, survey research, it makes sense for social scientists to execute the case studies. The experiences obtained in the AAR project show that this is valid even when the interviews focus on agronomic and economic topics rather than on socio-cultural ones, as was the case with the analysis of the problems of late transplanting and sowing out of season of rice. When such "technical" topics are touched upon in a case study, a follow-up study involving close collaboration with biological scientists is imperative. In this way, relevant topics can be further elaborated in a three way dialogue between farmer, agronomist and social scientist.

An important implication of a major role for the social scientist in diagnostic agricultural research is that he or she should have a working knowledge of all areas involved, including agronomy. To be able to communicate with both biological scientists and farmers, to develop reliable instruments for case study and survey research, and to identify relevant topics for further analysis in cooperation with biological scientists, a basic understanding of the principles of agronomy and related sciences is essential.

Conclusions

The central argument of this paper is that sociologists and anthropologists have an important role to play in agricultural research directed at technology development for the small farm sector. The current methodology for diagnostic research has several weaknesses, a fact that can be ascribed at least partially to the limited participation of non-economic social scientists. Through the introduction of systematic qualitative research in the form of farmer case studies, the currently predominant methods of Rapid Rural Appraisal and formal survey can be complemented.

The main aim of diagnostic case studies is to identify the most important factors influencing farmer decision-making and needs for new technology. In close collaboration with team members of other disciplines the social scientist must engage in in-depth analysis of the technical, ecological, infrastructural and socio-economic factors that influence the needs for new technology. In the study of specifically technical aspects, the role of the social scientist is to function as a go-between between biological scientist and farmer. Where social and cultural factors are found to have a major influence on farmer decision-making the role of the social scientist is extended to the detailed study of these aspects.

The incorporation of social scientists in interdisciplinary research teams also offers perspectives for strengthening the participatory element in applied agricultural research. By making a detailed analysis of farmer perceptions, motivations and goals, as well as an exhaustive inventory of local technology, farmers' influence in technology development can be enhanced indirectly. By employing the information generated in the case studies as a basis for creating a dialogue between farmer and biological scientist in subsequent trial research, farmer participation is reinforced directly.

Three elements are essential for social scientists functioning satisfactorily in agricultural research teams. The first is the ability to function in an interdisciplinary team, which implies a basic knowledge of the methods and subject matter of the other disciplines involved. Some expertise in agronomy and economics is essential not only for the understanding of and communication with other scientists, but also for making the kind of thorough inventory that is the main objective of the case studies.

The second condition is that social scientists should present workable results in a relatively short time. This is related to the demand, prevalent in virtually all agricultural development projects, for the rapid, cost effective obtainment of knowledge that can serve as a basis for action. The diagnostic research in which social scientists are to play a major role should, within at most three to four months, yield information that biological scientists can use as a basis for technology development.

The third condition is a logical consequence of the second. It involves a willingness to compromise academic standards, at least in the diagnostic stage of agricultural research. Obviously, there has to be a trade-off between speed and quality: in Chamber's terms (1983), what is needed is "fairly quick and fairly clean" research. In post-diagnostic research the checking of this information by more thorough social science methods, such as participant observation, multiple visit surveys and more elaborate case studies, may well be possible. However, before engaging in this more thorough research, social scientists must be ready and willing to present essential information on a fairly narrow data base, both in terms of quantity and quality. It is this kind of compromise of academic standards that will be necessary for the successful incorporation of social science contributions into applied agricultural research.

IX. THE USE OF SOCIAL SCIENCE METHODS IN AGRICULTURAL RESEARCH: THE CASE OF LATE TRANSPLANTING OF RICE IN THE DOMINICAN REPUBLIC[*]

Abstract

This article aims to show how social science methods can be combined with agronomic research to yield information directly relevant to the development of agricultural technology for small farmers. First, problem identification and definition are worked out through reconnaissance and case studies. Then, quantitative estimates of the prevalence and impact of those problems can be obtained through the execution of a survey and trials. The combination of qualitative and quantitative methods can result in a substantial change in outlook on a specific problem, as is indicated for the case of rice transplanting in the Dominican Republic.

Introduction

In recent years, there has been a growing recognition that the development of new agricultural technology for small farms in the Third World should not be the exclusive domain of biological scientists. As a result, the input of such disciplines as economics, sociology and anthropology is now considered of major importance in understanding the complexities of small scale farming (Fresco, 1984). Currently, the most well-known interdisciplinary approach to developing agricultural technology for small farmers is Farming Systems Research (FSR). The objective of FSR, as described by Gilbert, et al. (1980), is "to increase productivity of farming systems given their constraints and potential and taking into account the farm household's private goals". The core of FSR is its systems

[*] Published in: Netherlands Journal of Agricultural Science (37):97-105 (1989)

perspective: rather than focussing on a single crop or an aspect of its cultivation, agricultural activity is studied within the context of the physical, biological and socio-economic conditions that determine the farm families' goals, access to resources and decision-making (Shaner 1982). Initially, the social scientists that studied the socio-economic aspects of small farm systems were almost exclusively economists. This led, on the one hand, to a notable lack of emphasis on the analysis of social and cultural factors influencing farmer decision-making (Garrett 1984). On the other hand, in the area of method it has resulted in a strong emphasis on quantitative research, usually through surveys, and little attention for qualitative analysis.

Since the early 1980's there has been a growing interest in increasing the role of sociology and anthropology in agricultural research for small farmers (see for instance Gladwin, 1983; Horton, 1984; Rhoades, 1984; De Walt, 1985 and Tripp, 1985). One approach, building on FSR, but incorporating methodological and conceptual elements of social sciences other than economics, is what in this article will be called adaptive agricultural research. Adaptive research, more so than FSR, puts emphasis on farmer participation in technology development. It does this not only through direct involvement of farmers in on-farm agronomic research, but also by basing the new technology as much as possible on indigenous technical knowledge. Other important elements of adaptive research are the analysis of the influence of social, cultural and political factors on the farming system, and a historical perspective on the decision-making therein. Also, adaptive research involves qualitative analysis of farmer decision-making and the motivations, perceptions and aspirations that lie behind it. In the area of method, qualitative case study research is added to quantitative survey research. As will be shown in this article, both these social science methods are used not only for studying what is normally considered the domain of the social sciences, but also for analyzing specifically "technical" problems.

In this article, a specific topic of rice research in the Dominican Republic, that of the late transplanting of rice seedlings, will be used to illustrate how adaptive research, through combining the social science methods of case study and survey interviewing with agronomic research, can be employed to yield information relevant to the development of agricultural technology for small farmers. Thereby, emphasis will be put on the methodological contribution of the social sciences to the study of agronomic problems, rather than on the analysis of the social, cultural, and historical factors referred to in the above. We will start with a brief description of the setting, the rice producing area around the town of Nagua in the Dominican Republic. This will be followed by an introduction to the methodology used. Then, the identification and definition of the problem of late transplanting will be discussed. Subsequently, some quantitative estimates of the prevalence and impact of the problem, as obtained in the survey and agronomic research, are presented. Finally, some general conclusions are formulated on the methodology used, with particular emphasis on the social science contribution.

Setting

Research took place in the Land Reform Project of El Pozo, in the north-east of the Dominican Republic. The area has a tropical lowland climate, with an average annual precipitation of some 2000 mm, with peaks in May and November. Although low in phosphate, in overall terms soils are fertile, with high organic matter and potassium contents. Rice cultivation is almost entirely irrigated; however, due to an insufficient water management infra-structure, many zones face irrigation problems, especially during dry spells.

The El Pozo project is administered by the Dominican Land Reform Agency, the Instituto Agrario Dominicano (IAD). Other government institutions supply services such as the upkeep and expansion of the irrigation and drainage systems, credit, and extension. Also, there is a local experimental station of the national rice research institute CEDIA (Centro de Investigaciones Arroceras).

Land Reform farmers occupy plots between 1.5 to 4 ha. in size, with an average of some 2.8 hectares (Doorman, 1986a). Some 85% of the around 1300 beneficiaries that are registered as actively engaged in commercial rice production use credit from the state run Agricultural Credit Bank (Banco Agrícola). Fertilizers, post-emergent herbicides, insecticides and modern semi-dwarf varieties developed by CEDIA are widely used.

Methodology

Research was initiated with a reconnaissance, in which information on the research area in general, and cropping systems involving rice in particular was collected. Apart from interviewing key-informants such as local government officials, some 60 interviews with farmers randomly encountered in different parts of the research area served both to obtain some preliminary insight in rice cultivation practices and to select informants for the second research phase, the case studies. These consisted of extensive interviews with 18 of the most knowledgeable farmers identified in the reconnaissance, with a strong focus on the "how's" and "why's" of decision-making in farm management. This resulted in a wealth of qualitative information on every aspect of rice farming, including the management of land, labour and capital, the farmers' perception of farmers' organizations and government institutions, and farmer goals, preferences and aspirations. Most importantly, a number of specific problems in rice farming were encountered, along with the adaptations farmers made to counter the negative effects of these problems on yields.

Since the information gathered in the case studies could not be considered representative for the El Pozo farmer population at large, the next step in the research process was to evaluate a limited number of the topics encountered in the case studies in a survey applied to a 10% sample of the reform project's registered beneficiaries. That way it was possible to obtain statistically meaningful estimates of key variables such as the number of farmers affected by specific problems identified in the case studies, resulting yield losses, and the frequency of the use of adaptations. At the same time, agronomic research was initiated on one of the problems identified in the case studies, late transplanting. The objective of these "adaptive trials" was to establish the impact of late transplanting on yields, and the effect of farmer adaptations on countering yield losses.

Problem identification in the case studies: late transplanting

In the case studies it was found that the frequently occurring shortages of irrigation water and machinery for land preparation often lead to delays in the transplanting of seedlings. To be able to transplant as soon as the rainy season starts, usually mid-April, farmers establish their seedbeds in March or sometimes even in February. The idea is to transplant the seedlings when they are about 45 days old, which is considered the optimum age by most farmers. However, water shortages and the lack of tractors in the zone cause delays in land preparation or inundating the land for sowing. As a result seedlings may be in the seedbed for anywhere from 60 to over a 100 days before being transplanted. Most farmers interviewed in the case studies testified that the use of seedlings of over 50 days old reduced yields, as a consequence of lesser tillering of older seedlings. However, most informants also claimed they could counteract this problem by increasing plant density, the application of a higher than normal dose of NPK fertilizer to increase tillering, or planting the seedlings in an inclined rather than upright position. The latter practice was asserted to result in root formation from the second and third node of the seedling. Thus, out of one seedling several plants would evolve, each with it's own root system and tillers.

The rice specialists' and extension-agents' view

The research team also verified what agronomists and extension agents had to say about late transplanting. It appeared that almost unanimously, the use of seedlings older than 45 or 50 days was condemned as leading to unacceptable yield reductions. It was not very clear where this idea had originated. It appeared to be an extrapolation of a recommendation that 30 to 40 days is the optimum age for transplanting. This advice appeared both in teaching materials for extension agents and in a leaflet published by the Ministry of Agriculture for distribution among farmers. However, in research done by a CEDIA investigator in the early seventies (CEDIA, 1974) the use of seedlings of 70 days old of the long cycle (5 to 6 months) variety Juma 57 had resulted in yields that were actually higher than the yields of 35 day old seedlings. Only in 1983, several years after it was formulated, was the above recommendation confirmed by research with a medium cycle (4 months) variety (Pérez Rodríguez, 1983).

Literature on late transplanting

Both as a preparation to agronomic research and to shed some light on the possible origin of the seedling age recommendation used in the Dominican Republic, part of the literature on the late transplanting of rice was consulted. The International Rice Research Institute, in a growth and yield test involving 29 cultivars, reports that only four yielded more than 3.0 tons per hectare when transplanting was delayed until 60 days after seeding. For IR 36, an early variety widely sown in the Philippines, declines in yields were as much as 83 and 90 % in comparison with 40 and 20 day seedlings respectively (IRRI 1985). Other authors such as Sharma et al. (1979), Rajendra & Reddy (1981), Padalia (1981) and Ghosh (1982) all report significant yield reductions with the use of 55 to 65 days old seedlings. On the other hand, normal yields with old seedlings are mentioned by Shahi & Gill (1977), Kailasam and Ramamurthi (1978), and Murty and Sahu (1978). Most notable is the study of Kailasam and Ramamurthi, in which even 90 day old seedlings showed no significant yield reductions.

From the literature it appears that the best results with the use of old seedlings are obtained with long cycle varieties. As some of the cited authors indicate, the effects of late transplanting do not depend on the age of the seedlings measured in days, but on the "biological" age, that is the stage of development of the rice plant. Apart from genetically determined characteristics, particularly cycle length, the biological age is also influenced by environmental factors, especially climatological conditions and water supply. For example, Purseglove (1985), indicating the relationship between water management and seedling age, recommends to transplant seedlings from a flooded seedbed before they are 40 days old while seedlings from a dry seedbed can be used up to an age of 70 to 80 days.

Finally, it is interesting to look at what the literature has to say about ways to counteract yield reduction. Hagens (1986), cites Sharma et al. (1979) and Nair et al. (1981), both of whom indicate increasing plant density. Nair et al. (1981) suggest increasing nitrogen application, while Ishii (1977) recommends transplanting in an inclined position to enhance tillering at the higher nodes (all citations from Hagens, 1986).

From the above, it seems probable that the 45 day recommendation used by Dominican rice experts is derived at least partly from the Asian work on late transplanting with IRRI's new dwarf and semi-dwarf varieties. However, in formulating the 45 day recommendation apparently no account was taken of the effects of cycle length or varying environmental conditions on seedling development. The result has been a rigidly formulated recommendation uniformly applied in a wide variety of settings and circumstances.

Follow-up studies: survey and agronomic research

After pinpointing the problem in the case studies, late transplanting was selected as one of the topics for further research in the subsequent phases of the Adaptive Agricultural Research project: a survey among a representative sample of the El Pozo project's population, and adaptive trials. The reasons for selecting this particular topic were several. First, here was a problem that, both among farmers and rice specialists, was claimed to be fairly widespread. Then, the specialists maintained that it had a significant impact on yields; some farmers, however, claimed that these yield reductions could be counteracted by specific practices. The survey was directed at obtaining quantitative estimates of the number of farmers affected by late transplanting and the frequency of the use of adaptations. Also, some first crude estimates were expected of the impact of the problem on yields. The trials were aimed at obtaining more exact quantitative estimates of yield losses, and evaluating the effectiveness of some of the farmers' adaptations. The final result was expected to be useful in developing more specific recommendations for farmers faced with late transplanting. These recommendations should be based on the most effective solutions for the problem applied by farmers. Thus, indigenous technology used by what was assumed to be an elite group of farmers, namely the informants selected for the case studies, would so become available for much larger groups.

Survey results confirmed the frequency of late transplanting: of 177 harvests taken into account, one third was sown with seedlings of over 45 days old, and in some 13 % of all cases seedlings older than 60 days were used. On the other hand, the farmer adaptations encountered in the case studies were much more widespread than expected: only 5 out of 91 respondents affected by the problem reported not doing anything specific when transplanting late. The most frequently encountered adaptation was increasing plant density: 56 respondents (61.6%) claimed either to plant more seedlings per hill, to reduce distances between hills, or both. As far as yields were concerned, in accordance to farmers' claims, the difference between the average yields of crops planted on time (3.55 tons per hectare) and those of crops planted late (3.46 tons) were not found to be statistically significant (at the 5% level, the total number of harvests taken into account was 150). The interesting question that remained was if this apparent absence of yield reductions was a result of farmers' adaptations, or rather, if the yields obtained with old seedlings were equal to those of crops transplanted on time regardless of farmers' practices.

To obtain an answer to this question, that is to say, to obtain more exact estimates of yield losses resulting from late transplanting both with and without adaptations, agronomic research was undertaken by a team of Dominican agronomists and Dutch and Dominican agronomy students. A first series of 3 trials, executed by agronomy students under supervision of rice specialists from CEDIA in the Central Valley region of the Dominican Republic, used seedlings of the long cycle variety of 40, 60 and 80 days old. It resulted in the highest yields for the 60 days seedlings, and, even more remarkable, no statistically significant differences were found between the yields of the 40 and 80 days seedlings (Rosario & Rosario, 1984, and Columna & Cedano, 1984). In a second series of trials, the performance of "young" seedlings (36 to 60 days) old was compared with that of "old" ones (75 to 116 days) in the El Pozo region. Four trials were laid out on farmers' fields and three on the local experimental station of the national rice research institute CEDIA. In all 7 trials the cultivar Juma 57 was used; in addition, in two of the three on-station experiments one medium cycle variety, ISA 21, and two promising new medium cycle lines developed at CEDIA were evaluated. Significant yield reductions occurred in two of the four on-farm trials, and in the on-station trial with the 116 day seedlings. Surprisingly, in this latter case, the reduction was only some 17%. Interestingly, both on-farm trials resulting in significant yield reductions (of some 25 and 30% respectively) were seriously affected by drought, which led to the hypothesis that adverse conditions may have a stronger effect on older seedlings than on younger ones. But in 4 trials executed under non-stress conditions, no significant differences were found between the "young" seedlings of 36, 38, 47 and 60 days, and the "old" ones of 80, 73, 106 and 80 days respectively.

On the other hand, in none of the trials any indication was found that the farmer adaptations tested, i.e. the increase of plant density and, in one trial, applying extra fertilizer, had any effect on yields. In one of the two on-farm trials affected by drought the yields obtained with older seedlings were less in spite of increased plant density, while in the other trials yields remained stationary both with and without this specific farmer adaptation. In the other on-farm trial affected by drought, it was found that extra fertilization did not have counteracting effects on yield reductions either. It also became clear that in those cases where significant yield reductions were found these were due not to decreased tillering and a resulting lesser number of panicles, but rather to smaller sized panicles. Apparently, this weight loss per panicle could not be compensated by augmenting the number of panicles through increased plant density.

What are the conclusions that can be drawn from these findings? The first one is, that more research is needed to establish more clearly which factors influence the late transplanting of rice seedlings and to what extent. The apparently complex interactions between cycle length, environmental conditions and seedbed treatment needs to be explored more thoroughly if relevant recommendations are to be developed for varying circumstances.

A second conclusion is that the data obtained indicate that under certain circumstances the use of seedlings older than 45 days is indeed feasible. This implies that the current recommendation given by Dominican extension agents should be adjusted to fit specific circumstances. The research suggested in the above should yield the necessary indications as to what those circumstances are. The adjustment of the current recommendation is all the more important since extension agents may advise the Agricultural Credit Bank to withhold credit to farmers who transplant late. Thus, the latter are deprived of credit for the rest of the production cycle, or will incur considerable costs by having to make a new seedbed or having to buy seedlings elsewhere.

Conclusions

The aim of this article was to show how methods of the social sciences, i.e. farmer interviewing in case studies and surveys, can be combined with agronomical agronomic research to yield insight into crop production problems faced by small farmers. The specific social science contribution consists, in the case-studies, of making explicit small farmer production conditions, the problems resulting from those conditions, and farmers' adaptations to those problems. In the survey research quantitative estimates can be obtained of the frequency and impact of the problem, which will help determine the potential pay-off of an agronomical research program directed at diminishing the negative effects. Particularly case studies can be a quite efficient and cost-effective instrument, since a limited number can be executed within a couple of weeks, yielding a host of high-quality information on the intricacy of small scale farming problems.

It should be emphasized that systematic and in-depth interviewing can be of particular value in identifying occasionally occurring problems such as late transplanting. As such, it may be more suited for problem identification than the more classic forms of agronomical problem identification, that is, observation through field visits and exploratory trials. Of course, it is not suggested here that observation should be substituted by interviewing; indeed, an essential element of case studies is making a visit to the farmer-informants' fields. The argument is for combining agronomical and social science methods by an approach based on intensive interviewing of farmer-informants on the one hand and agronomic research on the other. Thus, a more complete picture can be obtained of the complex problems of small scale farming as a base for the development of technology adapted to small farm conditions.

X. IDENTIFYING TARGET GROUPS FOR AGRICULTURAL RESEARCH: THE CATEGORIZATION OF RICE FARMERS IN THE DOMINICAN REPUBLIC[*]

Abstract

A method is discussed for classifying small scale rice farmers from the Dominican Republic who have similar production systems and access to land, but differ widely in the yields they obtain and in the adoption of new technology. The results are used to define two recommendation domains, for farmers with "good" and "poor" production conditions, and to suggest appropriate technology for each. For farmers working in good production conditions the development of a technological package based on the doublecropping of semi-dwarf varieties with high yield potential and production efficiency is recommended; for farmers with poor production conditions, a technological package is suggested based on varieties with a high tolerance for drought, flooding, and weed development, yielding adequately at low input levels.

Introduction

It is by now commonly accepted that the development of the small farm sector in developing countries requires agricultural technology specifically adapted to local agro-ecological and socio-economic conditions. The concept of such an adapted technology has been incorporated in approaches such as Farming Systems Research, which is directed at the generation, adaptation, testing and dissemination of improved technology for the small farm sector (Shaner et al. 1982). To help determine the target groups of such research, FSR specialists

---

[*] To be published in: Experimental Agriculture (1991)

have developed the concept of recommendation domains (Perrin et al. 1976, Byerlee et al. 1980, Shaner et al. 1982). Byerlee et al. define this term as "a group of roughly homogeneous farmers with similar circumstances for whom we can make more or less the same recommendations". Harrington and Tripp (1984) indicate the importance of defining recommendation domains for identifying technological needs and corresponding themes for on-farm trial research. Rhoades (1982:20) links the definition of recommendation domains to the construction of farmer typologies, based on variations in the size of land holdings, cropping systems and the purpose of production (subsistence or market oriented). He also points out that considerable differentiation may occur among farmers of a specific type. Similarly, Wotowiec et al. (1986) indicate that by describing a group of farmers as relatively homogeneous on a few standard characteristics, existing variability among farms is often not sufficiently considered.

When establishing the technological needs of farmers, it may therefore be necessary to make subdivisions within a recommendation domain that is fairly homogeneous as far as land tenure, cropping systems and purpose of production are concerned, but in which variation occurs with regard to other traits. The present paper will discuss a method to make such subdivisions, and the results of its application among small scale growers of irrigated rice (*Oryza sativa*) in the Dominican Republic.

Research methodology

The diagnostic research process comprised a reconnaissance, case studies and a survey. Basic information on rice cultivation in three land reform projects, El Pozo, El Aguacate and Laguna Salada, was collected in the reconnaissance. The case studies, executed among 42 farmers who had proved to be valuable informants during the reconnaissance, consisted of in-depth interviews on all aspects of rice production, in which particular attention was paid to factors influencing farmer decision making. In the survey, key variables were evaluated quantitatively among 242 farmer-respondents, comprising a 10 % random sample from the two largest research areas, El Pozo and El Aguacate, with populations of approximately 1200 and 600 farmers each, and a 20 % random sample from the smallest area, Laguna Salada, with a population of about 300 farmers.

The research areas

The three research areas were selected on the suggestion of officials from the Dominican rice research institute, the Centro de Investigaciones Arroceras (CEDIA), as showing different levels of successful adoption of CEDIA's modern rice technology. Two of the projects, El Pozo de Nagua and El Aguacate de Arenoso, were situated to the south of the town of Nagua, in the northeast of the Dominican Republic, and the third, Laguna Salada, near the city of Mao, in the northwest of the country. The farming systems in the three projects were homogeneous on the principal criteria used for identifying recommendation domains: farm size, which varied from 3 to 4 hectares; and cropping system and purpose of production, namely the commercial growing of irrigated rice. Nevertheless, CEDIA officials had indicated before fieldwork started that the three areas showed considerable variation in production levels and in the adoption of CEDIA's technology package, based on high input doublecropping of modern semi-dwarf varieties.

The El Pozo project was considered as a showcase for modern rice production, and reconnaissance and case study data showed that a considerable group of farmers doublecropped their land with semi-dwarf varieties. Case study farmers reported yields of up to 5 t/ha. of paddy, while survey data showed average production levels of 3.39 t/ha. (Doorman 1983, 1986a). However, doublecropping and high yields were only obtained in about one third of the area dedicated to commercial rice cultivation. The estimated 300 to 400 farmers in this area had better access to irrigation water, credit and machinery for land preparation, and had better levelled and drained plots than farmers elsewhere in the project. In those other sections, problems with water management resulted in lower yields, and a lack of land preparation machinery led to delays in establishing crops, sometimes limiting farmers to sowing only one crop a year. Survey data showed that in 1981, 1982 and 1983 doublecropping was practiced in only 53 % of 377 annual cropping cycles considered, even though 83.3 % of the 126 farmers interviewed expressed a preference for doublecropping (Doorman 1986a). However, the survey also showed that CEDIA's semi-dwarf varieties were used in 80.5 % of the 400 harvests considered.

Reconnaissance and case study data from El Aguacate indicated problems that were similar, but more serious than those in the lesser developed parts of the El Pozo project. Due to deficient irrigation, drainage and levelling, yields seldom exceeded 3 t/ha. of paddy, with an average of 1.94 tons/ha. As a result of particularly acute shortages of land preparation machinery, doublecropping was the exception rather than the rule and was practiced in only 15.4 % of the 175 annual cropping cycles examined (Doorman 1986a), while crop failures due to draught or excessive flooding were numerous. Semi-dwarf varieties were only used in 41.6 % of 113 crops considered. This finding was not surprising since several case study farmers had explained that they preferred the tall local varieties, which were more tolerant to drought or flooding, and performed equally well or better than the semi-dwarfs in poorly levelled terrains with low input use. This was confirmed by the survey data presented in Table 10.1: average yields of the modern varieties in El Pozo were almost 45 % higher than those of local ones ($p<0.0001$). Average yields of the local varieties in El Aguacate were 8 % higher, but the difference was not statistically significant.

Table 10.1. Number of harvests and average yields (t/ha) of modern semi-dwarf and tall local varieties in the El Aguacate and El Pozo land reform projects, 1981-83

Project	El Pozo		El Aguacate	
Variety type	Number of harvests	Average yield	Number of harvests	Average yield
Modern/semi-dwarf	322	3.60	47	1.84
Local/tall	78	2.49	66	2.01
Total	400	3.39	113	1.94

The Laguna Salada research area had a lower annual precipitation (600 mm) than the El Pozo and El Aguacate projects (over 2000 mm), and soils with less organic matter and higher salinity. Nevertheless, maximum yields there equalled or surpassed those in El Pozo, due to good water management conditions and high input use. Survey results showed average applications of 115 kg N /ha, compared to 75 kg/ha in El Pozo, and only 16 kg/ha in El Aguacate.

Adoption levels of CEDIA's recommendations on cropping system and variety use were low in Laguna Salada. Doublecropping was only practiced in 59 of the 174 cases considered while in 75 cases the first crop was followed by a ratoon. Although ratoons were reported to yield at best only some 60 % of a second sown crop, many Laguna Salada farmers opted for growing a ratoon because of lower production costs - no costs for land preparation, seed and transplanting, and reduced costs for chemical inputs - and consequently, high net benefits (Doorman 1983, Doorman & Cuevas Pérez 1984). The CEDIA semi-dwarf varieties were grown even less often than in El Aguacate; the local tall variety "Mingolo" was reported to have been used in 144 of the 230 crops considered, including ratoons. Reconnaissance and case study data had already shown that Mingolo - named after the farmer who had obtained and released the variety - was considered to have the best ratoon potential. Also, when sown Mingolo was said to combine a yield potential equal to that of CEDIA's best semi-dwarf varieties with a high tolerance of salinity and drought.

In all three projects, farmers frequently mentioned five factors that determined crucial decisions regarding cropping intensity and variety choice. These same factors also influenced other important decisions, such as those on the direct seeding or transplanting of a crop, sowing dates, and the use of fertilizer and pesticides. These factors were access to irrigation water, availability of machinery for land preparation, credit, and the quality of drainage and levelling of the rice plots. Variations in these production conditions were concluded to be the main causes of the differentiation in technology adoption and production levels. Consequently, groups of farmers with marked differences in these conditions were expected to have varying needs for new technology and thus, to belong to different recommendation domains. Farmers from the three research areas were therefore categorized according to these five factors.

This enabled the differing technology needs within the three research areas to be identified and allowed for farmers with similar technological needs from different areas to be grouped together.

Categorization methodology

During the case studies, a first categorization was made using the researchers' evaluation of the five above mentioned factors. On the basis of the results of interviews and observation points were given for each factor, with a maximum of 3 and a minimum of 0. The scores per factor were added, giving a total score between 0 and 15. Within this range four categories were established: A, with good production conditions; B, with regular conditions; C, with poor conditions; and D, with very poor conditions.

Although categorization was first practiced on the case study farmers, the objective of delineating recommendation domains obviously required that it should be extended to the farmers interviewed in the survey. Since the survey interviews were mostly executed by a team of hired interviewers and not by the responsible researcher, it was necessary to develop a system in which the scores for each factor were determined on the basis of the answers to relevant survey questions. Details on the system used are given in the Appendix. As with the categorization of the case study farmers, the sum of the scores for each of the factors determined the respondent's category: good, fair, poor or very poor.

To establish the usefulness of the method for the definition of recommendation domains, the four categories were compared on several key indicators for assessment of production results. After showing the results of the categorization of the 242 surveyed farmers, the findings are presented for three such variables, average yields per crop, cropping intensity and net annual income derived from rice production during 1982. All three variables are assumed to show a downward trend as production conditions deteriorate, from category A to category D. One-tailed analysis of variance was used to test for differences between the means per farmer category for each of the three variables.

Results

As was to be expected on the basis of reconnaissance and case study information, the majority of Laguna Salada and El Pozo farmers grew their crops under good or fair conditions, while most El Aguacate farmers did so under poor conditions. Considerable variation in production conditions was found within the El Pozo and El Aguacate areas (Table 10.2).

Table 10.2. Categorization, on the basis of five principal production conditions, of 242 rice farmers in three land reform projects in the Dominican Republic

Category	Laguna Salada	El Pozo	El Aguacate	Total
A (good)	18	38	2	58
B (fair)	36	65	19	120
C (poor)	3	23	29	55
D (very poor)	-	-	9	9
Total	57	126	59	242

The differences in average yield per cropping cycle (Table 10.3) were significant for the total population (encompassing all three projects) and for El Pozo (in both cases $p<0.001$), and for Laguna Salada ($p<0.005$), where the deviant figure for category C only involves harvests of three farmers. No significant differences were found for El Aguacate farmers.

Average cropping intensity, i.e., the average number of crops and ratoons sown per year, is shown in Table 10.4. Significant differences were found for the total population of the three areas ($p<0.0001$) and for El Pozo ($p<0.0005$). No significant differences were found for Laguna Salada and El Aguacate.

Table 10.3. Average yield (t/ha) of paddy per cropping cycle in three land reform projects in the Dominican Republic. Based on two cropping cycles in 1981 and 1982 and the first cycle in 1983; n = number of farmers

Category	Laguna Salada	El Pozo	El Aguacate	Total
A (good)	5.15 (n=16)	3.65 (n=38)	2.01 (n=2)	4.02 (n=56)
B (fair)	3.70 (n=30)	3.23 (n=63)	1.98 (n=18)	3.15 (n=111)
C (poor)	5.03 (n=3)	2.53 (n=23)	1.90 (n=28)	2.34 (n=54)
D (very poor)	-	-	1.92 (n=9)	1.92 (n=9)
Total	4.26 (n=49)	3.23 (n=124)	1.94 (n=57)	3.13 (n=230)

Table 10.4. Average cropping intensity (no. of crops and ratoons sown per year) for three land reform projects in the Dominican Republic. Based on data from 1981, 1982 and 1983; n = number of farmers

Category	Laguna Salada	El Pozo	El Aguacate	Total
A (good)	2.0 (n=18)	1.9 (n=38)	1.2 (n=2)	1.9 (n=58)
B (fair)	1.6 (n=36)	1.6 (n=65)	1.4 (n=19)	1.6 (n=120)
C (poor)	1.9 (n=3)	1.4 (n=23)	1.1 (n=29)	1.3 (n=55)
D (very poor)	-	-	1.0 (n=9)	1.0 (n=9)
Total	1.8 (n=57)	1.6 (n=126)	1.2 (n=59)	1.6 (n=242)

The tendencies noted for yield and cropping intensity were repeated for the net annual income obtained from rice production (Table 10.5), with significant differences ($p<0.001$) for the total population and for El Pozo, and at $p<0.1$ for Laguna Salada. There was no significant relationship for El Aguacate. It is noteworthy that the average income in El Aguacate was less than one-fourth of that in El Pozo, and less than one-sixth of that in Laguna Salada.

Table 10.5. Average annual income from rice production, in RD$ *, in three land reform projects in the Dominican Republic. Based on data from 1982; n = number of farmers

Category	Laguna Salada	El Pozo	El Aguacate	Total
A (good)	3582 (n=16)	1625 (n=34)	-4 (n=1)	2207 (n=51)
B (fair)	2010 (n=25)	1098 (n=49)	712 (n=14)	1296 (n=88)
C (poor)	1745 (n=3)	40 (n=21)	189 (n=20)	224 (n=44)
D (very poor)	-	-	446 (n=7)	446 (n=7)
Total	2563 (n=44)	1057 (n=104)	401 (n=42)	1261 (n=190)

* 1 RD$ = 0.70 US$

Discussion

The results presented indicate that for the overall population and the El Pozo and Laguna Salada projects the method used for categorization was effective in differentiating farmers on the pre-selected indicators. The method was not suitable for El Aguacate, probably because this project was relatively homogeneous on the five factors used for categorization. Since overall production conditions in El Aguacate were poor, yields, cropping intensity and net income were low overall. It can therefore be concluded that the method discussed in this paper, when used in a fairly homogeneous area, may indicate unrealistically high levels of differentiation. Probably, this is partly due to differences between farmers: what one farmer considers "a problem" or "poor", another considers "fair" or "good".

It is also possible that the method used, although useful for distinguishing between "good", "fair" and "poor" conditions, may not have separated different levels of "poor". A complicating factor in this respect is that severe constraints in one factor may have obscured problems in others. For example, single cropping due to problems with drainage or irrigation could have obscured the fact that the farmer would have had problems with credit or obtaining machinery for land preparation had he been able to sow the second crop.

However, since these problems did not actually occur, scores on access to credit and machinery could have turned out high, contributing to a relatively high total score.

The large variations between the same categories in different projects indicate that categorization of the whole research population, so as to establish recommendation domains that transcend specific geographical areas, is not advisable. For instance, average yields in category B in Laguna Salada, El Pozo and El Aguacate were 3.0, 3.3 and 1.9 t/ha respectively. Use of the method without distinguishing between the three research areas would therefore not have been helpful in establishing which groups of farmers would benefit from specific technological packages: the technological needs of El Aguacate category B farmers can be assumed to be quite different from those of category B farmers from the El Pozo and Laguna Salada projects.

Application: identifying lines of research

The categorization results were used to define two general recommendation domains. The first consisted of the farmers working in good to fair production conditions in Laguna Salada and El Pozo. In general terms, these farmers would continue to benefit from a technological package based on the doublecropping of semi-dwarf varieties with high yield potential under favourable production conditions. Due to the fact that national rice prices did not keep pace with rising prices for chemical inputs, it was recommended that breeding programmes for this domain should consider the production of varieties producing satisfactory yields with lower requirements for chemical inputs and, particularly for Laguna Salada farmers, with good ratooning capacity and tolerance of saline conditions.

The second general recommendation domain was formed by Category C farmers of the El Pozo project, and all farmers of the El Aguacate project. For these groups, the development was recommended of a technological package based on varieties with a high tolerance for drought and flooding and with acceptable yields at relatively low input levels. Because of reduced possibilities of weed control through water management, and frequent problems with the timely availability of herbicides, aggressiveness in competition with weeds was also suggested as a desirable trait.

Delays in the supply of irrigation water and/or machinery for land preparation led to two additional problems for the farmers of this second domain, as well as for category B farmers from El Pozo. These were the transplant of seedlings that had remained too long in the seedbed, and the sowing of the second cropping cycle "out of season", in a period of the year in which unfavorable climatic conditions reduce yields and may even lead to crop failures. Tolerance of late transplanting and of the lower temperatures and solar radiation associated with sowing "out of season" were therefore also proposed as desirable traits for breeding programmes. Ratooning was suggested as an attractive alternative in situations where shortages of water and machinery for land preparation were likely to prevent the establishment of a second crop. Improvement of the management of a ratoon crop under poor production conditions and at a low level of input use was therefore proposed as another useful line of research.

Conclusions

Farmer categorization along the lines suggested in this paper can help in defining research priorities for a farming population which is fairly homogeneous for the characteristics usually employed for the definition of recommendation domains, but highly differentiated on other variables that are relevant for technology development. Classification of farming conditions as good, fair, poor and very poor proved effective, in the sense that significant differences between farmer categories were obtained for three key indicators - yield/ha, cropping intensity and annual income - used for establishing guidelines for the development of new rice technology.

Although useful results have been obtained a number of shortcomings of the methodology have been exposed. Categorization did not yield the expected results in one of the three research areas, both as a result of shortcomings in the method itself and because this area was relatively homogeneous. This suggests that preliminary research to establish if categorization is warranted is important in identifying recommendation domains. Secondly, the method did not take into account that the different production conditions used for categorization may influence the dependent variables in varying degrees. For instance, although access to machinery for land preparation can be assumed to have limited influence on yields, it is a major determinant of cropping intensity. On the other hand, levelling will have no influence on cropping intensity, but will be a major determinant of yield levels. Although it would complicate the method considerably, it might be desirable to link specific dependent variables to those production conditions that, in reconnaissance and case study research, would be identified as their major determinants. Thirdly, the categorization method is static and therefore does not take account of changes in production conditions. Categorization of the farmers of the three research areas was based on the "average" production conditions during a period of three years, but did not take into account changes which might have taken place during that time. Since farmer needs for new technology depend on actual production conditions rather than an average of past ones, the method used is obviously less suitable for areas in which rapid change takes place. However, in conditions where there is little or no change, evaluation over a longer period will strengthen the data base on which conclusions are drawn, and reduce the chance that such conclusions are arrived at on the basis of an unrepresentative cropping cycle.

XI. CONCLUSIONS

Of the wide array of roles of social scientists discussed in Chapter 1, a considerable number has been, to a greater or lesser extent, performed in the research described in this book. Most importantly, the sociological input in the research process resulted in strengthening diagnostic research methodology, particularly by supplementing "traditional" reconnaissance and survey research with diagnostic case studies. AAR research also focussed on the ex-post evaluation, at farm level, of the impact of the new rice technology, and assumed a "steering" role by indicating to biological scientists topics of research for the development of technology adapted to the needs of distinct categories of farmers. The AAR team, particularly the social scientists, also played a broker-sensitizer role, not only by indicating to researchers the agronomical problems caused by constraints in production conditions, but also by pointing out how farmers coped with those problems through the use of local knowledge.

The topics for social science research mentioned in Chapter 1 were also covered in the AAR research process, either in a general sense in the reconnaissance, as described in Chapter 6, or in detail in the case studies. As indicated in the above, the analysis of farmer decision making and the taking of inventory of local knowledge were two cornerstones of the research process; institutional analysis was another important component. Topics such as the size and structure of farming families, the division of labour in the household, and farmer perceptions were also investigated in detail, as were the linkages between farmers and government institutions and officials.

There are also social science roles and tasks mentioned in Chapter 1 that, for various reasons, were not included in the AAR approach. Most importantly, the AAR team did not assume the "accommodator" role. The fact that the Dominican rice technology package was, as shown in Chapter 4, the typical result of the traditional "top-down" approach in agricultural research, would have made the accommodator role contrary to the project's basic premise that technology development should start at farm level. Also, the team did not engage systematically in the ex-post evaluation of the impact of the new technology at the regional or national level - the study of effects on overall production, employment and (the distribution of) income. Two reasons can be given for this omission. The first is that such research would be better executed by economists. The second is that, in relation to the amount of time it would take up, such research would not have contributed in a major way to the principal aim of the project: the development of a methodology for the generation of information that can be translated into concrete guidelines for technology development by biological researchers.

Sensitizing non-social scientists to the possible influence of social and cultural factors on farmer decision making was another element which received relatively minor emphasis. The main reason for this omission was that, as was indicated in Chapter 6, these factors appeared to be of less influence in the highly atomized, recently settled land reform projects than factors of an economic and infrastructural nature. Finally, in the area of methodology, no use was made of the typical anthropological methods of participant observation and ethnographic eliciting techniques. The main reason for not engaging in participant observation was time pressure, while ethnographic eliciting techniques were not used for lack of familiarity with these techniques. In hindsight, it can also be said that, in a situation where the social and cultural characteristics of the local populace are relatively similar to those of the researchers, the need for such techniques is less than in situations where major differences exist.

The use of local knowledge for technology development

In Chapter 1, the advantages of incorporating local knowledge in technology development were discussed, both as regards its practical value and in terms of the ethical need to make development oriented research a more participatory process. IDS (1979), Swift (1979) and Chambers (1980) were cited as proponents of the postulate that structural-institutional factors and attitudes prevalent among officials constitute a major problem in incorporating local knowledge in agricultural research. This argument was supported in Chapter 4, with the presentation of the case of the linkages between Dominican rice researchers, extension agents and farmers. It was demonstrated that Dominican rice farmers lack ways of indicating their needs and priorities to rice researchers, as a consequence of which important components of the official technology package are not or only partly applicable in small farm production conditions. The principal cause of this phenomenon was found to be the lack of communication between researchers, extension agents and farmers, a result of both institutional constraints and attitudes prevalent among officials.

In Chapter 5, the case of the ratooning of a rice crop was used to indicate both the rationality of small farmer decision making and the fact that the institutional and attitudinal problems described in Chapter 4 can lead to perceived rather than real conflicts of interest between officials and farmers. Growing a ratoon crop was shown to be an efficient way of producing rice, from both a micro and a macro point of view, particularly in production systems that face constraints in access to machinery for land preparation, credit and water. Therefore, it was suggested that official Dominican policy towards ratooning should be directed at taking advantage of its production potential, among others, through the uses of the local knowledge developed with regard to this particular cropping system.

The influence of social and cultural factors on small farmer decision making and the nature of the local knowledge in the research areas

The conclusion, presented in Chapter 6, that social and cultural factors did not influence to an important extent farmer decision making in the AAR research areas appears to undercut the argument that social scientists have a significant role to play in diagnostic agricultural research. However, two arguments can be made against such an inference. The first is that it was exactly the execution of a research process based on social science methods, with a major input of social scientists, that generated the conclusion. The second argument is that the question must be asked if this finding can be generalized to other situations, or if it pertains specifically to the AAR research population. This question was briefly treated in Chapter 6, and it was concluded that the situation in the research areas can be considered characteristic for recently settled areas with heterogeneous populations, but atypical for situations where local populations have lived and practiced agriculture for centuries. The influence of cultural factors - for example, religion or magical beliefs - on farmer decision making, through the intertwining of practical-technological knowledge with metaphysical thought, can be assumed to be a result of long term processes measured in generations rather than years. The irrigated rice farming practiced by the research population, however, was obviously not a traditional occupation. At the time the research was executed, the vast majority of the investigated population had grown irrigated rice for less than 20 years, and in many cases less than 10 years.

Other factors that contributed to the almost exclusively "secular" character of the local knowledge on rice in the research areas were that the settlers shared a predominantly Latin, western cultural heritage with officials, and that, due to the fact that they came to the region from all over the Dominican Republic, communal, sanguineal and other social ties were weak. As a result, a "local" or "indigenous" culture was virtually non-existent. In addition, much of the technology base of the research population - semi-dwarf varieties, mechanical land preparation, direct seeding and the application of chemical inputs, to name but a few examples - could be defined as extraneous, originating from research and technological development elsewhere in the Dominican Republic and abroad. Thus, it can be concluded that neither the historical nor the socio-cultural context of irrigated rice farming was conducive to the generation of an indigenous body of knowledge, in which metaphysical aspects are interwoven with practical-technological knowledge.

However, the "secular" character and short history of rice cultivation in the research areas does not imply the absence of a body of local knowledge on rice cultivation. In spite of the predominance of extraneous technology, Chapters 5 through 9 yielded many examples of Mao and Nagua farmers developing a body of local knowledge on the basis of a process of adaptation of imported technology to prevailing local production conditions. This adaptation was either forced - in those cases where farmer production conditions inhibited integral adoption - or voluntary - in cases where farmers preferred alternative actions after empirical observation and experience made them conclude that those alternatives would serve them better. The described conflicts between officials and farmers can for a large part be reduced to the failure of the former to recognize the value of this indigenous farmer knowledge, both for the pinpointing of problems caused by major constraints in production conditions, and as a basis for technology development. The cases discussed in Chapters 5, 7, 8 and 9, i.e., the ratooning of rice crops, the sowing out of season of a second crop, and the late transplant of rice seedlings are all clear examples of this phenomenon.

Adapted methodology for diagnostic research

The central argument of this book is that an important social science contribution to applied agricultural research for small farmers can be made in the area of methodology. This contribution of what has been called adaptive research must be considered in relation to the currently dominant approach to applied agricultural research for the small farm sector, Farming Systems Research. Standard FSR diagnostic research tends to focus on the agronomical and economic aspects of small farm development, which are usually analyzed through a combination of rapid appraisal techniques and a survey. By broadening and deepening the diagnostic research process through the inclusion of qualitative research methods, shortcomings in current diagnostic research can be remedied and a firmer basis for technology development created. This qualitative analysis serves both to obtain a better understanding of the technical and economic factors influencing farmer decision making, and to take inventory of the influence of social, cultural and political factors on the farming system.

In addition, adaptive research aims to add a historical perspective to the standard FSR approach, with regard to both the development of the small farm systems being studied, and farmer decision-making. Finally, the AAR approach strives to increase farmer participation in technology development by strengthening the influence of the farmer's perspective in setting guidelines for research, and by taking indigenous technical knowledge as a basis for technology development.

Three specific methodological contributions to diagnostic research were discussed in this book. The first referred to the first step of the research process: the reconnaissance (also called sondeo, exploratory survey and rapid rural appraisal). In Chapter 6, a framework was presented to analyze, at this stage, in a global but systematic manner all factors that may influence farmer decision making, with the purpose of selecting for further analysis those that are considered to have the strongest impact. It was argued that the - qualitative - reasoning underlying this selection must be made explicit by indicating for each factor or group of factors, why it was selected or discarded for further analysis. It was this preliminary analysis, borne out by the information gathered in the case studies, that led to the conclusion that the main factors influencing farmer decision making were of an agro-infrastructural and economic nature: access to irrigation water, machinery for land preparation and credit, and plot levelling and drainage.

In Chapter 7, the second methodological contribution of adaptive research was discussed. It was argued that the combination of Rapid Rural Appraisal and formal survey are unlikely to yield a sufficiently thorough understanding of the complex interrelationships between agro-ecological, socio-economic and cultural factors in small farm systems. Therefore, it was suggested to complement these methods with a more qualitative, in-depth and participatory research method, the diagnostic case study. The results of the case study research presented in Chapters 7, 8 and 9 showed the method to be particularly apt for the detailed analysis of small farm production conditions, problems resulting from constraints in those conditions, and farmer adaptations in the form of locally developed technology.

In Chapter 9, the example of the late transplant of rice seedlings was used to indicate how the qualitative and quantitative social science research methods of reconnaissance, case studies and survey can be combined with agronomic trial research to provide guidelines for developing recommendations adapted to small farm production conditions. In this merger, the case studies are used for problem identification, the generation of information on the production conditions that cause specific problems, and ways that farmers cope with such problems through the adaptation of their agricultural practices. The survey yields information on the frequency with which the identified problems occur, as well as the frequency with which specific adaptations are practiced. Trial research, both on-station and on-farm, measures the impact the problems have on crop yields, and evaluates the effectiveness of farmer adaptations in limiting yield losses to acceptable levels. For the case of the late transplanting of rice it was shown how the combination of these research methods led to the conclusion that, in most instances, small rice farmers from the Nagua and Mao regions of the Dominican Republic acted rationally when, against official advice, they used seedlings that had remained in the seedbed longer than the recommended period of time. This resulted in the conclusion that the official recommendation should be adjusted to fit the specific combination of circumstances which were found to influence the effects of late transplanting: cycle length of the variety sown, environmental conditions and seedbed treatment.

The third methodological contribution to applied agricultural research, with both qualitative and quantitative components, was presented in Chapter 10. It concerns a method for classifying, according to their needs for new technology, small farming systems that are fairly homogeneous on the criteria commonly used for such classifications, i.e., production system and farm size, but are highly differentiated on other variables that are important for determining needs for new technology. The discussed method is relevant for defining what in FSR terminology are called recommendation domains: groups of farmers for whom specific technologies, to be developed after the diagnostic stage of the research process, will be equally relevant. Categorization of the farmers of the three research areas took place on the basis of the above mentioned production conditions - access to water, credit and machinery, and plot conditions regarding levelling and drainage - and was used to differentiate between farmers on several variables relevant to technology development. The results were used to define two recommendation domains, for farmers with "good" and "poor" production conditions, and to make recommendations for the development of appropriate technology for each.

A main task for the social scientist in interdisciplinary diagnostic research: methodology specialist

In Chapter 8, specific attention was paid to the task of the social scientist - rather than social science in general - in diagnostic research for technology development. It was argued that diagnostic research necessarily depends for an important part on the recollection of information through interviewing. The interview, in all its variations, is a social science method and the systematic recollection, processing and analysis of information obtained through interviewing is the domain of the social scientist. Considering the limited training of biological scientists and economists in the methodological aspects of research based on interviewing, the methodological contributions of a social scientist to an interdisciplinary team engaged in diagnostic research are of primary importance. Thus, it was argued that from a methodological point of view alone there is sufficient justification for incorporating social scientists in technology development programmes directed at the small farm sector - even in cases where diagnostic research is primarily concentrated on agronomic or economic subjects.

The presented argument can be strengthened by pointing to the importance, suggested in this book, of qualitative research for gaining systematic insight and understanding of complex small scale farming systems, and of the perceptions of the people that manage them. If the knowledge of agronomists and, to a lesser extent, economists, of social science methodology in general is limited, this is even more the case for qualitative research. This points, then, to an additional need for the incorporation of sociologists and anthropologists in interdisciplinary teams involved in technology development for small farmers.

Chapter 8 also discussed the conditions that should be met for the successful incorporation of social scientists in interdisciplinary research teams. The first is the ability of the social scientist to function in an interdisciplinary team. This implies a basic knowledge of the methods and subject matter of the other disciplines involved, particularly agronomy and economics. This knowledge is essential not only for the understanding of and communication with other scientists, but also for making the kind of thorough inventory that is the main objective of diagnostic research. The second condition is that social scientists should present workable results in a relatively short time. This implies that a certain amount of scientific rigor will have to be traded for speed, so as to obtain, in a rapid, cost effective way, knowledge that can serve as a basis for technology development.

Balancing official and farmer priorities

In the particular case of the Dominican Republic, this book has indicated that the orientation and priorities for rice research were set by the Government with the objective of attaining national self-sufficiency in rice production. This approach resulted in the selection for research of those topics which, in the short term, were expected to have the highest impact on national rice productivity. Although this approach was partly successful, it led to a bias towards the larger farmers with good access to essential production factors, and to the exclusion from agricultural research of topics that were related to the constraints in production conditions suffered by small farmers. For example, the cases presented in this book of the late transplant of rice seedlings and the sowing out of season of a rice crop were not recognized by officials as a problem, let alone investigated. Similarly, rice research was directed at the development of high yielding technology under good production conditions, rather than the creation of technology "adapted" to deficient production conditions. Consequently, no attention was paid to, for example, the creation of varieties tolerant to drought, flooding and unfavorable climatic conditions, and there was no research on the practice of ratooning. Indeed, the whole concept of adapting technology to production conditions rather than the other way around was anathema for most officials.

Interestingly, even though rice farmers themselves were found to continually adapt technology, the concept of *researchers* adapting technology to production conditions appeared to be as unconventional to them as it was to researchers. Farmers did not suggest investigating the problems of late transplanting or sowing out of season, or the breeding of rice cultivars tolerant to unfavourable conditions. Rather, in agreement with researchers, they emphasized the need to resolve the constraints in those conditions: to improve the water management infrastructure, to increase the availability of machinery for land preparation and credit, etcetera. One can suggest several reasons for this phenomenon. In the first place, farmers were unfamiliar with the concept of agricultural research as problem solving. New technology came either from the research station (for the few farmers who had visited research stations or had been in contact with researchers in other ways) or out of the blue (for those who had not), and was presented - by extension agents, salesmen of chemical inputs, the mass media or other farmers - as an improvement over current practices. Presented with the alternatives, farmers adopted, adapted or rejected the new techniques. However, the concept of small farmers suggesting researchers to investigate specific problems was found to be as alien to farmers as it was to researchers.

Another reason for farmers not suggesting to investigate the problems of late transplant and sowing out of season was that they, like rice researchers and other officials, considered that problems due to constraints in production conditions should be solved through the elimination of those constraints rather than the development of adapted technology. In other words, instead of asking for rice varieties more tolerant to late transplanting or the adverse climatic conditions of sowing out of season, they demanded better access to irrigation water and machinery for land preparation. Since these services were monopolized by government institutions, farmers looked to the State for the solution of these infrastructural problems. Particularly in cases where farmers saw that access to irrigation water, machinery and credit were better arranged for in other Land Reform Projects or even in other sectors within the same Project - as was the case in El Pozo - they demanded better conditions, rather than technology to alleviate the effects of inferior production conditions.

The question may be asked if in situations like the one described, it is legitimate for a researcher to offer recommendations for technology development to agricultural researchers that do not enjoy the whole hearted support of farmers. Or, in other words, is it congruent with the "farmer first" model that the research team offers their own recommendations to the problem encountered (in this case, adapted technology) rather than those suggested by farmers (improvement of conditions)? It will have become clear in this book that the author's standpoint is that both questions should be answered affirmatively. The main justification is that researchers applying the model have better criteria than farmers to evaluate the feasibility of the solutions proposed by farmers. In many instances, the farmers' call for the improvement of production conditions cannot or will not be heeded, due to a lack of state resources, other government priorities, or the fact that the major infra-structural improvements needed are not economically feasible. It is logical that farmers are not aware of or interested in the fact that the State's financial situation does not allow for any major investments in their region's infrastructure and that consequently other, cheaper solutions must be sought. The agricultural researcher however, also when working along the lines of the "farmer first" model, has both the task and the responsibility to take into account the economic and political realities of the situation. That may imply suggesting a less than optimal solution for the farmer population that is targeted for development, as is the case when the option to adapt technology rather than improve production conditions is chosen.

Some final considerations and recommendations

The three principal recommendations made in this book are to incorporate non-economic social scientists into interdisciplinary research teams, to have them assume a primary role in all questions regarding the methodology of the diagnostic research process, and to incorporate into that process the diagnostic case study. The final conclusion is, then, that even in a context where social and cultural factors do not play a major role in farmer decision making the social scientist has an important contribution to make to agricultural research, namely as a specialist in all matters concerning the recollection and analysis of data obtained through interviewing farmers.

Apart from the methodological issue, another important contribution of the social scientist that has come to the fore in the AAR research is that of fostering communication between farmers and the biological scientists responsible for technology development. However, it should be remembered that, important though the latter role of "two-way translator" may be, it does not in principle require the specific skills of a social scientist. At least in the Dominican situation, biological scientists with the necessary openness, flexibility and a constructive attitude towards small farmers and their knowledge do not need a social scientist to be able to communicate and understand. That does not mean that in the Dominican Republic such understanding is not still a long way off, or that social scientists could not play, for many years to come, an important role in furthering it. It does mean that it is a role for which a social scientist is well equipped, but not essential. Even more important, to further successful technology development, it is imperative that the social scientist strives to make him- or herself superfluous in this "two way translator" role, by fostering direct communication and understanding between biological researchers and farmers.

The fact that in this book no specific recommendations are made regarding possible roles of the social scientist in the post-diagnostic research process, that is, in actual technology development, does not imply that such roles do not exist or would be of lesser relevance. Rather, it is a result of the fact that the experiences in the rice research component of the AAR project do not provide a sufficient basis for such recommendations. Due to a number of circumstances, the on-farm rice research was executed almost entirely by Dutch agronomy students with attitudes much more conducive to researcher-farmer cooperation than those normally found among researchers and other officials (one fact pointing to such "deviant" attitudes is that the students involved lived in the field, either with the families of the farmers with whom they executed the trials or with other farming families living nearby). Although the students received general supervision from Dominican rice researchers and the AAR team's social scientists, the actual input of these supervisors with regard to day-to day trial management and researcher(student)-farmer interaction was small. It would, of course, have been extremely interesting for the social scientist to follow and analyze the researcher(student)-farmer interaction from nearby; however, due to other project responsibilities this was impossible. The further definition of the role of the social scientist in on-farm research is therefore left to other authors - among others, Box (1989a, 1989b) makes useful suggestions on the basis of the experiences in the cassava component of the AAR project - and for future studies.

Interdisciplinary research is full of pitfalls, as a number of authors have indicated, and the successful incorporation of social scientists in agricultural research teams will have to surmount many obstacles. The only feasible starting point for doing so is to create a mutual understanding between the practitioners of the different disciplines involved and to create realistic expectations about the results of each others' work. The basis of such understanding is a minimum of both methodological and conceptual knowledge of the disciplines of other team members. Therefore, the social scientist who goes to work in an interdisciplinary agricultural research team should have a basic knowledge of agronomy as well as of agricultural economics. Similarly, the agronomist should have a basic knowledge of similar aspects of the social sciences, both methodological and conceptual. In many instances, it may be necessary as a first step in interdisciplinary cooperation to supply each other which such basic knowledge. Although the suggestion to have the members of an applied agricultural research programme start out with tutoring each other in some of the basics of each others' disciplines may seem somewhat eccentric, the failure to have this kind of exchange at the beginning of the programme is bound to lead to misunderstandings later on in the research process. Through a number of intensive sessions, and the provision of other team members with some elementary literature on one's own discipline, a couple of days can serve to create a basis for mutual understanding. This understanding, in turn, will greatly contribute to avoiding many of the pitfalls of inter- and multidisciplinary research described to some extent in this book and more elaborately elsewhere.

As was made explicit in Chapter 8, the expectations of social science participation by other members of interdisciplinary teams will be high: results that can serve as the basis for initiating actual technology development will be expected within months, and sometimes less. In this respect, the most difficult task of the social scientist is to find a balance between complying, to the extent possible, with the time given for diagnostic research on the one hand, and generating knowledge sufficiently reliable to serve as a basis for technology development on the other. Compromises will have to be made from both sides: as indicated in Chapter 8, the social scientist will have to sacrifice some thoroughness for speed, and the other team members will have to accept that a social scientist can not do the impossible. The exchanges between disciplines mentioned in the above are important to create, among all parties involved, the mutual understanding that is necessary for these sacrifices.

The social scientist can speed up the completion of a first cycle of diagnostic research to a considerable extent by not engaging in the complete analysis of data and elaboration of reports. Instead, preliminary analyses and reports should be elaborated rapidly as a basis for initiating technology development, while detailed analyses and the elaboration of final reports is realized - as quickly as possible - after the diagnostic stage, when the biological scientists are fully engaged in technology development. Similarly, more time consuming social science methods such as participant observation, extremely useful and in some instances indispensable for obtaining specific kinds of information as well as for crosschecking data obtained through other research techniques, can be used after the problem identification stage.

The above obviously implies that diagnostic research is not limited to the initial stage of the research process, but continues after a first set of guidelines for technology development has been formulated and the corresponding research has been initiated. This, in turn, means that the possibility should be held open to make adjustments to that first set of guidelines, and that biological scientists should have the necessary flexibility to adapt their research accordingly. Summarizing: the adaptive agricultural research process should not be considered as a rigidly structured process in which each stage ends with the start of the next, but rather as a flexible, reiterative and dynamic process in which the research stages overlap and interact, and in which the practitioners are able and willing to make adjustments as the need arises.

A final question that should be addressed concerns the cost of incorporating social scientists in applied agricultural research teams. Even if planners and policy makers can be convinced of the theoretical and practical necessity of doing so, many are bound to point to their limited budgets. Gladwin, in her contribution to a 1980 reader on the use of indigenous knowledge for development (Brokensha et al. 1980) gives a satisfying answer, when stressing that knowledge of farmers' reasoning is as necessary an input to successful rural development as scientific agronomic and economic knowledge. Those - non-social - scientists who claim that they lack the time and skills to "delve into farmer's reasoning", should consider what the alternatives are to such delving and what the ultimate costs will be of generating technology without it. As an example, Gladwin points out that if at the start of one of the best known agricultural development projects, the Plan Puebla in Mexico in which CIMMYT scientists played a major role, project planners had elicited farmers' decision criteria and their strategies to grow corn, specific recommendations - not followed by farmers - would not have been made. With this example she implicitly suggests that many man-years of work, and thus, a major amount of funds, could have been given a more productive use. In other words: the resources invested in technology development, almost always a several-year process, are too large to risk starting off on the wrong foot, and the incorporation of a social scientist in the research team can contribute importantly to avoiding such costly mistakes.

APPENDIX: The scoring procedure used for the categorization of the 242 rice farmers surveyed

As in the case studies, each of the five factors used for categorization was allocated a maximum of 3 and a minimum of 0 points. The score per factor was determined on the basis of the answers to questions referring, first, to the farmer's personal evaluation of the five factors, and secondly, to production problems which might have been caused by constraints in them. The farmer's personal evaluation was used to indicate the maximum score on a particular factor, and was arrived at by asking the farmer if he considered the conditions in his farm for that factor as "good", "regular" or "poor". The answer "good" was given the maximum score at 3, "regular" would bring it down to 2.2. and "poor" to 1.4.

The inventory of production problems was made by counting the number of times each problem was mentioned as the cause of yield losses, of delays in land preparation or transplanting, or on the omission of an entire cropping cycle. For each cropping cycle that a farmer did not sow at all as a consequence of a constraint in one of the five factors, one point was subtracted from the maximum of three of that particular factor. Half a point was subtracted for each cropping cycle in which such constraints had resulted in lower yields or delays in land preparation or transplanting a crop.

If the total number of points arrived at according to the inventory of production problems was less than the maximum value for the factor attributed on the basis of the farmer's judgement, the former would be used. If it was greater, the score determined by the farmer's judgement was taken as the final score. For instance, if a farmer reported regular drainage of his plot (maximum value 2.2), and two cropping cycles in which no crops were sown because of flooding (subtraction of 2 points of the maximum value of 3), the final value for the factor drainage would be 1, the value arrived at on the basis of the problems reported, since this score is lower than that determined by the farmer's judgement. However, if this same farmer only reported one cropping cycle in which yields were reduced as a consequence of flooding, requiring the subtraction of only 0,5 points from the maximum of 3 points, the final value for "drainage" would be that of the farmer's judgement, 2.2, since it is lower than the 2.5 arrived at on the basis of the problems reported.

ABBREVIATIONS

AAR	Adaptive Agricultural Research project
CECARA	Centro Nacional de Capacitación Arrocera
CEDIA	Centro de Investigaciones Arrocera
CENACA	Centro Nacional de Capacitación
CENDA	Centro de Desarrollo Agropecuario Zona Norte
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIP	International Potato Center
CIMMYT	International Maize and Wheat Improvement Center
ICTA	Instituto de Ciencias y Tecnológia Agrícolas (Guatemala)
IDA	Instituto Agrario Dominicano
INDHRI	Instituto Nacional De Recursos Hidráulicos
INESPRE	Instituto de Estabilización de Precios
IRRI	International Rice Research Institute
ISA	Instituto Superior de Agricultura
ISNAR	International Service for National Agricultural Research
PROSEMA	Programa de Servicios de Maquinarias Agrícolas
SEA	Secretaría de Estado de Agricultura

REFERENCES

ALMANAQUE MUNDIAL (1987), *Almanaque Mundial: El Mundo Hispânico.* Editorial America S.A., Panamá.

ALMANAQUE MUNDIAL (1988), *Almanaque mundial: El Mundo Hispânico.* Editorial America S.A., Panamá.

ANDERSON, J.R. & J.B. HARDAKER (1979), Economic analysis in the design of new technologies for small farmers, in: Valdes, A., G.M. Scobie & J.L. Dillon, eds., Economics and the design of small farmer technology. Iowa State University, Ames, Iowa.

ASHBY, J.A. (1986), Methodology for the participation of small farmers in the design of on-farm trials. *Agricultural Administration* 22: 1-19

BANCO CENTRAL (1977), Estudio sobre presupuestos familiares. Tomo II. Santo Domingo, Dominican Republic.

BARKER, R., & W.F. WHYTE (1983), Reorienting the social sciences, in: W.F. Whyte & D. Boynton, Higher-yielding human systems for agriculture. Cornell University Press, Ithaca, New York.

BARTLETT, C.D.S. & J.M. FAJEMISIN (1981), The social scientist's role in generating innovations for small farmers: maize in Nigeria. *Exploratory Agriculture* 17: 373-382

BEEBE, J. (1985), Rapid rural appraisal: The critical first step in a farming systems approach to research. *FSSP Network Paper No.5*, Farming Systems Support Project, University of Florida, Gainesville, Florida.

BOX, L. (1981a), Cultivation and Adaptation: An essay in the sociology of agriculture. *Sociologia Ruralis* XXI (2): 160-176

BOX, L. (1981b). Investigación Agrosociológica sobre yuca y arroz: Propuesta general. IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

BOX, L. (1989a), Knowledge, networks and cultivators: cassava in the Dominican Republic, in: Long, N., Encounters at the Interface. A perspective on social discontinuities in rural development, in: Wageningen Studies in Sociology: 27. Wageningen Agricultural University, The Netherlands.

BOX, L. (1989b), Virgilio's theorem: a method for adaptive agricultural research, in: Chambers, R., A. Pacey & L.A. Thrupp, eds., Farmer first: farmer innovation and agricultural research. Intermediate technology publications, London.

BOX, L., & F. DOORMAN (1985), The adaptive farmer: Sociological contributions to adaptive agricultural research on cassava and rice cultivation in the Dominican Republic. Preliminary version. IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

BOX, L., et al. (1987), Adaptive Agricultural Research Project, 1981-1985, the Dominican Republic: collected reports and papers. IDC Microform Publishers, Leiden / Department of Sociology of Rural development, Wageningen Agricultural University, The Netherlands.

BRAVO, C. (1983), Informe del Consultor. Informe a la FAO, Proyecto TPC/DON/2201, Santo Domingo, Dominican Republic.

BROKENSHA D. & B. RILEY (1977), Vegetation changes in Mbere division, Embu. Institute for Development Studies, Nairobi.

BROKENSHA, D., D.M. WARREN & O. WERNER (eds.) (1980), Indigenous Knowledge Systems and Development. University Press of America, Lanham, Maryland.

BRUSH, S.B. (1980), Potato taxonomies in Andean agriculture, in: D. Brokensha, D.M. Warren & O. Werner, eds., Indigenous knowledge systems and development. University Press of America, Lanham, Maryland.

BRUSH, S.B. (1986), Basic and applied research in Farming Systems: an anthropologists's appraisal. *Human Organization* 45 (3): 220-228.

BYERLEE, D., M.P. COLLINSON, R.K. PERRIN, D.L. WINKELMANN, S. BIGGS, E.R. MOSCARDI, J.C. MARTINEZ, L. HARRINGTON & A. BENJAMIN (1980), Planning technologies appropiate to farmers: concepts and procedures. CIMMYT, El Batan, Mexico.

CASLEY, D.J. & LURY, D.A. (1982), Monitoring and evaluation of agriculture and rural development projects. World Bank / Johns Hopkins University Press, Baltimore.

EDIA (1974), Experimento sobre la edad de las plántulas, fertilización y marcos de plantación, in: *Memoria Anual 1974*: 56-58, Secretaría de Estado de Agricultura, Juma, Bonao, Dominican Republic.

CHAMBERS, R. (1979), Editorial, in: IDS, Rural development: whose knowledge counts? *IDS Bulletin* 10 (2): 44-51

CHAMBERS, R. (1980), The small farmer is a professional. *Ceres* 13 (2): 19-24

CHAMBERS, R. (1983), Rural development: Putting the last first. Longman, London.

CHAMBERS, R. (1984), Shortcut methods in social information gathering for rural development projects, in: Michael M. Cernea (ed.), Putting people first: Sociological variables in development projects. Oxford University Press, Oxford.

CHAMBERS, R., & B.P. GHILDYAL (1985), Agricultural research for resource-poor farmers: The farmer-first-and-last model. *Agricultural Administration* 20 (1): 1-30

CHAMBERS, R., A. PACEY & L.A. THRUPP, eds. (1989), Farmer first: farmer innovation and agricultural research. Intermediate technology publications, London.

CHECO, H. & P. AZCONA (1982), Anotaciones para la historia del arroz (Oryza sativa, L.) en la República Dominicana (1900-1980). Graduate thesis, Instituto Superior de Agricultura, Santiago, Dominican Republic.

COLE, M., J. GAY, J.A. GLICK, D.W. SHARP (1971), The cultural context of learning and thinking. Methuen & Co. Ltd., London.

COLLINSON, M. (1981), A low cost approach to understanding small farmers. *Agricultural Administration* 8: 433-450

COLUMNA DIAZ, M. & R.A. CEDANO CRUZANO (1984), Efecto del número de plántulas por golpe en el rendimiento de arroz (Oryza sativa) trasplantado con plántulas viejas. Graduate thesis, Instituto Superior de Agricultura, Santiago, Dominican Republic.

CORDERO MORA, J.M. (1978), Areas arroceras de la República Dominicana. Departamento de Fomento Arrocero, Secretaría de Estado de Agricultura, Santo Domingo, Dominican Republic.

CUEVAS PEREZ, F. (1980), Inheritance and associations of six agronomic traits and stem-base carbohydrate concentration on ratooning ability in rice (Oryza sativa, L.). PhD Thesis, Crop Science Department, Oregon State University.

CUEVAS PEREZ, F. (1983), Informaciones sobre arroz. Instituto Superior de Agricultura, Santiago, Dominican Republic.

CUEVAS PEREZ, F. & A. NUÑEZ JIMENEZ, (1981), El costo de producción y la eficiencia de retoño del arroz en la República Dominicana. Instituto Superior de Agricultura, Santiago, Dominican Republic / CIAT, Cali, Colombia.

DEWALT, B.R. (1985), Anthropology, sociology and farming systems research. *Human Organization* 44 (2): 106-114

DOORMAN, F. (1983), Adopción y adaptación en el uso de tecnología en la producción de arroz. Resultados del estudio de casos en el cultivo de arroz entre pequeños productores de la región de Nagua. IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

DOORMAN, F. (1984), Who knows? Adaptive strategies among rice cultivators in Dominican Republic land reform projects. Paper presented at the 1984 Caribbean Studies Association Conference on Strategies for Progress in the post-independence Caribbean, StKitts. IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

DOORMAN F. (1986a), Condiciones, rendimientos e ingresos en el cultivo del arroz: Resultados de una encuesta entre 242 arroceros de la Reforma Agraria en las zonas de Mao y Nagua. IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

DOORMAN, F. (1986b), Qué pasa? Evaluación del sistema de generación y transferencia de tecnología en la producción arrocera en la Republica Dominicana. IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

DOORMAN, F., & L. BOX (1985), Contribuciones Agro-sociológicas a las Investigaciones Agrícolas en Yuca y Arroz: Informe final de la Investigación Agrosociológica sobre yuca y arroz (1981-1984). IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

DOORMAN, F., & F. CUEVAS PEREZ (1984), Farmers adaptations to production constraints and its implications for agricultural research: the case of rice production systems in the Dominican Republic. Paper presented at the 20th Annual Meeting of the Caribbean Food Crops Society, St.Croix, October 21-26, 1984. IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

DUSSELDORP, D.B.W.M. VAN (1977), Some thoughts on the role of social sciences in the agricultural research centres in developing countries. *Netherlands Journal of Agricultural Science* 25: 213-228

DUSSELDORP, D. VAN, & L. BOX (1989), Sociologists in agricultural research. Major findings of two research projects in the Dominican Republic and the Philippines. Department of Sociology of Rural Development, forthcoming in: Wageningen Studies in Sociology, 30, 1991. Wageningen Agricultural University, The Netherlands.

FLORA, C.B. (1988), Farming systems approaches to international technical cooperation in Agriculture and Rural Life. *Agriculture and Human Values* 5 (1,2): 24-34

FRESCO, L.O. (1984), Issues in farming systems research. *Netherlands Journal of Agricultural Science* 32: 253-261

GALJART, B.F. (1968), Itaguaí. Old habits and new practices in a Brazilian land settlement. PhD. thesis, Wageningen Agricultural University, The Netherlands.

GARRETT, P. (1984), The relevance of structural variables for farming systems research. *Rural Sociology* 49 (4): 580-589

GARRETT, P. (1986), Viable objectives for smallholder programs: variations by social strata. *Agricultural Administration* 22: 39-55

GHOSH, D.C. (1982), Effect of age of seedlings and planting density on growth and yield of rice under late planting. *Madras Agricultural Journal* 69: 376-380

GILBERT, E.H., D.W. NORMAN & F.E. WINCH (1980), Farming Systems Research: A critical appraisal. *MSU Rural Development Paper* 6, Michigan State University. East Lansing, Michigan.

GLADWIN, C. (1980), Cognitive strategies and adoption decisions: a case study of nonadoption of an agronomic recommendation, in: D. Brokensha, D.M. Warren & O. Werner, eds., Indigenous knowledge systems and development. University Press of America, Lanham, Maryland.

GLADWIN, C.H. (1983), Contributions of decision tree methodology to a Farming Systems Program. *Human Organization* 42 (2): 146-57

GOODELL, G.E., P.E. KENMORE, J.A. LITSINGER, J.P. BANDONG, C.G. DE LA CRUZ, & M.D. LUMABAN (1982), Rice insect pest management technology and its transfer to small scale farmers in the Philippines, in: IRRI, The role of anthropologists and other social scientists in interdisciplinary teams developing improved food production technology: Report of an exploratory workshop. IRRI, Los Baños, Philippines.

GROOT, J.P. DE (1983), Cómo evaluar el retoño en el cultivo del arroz. Centro de Investigaciones Económicas y Alimenticias, Instituto Superior de Agricultura, Santiago, Dominican Republic.

GUTIERREZ, A.T. (1983), Nota técnica de la Reforma Agraria Dominicana. CADER, Instituto Superior de Agricultura, Santiago, Dominican Republic.

HAGENS, P. (1986), Transplanting old rice seedlings in the Dominican Republic. Graduate thesis, Department of Tropical Crop Science, Wageningen Agricultural University, The Netherlands.

HAGENS, P. & F. DOORMAN (1985), El trasplante atrasado en el cultivo del arroz. Resultados de experimentos sobre el trasplante del arroz (Oryza sativa) con plántulas mayores de 45 días en la región de Nagua, Rep. Dominicana. IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

HARRINGTON, L.W., & R. TRIPP (1984), Recommendation domains: a framework for on-farm research. Economics Program Working Paper 02/84, CIMMYT, Mexico DF.

HILDEBRAND, P.E. (1981), Combining disciplines in rapid appraisal: the sondeo approach. *Agricultural Administration* 8: 423-432

HORTON, D.E. (1984), Social scientists in agricultural research: lessons from the Mantaro Valley Project, Peru. Publication IDRC-219e, International Development Research Centre, Ottawa.

HORTON, D. (1986), Farming Systems Research: Twelve lessons from the Mantaro Valley Project. *Agricultural Administration* 23: 93-107

HOWES, M. (1979), The uses of indigenous technical knowledge in development, in: IDS, Rural development: whose knowledge counts? *IDS Bulletin* 10 (2): 44-51

IAD (1982), *Boletín Anual*. Instituto Agrario Dominicano, Santo Domingo, Dominican Republic.

IAD (1983), *Boletín Estadístico 1983*). Instituto Agrario Dominicano, Santo Domingo, Dominican Republic.

IDS (1979), Rural development: whose knowledge counts? *IDS Bulletin* 10 (2), Institute of Development Studies, University of Sussex, Brighton.

IDS WORKSHOP (1989), Farmer's knowledge, innovations and relation to science, in: R. Chambers, A. Pacey & L.A. Thrupp, eds., Farmer first: farmer innovation and agricultural research. Intermediate technology publications, London.

INESPRE (1981a), *Boletín Estadístico 1980*. Instituto de Estabilización de Precios, Santo Domingo, Dominican Republic.

INESPRE (1981b), Plan Operativo 1981-1982. Santo Domingo, Dominican Republic.

IRRI (1982), The role of anthropologists and other social scientists in interdisciplinary teams developing improved food production technology: Report of an exploratory workshop. IRRI, Los Baños, Philippines.

IRRI (1985), Identifying rainfed rices for late transplanting. Annual Report for 1984: 26-27. International Rice Research Institute, Los Baños, Philippines.

ISNAR (1983), El sistema de investigación agropecuaria en la República Dominicana: análisis, evaluación y propuestas para su fortalecimiento. Draft. International Service for National Agricultural Research, The Hague, Netherlands.

JANVRY, A. DE, & L. CROUCH (1981), Technological change and peasants in Latin America. PROTAAL Document 56, IICA, San José, Costa Rica.

JOHNSON, A.W. (1971), Individuality and experimentation in traditional agriculture. *Human Ecology* 1 (2): 149-159.

KAILASAM, C., & T.G. RAMAMURTHI (1978), Planting date and seedling age effect on duration and yield of CO.40, *Aduthuran Report* 2: 51-53

KELLER SHUEY, B.D. (1985), The role of anthropology in renewable resource management: implications for farming systems research and extension. MSc. Thesis, Program in Environmental Science and Regional Planning, Washington State University, Washington.

LONG, N. (1984), Creating space for change: a perspective on the sociology of development. Inaugural lecture. Wageningen Agricultural University, The Netherlands.

LONG, N. ed. (1989), Encounters at the Interface. A perspective on social discontinuities in rural development. Wageningen Studies in Sociology: 27, Wageningen Agricultural University, The Netherlands.

LORA ULLOA, R.A., & V.M. PERSIA MORA (1985), Contribución de las variedades mejoradas al aumento de la productividad de arroz en la República Dominicana, 1970-1984. Graduate thesis, Instituto Superior de Agricultura, Santiago, Dominican Republic.

MAXWELL, S. (1986a), The role of case studies in Farming Systems Research. *Agricultural Administration* 21:147-180

MAXWELL, S. (1986b), The social scientist in Farming Systems Research. *Journal of Agricultural Economics* XXXVII (1): 25-35.

McCORKLE, C.M. (1989), Toward a knowledge of local knowledge and its importance for agricultural RD&E. *Agriculture and Human Values* VI (3): 4-12

MENDEZ, F. & F. DOORMAN (1984), Diferenciación y adaptación en la producción de arroz. Resultados del estudio de casos en el cultivo de arroz entre pequeños productores en la región de Nagua. IDC Microform Publishers, Leiden/Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

MERRILL-SANDS, D., P. EWELL, S. BIGGS & J. McALLISTER (1989), Issues in institutionalizing on-farm client-oriented research: a review of experiences from nine national agricultural research systems. ISNAR, The Hague, The Netherlands.

MURTY, K.S., & G. GAHU (1979), Effect of age of seedlings at normal transplanting on growth and yield of rice varieties. *Indian Journal of Agricultural Science* 49: 797-801

NWEKE, F.I. (1981), Determinants of agricultural progressiveness in the smallholder cropping system of southeastern Nigeria and consequences for research and extension administration. *Agricultural Administration* 8: 163-176

OASA, E.K. (1985), Farming Systems Research: a change in form but not in content. *Human Organization* 44 (3): 219-227.

OMNIDATA-EFE (1986), Nuestro mundo 1985/1986. Banco de Informaci6n, Agencia EFE, Espasa Calpe, Madrid.

PADALIA, C.R. (1980), Effects of age of seedlings on the stand establishment of transplanted rice under medium and lowland conditions. *Oryza* 17: 139-141

PADALIA, C.R. (1981), Effect of age of seedlings on the growth and yield of transplanted rice. *Oryza* 18: 165-167

PEREZ LUNA, A. (1979), Factors associated with the diffusion of innovations in rice cultivation in the Dominican Republic. PhD dissertation, University of Florida, Gainesville.

PEREZ RODRIGUEZ, F. (1983), Edad 6ptima para transplante manual y mecanizado en variedades de arroz de portes diferentes. Centro de Investigaciones Arroceras, Juma, Bonao, Dominican Republic.

PERRIN, R.K., D.L. WINKELMANN, E.R. MOSCARDI & J.R. ANDERSON (1976), From agronomic data to farmer recommendations: an economics training manual. CIMMYT, Mexico DF.

PLOEG, J.D. van der (1989), Knowledge systems, Methaphor and Interface: The case of potatoes in the Peruvian highlands, in: Long (ed.) Encounters at the Interface. A perspective on social discontinuities in rural development. Wageningen Studies in Sociology: 27, Wageningen Agricultural University, The Netherlands.

PURSEGLOVE, J.W. (1985), Tropical Crops. Monocotyledons. Longman, London.

RAJENDRA, P., & S.N. REDDY (1980), Nursery management studies in paddy (Oryza sativa L.). *International Rice Commission Newsletter* 29: 35-38

RHOADES, R.E. (1982), The Art of the Informal Agricultural Survey. Social Science Dept. Training Document 2, CIP, Lima, Peru.

RHOADES, R.E. (1984), Breaking new ground: Agricultural anthropology. CIP, Lima, Peru.

RHOADES, R.E. (1986), Using anthropology in improving food production: problems and prospects. *Agricultural Administration* 22: 57-78

RHOADES, R.E. & R. H. BOOTH (1982), Farmer-back-to-farmer: A model for generating acceptable agricultural technology. Working paper 1982-1, Social Science Department, CIP, Lima, Peru.

RHOADES, R., R. BOOTH, R. SHAW & R. WERGE (1982), Interdisciplinary development and transfer of postharvest technology at the International Potato Center, in: IRRI, The role of anthropologists and other social scientists in interdisciplinary teams developing improved food production technology: Report of an exploratory workshop. IRRI, Los Baños, Philippines.

RHOADES, R.E., P. BATUGAL & R.H. BOOTH (1985a), Turning conventional agricultural research and development on its head: the farmer-back-to-farmer approach. Reprint from: Applied agricultural research for small farms in Asia, FFTC Book Series No. 31.

RHOADES, R.E., D.E. HORTON, & R.H. BOOTH (1985b), Anthropologist, biological scientist and economist: the three musketeers or three stooges of Farming Systems Research? in: J.R.Jones & B.J. Wallace, eds., Social Sciences and Farming Systems Research: Methodological Perspectives on Agricultural Development. Westview Press, Boulder, Colorado.

RICHARDS, P. (1980), Community environmental knowledge in African rural development, in: D. Brokensha, D.M. Warren & O. Werner, eds., Indigenous knowledge systems and development. University Press of America, Lanham, Maryland.

RICHARDS, P. (1989), Agriculture as a performance, in: R. Chambers, A. Pacey & L.A. Thrupp, eds., Farmer first: farmer innovation and agricultural research. Intermediate technology publications, London.

RIKKEN, B., & F. DOORMAN (1984), La siembra fuera de época en el cultivo del arroz (Oryza sativa): Informe sobre una prueba experimental y dos pruebas adaptivas ejecutadas en la región de Nagua, República Dominicana, in: IDC Microform Publishers, Leiden / Department of Sociology of Rural Development, Wageningen Agricultural University, The Netherlands.

ROGERS, E.M. (1969), Modernization among peasants. The impact of communication. Holt, Rinehart and Winston, Inc., New York.

ROGERS, E.M. (1983), Diffusion of innovations. The Free Press, New York.

ROSARIO JAQUEZ, O.R., & R.M. ROSARIO YAPORT (1984), Efecto de diferentes niveles de nitrógeno en el rendimiento de arroz transplantado a diferentes edades de planta. Graduate thesis, Instituto Superior de Agricultura, Santiago, Dominican Republic.

RUTTAN, V.W. (1982), Agricultural Research Policy. University of Minnesota Press, Minneapolis, Minnesota.

SAINT, W.S. & E.W. COWARD (1977), Agriculture and behavioral science: emerging orientations. *Science* 197: 733-737

SCOBIE, G.M. & R. POSADA (1977), El impacto de variedades de arroz con altos rendimientos en América Latina, con énfasis especial en Colombia. CIAT, Cali, Colombia.

SEA (1981), Programa Nacional de Investigación en Arroz (1980-1982), Santo Domingo, Dominican Republic.

SHAHI, H.N., & P.N. GILL (1977), Quantitative relationship of grain yield and its components to age of seedlings under different dates of transplanting in rice. *Indian Journal of Agronomy* 22: 140-144

SHANER, W.W., P.F. PHILIPP & W.R. SCHMEHL (1982), Farming Systems Research and Development: guidelines for developing countries. Westview special studies in agriculture/aquaculture, Westview Press, Boulder, Colorado.

SHARMA, G.L., R.C. GAUTAME & P.S. BISHT (1979), Effect of seedling age and number per hill on grain yield of rice varieties. *International Rice Research Newsletter* 4: 19-20

SIMMONDS, N.W. (1985), Farming Systems Research: A review. World Bank Technical Paper Number 43, The World Bank, Washington D.C.

SIMMONDS, N.W. (1988), Observations on Induced Diffusion of Innovations as a Component of Tropical Agricultural Extension Systems. *Agricultural Administration and Extension* 28: 207-216

STANFIELD, D. (1985), An inquiry into the management models used in the Dominican Republic's agrarian reform "asentamientos". Land Tenure Center, University of Wisconsin, Madison, Wisconsin.

STONE, L., & J. GABRIEL CAMPBELL (1984), The use and misuse of surveys in international development: an experiment from Nepal. *Human Organization* 43 (1): 27-37

SUTHERLAND, A. (1987), Sociology in Farming Systems Research. *Agricultural Administration Unit Occasional* Paper 6, ODI, London.

SWIFT, J. (1979), Notes on traditional knowledge, modern knowledge and rural development, in: IDS, Rural development: whose knowledge counts? *IDS Bulletin* 10 (2): 41-43

TRIPP, R. (1985), Anthropology and on-farm research. *Human Organization* 44 (2): 114-124

VALDES, A., G.M. SCOBIE & J.L. DILLON, eds. (1979), Economics and the design of small-farmer technology. Iowa State University Press, Ames, Iowa.

VOH, J.P. (1982), A study of factors associated with the adoption of recommended farm practices in a Nigerian village. *Agricultural Administration* 9: 17-27

WALLACE, B.J., & J.R. JONES (1985), Social Science in FSR: Conclusions and future directions, in: J.R.Jones & B.J. Wallace, eds., Social Sciences and Farming Systems Research: Methodological Perspectives on Agricultural Development. Westview Press, Boulder, Colorado.

WERNER, O. & K.Y. BEGISHE (1980), Ethnoscience in applied anthropology, in: D. Brokensha, D.M. Warren & O. Werner, eds., Indigenous knowledge systems and development. University Press of America, Lanham, Maryland.

WHYTE, W.F. (1983), Farming systems research approach: The rediscovery of peasant nationality, in: W.F. Whyte & D. Boynton, Higher-yielding human systems for agriculture. Cornell University Press, Ithaca, New York.

WORLD BANK (1983), Dominican Republic medium term economic adjustments. The World Bank, Washington D.C.

WOTOWIEC, P., S. POATS & P.E. HILDEBRAND (1986), Research, recommendation and diffusion domains: a farming systems approach to targeting. Paper submitted to the 1986 Conference on Gender Issues in Farming Systems Research and Extension, University of Florida, Gainesville.

YIN, R.K. (1986), Case study research, design and methods. Applied Social Research Methods Series 5, Sage Publications, Beverly Hills.

ZANDSTRA, H.G., E.C. PRICE, J.A. LITSINGER & R.A. MORRIS (1981), A methodology for on-farm cropping systems research. IRRI, Los Baños, Philippines.

SAMENVATTING

BEDREVEN IN AANPASSING

BIJDRAGEN VAN DE SOCIOLOGIE AAN LANDBOUWKUNDIG ONDERZOEK TEN BEHOEVE VAN KLEINE BOEREN IN ONTWIKKELINGSLANDEN: HET VOORBEELD VAN RIJST IN DE DOMINIKAANSE REPUBLIEK

In dit boek worden mogelijke bijdragen van de sociologie en antropologie aan het landbouwkundig onderzoek besproken. Het is gebaseerd op een studie uitgevoerd van 1981 tot 1985 in de Dominikaanse Republiek binnen het kader van het projekt "Adaptief Landbouwkundig Onderzoek", een samenwerkingsverband van de Landbouwhogeschool Wageningen en het Dominikaanse Ministerie van Landbouw. De oorsprong van dit projekt ligt in de groeiende belangstelling gedurende de laatste tien jaar in de potentiële baten van de deelname van sociologen en antropologen aan toegepast landbouwkundig onderzoek.

In Hoofdstuk 1 wordt de stand van zaken op het gebied van sociologie en antropologie in landbouwkundig onderzoek besproken. Aan de hand van de literatuur worden een aantal rollen voor de niet-ekonomische sociale wetenschapper aangegeven, alsmede een verscheidenheid van onderwerpen voor sociologisch en antropologisch onderzoek. Ook wordt ingegaan op enkele van de problemen van interdisciplinair onderzoek waarbij natuurwetenschappers, ekonomen en sociale wetenschappers betrokken zijn.

In Hoofdstuk 2 wordt de metodologie van het ALO rijstonderzoek uiteengezet en vergeleken met de diagnostische onderzoeksmetodologie van de bekendste strategie voor de ontwikkeling van het kleine boerenbedrijf: Farming Systems Research. Bijzondere aandacht wordt er besteed aan de invoering van de diagnostische case studie in het onderzoeksproces als een middel om op doelmatige en goedkope wijze een rijkdom aan informatie over de hoe's en waarom's van boerenbesluitvorming te verkrijgen.

In Hoofdstuk 3 wordt er achtergrondinformatie gegeven over de Dominikaanse Republiek, de Dominikaanse rijstteelt en de drie gebieden waar het ALO rijstonderzoek werd uitgevoerd.

In Hoofdstuk 4 worden de banden tussen Dominikaanse rijstonderzoekers, voorlichters en boeren geanalizeerd. Er wordt aangetoond dat het de kleine Dominikaanse rijstboeren aan manieren ontbreekt om rijstonderzoekers te wijzen op hun behoeften aan nieuwe technologie, en dat zij als gevolg daarvan op geen enkele wijze betrokken zijn bij het vaststellen van onderzoeksprogramma's en -prioriteiten. De bijna totale afwezigheid van een informatiestroom van het niveau van de kleine boer naar het onderzoeksniveau wordt omschreven als een gevolg van institutionele beperkingen en het bij funktionarissen overheersende stereotype van kleine boeren als een ongeschoolde, traditionele en achtergebleven groep. Een gevolg van het gebrek aan kommunikatie is dat een belangrijk gedeelte van de technologie die ontwikkeld is op het proefstation niet of slechts gedeeltelijk toepasbaar is in de produktieomstandigheden van het kleine boerenbedrijf.

In Hoofdstuk 5 wordt een voorbeeld gegeven van de doelmatigheid van de handelingen van kleine boeren in het verkrijgen van goede produktieresultaten met beperkte hulpbronnen. Het gepresenteerde voorbeeld betreft het verbouwen van een "ratoon" - dat wil zeggen, het verkrijgen van een tweede rijstoogst van de stoppels van de eerste (gezaaide) oogst. Er wordt aangetoond dat zowel vanuit een mikro- als een makroperspektief een ratoon een efficiënte manier van rijst produceren is, vooral in produktiesystemen die te kampen hebben met beperkingen in het verkrijgen van irrigatiewater en machinerie voor grondbewerking.

In de Hoofdstukken 6 tot en met 9 wordt het centrale argument van dit proefschrift uitgewerkt, namelijk dat een belangrijke bijdrage van de sociologie en antropologie aan het toegepast landbouwkundig onderzoek voor kleine boeren geleverd kan worden op het gebied van de diagnostische onderzoeksmetodologie. In Hoofdstuk 6 wordt aangegeven dat in de eerste fase van het diagnostisch onderzoek, de verkenning, alle potentieel relevante faktoren in aanmerking moeten worden genomen om diegene voor verder onderzoek te selekteren waarvan is ingeschat dat ze de meeste invloed hebben op de boerenbesluitvorming. Er wordt een kader voor het maken van zo'n inschatting gepresenteerd, alsmede de resultaten van de toepassing ervan in de drie gebieden waar het ALO rijstonderzoek plaatsvond. De konklusie wordt getrokken dat de voornaamste faktoren die de besluitvorming van de onderzochte boeren beïnvloeden van agro-infrastrukturele en ekonomische aard zijn: beschikking over irrigatiewater, machinerie voor grondbewerking en krediet, en de nivellering en drainage van het bouwland.

In Hoofdstuk 7 worden de tekortkomingen besproken van de op dit ogenblik overheersende diagnostische onderzoeksmetoden in toegepast landbouwkundig onderzoek: de snelle verkenning en de enquete. Er wordt betoogd dat het in de meeste gevallen onwaarschijnlijk is dat de kombinatie van deze twee technieken de grondige kennis van ingewikkelde kleinschalige boerenbedrijfssystemen oplevert die benodigd is voor het vaststellen van richtlijnen voor het ontwikkelen van aangepaste technologie. Daarom wordt er aanvulling met een meer kwalitatieve en diepgravender onderzoeksmetode, de diagnostische case studie, voorgesteld. Het opnemen van case studies in de diagnostische onderzoeksmetodologie maakt ook een meer participatieve benadering bij technologieontwikkeling voor kleine boeren mogelijk, doordat aan hun gezichtspunten meer gewicht gegeven kan worden bij het formuleren van onderzoeksprogramma's.

In Hoofdstuk 8 wordt betoogd dat het feit dat agronomen en ekonomen niet zijn opgeleid voor het uitvoeren van kwalitatief onderzoek, noch voor de analyse van de percepties, ambities, doeleinden en gevoelde behoeften van boeren, de deelname rechtvaardigt van sociologen en antropologen in interdisciplinaire teams die zich met technologieontwikkeling bezighouden. Echter, om in zulke teams naar behoren te kunnen funktioneren moet de sociale wetenschapper in staat zijn snel resultaten te produceren die als basis kunnen dienen voor het ontwerpen van nieuwe technologie. Daar de beschikbare tijd voor diagnostisch onderzoek meestal beperkt is, kan dit betekenen dat de sociale wetenschapper een zekere mate van de grondigheid vereist voor wetenschappelijke doeleinden zal moeten inruilen voor snelheid.

In Hoofdstuk 9 wordt aangetoond hoe de sociaalwetenschappelijke case studie en enquete metodes kunnen worden gekombineerd met agronomische proeven om een kompleter beeld te scheppen van de specifieke problemen van het kleine boerenbedrijf. Het gepresenteerde voorbeeld betreft het verlaat overplanten van rijstzaailingen. Case studies verschaften informatie omtrent de oorzaken van het probleem alsmede de manieren waarop boeren eraan het hoofd boden door bepaalde handelingen in de bedrijfsvoering aan te passen; enquete onderzoek leverde schattingen op van de aantallen boeren die met het probleem te kampen hadden, en proefonderzoek resulteerde in kwantitatieve schattingen van oogstverliezen en de doeltreffendheid van boerenaanpassingen.

In Hoofdstuk 10 wordt de kategorizering van de boeren in de drie onderzoeksgebieden op basis van de hierboven genoemde vijf faktoren - nivellering en drainage van het bouwland, en beschikking over irrigatiewater, machinerie en krediet - besproken. Er wordt aangetoond dat voor de gehele onderzoekspopulatie alsmede voor twee van de drie onderzoeksgebieden de gebruikte kategorizeringsmetode op effektieve wijze boeren onderscheidt met betrekking tot drie indikatoren die belangrijk zijn voor technologieontwikkeling: opbrengsten, gewasintensiteit en het met de rijstverbouw verdiende inkomen. Op basis van deze resultaten worden twee "recommendation domains" ("aanbevelingsdomeinen") gedefinieerd, met goede en slechte produktieomstandigheden, en voor beide worden aanbevelingen gedaan voor de ontwikkeling van aangepaste technologie.

De konklusies van dit boek, die worden gepresenteerd in Hoofdstuk 11, beginnen met een overzicht van de onderzoeksonderwerpen en rollen van de sociale wetenschapper, besproken in Hoofdstuk 1, die in aanmerking werden genomen in het ALO rijstonderzoek. Er wordt konkludeerd dat de belangrijkste sociaal wetenschappelijke bijdrage werd geleverd op het gebied van de onderzoeksmetodologie, door het aanvullen van de informatie verzameld met de "traditionele" diagnostische metodes van de snelle verkenning en de enquete met de kwalitatieve, diepgaande kennis die wordt verkregen met behulp van de case studies. Andere belangrijke rollen die werden vervuld door de ALO socioloog waren die van een "ex-post" evaluator van het overnemen en aanpassen van nieuwe rijsttechnologie, van een vertaler en tussenpersoon die de kommunikatie tussen natuurwetenschappers en boeren bevordert, en die van een aangever van de behoeften aan nieuwe technologie. Van de in Hoofdstuk

1 genoemde onderwerpen werd er bijzondere aandacht besteed aan de analyse van de boerenbesluitvorming, -motivering en -percepties, en aan de analyse van de lokale kennis over rijstteelt. Andere belangrijke onderzoeksonderwerpen waren de samenstelling en organisatie van het huishouden, de banden tussen boeren en funktionarissen, en boerenorganisatie.

Na een kort overzicht van de konklusies met betrekking tot de wenselijkheid van het betrekken van lokale kennis bij het ontwikkelen van landbouwtechnologie worden er een aantal opmerkingen gemaakt over de specifieke kenmerken van de lokale kennis van de onderzochte rijstboeren. Er wordt aangegeven dat ondanks de korte geschiedenis van de rijstteelt in de onderzoeksgebieden er al een aanzienlijke hoeveelheid lokale kennis was ontwikkeld die voor een belangrijk deel gebaseerd was op aanpassingen aan beperkingen in de produktieomstandigheden. Echter, door het feit dat de onderzoekspopulatie bestond uit een sociaal verbrokkelde en heterogene groep kolonisten met een westers-Latijnse achtergrond, voor wie rijst een relatief nieuw gewas was, was de invloed van sociale en kulturele faktoren op de besluitvorming in de rijstteelt beperkt. In andere situaties, waar bepaalde teeltsystemen gedurende eeuwen de bestaansbasis voor boerengezinnen hebben gevormd, zullen sociale en kulturele faktoren in veel grotere mate de handelingen en besluitvorming van boeren beïnvloeden. Dientengevolge zullen die faktoren in ontwikkelingsgericht onderzoek meer aandacht moeten krijgen dan het geval was in het in dit boek beschreven onderzoek.

CURRICULUM VITAE

Frans Johan Doorman was born on April 27th 1954 in Enschede, the Netherlands. After finishing highschool (HBS-B) in 1971, he spent a year as a foreign exchange student in the United States. In 1972 he initiated his studies at the Agricultural University of Wageningen with the introductory courses in the natural sciences, but in 1973 he changed to the social sciences, choosing as his major Rural Sociology for the Tropics and Subtropics. After doing research in Colombia in 1977-78 and Surinam in 1980, he obtained his degree in March 1981, with as minor subjects Development Economics and Sociological Aspects of Development Planning. In that same year he co-wrote and co-edited a reader on the socio-economic aspects of cassava cultivation in Latin-America. In October 1981 he left for the Dominican Republic as a research associate in the Adaptive Agricultural Research (AAR) project, a joint effort of the Agricultural University of Wageningen and the Dominican Ministry of Agriculture, with financing from the Dutch Ministry of Development Cooperation. The AAR project was directed at defining what and how sociology can contribute to agricultural research; this thesis is based on research carried out within it.

After the conclusion of the AAR project in 1985, Frans Doorman participated, in the first months of 1986, in the setting up of a project in the Dominican Republic for the local production of a small rice thresher developed by a Dutch company. In the summer of 1986 he worked for several months in a research project on the social and economic aspects of the use of wind energy in developing countries. In 1987 he left, with his wife and son, for a four year stay in Costa Rica as senior expert and coordinator of a project of the Netherlands' Universities Foundation For International Cooperation (NUFFIC), involving the Agricultural School of the Universidad Nacional of Heredia, Costa Rica, and the Institute of Cultural Anthropology of the State University of Utrecht.