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A CASE STUDY ON FARMER INNOVATIONS AND COMMUNICATION IN NIGER

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ACRONYMS

AED	Academy for Educational Development
AGRHYMET	Sahel Water Data Management Project
APS	Agricultural Production Support Project
CDSS	Country Development Strategy Statement
CIP	Centro Internacional de la Papa (International Potato Center)
CLUSA	Cooperative League of the USA
CRED	Center for Research on Economic Development, University of Michigan
CRSP	Collaborative Research Support Program
CTTA	Communication for Technology Transfer in Agriculture
DAI	Development Alternatives, Inc.
DECOR	Department de Recherches en Economie Rurale, of INRAN
DVM	Doctor of Veterinary Medicine
ESC	Extension Support Center (of APS)
E	Extension(ists)
F	Farmers
FAO	Food and Agriculture Organization
FEWS	Famine Early Warning System
FLUP	Forestry and Land Use Planning Project
FSR/E	Farming Systems Research and Extension
IAK	Indigenous Agricultural Knowledge
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDA	International Development Anthropology
IDRC	International Development Research Centre
IFDC	International Fertilizer Development Center
IITA	International Institute for Tropical Agriculture
ILP	Integrated Livestock Project
INRAN	Institut National de Recherche Agricole du Niger
INTSORMIL	International Sorghum and Millet CRSP
IPDR	Institut Pratique de Developpement Rurale, at Kolo
INTERPAKS	International Program for Agricultural Knowledge Systems
ISNAR	International Service for National Agricultural Research
LDC	Less Developed Country
MOA	Ministry of Agriculture
NAAR	Niger Applied Agricultural Research Project
NCR	National Cereal Research Program
NDD	Niamey Department Development Project
NGO	Non-Governmental Organization
NRM	Natural Resources Management
PID	Project Identification Document
PVO	Private Voluntary Organization
R	Research(ers)
R&D	Research and Development
RD&E	Research, Development, and Extension
S&T	Bureau for Science & Technology of AID
TDY	Temporary Duty
TROPSOILS	Tropical Soils CRSP

T&V	Training and Visit
UNDP	United Nations Development Program
USAID	United States Agency for International Development
VPC	Vulgarisation et Promotion Cooperative

FIGURES

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9. Bridge Ties

EXECUTIVE SUMMARY

In efforts to encourage development and spread of appropriate technologies, the importance and role of farmer-based research and extension efforts need further attention. Nowhere is this more apparent than in the African Sahel.

The Sahel offers a natural laboratory in which to observe and analyze farmers' adaptive and adoptive processes related to agricultural innovation and change. Sahelian farmers need a continuing supply of appropriate technologies, and they are dynamic participants in meeting their need. With what ideas are farmers experimenting? How do farmers complement their indigenous agricultural knowledge and practices with new ideas?

Information flow and the communication or sharing of ideas for a common purpose are critical aspects of technology transfer. How do farmers learn of and communicate new ideas? How can research and extension structures learn from and build on farmer experimentation and farmer-to-farmer communication?

For these reasons and to answer these questions, the AID/S&T Office of Rural Development planned and funded, through the Communication for Technology Transfer in Agriculture (CTTA) Project, A Case Study on Farmer Innovations and Communication in Niger.

CTTA researchers observed and described farmer-to-farmer communication networks in relation to the transfer of farmer innovations. Emphasis was placed upon farmer-to-farmer information flow with related opportunities for involving research and extension in farmer networks.

Field research was conducted in seven villages with and without cooperatives, expatriate projects, and resident extension agents; located on and off roads; and located near to and far from urban areas. One team member visited all the villages. The other conducted in-depth research in one village. The team interviewed several hundred Nigerien men and women.

Twenty case studies were compiled. In each, at least part of the communicative route an innovation took in reaching the study site could be traced. The case studies became thumb-nail histories of introduction and adoption of specific agricultural technologies.

In studying agricultural innovation in Niger, the CTTA team refined concepts of innovation and diffusion and identified three types of innovations, those made by or adopted from Sahelian farmers, those introduced from other sources, and those which represent a mixture of processes.

The team found that Nigerien farmers are open to, seek out, and apply new agricultural ideas; plan, implement, and evaluate on-

farm research trials; and demonstrate a sophisticated understanding of the complex interactions among the many variables they manage. The case studies also show that there is a rich body of local technical knowledge in agriculture that could be useful to farmers throughout the Sahel.

The scope of work asked, "What characterizes the technologies that farmers have adopted?" Researchers found that farmers chose technologies because they reduce risk, generate income, are affordable, are readily available, save labor, and fit into farming practices.

This study focussed on farmers. Observation of and interviews with farmers suggested that rich communication networks exist and are linked by individuals and groups. The CTTA team also identified other communication channels which are used for agricultural information or have potential for use.

Although the study did not directly address research-extension linkages in Niger, documents and interviews with USAID personnel and others indicate that connections between the two are quite weak. The limited information collected by the team during in-depth and survey research suggests several conclusions, including

- very few technologies offered by research and extension are deemed appropriate by farmers, and
- farmers reinvent technologies coming from formal research, but there appear to be poor feedback loops to research and extension that show how farmers are thinking about and changing these technologies.

Based upon its findings, the team recommended that efforts be made to:

- strengthen farmer-to-farmer communication of indigenous agricultural knowledge;
- strengthen farmer feedback loops to research and extension;
- allow farmers to participate in trials of new technologies;
- offer farmers greater opportunities and incentives to more systematically experiment for themselves;
- use interactive radio and television, and other mass media, with priority topics determined by farmers, to disseminate findings and practices; and
- mobilize women's and young people's associations to participate in on-farm experiments, and cultivate cooperatives as major conduits of agricultural information.

Chapter 1

INTRODUCTION

in...technology development and transfer... communications is...a factor of major importance and the absence of effective communication support...a major constraint. ...the problem of communications support... is compounded by the need to link research, extension, and other provider systems with each other and with the farmer (Meyer 1985:2, 3; italics added).

The CTTA Concept

Communication is sharing for a common purpose. Sharing thoughts, feelings, and information leads to their modification -- sometimes great, sometimes small. Change does not occur without communication, but communication does not guarantee change. The sense of mutuality -- knowledge of the other -- is inherent in all successful acts of communication, whether they involve individuals, small groups, or mass audiences.

The Problem

Historically, efforts in development communication to support the diffusion of technology in agriculture around the world have been largely top-down and paternalistic. Too often, the essential ingredient of mutually has been forgotten. Also, as Awa (1988), Rogers (1983), and others have pointed out, such efforts tended to be strongly biased in support of the technology and its funding or diffusion agency. The first models of the communication process therefore tended to be linear, one-way, and simplistic, e.g.:

SENDER(S) ⟶ CHANNEL(S) ⟶ RECEIVER(S)

In agriculture, the stereotypical players and their prescribed roles or functions in such models of technology transfer were identified as shown below. In this early conceptualization, farmers who were exposed to new ideas and then adopted them were called <u>opinion leaders</u> and <u>innovators</u>. Farmers who rejected new ideas or technologies were labelled <u>laggards</u>. Little effort was made to determine why the laggards rejected messages they had clearly received and understood.

RESEARCH (R) ⟶ **EXTENSION (E)** ⟶ **FARMERS (F)**
(messages) (media & methods) (producers)

These notions of communication processes in technology transfer still dominate much of the thought and behavior of agricultural development agencies and actors. Two generations of American scientists, extensionists, and applied communicators have been schooled in such models. Hence the models have been exported and applied in other parts of the world.

In theory, agricultural communication concerns itself with the <u>process</u> of moving technical information among critical stakeholders to effect positive behavioral change. Successful interaction and exchange may be supported by creative media methods and products (i.e. demonstrations, telelectures, photo novellas, radio learning centers) and one-on-one or small-group interpersonal methods.

In practice, however, agricultural communication has often been more narrowly conceived as the production of media products or educational materials. Agricultural communicators commonly define themselves as specialists in a medium (print, audiovisual, radio, television) and tend to be more product- than process-oriented. Consequently, communication efforts in agriculture have been most closely identified with media specialties and products, and with extension organizations and activities. Communicators as well as researchers and extensionists have often ignored or downplayed the importance of larger questions about the appropriateness and effectiveness of the technologies and the outreach activities with regard to behavioral change.

However, as it became increasingly evident that simple communication models were inadequate to the task of technology transfer, new approaches began to emerge. Recently, more sophisticated contingency, domain, and system models of technology transfer have been elaborated. They have enlarged the role and importance of communication in technology transfer by incorporating concepts such as social marketing (the "selling" of socially beneficial ideas and behaviors using marketing techniques) and integrated, participatory planning (interpersonal and organizational communication) into the transfer process. Most recently, the rapid development and deployment of electronic, interactive communication technologies have challenged communicators to reassess their roles and responsibilities in technology or knowledge transfer systems.

Nevertheless, a basic problem remains: much of the practice of communication for technology transfer in agriculture has not kept pace with the rapid evolution of interdisciplinary thinking about the communication process or with accelerating global transformations in communication technology, equipment, and infrastructure.

By working with existing resources and situations, the Communication for Technology Transfer in Agriculture (CTTA) Project seeks to fill this gap, utilizing state-of-the-art theories and practices from a wide variety of disciplines and fields to assist in solving the ever more complicated and critical issues surrounding knowledge transfer in agriculture. In broad strokes, the goal of the CTTA project is to put communication to work in creative ways in concert with other resources to increase:

- farmers' active participation and involvement in the technology development and transfer process;
- the effectiveness of research in designing appropriate agricultural technology for farmers in developing countries;
- the impact of extension in transferring these technologies to farmers; and

- the contribution of other provider systems and farmers to the process of technology transfer.

CTTA is not itself designed to generate the technologies to be transferred or to provide the conditions necessary to permit farmers to adopt them. For this reason, it must be linked to in-country projects and activities that have these tasks as primary goals. Once these linkages are forged, CTTA works with the collaborators to implement activities.

The CTTA communication process is depicted in the conceptual model in Figure 1. In practice, the model is always adapted to the context of each operational situation. In addition, the model does not have to be applied in a linear fashion. Depending on the context, action can begin at various points in the model.

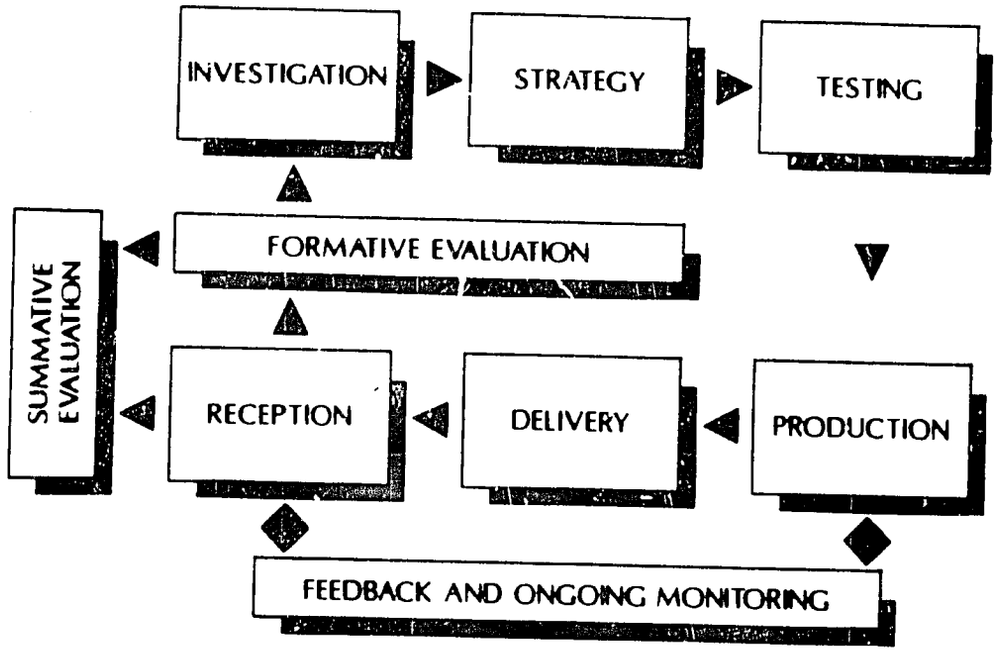


Figure 1. The CTTA Communication Process.

The CTTA/Niger Study

CTTA operates in four countries -- Honduras, Indonesia, Jordan, and Peru. Initiated in 1985, the cumulative experience of CTTA has reinforced the importance of focusing upon farmers as key participants in the technology development and diffusion process. The exact nature of farmer involvement varies from country to country and site to site due to contextual differences. For the CTTA/Niger study, farmers were viewed as the central node in the F-R-E triangle. Specifically, farmer-to-farmer communication net-

works were observed and described in relationship to the transfer of farmer-developed and -modified innovations. Figure 2 reflects the study's emphasis on farmer-to-farmer information flows, and on related opportunities for greater involvement of research and extension in farmers' naturally occurring communication networks.

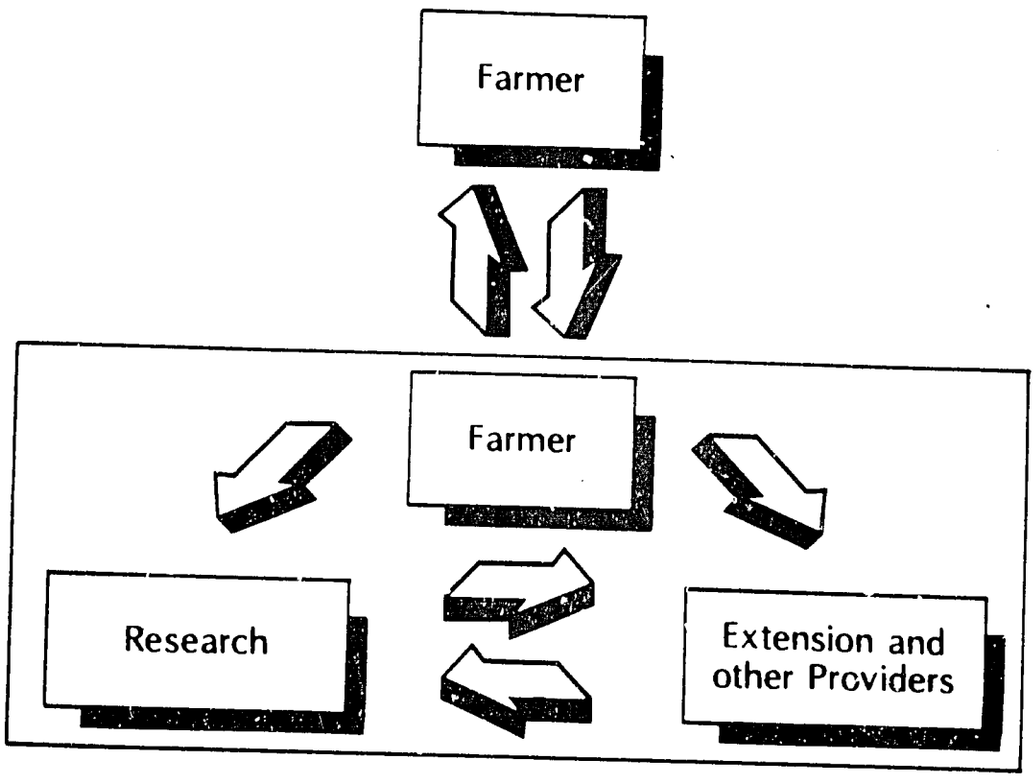


Figure 2. The Concept of the CTTA Niger Study.

Context

A continuing supply of appropriate, locally-adapted technologies is essential to the success of any agricultural development program. Without this essential ingredient, no program of transfer can proceed. However, there is evidence (e.g. AED 1988, Lebeau 1986) that the supply of Western-scientific research-generated technologies that are truly appropriate to Sahelian farmers is currently very limited. A logical place to look for alternative research directions is among farmers. What new ideas are farmers experimenting with and what features of their experimental technologies are most important to them?

There is also evidence that, for a variety of reasons, traditional extension methods are not working -- in Sahelian Africa and else-

where in the developing world (e.g. Coombs and Ahmed 1974, Hornick 1982, Lele 1975, Mosher 1976, Rice 1974, Röling 1988, Schultz 1964, World Bank 1985). Again, the logical place to look for alternative means of technology transfer is among farmers. How do they learn of and communicate new ideas in agricultural technology?

The larger question here is: how can formal research and extension structures build upon and learn from farmer-level experimentation and farmer-to-farmer communication? In other words, how can farmers be incorporated as leaders in research and outreach? The answer lies in increased communication -- specifically, increased information flows:

- among farmers themselves about their on-farm innovations and experiences;
- from producers to researchers, extensionists, and public and private sector suppliers and buyers on producer needs, interests, and experiences;
- from private suppliers or buyers to farmers on technology capacities and options; and
- from producers, suppliers, and buyers to policy makers on the effects of existing policy environments on technology transfer.

Preliminary CTTA tasks to address the need for greater farmer involvement in the communication process included the following.

- A review of literature on existing experience, skills, and available technology, with priority given to AID-funded projects such as Farming Systems, INTERPAKS, and Food Policy Analysis, as well as associated research and policy findings.
- Based on the above, development of an initial outline of possible approaches to identifying and upgrading the role of communication in the agricultural transfer process, in situations where no identifiable technology package exists. The outline includes encouraging on-farm innovation, effecting innovation-positive public policies, and encouraging more effective private-sector producer, supplier, and buyer coordination in technology transfer.
- Identification of interested and promising African countries in which to analyze and design interventions.
- CTTA team visits to selected African countries to determine:
  - if CTTA could usefully expand its intervention to situations where no standardized technology package appropriate for diffusion presently exists;

- if so, what procedures CTTA would recommend for interventions in such situations; and

- to what sites and subjects these interventions and procedures could be most fruitfully applied.

Objectives

The Niger field study represented the next step in tackling the tasks outlined above. It followed upon a previous CTTA team's trip to Senegal and Niger in November 1987 to survey agricultural technologies currently available from national, international, and regional research institutions and programs (ALD 1988). The broad aim of the present study was "to investigate farm-level communicative processes in agricultural innovation and technology transfer among representative farmers in the Niamey and Dosso Departments (USAID S&T 1988:1). More specifically, the CTTA team was charged with researching:

- how knowledge of technologies has been generated and transmitted farmer to farmer;

- which farmer characteristics are most closely associated with receptivity to information from informal sources on new agricultural technologies and which kinds of farmers make the most effective target groups for such messages;

- why certain kinds of technologies diffuse rapidly over informal channels while others do not; and

- what characterizes these technologies (see Annex A for the complete scope of work).

This research was to be based on intensive anthropological field investigations within Nigerien farming communities. From the research, recommendations of two types were to emerge.

- How such farmer-level innovation, experimentation, and technology transfer processes could be used to enhance and facilitate a reciprocal flow of information between farmers, research and extension institutes, private sector suppliers, etc. to make these entities more responsive to farmer needs and capabilities.

- How improved communication processes and technologies could enhance indigenous farmer innovation, experimentation, communication, and technology transfer (after USAID S&T 1988:1).

Because of the limited time in-country (three weeks), it was felt that specific, promising cases of innovation and diffusion should be identified and targeted for focussed field investigation before

departure for Niger. Based on an extensive literature review, the previous CTTA team's findings, and a workshop expressly convened to consult on this question with experts in Nigerien agriculture, two such cases were identified: the adoption and diffusion of modern seed dressings and of improved, short-cycle millets.

These two technologies were selected as representative of a variety of parameters. The first, an "exogenous" innovation introduced from other-culture sources, was known to have been occurring for some time in Niger and to have achieved widespread acceptance. Thus it furnished an opportunity to study diachronic (i.e. cross-time) processes of technology transfer.

With regard to short-cycle millets, there was also evidence that certain research-generated varieties were beginning to win some acceptance with Nigerien farmers. As the CTTA team was to discover in the field, farmers were also assiduously conducting their own on-farm trials with numerous local types of short-cycle millets. Thus this innovation -- at once exogenous and endogenous -- provided fertile ground for synchronic (i.e. present-time) investigation of on-going experimentation, adoption, and diffusion.

At the same time, preliminary information on any additional farmer-level experimentation and innovation was to be gathered. In fact, this proved to be the richest and most exciting part of the study.

Study Sites and Methods

The CTTA/Niger team was composed of two anthropologists with many years' experience in West Africa and the Sahel. Given the brevity of the research period plus logistic constraints, the USAID/Niger Mission suggested that the team concentrate its fieldwork in Niamey and Dosso Departments (Figure 3), in the western portion of the country near the capital city of Niamey. Equally important, the Mission has a number of longstanding projects in agricultural development in these areas.

In addition to field research in rural communities, one or both team members also visited the seed multiplication center at Hamdallaye, the FLUP Project in the Guesselbodi forest, the national agricultural technical school at Kollo, and the audiovisual units at both Kollo and the NSP/APS/CAV.

Field research was conducted in seven villages -- three in Dosso (Bamey, Goubey, Wazeye) and four in Niamey Department (Goube, Kone Beri, Guesse, Bouboussaye) (Figure 4). All of the communities are Zarma-speaking, although one (Wazeye) is ethnically Mawri.

These sites were chosen in consultation with members of USAID and other projects, Ministry of Agriculture (MOA) officials, and regional Nigerien extension agents and MOA representatives in both departments (Annex B). The minimal criteria for selection were that a

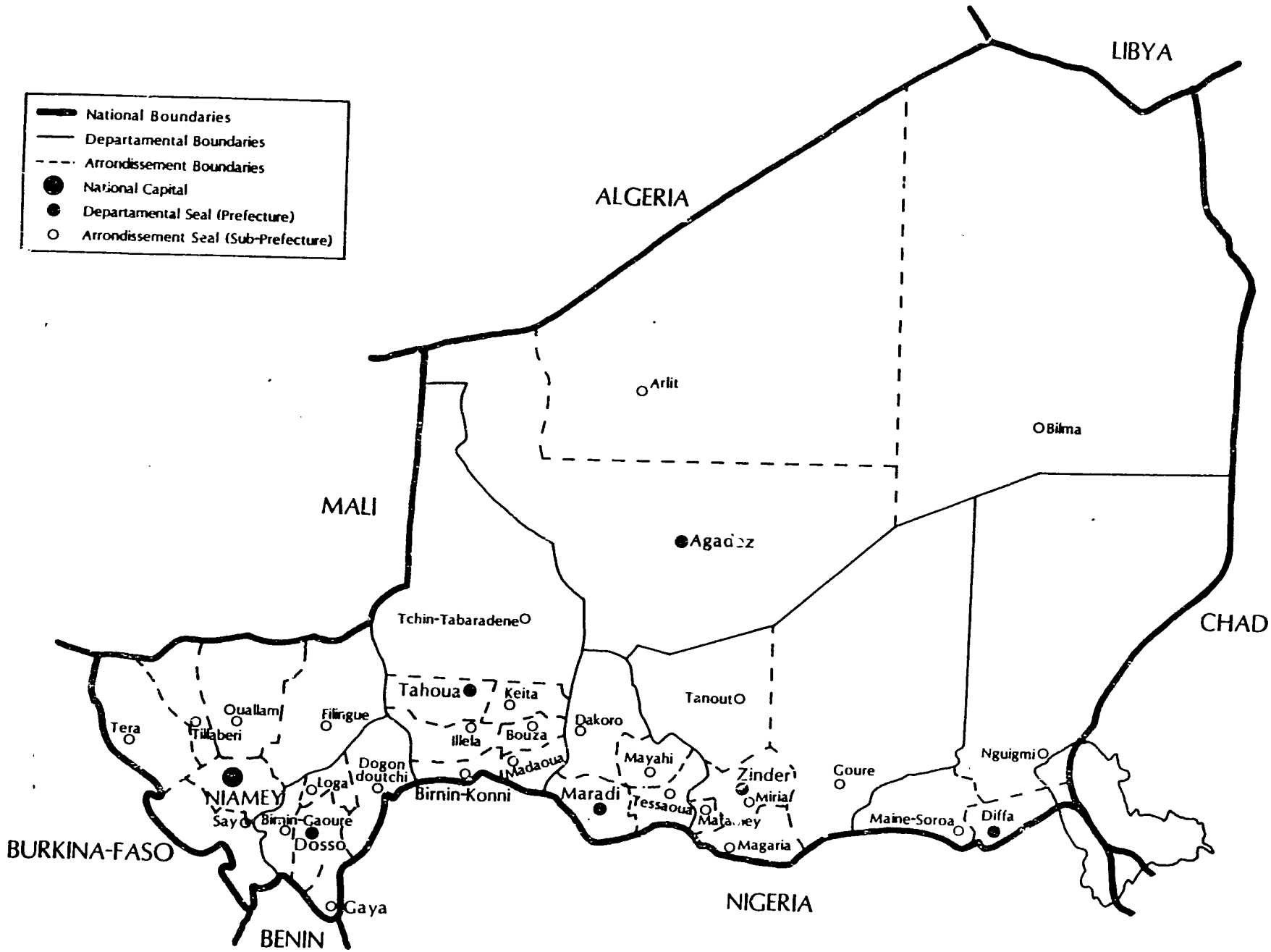


Figure 3. Niger Administrative Divisions.

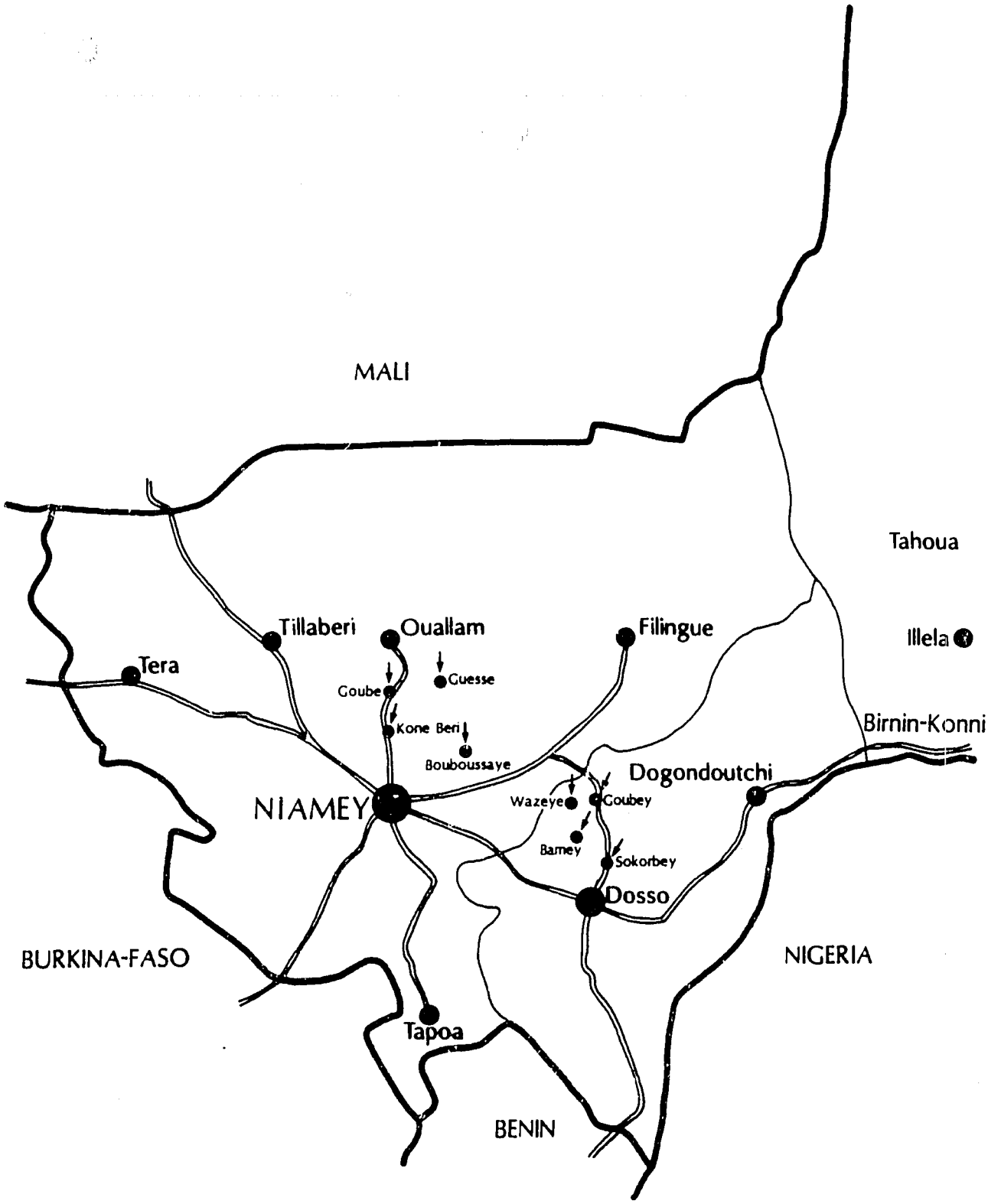


Figure 4. CTTA Study Villages in Niger.

village be known to have at least some members who used modern seed dressings and who had adopted or were experimenting with short-cycle millets.

However, the team sought out hints of other, farmer-level innovations in deciding upon a particular village. Logistic constraints also had to be taken into account, i.e. sites needed to be located in such a way that two researchers with only one vehicle could maximize their in-field time. Additionally, a mix of village types was desired -- including communities with and without cooperatives, expatriate projects, and resident extension agents; and located both on and off of roads, and near to and far from urban areas. This mix was important in capturing some of the diversity in rural Nigerien communities and their access to agricultural information networks, so as to enhance the representativity of findings.

The research methodology was two-pronged. One team member used an open-ended survey approach and visited all seven communities. He was accompanied on his visits by research and extension personnel from a variety of USAID projects, and by national and local extension agents. With an experienced Zarma-speaking translator,[1] the other team member conducted in-depth research in a single village (Wazeye), that focussed on obtaining detailed case histories of specific instances of agricultural innovation and communication.

It should be noted that more stringent criteria were applied in selecting the latter site. The researcher specifically sought a village that had little or no history of project or research interventions, did not lie on a major or even secondary road, lacked resident extension agents or co-op officials, and was far from any urban area. The aim was to partially control for exogenous or outside influences in researching farmer-level innovation and to clarify "natural" communication networks in a context that likely represented the situation of most Nigerien farming communities. It was also felt that farmers with less direct "outside" contacts would be less prone to give learned responses to the researcher's questions.

This approach permitted compilation of a number of "mini case studies" for subsequent analysis. In contrast to survey findings or more general, background information, these case studies are defined by the fact that at least part of the communicative route an innovation had taken in reaching the study site could be traced. Put another way, the case studies constitute thumbnail histories of the introduction and adoption of specific agricultural technologies, technological components, management techniques, or tools.

To ensure a modicum of data comparability between the two methodologies, a series of rough interview guides was employed (Appendix C). In essence, these served as simple mnemonic devices, to promote coverage of the same issues in each of the study villages. More focussed questions emerged as research progressed and as the team

met to review, compare, and refine findings at the close of each day of fieldwork.

Both team members conducted individual and group interviews. Individual interviews were held with informants identified as "special" in some sense: particularly knowledgeable on a given subject; exceptionally prolific experimenters or innovators; or key communicators, opinion leaders, or farmer paragons in their communities. In Wazeye, these individuals included both males and females.

Group interviews ranged in attendance from as few as 6 to as many as 60, and in age from perhaps 16 to 75 years. Survey groups generally were primarily composed of men. However, women participated in most of the in-depth group interviews in Wazeye; and one day of interviewing there was devoted solely to women.

Across 14 person-days of anthropological fieldwork, several hundred Nigerien farmers participated in group and/or individual interviews. These discussions were almost invariably lively and provocatively insightful. Indeed, research conditions were optimal, and the team was deeply indebted to the many Nigeriens who made this study possible by unstinting contributions of their time, intellectual energy, and hospitality.

NOTES

[1]Throughout the text, terms in Zarma, Hausa, or other local languages are italicized (underlined) or transcribed in the International Phonetic Alphabet (bracketed). French terms appear in apostrophes.

Chapter 2

FARMERS' AGRICULTURAL INNOVATIONS

More than any individual technology, the dynamic adaptive processes by which African farmers and herders collect information, experiment, and continually adjust their own technologies is considered to be a helpful starting point for research and development efforts (COTA 1986:66).

Indigenous Agricultural Knowledge and Innovation

The subject of innovation, adoption, and diffusion of agricultural technology has a long history in the social sciences. Rogers (1983) has comprehensively summarized the vast literature on the topic, and significantly broadened its theoretical perspectives. He defines the key concepts in this research domain as follows. Innovation is "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (1983:11). Diffusion "is the process by which an innovation is communicated through certain channels over time among the members of a social system" (1983:5).

In the vast body of literature from which Rogers elaborates these basic definitions, studies of agricultural innovation and diffusion are well represented. However, most of such discussions center on "top-down" invention and transfer of technology, i.e. from research and other institutions to farmers, usually via extensionists. Relatively little attention has been given to local, farmer-level innovation generally, still less to farmer experimentation and innovation in the Third World, and perhaps least of all to farmer innovations in Africa.

This gap in the literature is largely due to two biases. The first is many modern-day researchers' and policy makers' unthinking assumption that agricultural technology has primarily arisen and diffused through the efforts of formal research and extension institutions -- and that this is the "normal" or "scientific" mode of innovation and diffusion. However, even a cursory overview of the evolution of plant and animal agriculture in human history is enough to reveal this assumption as spurious.

The second is a crude European ethnocentrism which persists in characterizing Third World farmers and their farming systems as backward, ignorant, static, unchanging, and mired in tradition. Until very recently, African agriculture in particular has been subject to this stereotype, in contrast to many Asian and native Latin American farming systems.

As one authority aptly summarizes:

> Those with formal education and training believe that their knowledge and skills are superior and that uneducated and untrained rural people must, by definition, be ignorant and unskilled. From rich-country professionals and urban-based professionals in third world countries right down to the lowliest extension workers it is a common assumption that science-based knowledge is sophisticated, advanced and valid and, conversely, that whatever rural people may know will be unsystematic, imprecise, superficial and often plain wrong. Development then entails disseminating modern and scientific knowledge to inform and uplift the rural masses. Knowledge flows

> in one direction only -- downward -- from those who are strong, educated and enlightened towards those who are weak, ignorant and in darkness (Chambers 1979:1).

The continued intractability of the African agricultural crisis (Gakou 1987, Gorse and Steeds 1987, Harrison 1987, ICIHI 1985, Lateef 1980, Mellor et al. 1987) has at last led to a reevaluation of the role of the smallscale farmer in the generation and transfer of agricultural technology (Lele 1975) and her/his relationship to the formal research establishment. As the Congressional Office of Technology Assessment (COTA 1984:13) notes, "low-resource producers need to be incorporated into the process of designing, planning, and evaluating research" if research is to be effective in alleviating Africa's acute and growing production problems.

While the necessity of including farmers as active participants in the research enterprise is now more widely acknowledged, recognition that they typically engage in empirical, on-farm research of their own has been slower. However, there is a small but growing body of work documenting the rich storehouses of indigenous agricultural knowledge (IAK) and the dynamic processes of experimentation and innovation occurring at the grassroots level worldwide (Barlett 1980; Brammer 1980; Brokensha et al. 1980; Dommen 1988; Innis n.d.; Johnson 1972; McCorkle 1986, forthcoming; Swinton and Deuson 1988; Vondal 1987.)

For Africa, anthropologists were among the first to record such observations. For example, from his fieldwork among the Nupe of Nigeria early in the colonial period, Nadel (1942:350) found that these African cultivators:

> ...are, within limits, extremely progressive people, and keen on trying out new things... The fact that the Nupe farmer is go-ahead with respect to certain farm techniques and "conservative" with respect to others is not due to any tribal or racial "conservatism," but reveals itself as a clear instance of the working of free economic choice.

Writing of specific farming techniques like crop rotation, manuring, fallowing practices, plant thinning, and harvesting, Nadel further notes that "so advanced a technique and so conspicuous a standard of husbandry must involve a body of theoretical knowledge which goes beyond the counsels of peasant lore, and could avouch statements of very nearly scientific authority" (ibid.).

Another early student of African agriculture demonstrates that as a result of farmer experimentation and innovation, field types have changed over generations, and the acceptance of such significant innovations as cash crops and their thorough integration into local farming systems have engendered major changes in agronomic practice (de Schlippe 1956).

Indeed, African peoples have been farming for thousands of years, perforce readjusting their cropping and herding techniques to innumerable social, economic, and environmental changes. Johnson (1972) has studied the relationship between farmers' traditional agricultural practices and their specific ecological, social, and personal situations. He distinguishes three significant variables which influence individuals' selection of technological alternatives: micro-ecological differences in farms, e.g. in soil types, drainage, degree of slope, location of fields; differences in the qualities and abilities of the producer unit, such as age and availability of household labor; and individual difference in farming opinion, e.g. whether certain crop mixes are superior to others, or when is the best time to plant. Any one of these variables can significantly influence local innovation and experimentation, and the diffusion of the knowledge thus discovered to other farmers.

Anthropologists in particular have investigated farmer-level innovation and experimentation from an "emic" perspective, i.e. focussing on farmers' own technological needs, knowledge, and rationales. Drawing upon research throughout Africa, Asia, and Latin America, Brokensha et al. (1980) anthologize numerous examples of the depth and breadth of IAK and how it is used by local people to successfully order and implement their agricultural and other activities. Such topics as environmental knowledge, intercropping techniques, crop and soil classifications, concepts of measurement, the adaptive strategies of pastoral peoples of the Sahel, and fish processing and marketing are explicated from the "natives'" point of view.

Writing solely of African agriculture, Richards (1975, 1979, 1983a, 1983b, 1985) has likewise emphasized the richness of African farmers' IAK. Further, he demonstrates that this knowledge has been acquired through application of a rigorous ethnoscientific methodology. He documents how Africans regularly test and select for new seeds and cultigens, experiment with new techniques, and adopt and adapt new technologies to their specific physical and socioeconomic environments. Richards details numerous innovations developed by African farmers themselves in many arenas: complex systems of intercropping; sophisticated combinations of irrigated with rainfed cultivation, and of cropping with herding; and new ways of organizing agricultural labor. On the basis of such evidence he suggests:

> that West African farmers long ago laid the experimental and practical foundation for an "improved" agriculture, in much the same way that...innovations and experiments by ordinary farmers in England over a period of several centuries provided the basis for what eventually came to be recognized as the "Agricultural Revolution" (1983b:27-28).

In sum, using their own ethnoscientific methodologies and the means at their disposal, African farmers have been responsible for signi-

ficant agricultural innovations. They are by no means bound by tradition or reluctant to change cropping or agrosocial systems to improve production and/or adapt to changing circumstances.

The larger message of these studies is that farmers are a rich resource for agricultural research. If their micro-ecological and -economic knowledge and ethnoscientific skills can be put to work alongside Western scientific (etic) techniques and knowledge, agricultural R&D is sure to profit. Local or "people's science" (Chambers 1983) must complement conventional science. The latter must build upon IAK to design and implement sensitive, cost-effective, bottom-up interventions that truly "work." Moreover, in this process, the bearers of IAK must take an active role as co-researchers and developers and even designers of research directions (after McCorkle forthcoming).

The benefits of such collaborative R&D are now evident, and methods for increasing farmer participation in the research enterprise have already proven effective (Matlon et al. 1984, Rhoades 1984). Paramount among these methods are joint, on-farm experimentation, following guidelines like those set forth below (after Kirkby and Matlon 1984).

- In mounting collaborative on-farm experiments, make sure that farmers play a significant role in the choice and design of experiments and can suggest modifications. This will also ensure that farmers understand the objectives of the experiments; farmers, as well as researchers, need to distinguish between an on-farm experiment and a demonstration.

- Make use of farmers' experiences with technology; they are the products of non-formal experimentation conducted by most farmers.

- Organize on-farm trials in a manner similar to producers' own experimentation.

- Include technology designed to meet farmers' perceived problems.

- Select farmer cooperators according to experimental objectives; farmers' circumstances and needs for research differ.

- Reach agreement with cooperating farmers about who will contribute what to the tests.

- Above all else, respect farmers; they are a valuable source of local knowledge and experience and ultimately, the people who determine whether a new technology is adopted.

As the literature attests and as the findings presented here confirm, African farmers actively engage in applied and adaptive re-

search of their own. Hence, one further item needs to be added to the foregoing list.

- Assist farmers to enhance and increase their own on-farm experimentation, encouraging both the quantity and quality of local innovation in every way -- including facilitating communication among farmers and between farmers and research and extension.

Point Studies of Innovation in Niger

In researching agricultural innovation in Niger, the CTTA team refined Rogers' definition to further distinguish among different sources and processes of local-level experimentation and innovation. Endogenous innovations are defined as those made by (or adopted from) Sahelian farmers. Exogenous innovations are those introduced by other-culture sources, promoted by projects or extension structures, but subsequently copied by other farmers without assistance from any agencies or organizations. Finally, syncretic innovations represent a mix of exogenous and endogenous; often, innovations from other-culture sources are subjected to creative local modifications.

Along with the diachronic/synchronic dimension noted in the previous chapter, what we have called "point studies" were chosen with these domains in mind. The first -- use of modern seed dressings -- is clearly an exogenous technology, introduced from outside the indigenous agricultural system. Experimenting with short-cycle millets, on the other hand, is an endogenous practice, as farmers themselves seek out, develop, and diffuse new cultigens in response to changing Sahelian climatic and other conditions. Indeed, farmers experiment freely with both these innovations and their components, in effect syncretically applying technologies from any source to their own farming situations.

Modern Seed Dressings

Composition and Standard Application. Commercial seed dressings in Niger typically combine a fungicide (thirame) and an insecticide (heptachlor) (INRAN 1985). They protect and save seed in planting, fend off fungus and insect attacks, and thus ensure up to 100% germination of all seeds treated. The dressings can be used with millet, sorghum, and cowpea, as well as dry-season garden vegetables. Currently, the most popular dressing in use in Niger is a red-colored chemical powder, brand name "Callthio."

The dressings are easy to use. One merely pours a pre-measured packet (25 g) of the powdered chemical mix over the seeds to be planted and then hand-mixes until the seeds are thoroughly coated. INRAN (1985) and the agricultural service recommend 20 g/10 k of millet or sorghum and 25 g/10 k of groundnuts and cowpeas. This recommendation reportedly has been rephrased in units comprehensible

to Nigerien farmers -- one matchbox per four standard calabashes of seed.

At least three types of seed dressings have been used in Niger. Until just a few years ago, a reportedly excellent dressing was imported from the Ivory Coast. This was clearly farmers' preferred brand. As one man quipped, "It kills everything." Currently, however, a Nigerien parastatal imports chemical ingredients in bulk and mixes and packages them into the 25 g envelopes of "red powder" now sold in Niger. But farmers complain that the envelopes often contain less than 25 g and are so poorly sealed that they easily break. Finally, a third dressing comes from Nigeria. While apparently not so powerful as the Ivory Coast product, it is still preferred to the local brand. But it is less available to farmers who do not live near the border with Nigeria.

Introduction of Seed Dressings. Commercial seed dressings apparently were introduced in the late 1950s and early 1960s by the national agricultural service to increase production of groundnuts as a cash crop. In the 1970s, productivity projects also vigorously promoted seed coatings as part of technical packages for cereal production.

Initially, the service gave the dressings to farmers. As farmers grew to appreciate the value of the new technology, the service began to charge for the chemicals, incrementally raising the price across the years. Because of the treatment's visible efficacy, reportedly farmers gladly paid the price. And when dressings were unavailable locally, people would travel great distances to buy them -- in the past, reportedly even as far as the Camerouns.

Today, responsibility for distributing and selling the dressings rests with the national system of farmer cooperatives. But these products are readily available through other sources as well, in stores and markets, and from farmers who serve as petty merchants, retailing packets of seed dressing to co-villagers. A 25 g packet sells for 80 FCFA (U.S. $0.35) at village cooperatives; but the same packet can cost as much as 100 FCFA in stores or marketplaces. Even at such prices, since the product is sold in such small quantities, nearly every farmer who wishes to do so can afford to buy at least some.

Adoption and Diffusion Seed Dressings. Commercial coatings have been known and regularly used in various regions of Niger for nearly 25 years. Today, the dressings appear to be used throughout the country, from Ouallam in the north to Gaya in the south, and from Tillaberry in the east to Diffa in the west. However, this is not to say that everyone everywhere uses the dressings.

The pattern of diffusion has been irregular. For example, in a village barely 75 km north of Niamey city, some people say they started using seed coatings only about five years ago. The innovation reached other areas even more recently.

The dressings have diffused by many routes. The role of the national agricultural service and of productivity projects was already noted. Indirect and non-formal means of extension from farmer to farmer have also played a part. One village learned of them from a village returnee who took a training course with the agricultural service. In another community, farmers learned of them by observing the planting practices of petty bureaucrats from Niamey city who worked fields near their own. Farmers have seen and discussed the utility of the treatment in many other contexts, as well, e.g. while travelling or visiting relatives. Also, there is evidence that merchants and marketplaces have been active in diffusing the dressings.

Apparently people were generally quick to adopt seed coatings once they had learned of them and had witnessed their dramatic results. Informants describe how, only two weeks after planting, fields sown with treated versus untreated seed are visibly lusher and healthier.

Doubtless another factor in the widespread acceptance of this innovation is that it enjoyed several parallels in indigenous agricultural practice. One informant recalls how the sarkinoma -- the traditional chief of agriculture in Zarma villages -- used to sell a powdered seed dressing along with powerful incantations to insure a good crop.[1] Indeed, powders are an ancient and ubiquitous form of magical and medicinal treatments throughout West Africa. Another informant noted that in the past, the bark of a certain tree was burned and the ashes mixed with millet seed before planting. (Unfortunately, he was unable to state the precise rationale for this practice -- whether as a fertilizer, insecticide, or fungicide.) And in some regions, seeds traditionally were, and still are, coated with natron (hydrated sodium carbonate) so they would attract and hold moisture after planting, thus promoting germination.

In adopting this exogenous innovation, farmers have naturally made modifications and innovations of their own. Of course, they freely vary the recommended applications according to their financial means, hypothesizing that even a little is better than none at all. Most informants said they use three to five packets per planting season, although this figure varies according to field size and number of re-plantings. The village chief of Goubey, for example, said that he was going to use ten packets this year, suggesting rather large field holdings.

Rightly or wrongly, farmers attribute multiple benefits to the dressings beyond their role in seed germination. Some claim there is a systemic effect of the coating which adheres to the young plants, warding off grasshoppers and other insects. Other adopters claim the dressing helps protect seed from rats.

Still other farmers believe the dressings also work as a fertilizer. Precisely because of this belief, however, some people do not use them. They fear that the dressing will "burn" the seeds. Others

say that, thanks to the "fertilizer effect," stands of millet treated with these products will be so dense that a household may not have enough labor to properly thin them. In one village, however, this problem reportedly has been overcome by mixing small stones with the seeds in the calabash, thus decreasing the number of seeds put into the pocket and producing a pre-thinning effect. When asked why not just put fewer seeds in the pocket in the first place, informants said children are generally given this task and cannot be trusted to do so.

Given the insecticidal properties of seed coatings, rural Nigeriens have found other ingenious uses for this product, including: dusting it into hair and clothes to chase out lice and fleas; treating sores and wounds on camels, horses, and donkeys, to keep insects and birds from picking at them; and sprinkling it into granaries to deter rodent attacks on stored foodstuffs. Indeed, the Zarma word for "poison" seems to be the popular term for seed coatings.

Short-Cycle Millets

Zarma farmers categorize millet or mil as early [haynikire] and late [somono]. The two are always planted in separate fields. In a normal year, the average farmer plants one variety of each type. Varieties[2] are emically distinguished by size, shape, color, density, and weight of grains, length of candle, the presence of "hairs" or barbs on the head, and of course the speed with which the plant matures. Early millets are most often mentioned as maturing in 70, 90, or 100 days while late varieties average around 120 days, according to farmers' reports. Both short- and long-cycle millets have their advantages and disadvantages.

One of the most frequently cited advantages of early millet is that its rapid maturation can ease the end of the soudure 'hungry season' for families in immediate need of food. Conversely, it can also be planted at the "last minute," when multiple re-seedings have failed due to irregular and/or inadequate rainfall. The short-cycle millets afford a final hope for getting at least some harvest when the rains are late. Additionally, farmers say that on "earth that is tired" short-cycle millets grow better than long-cycle ones. In communities where fallow periods have plummeted from the traditional 7-10 years to a mere 2-3 years (the case for Wazeye) this is a critical consideration.

Farmers further claim that short-cycle millets have fewer problems with striga, a parasitic plant which entwines itself around and feeds off the roots of millet. Striga is a common plague of millet in the Sahel. Informants said striga generally attacks when normal mil is in mid-growth. But early millets grow so quickly that, by the season when striga is most active, they have formed heads of grain and may even have been harvested. The implication is that, coupled with very early or very late planting, these varieties' shorter cycle helps them "avoid" the worst attacks of striga.

There are also ethnogustatory and ethnonutritional advantages to the short-cycle millets. Many people feel their flavor is better ("more sweet") and that they produce finer, whiter porridges than late millets. Moreover, they say that early mil has a softer shell. This means that it is easier to pound and cook -- a feature much appreciated by women. And, unlike the late varieties, this softer shell can itself be consumed by human beings as well as animals. In particular, new mothers eat this material to promote lactation.

Disadvantages to early millets reportedly include less resistance to drought, generally lower yields, and inferior bulk (and by implication, caloric quality) in food preparation. In the latter regard, for example, informants claim that twice as much porridge (French "boule") can be made from with the same volume of late, as versus early, millet. Similar observations were made regarding the stiff porridge (Zarma [haru]) which is the staple dish throughout rural West Africa.

Another disadvantage cited by farmers is birds' heavy attacks on the early millets. This is a particular problem for families who are in immediate need of foodgrain toward the end of the hungry season. As one man explains: "The birds eat all of the first heads of the early millet. Like people, they, too, are very hungry at this time."

The advantages and disadvantages of late mil are in large part simply the obverse of the early varieties'. I.e., they are claimed to be more drought resistant. (Informants explain that, once the plants have formed a head, they will continue to grow to maturity even without rain.) And the long-cycle millets are considered higher yielding and more nutritious. Moreover, there is some suggestion that their harder shell makes them store better. On the other hand, long-cycle millets are said to be more susceptible to striga and to require richer soil than their short-cycle cousins.

Weighing together all these pros and cons, farmers throughout Niger are increasing both the hectarage and numbers of varieties planted to short-cycle millets. In Wazeye, for example, in the past only a single variety of early mil was planted, plus three types of late. Today, ten short-cycle millets are regularly used throughout the village, and many more are undergoing systematic "on-farm trials" as innovators cast about for further strategies with which to confront their ever more difficult environment.

Drawing upon the CTTA team's field research, particularly telling "mini-case studies" of farmers' innovations in short-cycle millet are presented below. As a mnemonic aid to the research team in conducting, discussing, and writing up its field investigations (and building upon a common West African tradition), nicknames were assigned to the innovators involved.

Case No. 1

In Wazeye, one man has experimented with a modern improved variety of 70-day millet. Dubbed "Mr. Radio" by the team -- because he was never seen without his radio in hand -- this man obtained the seed in Tillabery, where he had travelled to do eight months' wage labor on a wells project. He learned of the variety from the Chief of the Tillabery Department of Agriculture, whom he met and befriended. (Tillabery is the site of the Fossa seed multiplication center.)

This villager immediately tried out the new variety upon his return home. In evaluating the results of his first-year trials, he notes that "It is very rapid." He adds, however, that it demands heavy inputs of fertilizer. Moreover, "Because it comes up so early, the birds really go after it." As he and his co-villagers point out, "This means that you must have a large family" to access the labor necessary to scare off the birds.

Other farmers in Wazeye have gone to see this man's field trials and would also like to try this dramatic, 70-day variety for themselves. Of course, after only a single year's trial, Mr. Radio does not have enough seed to supply his co-villagers. So he plans to consult his cooperative in Sokorbey and the district extension agent there to see how or if he and his fellows can obtain more of the seed.

Assuming they can obtain the new variety, these other farmers say they will plant it for two years. However, unlike the man who first brought it to the village, they will conduct their trials without any fertilizer, "To see if it can survive under our own farming conditions" and to determine whether it is "economical." They volunteered the further information that, if these criteria are met, they will adopt the new variety and abandon some of the local short-cycle millets they are currently using.

Case No. 2

Another man of Wazeye has been systematically experimenting with different varieties of millet, with such a lively scientific curiosity that the team immediately named him "Mr. Researcher." On one occasion, this man bought a sack of a short-cycle millet in the village marketplace, for home consumption. He noted that it was clearly a nonlocal variety and found that it was especially tasty and made a particularly fine, white porridge.

Intrigued by these properties, Mr. Researcher planted some of this millet in an experimental field of about 10 m^2 to see how it would produce under local conditions, i.e. on a regular "bush" plot without any chemical or natural fertilizer.

The results of this initial trial were disappointing. Mr. Researcher found that the heads were too short, the grains were small, and hence yields were low. But he has not yet given up on it. This year he is going to make one further, controlled experiment. He will again plant the millet in a 10m2 area, but this time he will make two such plots, adding animal manure to one and chemical fertilizer to the other. Based on the comparative results of these two experiments, plus his data from last year's trial, he will decide whether or not to add this millet to his larger repertoire of varieties.

Case No. 3

Meanwhile, Mr. Researcher has also been experimenting with another short-cycle millet which he discovered during a trip to Filingue, northeast of Niamey. A market woman of Filingue was selling this variety. He liked the looks of it, and she gave him a handful of the millet, to try in his fields back home.

For two years he has been cultivating a small plot (7-8 m_2) of the new variety, and has been very pleased with its performance. He finds that "It gives many kernels and it does very well without fertilizer." Hence he plans to continue and increase his cultivation of this hardy, short-cycle millet.

Case No. 4

Dubbed "Johnny Appleseed" by the team, a third man is always looking for new varieties of all sorts of cultigens. In fact, he is something of an ethnobotanist. He keeps a garden of exotic, medicinal, and/or almost forgotten trees, cacti, shrubs, and other plants near his home in Wazeye.

Recently, Mr. Appleseed travelled to "Hausa country" in Nigeria, to attend the funeral of a family member of one of his relatives. During this visit, the relative introduced him to a new variety of short-cycle millet unknown in Wazeye, plus a new type of fonio. (Mr. Appleseed is the only Wazeyan to cultivate fonio.) Mr. Appleseed is looking forward to trying both of these fresh acquisitions this year, to see if they may prove a useful addition to his already large collection of cultigens.

Case No. 5

The President of the Goube cooperative is obviously a man with some respect, evidenced by the deference he is shown. He has earned this respect through his leadership in helping to build a cooperative warehouse and store in Goube and overseeing their successful management.

At the last biannual national agricultural fair a few years ago, the President saw an interesting local variety of millet being sold for seed by a farmer from the village of Koure, on the road to Dosso. Last year, at the fair in Say, the President decided to buy some of this seed from the farmer and try it in his own field. He bought a sack of millet heads for 1200 FCFA ($4.50). Considering that a kilo of threshed grain cost about 100 FCFA at the time, the President was exhibiting great confidence in this seed.

He showed this millet to the CTTA team. The candles were long, stout, and tightly filled with grain. And the grains were white with a soft coating, making it easy to pound and prepare. The President opined that this was a short- cycle variety of 80-90 days. He is going to plant it this coming season. If it grows well, he will keep some seed for the next year, give some to his friends and neighbors, and eat the rest.

As we talked, passing a stalk around for all to see and comment on, an older man on the periphery of the group casually took a piece of plastic out of his pocket and began to meticulously pick out of the sand all the loose grains that had fallen out of the sack of millet when it had been opened. This man had listened carefully to the discussion, but never participated. When he had collected all the seeds he could find -- perhaps half a matchbox -- he carefully tied up the plastic and put it back in his pocket.

The interview with the President had thus served as a forum for the exchange of ideas and an occasion for technology transfer. The team had no doubt that after the first good rain, this seed would be planted by its "gleaner" and the results carefully monitored, to be multiplied the next year if it produced well.

One type of millet with which most farmers interviewed in both Dosso and Niamey Departments were <u>not</u> experimenting but which they intensely desired was [kini faso]. This is a short-cycle millet with barbs or "hairs" which discourage bird attacks. (The barbs are said to put out the birds' eyes as they bob down to pick at

the kernels.) Wazeye villagers note that until 1984 they raised a useful, long-cycle variety of this barbed millet. But with the great famine of that year, "We were forced to eat all the grain we had, even our seed."

Nor can they find any such seed for sale in regional marketplaces, or even far distant ones. Single plants of this barbed millet do appear randomly in fields, and farmers have selectively saved this seed. However, they report that their attempts to reproduce it fail because the plants rapidly degenerate, giving only smooth varieties. So profound is their concern over the loss of this advantageous feature that village elders formally requested the CTTA team to investigate and report to them where such seed could be obtained. The team did so, only to learn from both the extension service and an ICRISAT production agronomist that no such varieties exist in the country.[3]

Two short-cycle millets developed by INRAN and released for multiplication and extension were frequently mentioned by informants: CIVT and HKP. The former is a 90-100-day variety that requires considerable rain; the latter matures in 70-90 days and is suitable to more arid conditions. But informants cite well-known problems with both. For one thing, these varieties degenerate rapidly. HKP, for example, reportedly shifts from 70-90 to 120 days' maturation in only three years. Hence if farmers wish to use this millet, they must regularly buy replacement seed. Yet high-quality seed from the multiplication centers is always in short supply. Furthermore, its distribution network is limited. Lastly, both varieties are highly susceptible to the ravages of birds.

A third short-cycle millet named Ankatess was also mentioned frequently. This variety was developed under the very dry conditions around Zinder and Tanout. Informants note that they have experimented with and rejected this millet, despite the facts that it matures in only 70 days and requires no more than four days of rain. They explain that Ankatess has a very short head and so must be harvested with a basket, contrary to all traditional practice. Also because of the abnormally small heads, farmers are unable to calculate how much of the grain to reserve for consumption versus seed. Thus, in spite of its rapid maturation and drought resistance, this variety has been almost universally rejected.

Other Agricultural Innovations

Adoption of seed dressings and selection of new millet varieties represent only two among a host of innovative activities which farmers are pursuing -- whether in the production, consumption, transformation, or distribution of their animal, tree, and other crops. Many additional areas and instances of innovation were attested in the course of CTTA research in Niger. A number are presented here.

Some of the practices described below have been observed in other parts of Niger and the Sahel. Nevertheless, they represent innovations in the study villages where they were found. I.e. in Rogers' definition, they are "perceived as new by an individual or other unit of adoption." As such, like the cases presented above, these innovations offer concrete data for tracing out the communicative networks of technology transfer in agriculture.

Soil and Water Conservation

Land Preparation. The following case is recounted in Wazeye.

Case No. 6

About 20 years ago, villagers began to notice increasing wind erosion on their fields. The fierce, gusting winds of the Sahel were sweeping away the sandy soil, leaving bare the sterile hardpan underneath, "Where nothing can grow."

Until this time, villagers had always prepared fields for planting by burning off all standing stover. But they began to rethink this practice, hypothesizing that if they left the stalks in place "This would keep the wind from blowing away all the earth."

Their reasoning was simple. "We saw that, so long as some sand was left around the base of the plants, they would live. But if all the sand had blown away, the stand would die." So a conscious change in land preparation (and soil conservation) techniques was made. When queried about the source of this then-new idea, informants shrugged that "We saw this for ourselves."

Mini-catchments. Some of the techniques being applied by the FLUP project in the Guesselbodi forest have recently begun to diffuse among smallscale farmers in the area.

Case No. 7

FLUP laborers engaged in digging the mini-water catchments noted the visible success of this technique. The V's catch not only water but also sand and organic debris. Several workers living near Guesselbodi have begun dig catchments on their own farms, at their own initiative. Other villages elsewhere are doing likewise, in an effort to counteract advanced land erosion.

Planting and Fertilizing

Dry Planting. Wazeye and other farmers report that, in the past, they regularly "dry planted" a substantial portion of their millet fields, thus distributing their labor across a longer, more leisurely period. With ever diminishing and uncertain rainfall, however, this practice has lessened. Informants explain that they can no longer risk wasting so much seed. Because of inadequate and/or irregular rainfall, many newly sprouted fields wither and die. Seed is in too short supply for the many re-plantings that are now so often necessary.

Instead, for planting most of their millet crop, Wazeye farmers now wait for the first rain that penetrates at least three-fourths of a hand (approximately 15 cm) into the earth. Then they all rush to plant as quickly as possible since they have only two days before it becomes too dry to plant anymore.

Seed Pocket Manuring. In many villages, sheep and goat manure traditionally are broadcast on fields at planting time. In two communities in Niamey Department, however, a new innovation in manuring is taking place.

Case No. 8

A man in Goube is trying a new idea he learned of from a marabout (Moslem holy man). Before the first rains, he digs seed pockets, places manure directly into them, then re-fills them with earth. Termites help break down the manure, and with time any "burning" effects that the manure could have on seeds are dissipated.

After the first rain, the sand above the prepared pockets is discolored, making them easy to locate. The farmer re-opens the pockets and plants dressed seed. The dressing wards off the termites. This man believes his manuring technique is nearly as effective as chemical fertilizers, and certainly much less expensive.

Fertilizer Application. INRAN recommends broadcasting fertilizer, especially Super Simple Phosphate (SSP), at 50 k/h. Although farmers are generally aware of these recommendations, few follow them. Given the costs and risks of fertilizer use, farmers are experimenting with alternatives.

One innovative, farmer-inspired method of fertilizer application is being used in both Dosso and Niamey Departments. In this process, seeds, dressing, and SSP are mixed together in the same calabash for planting. Farmers claim several benefits for this technique. First, the most costly input -- fertilizer -- is localized in the eed pocket, thus economizing its use (as with manure

in case 8). If there is any burning of seeds because of the fertilizer, this is seen as an aid to thinning, offsetting the sometimes too-vigorous action of the seed dressing. Second, much less seed need be expended; precisely because of the use of both fertilizer and dressing, a higher percentage of the seed sown is sure to germinate. Careful calculation of the mix can also mean greater control over stand density and hence less work at thinning.

Another innovative application of fertilizer was documented in the village of Bouboussaye, about 75 kms from Niamey. There, some farmers plant after the first rain but without fertilizer. Then immediately after the second rain, the young shoots are circled with SSP. This technique represents yet a different approach to economizing on fertilizer by localizing its application. It also minimizes the risk of wasting fertilizer when rains are poor or belated.

Dry-Season Gardening

Two years ago, Wazeye families opened a dry-season gardening area in the village's bas fond -- a low-lying area which retains moisture throughout much of the year. The history of this innovation is as follows.

Case No. 9

About 15 years ago, a young man of Wazeye who was a then a high-school student in Dosso began a small garden in the bas fond. He worked his garden on weekends and holidays, selling the produce to help pay his school expenses.

After the drought of 1984, villagers began to cast about for more, and more secure, sources of food. "Before then, we usually had plenty to eat," they explain. "But now, in desperation, we recalled this petit and his garden and we turned to his idea."

Meanwhile, many villagers had observed the gardening successes of neighboring Goubey. Others had seen the flourishing dry-season gardens of Niamey. And Mr. Radio had worked in one such garden operated by a brother in Niamey. He thus learned the technical details of vegetable gardening. In addition, villagers had seen television shows on gardening techniques.

Given this cumulative corpus of information and evidence, after thoroughly debating the issue, villagers decided to start their own gardens. Seeds were purchased from the extension service, and the people set to work. After only two years, nearly every family in the village has now dug a shallow well and established a plot in the bas fond.

The gardens -- constructed using a type of tied ridges -- are cultivated in the cool-dry season. Currently, the following vegetables are grown: lettuce, carrots, sweet potato, Irish potato, onion, courgettes, melon, peppers, radishes, sorrel (for the leaves, not for the seeds -- as in the bush fields), eggplant, cucumber, okra, and beans.

People are very pleased with their efforts so far. They emphasize that the project was entirely their own doing, without any impulse or advice from outside. They further affirm that they explicitly established the gardens to grow more food for themselves; informants reckon that well over half of their produce is consumed at home.

However, villagers also appreciate the extra income from sales of their surplus vegetables in local and regional markets. They note that they can easily sell as much as they can grow. When harvests are particularly good, they may transport their vegetables to sell to the Co-operative Service in Loga. But functionaries and merchants also buy direct in Wazeye.

Perhaps most interesting is the elaboration of a new system of "green sales" for lettuce. I.e., purchasers come to Wazeye, examine the plots of lettuce, and then contract with farmers to buy all or part of their crop. Thereafter, the buyers periodically return to harvest the lettuce bit by bit, according to how much they can transport and sell before it wilts.

An even more dramatic and innovative case of dry-season gardening comes from the neighboring village of Goubey.

Case No. 10

As a young man, Ali Harouna (now age 57) moved to Niamey city where he worked at several jobs, including gardener. But in 1977 he was permanently disabled by a serious auto accident and returned home to Goubey, where his grandfather, father, and now a cousin have all served as village chief.

Unable to do heavy field work, Ali began dry-season gardening, putting to use the skills he had acquired in the capital. In 1986, with help from Project St. Gillis Tiers Monde, a Twareg worker was hired to build a donkey-powered chadouf well to irrigate Ali's garden. In effect, Ali now has an oasis garden of the type developed by the Twareg in the Air and elsewhere in the desert. Using

fertilizer from Nigeria (much cheaper than the co-op's), Ali now also raises a wide variety of vegetables for both home consumption and sale.

On a visit to Ali's garden several years ago, former President Kountche was so impressed with Ali's work and leadership that he granted Goubey funds to expand its gardening. Now 25 gardens stand on a large metal-fenced plot of a hectare or more, originally watered by 11 chadouf wells. (Unfortunately, last year five wells were destroyed by flooding.) While the area is devoted to gardening during the dry season, during the main growing season it is planted in millet and sorghum.

In addition to his gardening efforts, Ali has a producing tree nursery, including 26 eucalyptus trees about four years old, and a number of mango and papaya. (In a forest service course he learned how to graft mangos.) He now sells eucalyptus, mango, papaya, and neem seedlings in Goubey and other villages in the region. Recently, with seed he obtained in Abidjan, Ali began cultivating a new species of tree from which Moslem prayer beads are crafted. He hopes to stimulate a trade in this item.

After a recent training course, Ali became a promoter of the Centre d'Ecoute Radio-Club in the revitalized Radio Clubs du Niger. As a result of his leadership in gardening and agriculture in general, he is also one of the principle extension assistants in the canton.

Forage Utilization

In Wazeye, villagers have always collected and stored the mature, dried fruit of the gao (Acacia albida) tree as a critical dry-season forage for their livestock, along with the leaves of groundnuts, sorrel, and especially cowpea. (Human beings, too, consume dried cowpea leaves.) But Wazeyans traditionally did not store stovers or other kinds of hays "Because back then, there was plenty of grass everywhere." During the 1984 drought, however, some significant changes were made in forage utilization.

Case No. 11

In 1984, two men got a new idea from a passing pastoralist who was trailing his animals through Wazeye on his way back home in the north. His hungry herds greatly needed feed. Further, he said many other large, hungry herds were coming along behind him, returning from their not-so-successful southerly migration in this drought year.

Due to the drought, these two men's fields of millet had failed to produce any grain -- "just a lot of stalks." On the pastoralist's advice, they harvested the stalks and stored them in a specially constructed, fenced hangar (an open shed), with the plan to sell the fodder to other passing herders.

Their plan was successful, at least in 1984. Since then, however, villagers report that the large herds of transhuming animals have failed to return. Nevertheless, the practice of promptly cutting and storing stover from failed fields of both millet and sorghum has caught on throughout Wazeye. "Now everybody does this here." Moreover, villagers have further elaborated on this new idea, by also harvesting wild grasses to add to their stores of forage.[4]

The popularity of these innovations rests on the fact that villagers have found a ready cash market locally for all such feed. There is a large demand for quality fodder both in the local marketplace and among villagers. In particular, people who possess no animals find this an excellent source of income. Stockowners, too, sell surplus fodder. Despite the extra labor entailed (plus the potential loss of manure to fields, since animals can no longer graze the standing stover), everyone is very pleased with their earnings from this new idea.

Pest Management

Nigerien farmers have instituted a number of techniques to protect their crops from the ravages of pests. Across time, they have noted ever-increasing problems from pests, particularly rodents and birds. They astutely attribute this to a series of factors.

- The growing human population, which has forced more land to be brought under cultivation.
- Subsequently, drastic decreases in fallow periods.
- In consequence of both of the above, fewer wild grasslands and other resources for rodents and birds to feed upon.

As informants summarized, "The creatures can find nothing to eat in the bush, so now they are attacking human food." Several mini-case studies of innovative responses to this problem follow.

Case No. 12

Wazeyans have used commercial seed dressings since they were first introduced in the region by the OPVN (Office

de Produits Vivriers du Niger). Some 15 years ago, however, they began using these products to protect their cereal stores from insects and rats by sprinkling the chemicals around and in their granaries. Curiously, informants say that the idea of mixing this toxic material into their cereal stocks was suggested by the local agricultural service -- a claim the service denies. While indeed an innovation, this is perhaps a less felicitous one.

Case No. 13

Another, more appropriate and cheaper technique for controlling rats which come to feed on the stored grain has been tried by several Wazeye farmers in just the past year. This consists of placing a large basin or urn of water into a hole dug into the ground near the granary, and baiting the lip of the container with bran. Rats come to eat the bran, fall into the container, and drown.[5]

The first man to experiment with this idea in Wazeye learned of it from a radio broadcast. However, it had also been mentioned to him by several co-villagers. He happily recounts how, on his very first try, he caught seven rats in one night. Other villagers -- including the village chief, Mr. Radio, Mr. Researcher, and several unspecified men -- have now tried out this "better mousetrap," all with excellent results. Two of them learned of the technique from direct observation of its efficacy during trips to other parts of the country.

The entire population of Wazeye is now aware of this new idea. Based on the testimony of their co-villagers, they intend to employ it wherever rat infestations become severe -- not only near their granaries in the fields but also within family compounds. (A corollary of this new practice may be increased protein in children's diets, since they eat the rodents thus captured.)

Case No. 14

Radio broadcasts throughout Niger have lately aired programs on mixing the leaves of the neem tree in with stored grain to protect it against the ravages of insects. This is an ancient and well-known technique throughout much of the Sahel. But it is new to many Nigerien farmers. Throughout the CTTA research, numerous informants mentioned this new idea, and many planned to try it out this season.

Birds are of course an age-old bane of ripening stands of grain. But, the only control on bird populations that the CTTA team discovered is venturesome children's asystematic harvesting of baby birds. Children climb into the trees to capture, kill, roast, and eat the young of common species. Interestingly, however, they do not eat or destroy any eggs. As their elders bemusedly explained to the obviously benighted research team, "If the children did that, then soon there would be no more baby birds for them to collect."

Ethnoveterinary Medicine

In the time of the grandparents of Wazeye elders, a certain small tree populated the landscape of Wazeye. Known in local Zarma as [bukatun] (Mawri [mutuagatshi] and Hausa [gobarao]), the species was tentatively identified in Niamey city as a semi-domesticated member of the fig family. The root of this tree is highly prized for its medicinal qualities. It is reputed to cure all manner of stomach ailments among both humans and animals. So coveted was the root, however, that the species became extinct in the region. This gave rise to unique action on the part of one man.

Case No. 15

Greatly concerned about this loss of a valuable natural resource, Mr. Appleseed of ethnobotanical fame took advantage of a trip to Nigeria some 25 years ago to obtain some seeds of the tree. He carefully nurtured the seedlings in his garden, even risking the wrath of his co-villagers who, when he discovered that they came by night to chop away the roots of the young trees, dragged them before the Water and Forestry Service to be charged and fined.

As a result of his extraordinary efforts, several of these trees now flourish in Mr. Appleseed's botanical garden. More important, through repeated experimentation with the leaves, he has created a compound just as therapeutic as the medicines traditionally prepared from the roots. His co-villagers now regularly call upon him for a gift of this medicament, which reportedly has proven especially effective in treating livestock bloat, as well as stomach problems of human beings.

Transformation Techniques

Interviews with women were disappointing in terms of discovering innovations in agricultural production. This finding is not unique to Niger, however. For example, parallel research in the Sudan found that males cite twice the number of innovations in this realm as females (Coughenour and Nazhat 1985:44, Nazhat and Coughenour

1987). In the CTTA study, several factors may have been at work in women's lower response rate for innovations in production.

Rural women of nearly all sedentary groups in Niger participate in work on the household's collective millet fields, particularly at planting and harvest. And women of all rural groups typically raise some livestock. Beyond these two generalizations, however, women's contribution to agricultural production varies enormously within and across Nigerien ethnicities (after Veldhuyzen van Zanten 1987:55). This same study states that Zarma women traditionally practice less cropping than women of other ethnicities in the country. Instead, "Domestic tasks occupy a primordial place in their life" and a majority cultivate only "small houseplots of sauce products like okra, peppers, and herbs" (1987:29; translation ours). This author further notes that Zarma women generally enjoy less independence in agricultural production relative to other ethnicities. That the CTTA study villages were all Zarma or Zarma-speaking may therefore have skewed the data on women's innovation in agricultural production.

Some bias may also have resulted from the study mandate to focus on millet, leaving less time to inquire about other plant and animal crops. Most millet is grown on household (versus individuals') fields, where males control production decisions. It is noteworthy that interviews with women about livestock production revealed case 18 below, along with the fact that most families practice "embouche paysanne" or fattening of animals (mostly small ruminants) for sale.

Finally, it should be noted that men were present or within hearing distance at all interviews (both group and individual) with women. Thus, cultural stereotypes of sex roles might have constrained female informants' answers. At the same time, it must be recognized that such stereotypes have a basis in reality. African males and females traditionally have different primary responsibilities within the domestic economy.

Indeed, this role differentiation is evident in female versus male commentary on innovations in transformation versus production of agricultural products. Female informants readily and enthusiastically reported adopting new food preparation tools and techniques which they consider significant improvements in a number of respects. In particular, the women of Wazeye detailed the following two innovations.

Improved Cookstoves. Various models of more fuel-efficient cookstoves have been introduced by a wide variety of development organizations working in Africa, both in the Sahel and elsewhere (e.g. FAO, UNDP, numerous women's projects). The adoption of two such improved models has an interesting history in Wazeye.

Case No. 16

Improved cookstoves made of an adobe-like mixture of clay, straw, and other materials were introduced to Wazeye in 1987 by a village woman who had married and moved to Niamey city. On a visit home with her sister, she demonstrated the construction of the stove and reportedly proceeded to erect one in the home of every woman in Wazeye.

To impress upon the CTTA team the details of the stove's construction, clay and other materials were assembled, a miniature model was built, and the researcher was instructed to photograph it. Informants then pointed out two unique advantages of this culinary innovation. First, since the stove is firmly fixed in the earth, even large, heavy pots and vigorous stirring will not cause it to wobble or topple the family dinner out onto the courtyard. Second, of course, is the fact that all the materials necessary for the stove's construction are locally and freely available.

The women were initially very pleased with their new stoves. But unfortunately, within little more than a year, all but four had cracked and crumbled. (Perhaps the visiting sister was unskilled in the technical details of stove construction?) The women would like to continue using such stoves if only they could be made more durable.

Meanwhile, nearly all of the young married women of Wazeye now have purchased improved cookstoves of metal. These are often for sale in the village marketplace. One woman described how she bought her stove there five years ago, for only 300 FCFA. It is still in good working condition, and she considers that it was money well spent.

Whether of adobe or metal, the improved cookstoves embody many advantages over traditional models -- which consist of variations upon three rocks placed in a rough triangle, usually backed by a partial wall of adobe. (Once again, to ensure the researchers' appreciation of these details, villagers erected models of two traditional types of stoves.) Women emphasize multiple benefits of the new stoves.

- With only one small opening for inserting the fuel, the cookfire is almost completely walled in; hence the fierce winds of the Sahel can no longer blow out the fires, which are sometimes so laborious to start. (Taking out his flint box and tinder, one man demonstrated for the researchers how to make fire.)

- Both types of improved stoves call for less fuel, thus saving time and labor for both women and men, in their long treks to collect wood.

- Moreover, say informants, even though the improved stoves use less fuel, they produce a hotter cookfire.

- Lastly, the stoves are safer. Because the fire is walled in, the wind cannot blow sparks and bits of burning charcoal about the compound and thus set fire to hut and palisade. The corollary is that "Now women can go away and do other things, like drawing water from the well, while the food is cooking. We no longer have to tend the fire every minute." The new stoves free up more of women's labor for other purposes.

With all these advantages, improved stoves represent one innovation in agricultural transformation technology and natural resource management that is clearly here to stay.

Metal Sieves. Another innovation which the women of Wazeye wanted to demonstrate is metal sieves for sifting millet, maize, and other flours. The sieve is made of a circular strip of metal cut from a tin (often bearing the stamp of U.S. food aid) and covered with a wire screen. The traditional technique involved tapping a flat, tightly-woven basket over a calabash. The story of the changeover follows.

Case No. 17

The sieve was introduced to the village some 25 years ago by the elder sister of the current President of the Women's Association. The sister had married and moved to Sokorbey. One day, on a marketing trip to the town of Dosso, she bought this then-new piece of kitchen equipment, took it home to try out, was impressed with its qualities, and showed these off to her sister in Wazeye, who promptly followed suit. Soon, all the women of Wazeye possessed their own sieve. Today, this kitchen gadget is regularly available for purchase in the village marketplace.

The reason women prize this new tool so highly is that it sifts the flour thoroughly, thus making for much "finer" and "tastier" stiff porridge. In contrast, the traditional method of sifting left the flour, and any dishes prepared from it, unpleasantly coarse and lumpy.

Indigenous Agricultural Techniques

Items in this final section include techniques recorded in the

field by the CTTA team which do not strictly qualify as "innovations" because they have been used in the places where they were reported for as long as villagers can remember, "since the time of our ancestors." However, many of these practices give eloquent testimony to the richness and dynamism of IAK. Moreover, some represent kinds of techniques that might provide useful innovations in other parts of Niger or the Sahel where they are unknown. Hence, a few brief examples.

Sesame as a Striga Trap

When Wazeye farmers plant their millet, they may also throw some sesame seeds into the pocket to protect against striga. This parasitic plant entwines itself so tightly around millet's roots that "When you dig it up, it looks like a potato." "But when the sesame grows up alongside the mil," say informants, "this does not happen." Farmers claim the striga wraps itself around the root of the sesame, thus leaving the millet free.

Wazeyans further believe that this technique wards off a disease which halts millet growth at an early stage, causes the plants to "make many leaves but no grain," and turns the foliage yellow. An ICRISAT production agronomist said that this disease description also fits downy mildew (Phil Serafini, pers. com.).

An old idea among Nigerien farmers, this mixing of sesame and millet in the same pocket was a new one to agronomists consulted by the CTTA team. Scientists felt it was possible that sesame might indeed work as a striga trap. They were less sanguine about the claim that it also protects against other diseases, except in the sense that any plant attacked and weakened by striga becomes less resistant to diseases in general.

Intercropping

Informants in a number of villages describe how, after the first good rain, people rush to plant their millet. The basic pattern is to plant millet in sandy, light soil in paced rows of about two steps. After the second rain, cowpea (a legume) is planted between the millet rows. At about the same time, either interspersed among the millet and cowpeas or in a band circling the entire field, farmers plant sorrel -- a rapidly growing plant, the seeds and leaves of which are used in sauces.

Some farmers note that a "living fence" of sorrel helps protect the crops within from stray livestock. They say that sometimes the animals will circle the field eating the sorrel before attacking the principal crops. Other informants add that livestock will even graze the sorrel within a field before turning to the millet and cowpea -- suggesting that this cultigen is especially palatable to livestock.

Field Planning

Informants say they do not intercrop short- and long-cycle millets. Rather, they plant the former on smaller plots and the latter in larger fields. People also note that they try to keep their fields far apart. Despite the extra walking time this entails, they feel that this pattern improves the chance that irregular rainfall patterns will favor at least some of the fields.

Farmers plan their planting according to soil types. When a field has heavier, clayey, and/or moister soils -- as in a bas fond or around termite mounds and tree stumps -- sorghum is planted.

Cash crops, primarily groundnuts, are always planted in pure stands, and the fields are tilled before planting. These plots are regularly rotated and fallowed, in contrast to millet and cowpea fields.

Pest Control

As noted earlier, Wazeyans employ a number of techniques to protect their crops from pests. One of these is a very longstanding local practice, paralleling the use of neem leaves. Wazeye households use fresh leaves from the Anona senegalensis tree to protect stored cowpea. Villagers lay down a bed of these leaves on the floor of their granary, cover them with an empty grain sack, then add additional layers of leaves and cowpea. Informants claim that this technique guarantees protection against a certain black bug which would otherwise decimate their stores.

Also, Mr. Appleseed has a traditional technique for killing rodents that gnaw at the young trees he nurtures in his botanical garden. He prepares a poisoned bait from a certain cactus which he also raises, and then places the bait at the foot of the seedlings. Reportedly, any rodents that eat this tasty morsel are instantly paralyzed. The next morning, children collect the creatures for roasting and eating.

Natural Resource Management

Farmers in a number of the villages visited by the CTTA team are acutely conscious of their poor and deteriorating soils. Wazeyans have traditionally employed a simple strategy to improve particularly bare or poor patches in their fields. They collect the old thatching and straw from huts that have been refurbished, along with courtyard sweepings and other debris; carry these wastes to their fields; and spread them on the bare patches. Informants explain that termites will feed upon the materials and thus "create earth" from them.

The people of Wazeye are equally conscious of the value of what they term "the tall trees." These include: locust bean or nere, baobob, gao, shea nut or karite, mofa (identified above as Anona

senegalensis), a spiny tree which produces a fruit relished by human beings, and finally the dum palm. Whenever people notice a new seedling of any of these valued species, they take care to tie it to a stick and put a small fence around it for protection from browsing animals. Above all else, they lavish these attentions upon the gao which, in villagers' words, "is truly the most important tree of Niger."[6] Or as a local proverb puts it, "Two gaos are worth one wife."

Innovations that Failed

Cases where farmers tried and rejected new ideas are just as, if not more, instructive for research and extension as cases of successfully adopted innovations. Hence several such instances collected during the in-depth research in Wazeye are briefly presented.

Case No. 18

A dramatic instance of a failed innovation is the luckless poultry farm established in Wazeye in 1985. This project was instigated by the livestock service, which came to the village to recruit participants. One woman volunteered, and was given training in poultry management at Dosso and Gaya. Upon concluding the training, she and a girl "apprentice" were given 22 chickens and returned to Wazeye. Fencing and chicken coops were also provided. The objective of the project was to provide eggs for sale in the village. The details of the operation are vague, but apparently the idea was that egg sales would generate enough cash to buy high-quality feed for the layers.

In the second year of operations, however, a disease killed nearly all the chickens. Villagers' diagnosis is that "They died from the terrible heat here." In general, people feel the birds provided by the livestock service were too delicate to survive village conditions.

When the service learned of this situation, it collected the few surviving hens, and that was the end of this ill-starred project, designed and directed from outside the village.

Case No. 19

Wazeyans have rejected two new cowpea varieties introduced by the agricultural service -- the first about ten, and the second two, years ago. Informants adduce multiple reasons for rejecting these "artificial" varieties.

First, farmers say their own varieties are far more drought tolerant. Reportedly, three traditional types

of cowpea -- two early and one late -- are currently cultivated in Wazeye. Second, farmers say these local varieties give far more leaves. This feature is important, since the leaves are a regular part of both human and herd-animal diets. Third, people observe that the new varieties must be grown with chemical fertilizers, which they cannot afford. "Without fertilizer, the agricultural service's cowpeas give yield less than our own. And when the rains are good, our plants produce larger peas." Finally, informants complain that the service requires them to plant the cowpeas in pure stands, contrary to traditional practice throughout West Africa.

Case No. 20

On another occasion, the extension service introduced two new sorghum varieties. Wazeyans dutifully tried them, reportedly following all the technical recommendations. One variety gave disappointingly small grains. The other was even worse. "The plants just kept getting bigger and bigger. By the end of the agricultural season, they still had not finished growing, and they never did produce any grain."

In fairness, villagers note that when the extension agent observed these results, he did not insist that they continue the new varieties. "And," say informants, "he has never again brought any new sorghums for us to try."

Indeed, informants in several of the study villages had much to say about the extension service and/or their local cooperative. Much of their commentary was not very complimentary. Many complaints centered around these institutions' failure to extend credit for agricultural inputs. One man voiced the sentiments of many in observing that "They will not give us credit even for a bit of seed." And as another quipped, "They do not help us with anything. All they do is come to talk -- just like you" [the CTTA team]. Farmers also feel it is unfair for them to have to pay for experimental seed (as was true in case 19) when they are essentially ordered to plant unknown and unrequested varieties. These kinds of perceptions highlight the need for increased communication between farmers, extension, and research.

One particularly eloquent passage from the team's field notes aptly summarizes common perceptions of the extension service.

> Everything the service brings us needs to be grown in fertilizer. But who can afford this? It costs more than 3000 FCFA a sack. The extension service is not "honest" because it refuses to work with the realities of our village.

Summary and Analysis

Examples of innovative agricultural techniques (as well as long-standing traditional ones) could likely be multiplied by as many villages as are in Niger. But the larger points of the findings presented in this chapter should be evident.

- Nigerien farmers are clearly open to and actively seek out and apply new ideas in their plant and animal agriculture.
- Moreover, they plan, implement, and evaluate their own informal on-farm research trials.
- In the process, they demonstrate a sophisticated understanding of the complex interactions among numerous variables with which they must contend.
- Finally, there exists a rich body of local technical knowledge in agriculture, elements of which -- with increased cross-regional communication and in some cases validation and refinement by formal research -- could almost certainly be of use to farmers throughout the Sahel.

The point studies and virtually all of the mini-case studies unequivocally demonstrate the first observation. Clearly, the notion that African farmers are hidebound traditionalists is itself hidebound. As the next chapter emphasizes, whether travelling, working outside the village, receiving visitors, marketing, listening to the radio or watching television, conversing among themselves in community gathering places, or even entertaining teams of inquisitive anthropologists, Nigerian farmers are always on the alert for new agricultural information and ideas.

Indeed, the CTTA researchers were not the only ones conducting interviews. In all of the study villages, farmers, too, eagerly posed questions to the team -- about proper fertilizer application, thinning techniques, innovative pest control ideas like the use of neem leaves, different varieties of millet to be found in other parts of Niger or forthcoming from research and multiplication centers, market prices and rainfall conditions elsewhere in the country, and so on ad infinitum. The thirst for agricultural information among farmers of the arid Sahel is both deep and indisputable.

Part of their efforts to assuage this thirst include independently trying out new plant and animal varieties, management practices, tools, and technology components to see if these can be profitably adapted to "the realities of our village." These efforts embrace essentially every aspect of the farming system, whether crop (cases 1-10) or livestock (11, 15, 18) production, consumption (2, 9), storage (12-14) and distribution (9, 11), or transformation (16, 17).

Farmers' search for knowledge includes mounting their own on-farm trials (cases 1-5) -- as producers everywhere have doubtless done since the domestication of plants and animals some 10,000-12,000 years ago, long before there were universities, agricultural research institutes, or extension services. In designing, implementing, and evaluating these trials, farmers take several familiar-sounding steps.

- Gathering background information from farmer-colleagues and other knowledgeable persons and from direct observation of others' experiences with field-trial design and the variety to be tested -- akin to an oral "literature review" prior to initiating an experiment.

- Selecting the field trial sites according to consciously established criteria -- e.g. edaphic and hydrologic characteristics, proximity to the compound or to other plots of millet.

- Controlling for major variables -- in the cases recorded, these most often focussed on use versus non-use of manure or chemical fertilizer. Size of experimental plots (and presumably other variables like planting densities) may also be controlled to allow for greater comparability of data.

- Running the trials -- ideally for more than one year, to allow for differing performance results due to interannual climatic and other variations.

- Monitoring and evaluating the results of trials according to the features of interest. In the case of millets, the principal features cited included maturation period, resistance to drought and birds, high yields, and above all, good performance along these and still other parameters without large inputs of natural or commercial fertilizer.

In essence, farmers' ethnoscientific approach to on-farm trials consists of applying the scientific method to the best of their ability, and according to the research resources they can marshal. Naturally, Sahelian farmer-researchers do not enjoy the benefits of formal scientific training, ready access to technical information, or the financial resources to conduct elaborate or costly trials. But some of these advantages could be added through collaborative, interactive research, i.e. with farmers, scientists, and extensionists conducting trials jointly. Thus the quality of farmer-organized trials could be enhanced; and with tangible support and encouragement, their quantity increased.

If such efforts are to be successful in generating appropriate new technologies or technology components, however, experiments must be designed with the variables of concern to farmers themselves in mind -- plus the complex tradeoffs that must always be made in

optimizing across these variables. Otherwise, results will not be acceptable to and adopted by farmers.

Investigations like the CTTA's are useful in identifying these variables. Taken as a whole, the point and case studies demonstrate farmers' acute awareness of the difficulties with which they must contend in pursuing plant and animal agriculture in one of the world's most arid ecologies, with the added burdens of burgeoning human and animal populations, and declining natural resources. To name just a few, these difficulties include: land shortages and deteriorating soil qualities; diminishing sylvan and water resources; high cost and often uncertain availability and/or quality of basic agricultural inputs like seed dressings, manures, and fertilizers; attacks by birds, pests, and disease; strains on household labor supplies; and shifting market prices, demand, and outlets.

Peoples of the Sahel have confronted these challenges by adopting and adapting new agricultural ideas that come their way -- no matter whether from exogenous, endogenous, or syncretic sources. One of the principal questions in the CTTA team's scope of work is: what characterizes the technologies that farmers have embraced? A review of the data presented here suggests the following criteria. Further study would be necessary to order them by importance.

- <u>They reduce risk</u>. This is clearly a paramount feature in promoting ready acceptance of new ideas. Among the cases documented here: ensuring high germination rates by application of seed dressings; wherever feasible, selecting rapidly maturing, high-yielding, and drought-, disease-, and pest-resistant cultigens (cases 1-5, conversely 18-20); reducing potential losses of valuable manure or fertilizer by localizing its application (case no. 8 and ff.); storing quality forage against dry-season shortages (11); timing planting so as to reserve seed against multiple re-plantings; taking steps to stabilize or improve the physical environment (6, 7); relatedly, introducing additional, new and/or irrigated crops in order to increase food options and security (9, 10); protecting precious foodstocks against the ravages of pests (12-14).

  This feature characterizes the majority of innovations documented here, as well as many existing indigenous agricultural techniques, e.g.: intercropping to ward against plant diseases or hungry livestock (in addition to this technique's many other well-known advantages); or dispersing fields to plan for microzone differences in rainfall.

- <u>They generate income</u>. This feature characterizes several of the innovations studied, with actual or projected earnings from sales of garden produce (9, 10), improved seeds (5), seedlings and wood (10), and forage (11). A corollary feature is ready access to profitable markets and/or new distribution networks for the innovation.

- They are affordable. This is an obvious consideration in the adoption of any innovation. Affordability is one of the prime motivators behind farmers' creative experiments with fertilizer usage -- and their complaints about crop varieties generated by formal research. Affordability has also played a role in the widespread adoption of seed dressings, which are sold in quantities small enough that nearly every farmer who wishes to do so can afford to buy at least some.

- They are readily available. This is an equally obvious consideration, and one which has promoted the adoption of items like sieves and cookstoves (both are readily available in almost all marketplaces, and the former can even be made at home) and seed coatings (available through many outlets, including petty merchants within farming communities). Conversely, the availability factor may have constrained adoption of commercial fertilizer -- which farmers complain they cannot always obtain (or obtain in desired quantities) even when they can afford it.

- They save labor. Or, as in the case of seed dressings, they entail trivial amounts of additional labor. Examples of labor-saving innovations include: short-cycle millets' greater ease of preparation; improved cookstoves, which save time in fuel-gathering and free women to perform other tasks while food is cooking; and some informants' claim that calculated applications of seed coatings and fertilizer can subsequently save on the work of thinning.

- They fit into current farming practices. Telling examples come from rejected innovations: cowpea that must be planted in pure stands (19); or varieties of millet (like Ankatess) that cannot be easily harvested, bundled, or their yields accurately estimated because of unusual plant architecture or other characteristics. (Though not attested in the CTTA data, another common example is dwarf varieties that leave little stover for livestock.)

  Conversely, items like seed dressings, cookstoves, rat traps, and sieves do not imply any immediate changes in traditional practices. Best of all are innovations that find a parallel in indigenous technology -- again, like powerful "powders," stoves, sieves, or use of botanical materials as insecticides (neem leaves).

- They are easy to understand. Although informants did not enunciate this feature, it seems to characterize the majority of innovations documented; and it is partly related to the foregoing feature.

- They produce readily visible results within a reasonable amount of time. Or put another way, they clearly work. This is most noteworthy in the case of modern seed dressings. But it also applies to the performance of new varieties across the growing season and to other innovations like the "rat trap" and the improved stoves.

- They meet multiple needs. Examples include: the seed dressings -- which are also used in personal hygiene, as medicaments for livestock, insecticides for stored produce, and are believed by some to act as fertilizer; improved stoves -- which save both time and fuel and incorporate important safety advantages; and products which serve equally well for subsistence or cash income (garden vegetables, stored forages).

- They are attested by evidence from several sources, including those most trusted by farmers. This feature is explored in the chapter on communications.

- Other considerations. These include e.g. the taste preferences, culinary qualities, and nutritional beliefs cited in the adoption of new millets, stoves, and sieves.

Naturally, no one innovation embodies all of these features. And not all criteria are of equal weight in evaluating a given innovation. Moreover, there are sensitive trade-offs among them. Some risk-reducing innovations may entail more capital or labor; conversely, certain labor-saving techniques might increase risk. And so forth.

However, one fact seems clear from the CTTA study. The more of these features that an innovation incorporates, the greater its likelihood of adoption. The prime examples in this study include the widespread diffusion of modern seed dressings, the whole-hearted search for improved short-cycle millets, and the enthusiastic adoption of improved cookstoves.

Of course, in the ultimate analysis, adopters themselves make the final decision on the relative costs and benefits of an innovation, vis-a-vis a complex constellation of multiple, and often competing, considerations in their farming systems, household economies, ecological resources, and more. This is why it is imperative that researchers and extensionists join forces with farmers if they wish to design truly "appropriate" technologies. This task is manifestly impossible if the former work apart from the harsh interlocking realities of Sahelian farming systems, without direct input from the people with whose very survival they are experimenting.

Both researchers' and extensionists' work can be greatly facilitated by increased communication with their clients. The findings presented here give powerful testimony to farmers' inventive and enterprising spirit and their empirical scientific curiosity. Formal

research can take a cue from farmer experimentation, innovation, and IAK to better target its own research. And with a knowledge of how farmers send and receive new agricultural ideas and opinion, extension can find ways to exploit, accelerate, and expand the flow of such messages. The next chapter turns to the latter topic, the lines of communication which brought both the news and the reality of the innovations documented here to the CTTA study villages.

NOTES

[1]It is possible that, unbeknownst to the informant in this case, the sarkinoma's powder may have been one of the commercial seed dressings.

[2]"Varieties" is used throughout the text in a non-technical sense. It is difficult to ascertain in brief field interviews with farmers whether the crop types of which they speak are true varieties or not.

[3]Ugandi millet, developed by the Agricultural Research Corporation in the Sudan, has shown promise in north central Kordofan. It reportedly combines many of the characteristics that Nigerien farmers desire. Called abu suf 'father of hair' by Sudanese farmers, this variety appears to be drought resistant, early maturing, and unattractive to birds thanks to its barbs (Coughenour and Nazhat 1985).

[4]Such moves clearly have implications for land and resource tenure issues, for socioeconomic relationships between cultivators and herders, and relatedly, for crop/livestock interactions, e.g. field manuring (and its benefits for reseeding, soil structure, and fertility) versus animal feeding. However, it was not possible to investigate these in the time allotted for CTTA research.

[5]This device is known in Niger as a Kornaka trap. The technique has been reported as an indigenous innovation in other parts of Africa (David Brokensha, pers com.).

[6]It was not determined whether individuals limit their efforts only to seedlings in their own fields, nor what the implications of this practice for tree tenure are.

Chapter 3

FARMERS' AGRICULTURAL COMMUNICATION

Communication can accomplish many things. In fact, it is a necessary condition for bringing about most desired changes. But remember, communication is never a sufficient condition for bringing about change by itself. The other variables must also be reckoned with. Some ultimately can be changed and some you will just have to live with. But by understanding what they are and how they operate you will be better able to deal with them (Lionberger and Gwin 1982:7).

Models of Technology Transfer: Implications for Farmer Communication

The evolution of Western scientific thought regarding communication for technology transfer in agriculture across the past four decades can be summarized in increasingly sophisticated models of transfer and communication processes. As noted in Chapter 1, the earliest such model was highly centralized, linear, one-way, and biased in favor of technology (Awa 1988, Coughenour and Nazhat 1985, Rogers 1983). In its simplest version, it can be depicted as:

RESEARCH (R) ⟶ EXTENSION (E) ⟶ FARMERS (F)

This "first stage" model was originally elaborated to document the American experience in agriculture, and to provide a template for technology transfer elsewhere in the world. But even as a description of U.S. processes, it was oversimplistic and faulty in several respects.

For one thing, it did not capture Americans' optimistic belief in their ability to direct and/or create organizations and institutions on behalf of their own progress. During the first half of the 20th century, U.S. farmers had a strong voice in the technology generation and transfer process (Rivera and Schramm 1987). They could influence research and extension programs and budgets, and the method and manner in which they received messages from these sources. Extension helped link individuals and groups with strong mutual interests who were eager to share ideas and information, i.e. to communicate. And the technology generation and transfer process, also imperfectly expressed in the model, was institutionalized in young, flexible organizations and institutions which were anxious to respond to all client groups.

Relatedly, the model's linear, one-way design underrepresented grassroots traditions in American agricultural communication patterns. While U.S. farmers valued and sought out expert advice, they did not stand in awe of it. In American cultural tradition, a profound respect for "common sense" allowed for dynamic interaction between the educated and the uneducated. Moreover, the distance between the two was often small. Most extensionists and many agricultural scientists came from farming communities and continued to farm while pursuing their professional careers. Conversely, many farmers conducted self-directed research and experimented with innovations on their own farms. The proximity of F, R, and E players to one another and their willingness to reach out and interact created an ongoing dynamic that was never captured by the model.

These and other shortcomings of the early model became painfully evident when development agencies endeavored to apply it outside

the U.S. context. Much of the criticism of this and similar models centers on the kinds of functional linkages described above, i.e. the effective coupling of the principal players and institutions.

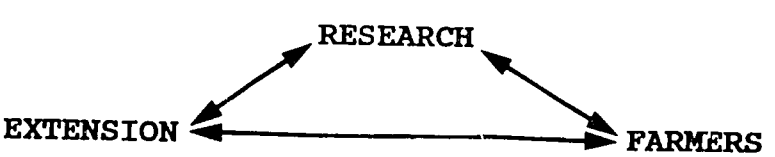
In particular, such models did not relate researchers directly to farmers. Rather, R is represented as communicating with E as the conduit, translator, disseminator, and interpreter of all technical information to F. The R-E and E-F linkages were therefore critical, since extensionists acted as the major agents of change and carried the burden of communication. I.e. in this configuration, R serves as the generator of knowledge, the alpha; F represents the receiver and beneficiary of knowledge, the omega; and E comprises everything in the middle.

In developing nations, these expectations were too great to place upon extension staff who often lacked the technical education or training needed to fill all these roles; who often experienced terrific logistic constraints in reaching their clientele; and who frequently had few professional, social, or cultural incentives to do the job. Operating under such a model, it is small wonder that many farmers in developing countries have failed to adopt recommended technologies. This is especially true in Africa. "Indeed, a whole literature has sprung up among Africanists trying to explain...why technology transfers have not worked as the solution to Africa's needs for rapid agricultural development" (Moris 1983b:v). First, farmers were blamed; then extension. In essence, this simplistic model encouraged simplistic explanations of what failed and why.

As efforts to transfer this early model met with repeated failure, the model began to evolve to include important communication concepts like feedback loops and interaction. The resulting "second-stage" models of technology transfer can be schematized as follows.

Here, flows are still linear and basically hierarchical, but the communication process is at least expressed as a two-way interaction.

Third-stage improvements in models incorporated a "high proximity" network with communication existing between all parties implicated in agricultural Research, Development, and Extension (RD&E), i.e.:



This model and others that followed sought to address the linkages criticisms leveled at technology transfer and extension efforts during the 1970s. Despite extension's numerous failings, by this time feedback mechanisms had worked well enough to convince many researchers that many of their technologies were inappropriate and unacceptable to farmers. Models like the one above represent a reconceptualization of communication processes so as to more directly involve the user in technology development. In this schema, R is more intimately engaged with F, and communication is perceived as multi-dimensional and dynamic. Whether it actually happens that way or not is another matter; the aim is to open new channels of communication to allow appropriateness or acceptability of technology to be defined somewhat in user terms.

Likewise, concepts like "sustainability" and "productivity" require information and perhaps definition from the farmer's perspective. Their introduction into technology transfer models has represented a clear attempt to increase F involvement in communication (if not decision-making) processes of technology generation. Concepts like sustainability also fostered recognition that farmers have expert knowledge that they bring to bear at every decision point. R thus began to acknowledge that it had something to learn from F in the interaction, as well as F from R.

This growing attention to the F-R linkage is best depicted in a more complex schema developed in the early 1980s (Figure 5; from Rhoades 1984:34). It promotes the farmer to a full partner in both communication and decision-making processes in technology generation. This "farmer-back-to-farmer" model involves four major activities, each with a specific goal; but it always begins and ends with input and evaluation by the potential users of the technology being designed. The hatched areas in the diagram indicate increasing understanding of the technological problem area as research progresses. Note, too, that research may constantly recycle.

This model depicts one approach within Farming Systems Research and Extension (FSR/E) -- the most comprehensive redesign of the technology generation and transfer process and the most contextually sensitive. Largely extracted from development experiences, FSR/E outlines a participatory methodology of technology development that emphasizes full farmer involvement in all phases of agricultural R&D. In addition, it calls for multidisciplinary analysis of the farm enterprise (Horton and Prain 1988, Matlon et al. 1984, Norman et al. 1982, Shaner et al. 1981, Simmonds 1985).

FSR/E begins and ends with the farm and the farm family. In addition to its user orientation, two formerly underutilized communication techniques characterize FSR/E work -- listening and observation. Multiple perspectives are actively encouraged in order to reach an in-depth understanding of the client's situation and goals.

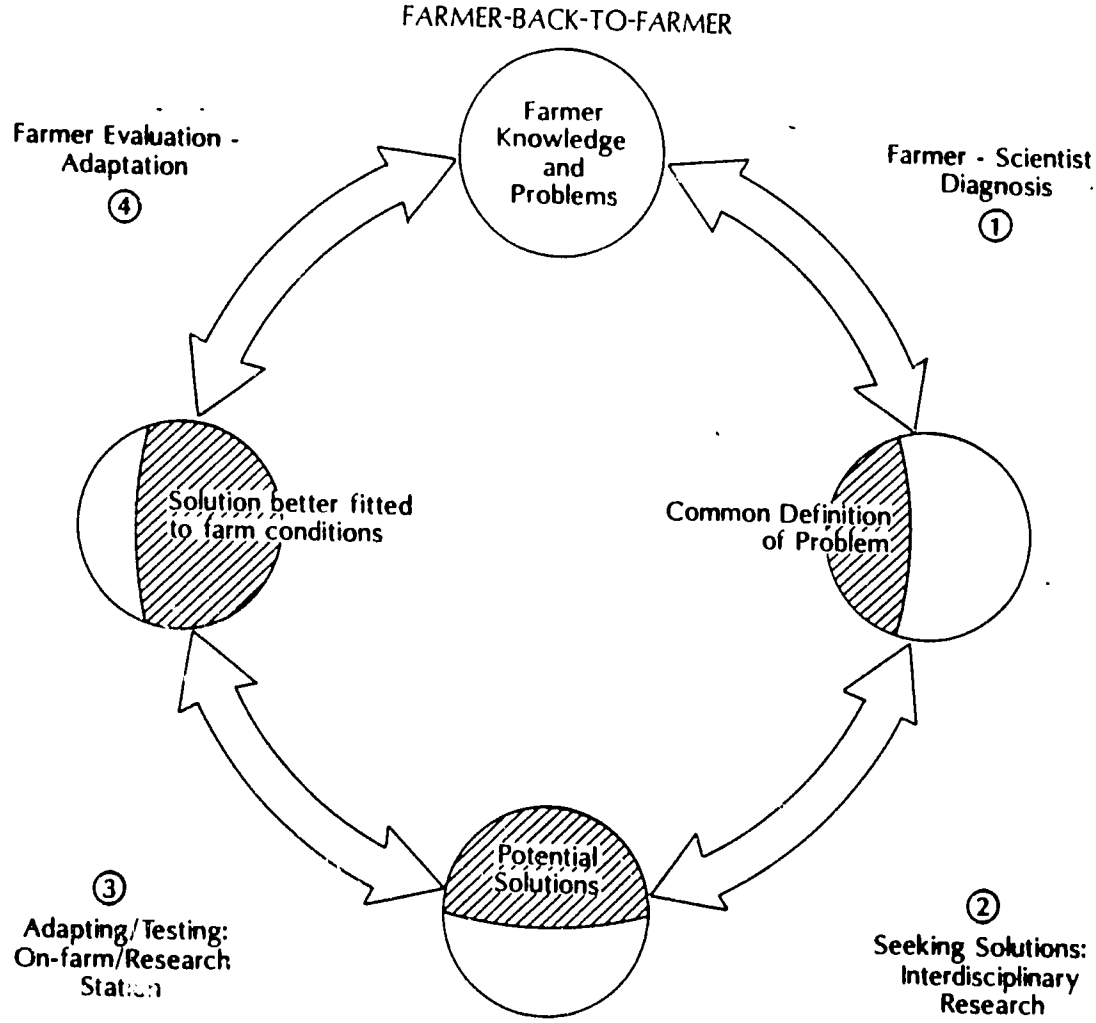


Figure 5. Farmer-back-to-Farmer Model of Technology Generation.

This perspective has strengthened not only farmer participation, but also the involvement of social scientists (e.g. anthropologists, sociologists, economists, and communicators) in the RD&E process.

To date, however, more effort has been spent on farming systems research than on farming systems extension (Sowers and Kabo 1987). But the FSR/E concept and model clearly embody both. The premier example of farmer-focussed approaches to extension is exemplified by the training and visit (T&V) system (Cernea et al. 1983). Unfortunately, "Typically the [T&V] system has been grafted to the innovation centered approach and there is a danger that it remains 'top down'" (Pickering 1987:69).

In a fourth and final stage, attention in agricultural RD&E has turned to holistic examinations of knowledge and information systems' role in technology transfer. In 1985, CTTA elaborated its own model of technology transfer (Figure 6). Like FSR/E and T&V, it centers on the farmer and stresses the need for closer interac-

tion between R and F to develop more appropriate technologies. But the transfer activity is explicitly characterized as communication and information processes rather than as structural extension entities.

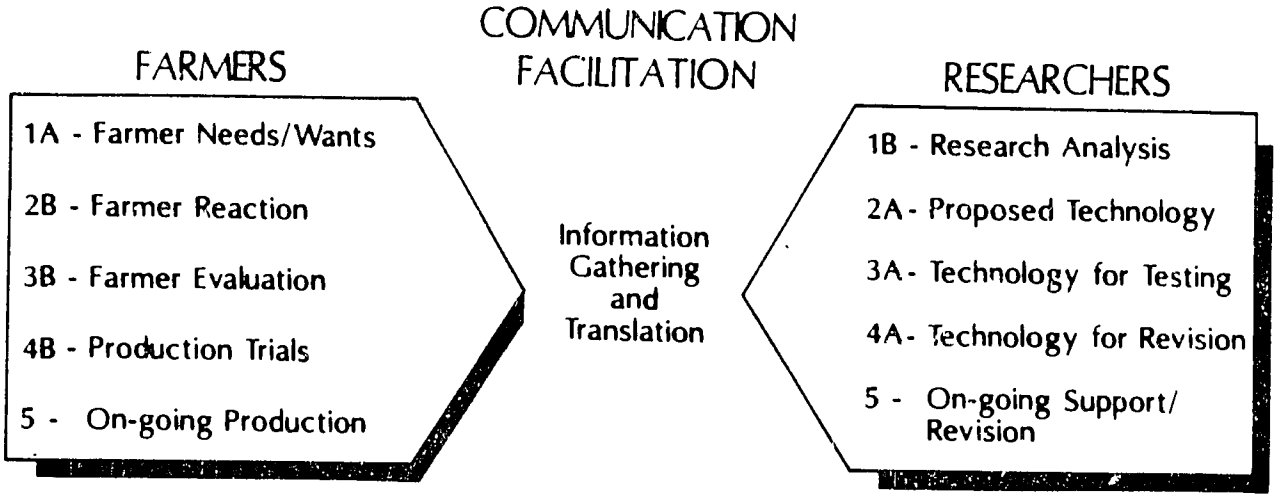


Figure 6. CTTA Model for Technology Transfer

This model was an attempt to acknowledge that many developing countries lack the infrastructural and institutional resources to make technology transfer the major function of extension. As Moris (1983b:35) observed for agricultural development initiatives in Africa:

> American advisors...persistently misjudge extension needs and capabilities in LDC contexts. Americans see extension as being primarily an <u>educative</u> function... [due to] very special advantages... Where in developing nations similar features were encountered -- e.g. among North Mexico's Sonoran wheat farmers or in North India's rich Punjab plain -- the US "extension" approach based on direct contact between idealistic agronomists and enthusiastic local farmers has been wondrously effective. But elsewhere the US model has not transferred easily... Let me stress, therefore, that <u>contexts</u> matter a great deal when we are diagnosing extension needs, designing field programs or offering farm level advice.

Depending on the context, the CTTA approach may or may not emphasize institutional linkages. Most recently, information science has influenced technology transfer models. Processes such as generation, transformation, storage, retrieval, and utilization serve as organizing principles. This perspective does not cast R as the single active source of technology, E as the sole disseminator of technology and information, nor F as the passive receivers. Rather it views all parties as dynamic participants in all processes (Rölings 1988, in progress).[1]

To summarize, approaches to agricultural development and technology transfer that relied solely on unilinear and top-down information flows and encouraged little or no active feedback from and communication among farmers have failed. Such models are not currently advocated by the leading specialists in any field. Many alternative multi-dimensional, interdisciplinary models have been put forward, but none has yet dominated the field as the traditional model did.

This is probably for the best. One of the problems with modeling is its apparent inability to reflect or direct reality. Farmers, governments, and USAID missions have problems. While models can help guide and plan strategies to solve problems, day-to-day reality is where problems actually get solved. Therefore, an eclectic, situational posture toward technology transfer models is indicated. This can be more instructive and practical than rigid, idealized notions.

Farmers' Communication Patterns

The model used to address the scope of work for the CTTA/Niger study was presented in Chapter 1, Figure 2. This idealized schema was elaborated to guide investigations into the reality of communication networks among farmers and between F, R, and E in Niger. Communication network analysis deals with:

> interconnected individuals who are linked by patterned flows of information. The point here is that networks have a certain degree of structure, of stability. It is this patterned aspect of networks that provides predictability to human behavior (Rogers 1983:294).

Communication network analysis is a method for identifying the communication structure of a system. Most network analyses assign individuals to "cliques" on the basis of their proximity to network links. Proximity refers to the degree of overlap among the personal networks of individuals in a clique. Proximity may be measured as low or high (Figures 7 and 8). For example, Figure 2's idealized

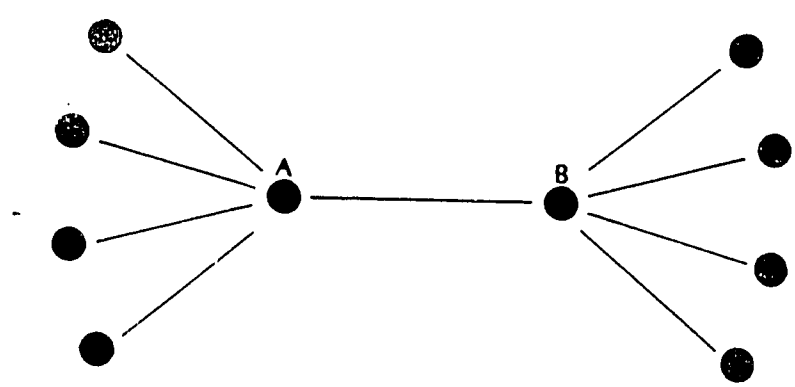


Figure 7. Low Communication Proximity Network.

model represents a high proximity network -- one which expectably was not born out in the CTTA/Niger study, since not all individuals in all cliques have personal networks that overlap. However, the study did identify many cases of interlocking networks, defined as a set of individuals who interact with each other.

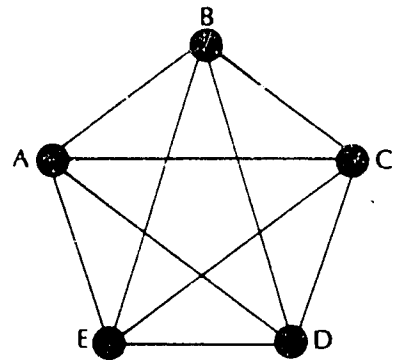


Figure 8. High Communication Proximity Network.

Another concept in network analysis is relevant to this study--what Granovetter calls the strength of weak ties (Figure 9). Basically, weak ties are interconnecting bridges among cliques or networks that are low in proximity. For diffusion of innovations to occur, "at least some degree of heterophily must be present" (Rogers 1983:297). Weak ties have greater potential for communication than strong ties. The latter often mean that a clique is ingrown and very little new information can enter it except through "the strength of weak ties."

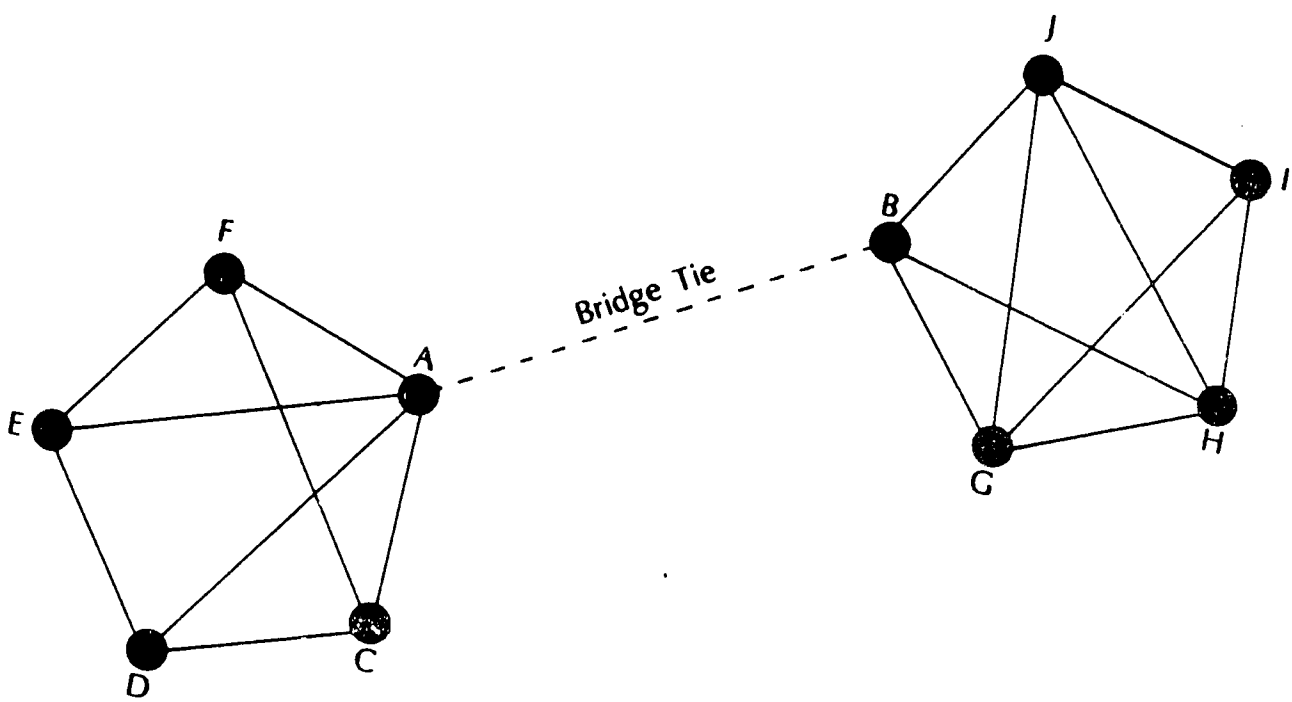


Figure 9. Bridge Ties.

These weak or "bridge" ties constitute what is often termed linkages. When a bridge is an individual, that individual acts as a boundary spanner. This term is not restricted to network analysis; it can be more broadly applied to individuals or groups who venture outside the established boundaries of their community or culture and who, by virtue of this increased exposure, serve as change agents.

The CTTA/Niger concept (Figure 2) embodies a multi-directional model of agricultural communication and consciously emphasizes the central role that farmers need to play in at least three of four critical information currents: F-F, F-E, F-R, and R-E. As per its scope of work (Annex A), the field study concentrated on the information networks among farmers.

Analysis of farmers' agricultural communication patterns draws upon both the survey and in-depth interview results, including the mini-case studies presented in the preceding chapter. The aim is to identify individuals, groups, and locales within communities,[2] mass media channels, and other contacts -- both informal and formal -- which serve as significant conduits in the flow of agricultural information among and to Nigerien farmers.

Individuals

Individuals with special impact on farmer-to-farmer information flows within communities can be categorized as innovators, key communicators, influentials, and others.

Innovators. Innovators can be described as "venturesome" and eager to try new ideas. Usually they have above-average resources, can apply technical knowledge, and live with uncertainty and setbacks (Rogers 1983:248). In the CTTA/Niger study, innovators include the kinds of individuals profiled in the mini-case studies -- Mr. Appleseed, Mr. Radio, Mr. Researcher, the President of the Wazeye Women's Association, the President of the Goube Cooperative, Ali, and the two unnamed men who first began to harvest stovers and wild grasses to store as forage.

In the time allotted for research, it was not possible to specify fully the social and economic characteristics of these individuals. However, excepting the woman, several commonalities did emerge. First, these are all men who have travelled fairly widely. I.e. they function as boundary spanners in their community, thus demonstrating the strength of weak ties. Second, all but one hold no official position within their community. Third, none are young men; they average around 50 years of age.

Innovators may or may not be respected by other members in their network. But they nevertheless function as "gatekeepers" by introducing new ideas from outside the network boundaries. Case 5 provides a good example, where the President of the Goube co-op served

as a catalyst of potential change for members of his network, like the "silent gleaner."

Key communicators. Above all else, key communicators are opinion leaders (Bembridge 1976, Lionberger 1959). They are highly respected in the network and can serve as "missionaries" in the diffusion process. They may or may not be innovators. Key communicators for agricultural intelligence in the study villages appear to fall into roughly two types.

According to informants, the first includes "those who possess radios." These men inform their co-villagers of recent news. More often than not, however, non-agricultural rather than agricultural information is sought. But with more, and more relevant and timely, agricultural programming on Nigerien radio, doubtless the role of this group of communicators could be expanded.

The second, and more important type of key communicator for agricultural information and opinion consists of men identified by their fellows as what we here term "farmer paragons" -- more or less equivalent to Nazhat and Coughenour's (1987:48) category of agricultural "opinion leaders." These individuals are widely and openly admired for their surpassing skills in plant and/or animal agriculture -- skills that are evidenced not by producing the highest crop yields or the greatest number of livestock but rather the highest quality products.

Such men are actively sought out for advice on farming problems. In this role, they serve as "expert consultants" to their networks, and they fill effective teaching or training functions, as well. Moreover, as the team found in Wazeye, the most highly admired among such individuals may be appointed by his co-villagers as the "porte parole" or go-between with the district extension agent.

Interestingly, however, aside from this distinction, none of the four farmer paragons in Wazeye held any official community position. Nor were they especially well-travelled men. But all were said to be exceptionally kind and calm individuals "who never grow angry." If such farmer paragons can be identified and strategically involved in RD&E initiatives, "expert" farmer feedback could be gained on proposed interventions, and their central role in agricultural communication networks could be capitalized on.

Influentials. Farmer paragons form one of a number of identifiable "influentials" in Nigerien communities. Others include, e.g.: the village chief, the chief of all marabouts in a community, the president of the women's association, the president of the cooperative (if any), and a variety of both male and female elders who are respected for their wisdom. When asked to characterize the latter group of influentials in very general socioeconomic terms, one informant described them as "simple and poor people who are compassionate in nature. They are listened to because they are like

everyone else here." He further remarked that these individuals have travelled little. "They are always here."

With the exception of farmer paragons and co-op leaders, however, such influentials currently appear to have little direct impact on the diffusion of agricultural production information. However, if they are opposed to a given innovation, the influence they wield could be a strong deterrent to its adoption.

Other. One last type of individual should be mentioned. These are community members who engage in petty commerce, e.g. of packets of seed dressing, or who serve as commission agents for merchants dealing in largescale sales of fertilizer. In more remote villages, such men stand as the local representatives of "private sector" participation in agriculture. In the course of marketing inputs to co-villagers, these local businessmen doubtless are consulted on the use and quality of their products. Their contacts with non-local merchants and other outsiders also make them natural bridges between outside networks and cliques within their community.

Groups

The power of group relationships and their influence on social change is well-known. As one authority notes:

> It is individuals who must change, but these individuals live in groups, work and play in groups, enjoy many of their most cherished experiences in groups. Many of the beliefs and values they hold most strongly are group norms -- commonly held and mutually defended... Practically, this means that social change is much easier if it is not contrary to group norms... The question is, how to confront them (Schramm 1964:118).

Schramm's answer to this question is the one that other communicators, social psychologists, anthropologists, and educators have been giving for 30 years or more. People must participate in decision-making and action that affects their lives; otherwise, little change will occur. In the process of change, individuals are typically influenced by multiple groups. Indeed, this is a natural part of cultural formation and replication (Schein 1985). The CTTA/Niger study team identified a number of groups and networks that are or likely could be involved in technology transfer and change in agriculture.

Cooperatives. In several study villages, farmer cooperatives played a significant role in transferring agricultural information and technology. Particularly in communities housing a cooperative center, this was a major foci of village economic life and a vigorous forum for the exchange of farm information and opinion -- as case 5, collected during interviews at the Goube co-op, illustrates.

Certainly, co-ops have contributed to the transfer of innovations like modern seed dressings and new vegetable crops (case 18), and they are looked to as real or potential sources of short-cycle varieties of millet (case 1). Cooperatives observed in the study villages are low proximity networks, with rich potential for expanded use.

Women. Women merit special mention as a "group" apart from others. As findings in Niger (Veldhuyzen van Zanten 1987) and elsewhere in patrilineal, Moslem Africa suggest (Coughenour and Nazhat 1985, Nazhat and Coughenour 1987), their access to agricultural information is more limited -- whether by cultural rules prohibiting their presence (e.g. in mosques) or active participation (e.g. at certain kinds of formal meetings or rituals) in some contexts, or by their restricted economic means (e.g. very few rural Nigerien women can afford radios of their own).

Female informants say they obtain most of their information about production techniques and technology indirectly, from their husbands or other male relatives. However, information about transformation of agricultural products appears to circulate freely among women, with female relatives often serving as the catalyst for innovation (cases 16 and 17). In-depth analysis of women-centered cliques and networks would yield much-needed insights on how best to introduce and nurture new ideas for technology transfer to this group.

Other Groups. Two additional groups in particular stand out as potential viaducts for disseminating agricultural information. One is the [samaria] or young people's association. In a pan-West African tradition, this association organizes agricultural and other workparties, hosts fetes, and contributes labor to other community events.

The second group is composed of all marabouts in a community, headed by a chief of marabouts. These Moslem holy men form part of a formalized pan-Nigerien (and indeed, pan-African) communication network -- "like the Church of Rome," explains one informant. Marabouts serve not only as religious and moral leaders but also as a cadre of rural scribes. Their co-villagers dictate letters to them for transcription into Arabic or Zarma in Arabic script, and recipients of such letters in turn seek out another marabout for decoding into their local language. Marabouts may comprise a significant proportion of the adult males in Nigerien communities. In Wazeye, for example, there are about 25 such individuals among 41 male heads of household. And, say informants, "They are a great force within our village."

Presently, neither group seems to be an important actor in any specific networks of agricultural communication. However, individual members of these groups often are. In Wazeye, for example, four members of the young people's association assist the farmer

paragon who serves as the village go-between with the extension service. And one of the remaining three farmer paragons of Wazeye is a marabout, as are too Mr. Researcher, Mr. Radio, and the unnamed man who diffused the idea of seed pocket manuring in case 8. Again, in-depth analysis of cliques and networks among young people's associations and marabouts could suggest innovative ways to put these communicative resources to work in agricultural RD&E.

Locales

Studies worldwide have shown the importance of "farm talk" in spreading the news and reality of innovative agricultural technology and practices. Identifying the locales and occasions for such talk is therefore an essential part of any study aimed at determining when, where, and how knowledge of technologies is transmitted farmer-to-farmer -- as per the CTTA/Niger scope of work. Moreover, less formal or readily visible groups are often found associated with specific, physical locales. These groupings are especially rich points of information exchange. Participants may not interact with each other in any other social contexts or groups. It is noteworthy that innovators often cite such settings as the source of new ideas. Across the CTTA study sites as a whole, informants named a wide variety of informal contexts and locales in which farm information and opinion regularly circulate. Some of these are classic sites for boundary spanning.

Marketplaces. In marketplaces, of course, people chat with other farmer-shoppers and with merchants. This is a likely place to learn about and/or acquire new seeds (cases 2 and 3) and tools (16, 17). Additionally, informants note that marketplaces are one of their main sources of information about current prices for agricultural products. In particular, they seek such information from known and trusted merchants who regularly sell at local and regional markets. In Wazeye, for example, more than a dozen such merchants from as many villages and towns were named. Many of these men have struck up "logeur" relationships with villagers -- in which each stores goods and stays at the other's home when visiting the market in the other's community.

Workparties, Social Events, Ceremonies, and Travel. Informants cite workparties in the fields as a significant forum for exchanging agricultural information and ideas -- particularly at planting and harvest, when such topics are in the forefront of everyone's minds. Workparties for well digging and for public works like mosque repair were also mentioned, along with house-raising bees and ceremonial events like funerals, baptisms, and children's naming days. People often travel considerable distances to attend such ceremonies. These occasions furnish an opportunity to learn of new and different agricultural practices in other parts of Niger and neighboring Sahelian nations (e.g. case 4).

Indeed, informants everywhere agree that travel is an important way of acquiring new agricultural information and materiel. They cite trips both within and without Niger, e.g.: to do wage labor (cases 1, 9, 10), attend agricultural fairs (5), investigate how co-ops in other villages function (as Mr. Radio once did in Hamdallaye), pursue longterm Koranic studies (as several informants reported, including Mr. Researcher and one farmer paragon of Wazeye), or for unspecified reasons (3, 10, 13, 15). Equally important is outsiders' travel to rural communities, bringing with them new ideas, tools, and techniques (10, 11, 16, 17). "The system of travel" (as informants term it) represents a major boundary-spanning mechanism throughout the Sahel.

Mosques. Given Islam's five-times-per-day prayers, the mosque constitutes one of the most regular and frequent communicative contexts for men. Men customarily gather at the village mosque well ahead of prayer time, with the purpose of sharing news. In fact, one of the CTTA team's interview sessions was held in a mosque on such an occasion.

Other Community Gathering Places. Almost every West African community has a public meeting place akin to a town square. Official visitors are received, public announcements made, and village-wide meetings and debates are held there. This area is open to both women and men at any time of the day. Often located near a shady tree, it is a frequent gathering place for informal chats -- whether about farming practices, other subjects, or just the latest gossip. Another community gathering place open to both sexes is the site of government-installed televisions (see below).

Across all the study sites, women most often exchange news while waiting their turn to draw water at the well and while pounding or milling grain -- events that take place several times a day. In some communities, a favorite forum for farm talk among men is the blacksmith's shed, where people lounge about waiting for repairs to agricultural implements, come to commission new ones, or just "hang out."

Mass Media, Folk Media, and Other Potential Channels

Mass media in the form of radio and television represent one, indirect, communicative link between farmers and research or extension. Niger is fortunate to have a well-established mass media infrastructure. Moreover, farmers seem receptive to increased utilization of such channels.

Radio. Radio is a longstanding and essentially ubiquitous source of information in Niger. The government-owned and -managed station, La Voix du Sahel, has been in operation for more than 30 years. It broadcasts in seven national languages and French. Widely travelled rural Nigeriens who have learned other national languages also tune in broadcasts from the Ivory Coast, Ghana, Guinea, Benin, Togo, and

Nigeria. And reportedly, the Voice of America's Hausa Language Service is regularly listened to (Connie Stephens, pers. com.).

Radio unquestionably constitutes the most widely accessible medium of mass communication in Niger. Informants cite three considerations in this regard. First, within even the smallest, poorest village of the country, radios are to be found In Wazeye, for example, 14 radios exist among the communities' families -- an average of one for every three families. Second, in contrast to TV, a radio is eminently portable. "You can take it with you anywhere, and listen to it whenever you want." Moreover, informants opine that vis-a-vis television, radio is a primary source of information -- not only because of the foregoing advantages but also because from the radio one can learn the type and time of programs to be broadcast on TV, and thus plan one's viewing ahead.

Within the CTTA study villages, farmers named the following as the most important and useful types of agricultural messages they receive via radio.

- Reports on market prices for agricultural products in different parts of the nation. (However, USAID interviewees state that such information is not presently disseminated by Nigerien radio. They suggest it may derive from Hausa-language broadcasts from neighboring Nigeria.)

- Similarly, reports on pasture conditions around the country.

- News of what regions have received rain, and of the timing of planting, cultivating, and harvesting in different regions.

- Exhortative agricultural messages -- like a call sent out during the period of CTTA research which urged travellers to return to their home villages for the planting season since, in proverbial terms, "The rain does not wait upon the farmer; rather, the farmer must wait upon the rain."

Radio also has played a significant role in the diffusion of agricultural information in other ways. As early as 1962, radio clubs were established in Niger to support national development. These clubs are operated by volunteers -- men like Ali (case 10) or often school teachers. Club members are organized into the nationwide Association of Radio Clubs of Niger. Volunteers receive notes and questions to ask local citizens. Answers are recorded and sent back to the central radio club in Niamey where they are edited and programmed in Hausa and Zarma. Topics for the radio clubs have included agricultural subjects, such as Operation Green Sahel. Currently, however, radio clubs have very limited resources, personnel, and equipment. Given some support, they could almost certainly be encouraged to address more agricultural topics.

Television. Tele-Sahel, Niger's government-operated television station, has transmitters in each of the nation's departments, where it reaches some 25,000 sets. Of these, approximately 3,800 are reportedly located in rural villages, about 2000 of which were believed operational at the time of CTTA research. A government-directed initiative established these sets in rural communities. In practice, villagers themselves are now largely responsible for maintaining them. With this nationwide network, Niger has one of the most impressive television communications systems in the Sahel.

Nigeriens are generally enthusiastic about television. Informants emphasize two advantages of TV over radio. First, since it is a community institution it is more accessible to women. Second, "We can actually see how something is done." The force of this latter fact is undeniable. Informants could readily recall and discuss any number of programs they have watched on agricultural topics, despite the fact that in one of the study villages, their television had been broken for over six months. Programs cited spanned a wide range.

- Innovative techniques of food preparation, like new ways to prepare rice, meat, stiff porridge, yams, and salad, plus how to pound and peel millet. These examples were recalled by female informants. They say they have also seen improved cookstoves advertised on TV.

- Various agricultural production techniques, including: cultivation of coffee and sugar cane; millet harvesting; plowing with ox and camel traction; the application of seed dressings, herbicides, and insecticides, including in the latter case the use of neem leaves to protect stored crops; seed selection criteria; and in one man's words, "how to follow the life of plants."

Villagers naturally note that not all the shows on farming are immediately relevant to their own situation -- e.g., those on coffee and sugar cane. (However, they may have some relevancy for men who do dry-season migrant labor.) Informants further remark that they lack the economic and material means to implement many of the techniques they have seen on TV. Thus, many shows on agriculture are relegated to the category of "common interest" items for rural Nigeriens.

Nevertheless, all the farmer-oriented programming is appreciated because, as one elder counsels, "With television, there can be a great opening up of the spirit. We can see what others are doing in the world." Some informants add that TV has a salubrious effect on village youth. For example, Wazeyans recount how after watching a show on millet cultivation, children then set up "play" fields, endeavoring to apply the techniques they had seen. "This is good experience for them," say their elders.

Informants also emphasize three things they would very much like to see more about on TV.

- Techniques and measures for applying chemical fertilizer. While some villages have men who have completed extension training courses in technical aspects of fertilizer application, informants note that such individuals' experience is of little use to their co-villagers since "We cannot afford great quantities of fertilizer; we have nothing here in which to measure kilos; and anyway, our fields are not measured, either." People would welcome information on different ways to apply fertilizer that are economical, comprehensible, and feasible to use under their conditions.

- Thinning practices -- both alone, and to accompany the use of fertilizers or seed dressings.

- Proper spacing between millet stands. Again, local measurement questions arise in this regard.

- Among some of the wealthier farmers, more information about farm implements like seeders and tillers, which they have seen demonstrated on TV.

Informants said television is a far better medium than radio for learning about topics like the foregoing because "They call for more 'precise' information" -- although one man cautions that, even when you can see various techniques being demonstrated, "This does not tell you the theory behind them." Others add that, although the visual medium of television represents an improvement over radio, they are not always able to remember all of the technical details of agricultural procedures they see on TV.

Many informants emphasize that, before applying any new agricultural techniques disseminated by either radio or television, they always discuss them at length with a group of peers. They also urge that programs be screened before the rains arrive. Thus, viewers can first try out the new crop or technique on small plots in their dry-season gardens "to see if it produces well, how much water is required, and which soils are best" and to debate the results among themselves. "Then, if it [the new idea] is advantageous, you can apply it during the main planting season. If it's not, you just drop it."

For both radio and TV, issues of programming language were raised. In some villages, people do not feel the current linguistic diversity of programming is a serious problem. In Wazeye, for example, most of the population reportedly speak and understand both Zarma and Hausa; others are conversant in Foulfoulde and French, and are happy to translate for their co-villagers. But this sentiment is not shared by all the CTTA study communities. In Goube, for example, people grumble that they tire of waiting through several

programs until one appears in a language they understand. Some of the more pious men of Goube further complain that many TV programs offend Moslem morals (e.g. by showing women in short skirts). Others said it is inappropriate and undignified for male elders to be part of a noisy and unruly crowd of children, teenagers, and women, for whom the community-wide TV showings are social events.

Finally, informants mentioned one further type of program they would like, whether on radio or television:

> ...an exchange of ideas among farmers and others, just as we have been doing [with the CTTA team] these past few days. This has made us reflect upon our agriculture. You found us sleeping and woke us up. Such a program would be very good.

When asked whether they would be shy or embarrassed to give their views on radio or TV, informants said they would not. Rather, they would be "proud." They further opined that it would be good for children to hear and/or see their elders in such contexts, to profit from their knowledge and experience.

Cassette Recorders. These do not currently play a role in the dissemination of agricultural information. But the team noted that even the most remote rural community has several functioning tape recorders. When queried, informants thought that the idea of taped agricultural messages would be a useful and viable channel of communication. Further, they observed "That would be a good way to remember" the content of detailed messages, and added that they would gladly bear the cost of batteries to listen to such tapes.

Folk and Traditional Media. Due to logistic and time constraints, the CTTA/Niger team did not investigate the present and potential uses of folk media for agricultural communication. Effective analysis of such media takes considerable time and cultural sensitivity. However, many countries in Africa, Asia, and Latin America have found traditional media extremely useful in conveying agricultural, health, or other information, either alone or in tandem with modern mass media like radio and TV. A few examples include: folk puppetry in Java, singing poets in Brazil, wandering story singers in Orissa, dramatized poetry in Tanzania, talking drums in Nigeria, adowa music in Ghana, calypso in Trinidad, and theatre in Botswana. As an authority on such communication resources writes:

> Oramedia or folk media are grounded on indigenous culture, produced and consumed by members of a group. They reinforce the values of the group. They are visible cultural features, often strictly conventional, by which social relationships and world view are maintained and defined. They take on many forms and are rich in symbolism (Ugboajah 1985:166).

Traditional media -- including crop and livestock rites -- are usually used to teach new lessons, review old ones, and initiate people into the historical and traditional values of the group. They communicate "directly through any of the senses via folkways" (Ugboajah 1985:167). Recently, growing charges of "cultural imperialism" have often centered on mass media and their attempts to replace or dislodge natural systems of communication and the value systems they represent. As Ugboajah (1985:175) notes:

> Development studies have for long held to a set of beliefs which has caused researchers and practitioners to focus on the technological and organizational aspects of mass-communication imported models and to underestimate the socio-cultural features of indigenous media. This set of beliefs is evident in the dominant paradigm of media sociology that prevailed in the 1930s and in subsequent orthodox modernization and diffusion theories of Weberian tradition. Such a theoretical framework that supports the diffusionist approach has necessarily led, as Shinar puts it, "to the development of the myth of the mighty media and to a frustration with their failures."
>
> A new approach or model is now necessary in the study of communication. Shinar suggests "a convergence approach" which will be more flexible than prevailing modernization approaches and free from their spatial, temporal, cultural and ideological constraints... The new approach would thus consider essentialism, a set of indigenous traditions and symbols, and epochalisms, the work of ideological, technological, economic and other foreign influences.

There is little doubt that folk media can play a more active part in technology transfer in agriculture. Theatre appears to have potential in Niger, as do traditional lineages of griots -- castes of musicians cum town criers cum community historians. As the team learned in Wazeye, the latter already function as messengers between co-op centers and outlying member communities, along with designated co-op and extension officials. However, focussed research would be required to formulate a concrete role for the use of these or other folk media in agriculture in Niger.

Other Potential Channels. During the course of research, still other possible communication channels were identified, although their potential for transmission of agricultural information was not established in field interviews. These spanned both formal and informal, modern and folk, channels and locales, including schools, family planning clinics, billboards, and printed cloths or pagnes. Before any such outlets could be integrated into a comprehensive agricultural communication campaign, however, an understanding of their workings in Niger would be essential.

Extension and Research

Entities with a primary mandate to transfer agricultural technology to Nigerien farmers include the national agricultural and livestock services and, in some regions, special agricultural training and/or development projects. Cooperatives, experiment stations, and seed multiplication centers also often have transfer functions and effects.

The principal official entity charged with agricultural research in Niger is the national agricultural research institute (INRAN), a monolithic multi-tiered structure which is responsible for approving all technology recommendations to be disseminated, and for passing these on to the national extension service and related agencies. Communication between these R and E structures is reportedly both limited and unbendingly hierarchical, although some steps are being taken to ameliorate this situation. Direct contacts between farmers and INRAN researchers are reportedly minimal, with the possible exception of certain INRAN subunits like the FSR group in DECOR.

Presently, the average Nigerien farmer's main contact with formal systems of technology RD&E is via local field extension agents. But communication between farmers and agents in Niger are plagued by the usual problems characteristic of formal extension systems throughout Sahelian Africa. Agents are spread thinly over the country, with each responsible for 30 to 40 widely separated villages. Coupled with a lack of adequate transportation, this leads to farmer complaints about agents' infrequent visits. Relatedly, agents are burdened with multiple data gathering, reporting, and other tasks beyond their primary mandate of technology transfer. Moreover, they often lack adequate technical training; sometimes treat their clients with disrespect; and in any case, have little to extend that farmers consider workable.

Despite these problems, one or two CTTA study villages proclaimed themselves satisfied with the quantity, quality, and appropriateness of information they received via formal extension and research systems. However, this sentiment was by no means universal -- as the mini-case studies of innovations that failed (18-20) indicate. As the previous chapter detailed, there are frequent farmer complaints to the overall effect that many of the plant and animal crop varieties offered and the agronomic techniques recommended by formal RD&E are inappropriate to most farmers' current circumstances. (Specific complaints are largely the obverse of the characteristics of appropriate technology catalogued at the end of Chapter 2.)

Here, we can do little more than reiterate the obvious. For successful communication and technology transfer:

> ...it is necessary to know what farmers desire from their information sources. Such an inquiry would almost cer-

tainly reveal deficiencies in the quantity and quality of scientific farm information available for distribution. This, of course, would suggest a need for some redirection of research efforts (Lionberger et al. 1975:66).

And, of course, of extension efforts and approaches.

Summary and Analysis

Using a multidimensional model expressly constructed for the CTTA/Niger study, information flows and exchanges related to agricultural innovations, news, and opinion were examined from the farmer's perspective. Farmer communication networks were identified through emerging analysis of data from mini-case studies, interviews, and participant observation. A number of lessons are to be learned from this exercise.

Above all, we again see Sahelian farmers' profound thirst for agricultural information. They actively -- but critically and differentially -- attend to multiple information sources: individual and group, interpersonal and mass, government and private-sector, and informal and formal communication channels.

Merging the data presented in Chapters 2 and 3, a hardly surprising finding is that as the quantity and quality of information sources about a given innovation increase, so does its likelihood of its successful adoption within informal systems. The case of the rat trap (13) offers a simple but apt illustration. News of this innovation was received in several ways -- by radio, peer testimony, personal observation, and firsthand experimentation and validation. And all of these but radio represent high-quality, credible sources which span types of individuals important in community communication networks (in this case, an innovator and an influential).

Wazeye's successful gardening enterprise (9) is equally instructive. Again, multiple sources of information were utilized in reaching the decision to adopt the new crops and techniques of gardening: personal observation of a village boy's efforts, of Niamey city gardens, and of a neighboring community's success (and no doubt peer testimony, e.g. in marketplace and other conversations, from Goubey gardeners); firsthand experience with vegetable cultivation (Mr. Radio's labors with his brother in Niamey); TV programs; and finally, community-wide debate and discussion.

A corollary lesson is the importance of group process and peer opinion, testimony, and demonstration -- i.e. farmer-to-farmer communication -- in the decision to adopt new agricultural ideas. This cannot be overemphasized. It is directly attested time and again in the case studies (notably 1, 5, 9, 10, 11, 16, 17) and indirectly in informants' remarks about the need to debate and test information deriving solely from non-interpersonal channels

like radio and TV. As leading authorities have likewise demonstrated time and again:

For final evaluations before actual use of an innovation, all farmers -- whether early or late adopters, young or old -- continue to rely very heavily on their own peers. ...no other information source has higher credibility or expertise... (Lionberger et al. 1975:7).

In addition to legitimizing innovations, farmers' social and communicative networks also speed their transfer.

> ...interpersonal communication provides most of the multiplying effect of local change-agent efforts in getting new information and innovations accepted and used... If all of the information from specialized agency sources had to flow directly to farmers, and if all the persuading had to be done by their representatives, acceptance would ...be very slow indeed (ibid.).

The importance of group process in achieving this multiplier effect is obvious. The CTTA team identified a number of groups engaged in technology transfer in agriculture either directly, or indirectly via the activities of individual members. These networks include: cooperatives, women, young people's associations, marabouts, radio clubs, and griots.

Less formal, more transient groups coalesce around locales that often involve people outside, and inside, established cliques. Such locales thus provide occasions for spontaneous and often boundary-spanning exchanges of information, e.g.: in marketplaces; at workparties, social events, and ceremonies; during various instances of travel; and at blacksmiths' sheds. In addition, mosques are a site of regular and frequent communication for men. Central village gathering places and government-installed community TVs are active sites of information exchange for both men and women. Women also share information while drawing water at wells, pounding or milling grain, and waiting in health clinics.

Formal mass media play a prominent, albeit different, role in farmers' communication patterns. These media primarily serve to make people aware of new ideas in agriculture, while interpersonal, peer, and group processes are more active in actual adoption decision making. But modern mass media are unquestionably well-established and attended to in Niger.

Radio is clearly the most widely accessible and utilized medium. Currently, farmers turn to the radio primarily for time-sensitive information such as market prices, pasture conditions, weather reports, and planting information. This medium has great promise for increased use at low cost, especially in the form of radio dramas and interactive formats like those of Niger's radio clubs.

While television programming currently carries a strong urban bias, the medium is well-diffused throughout the country via government viewing sites. Nigeriens are enthusiastic about TV. Almost everyone who can watches it. The only complaints about radio and TV concern language issues and the "morality" of some programs. Rural people report liking shows on new food preparation and cultivation techniques. Areas where farmers indicate high program interest are chemical fertilizer, thinning, and plant spacing practices. TV's visual medium lends itself to presentation of these more complicated agricultural techniques. Farmers would also like television programs that permit idea exchange. However, the economics of television production make it less attractive for increased programming when compared to the economics of radio.

Although folk media were not a focus of CTTA research in Niger, their potentially great contribution to technology transfer should not be forgotten. Neither should economical electronic outlets that could stimulate additional information exchange (e.g. tape recorded agricultural messages).

A larger lesson inherent in all of the foregoing observations is the demonstrable wealth of conduits and contexts for the flow of agricultural information which already exists in the Nigerien countryside. But as farmers themselves point out, more and better use could be made of these channels. They specifically cite deficits in formal communication: radio, TV, and extension communication. Deficits in the flow of agricultural information to women are also apparent, along with the most glaring gap of all -- communication among F, R, and E, and between R and E.

With regard to F-R-E communication, most farmers in the study do not currently consider researchers and extensionists significant parts of their idea exchange network or the process by which they go about deciding what to do. F-R and F-E bridge ties are not well established or effectively utilized. In fact, it is questionable whether a network actually exists among the three entities, other than on paper. This is a sad irony given the magnitude of investments already made in Nigerien R and E organizations and resources aimed at helping the farmer (see next chapter).

While the present study did not directly address R-E linkages, documents (AED 1988, DAI 1988, USAID/Niger 1986) and interviews with mission personnel indicate that connections between the two are quite weak in Niger. The question is whether they are well-established enough to function as "strong" weak ties. Initial information would suggest that bridge ties are few and poor, in contrast to rich F-F communication networks with cliques connected by multiple bridge ties.

Again, although the CTTA field study did not specifically focus on F-R-E interfaces, the in-depth and survey research among farmers does suggest several conclusions.

- Very few technologies offered by R and E are deemed appropriate "as is" by a majority of farmers.

- Relatedly, farmers do a lot of reinventing on technologies coming from formal research; yet there appear to be very poor feedback loops in place to inform R and E of what farmers are doing and thinking with regard to these technologies. In particular, researchers do not interact with farmers very much.

- Farmers often have a negative perception of extension.

- Differences in life styles, resources, and values between F, R, and E are great. It is not a high-proximity network and bridge ties are limited.

Likewise, the CTTA/Niger study raises the following, critical questions.

- What can be done to build upon the common commitment of R and E to help farmers?

- Do government policies and programs reflect farmers' realities?

- Are organizational resources and rural infrastructures in Niger adequate to allow extension to function within the traditional model of technology transfer and to implement the numerous changes which seem indicated?

- How can farmers become active rather than passive participants in all these processes?

One thing appears certain. Answers to these and other questions lie in working imaginatively with existing resources and problems. Improved communication could definitely help redirect, invigorate, and extend the dynamic processes involved in technology transfer, but it cannot bring about change alone -- any more than improved science can.

The next and final chapter turns to an examination of how, by integrating such lessons with the findings on farmer innovation, CTTA's expertise could be put to work in innovative ways to address technology design and transfer needs in Niger and elsewhere in the Sahel.

NOTES

[1]For details of this approach the reader is referred to Rölings in progress, one of a series of papers commissioned by ISNAR on the subject.

[2]Of course, these are not entirely discrete entities since individuals are typically members of several different groups which have specific locales associated with their functions. Hence the organization of information here is merely heuristic. In discussing individuals and groups, we draw very generally upon a model elaborated to look specifically at the flow of farm information within rural communities in relation to technology adoption decisions (Lionberger et al. 1975). However, in the three-week period of CTTA field research, it was not possible to access the detailed socio-structural and personal data called for by this model. The reader should therefore be aware that we apply its terminology only approximately.

Chapter 4

CONCLUSIONS AND RECOMMENDATIONS

In an era of scarce resources, it is more cost-effective to build development programs for agriculture on indigenous... organizations rather than create new... structures that... have to be imposed from outside. It is also cost-effective to... delineate the indigenous agricultural technical knowledge and... decision-making systems upon which... production practices are based...to understand where convergence exists between the local and scientific system, where communication difficulties may occur between the two... which aspects of the indigenous system may be superior to proposed innovations, and which could be improved by working with and through the existing system (Warren in press:10).

Conclusions

The CTTA/Niger study effectively demonstrates the following, summary points.

- Sahelian farmers manifest an indisputable demand for fresh agricultural information and ideas (and their associated technologies, tools, management practices, etc.) no matter what the source of origin, as farm families struggle to wrest a living from an ever-more-difficult physical and human ecology.

- Farmers are largely self-directed in their endeavor to access such information through a multiplicity of networks and communication channels, both informal and formal. But they rely more heavily on informal resources in evaluating information and formulating decisions, since formal sources do not (and cannot by themselves) fully meet farmers' need for credible and workable information.

- As part of their search for and validation of new agricultural information, Sahelian farmers design and conduct their own applied and adaptive research using empirical, ethnoscientific methods. Much of this experimentation is explicitly impelled by what producers perceive as the inappropriateness of technology currently offered by formal systems of RD&E.

- There is a wealth of indigenous agricultural knowledge and expertise in the Sahelian countryside, some of which, with inputs from formal RD&E systems, could undoubtedly benefit farmers throughout this ecozone.

One further, critical point is elaborated in this final chapter.

- So long as farmers' own research efforts and their plethora of communication resources are ignored, much of donor investment in R and E institutions and projects will be lost. Like it or not, both R and E depend for their success upon farmers' own, informal systems of technology validation and transfer for success.

There are new, overreaching approaches to the design and transfer of agricultural technology which meld anthropological, biological/technical, and folk or "people's science" to understand and successfully build upon indigenous knowledge and communication systems in designing, implementing, and disseminating sensitive, cost-effective, bottom-up interventions.

Building upon sophisticated but context-sensitive models which incorporate multiplex information flows, the CTTA concept consciously recognizes the existence and power of farmers' "natural" communication networks at the same time that it highlights blockages among F, R, and E. CTTA seeks to reduce obstacles to fluid motion in

naturally occurring communication channels. Where communication is impaired -- whether at the interpersonal, organizational, or system level -- CTTA acts as a discipline neutral catalyst to stimulate interaction, cooperation, organization, and management of technical knowledge for the welfare of the farmer.

In this approach, the key bearers, users, and communicators of agricultural knowledge and information -- men and women farmers-- ideally play an interactive and co-equal role alongside formal systems of RD&E. Coupled with the summary points listed above, this eminently practical perspective on the design and delivery of agricultural technology has several direct implications for formal systems of RD&E.

Implications and Recommendations

The most immediate implication of this new approach lies in the area of research. Other problems aside for the moment, extension cannot be blamed for failure if it has little or nothing appropriate to extend to its clients. As noted in the introduction to this report, there is mounting evidence that the supply of Western-scientific research-generated technologies that are truly appropriate to the farming realities of most Sahelian producers is currently very limited. One authority defines the root of this problem as follows.

> ...the difficulty is that the agronomists who usually receive such tasks [formulating more appropriate research programs] tend to perceive situational needs in substantive terms, e.g. more effort on synthetic maize or on cassava mosaic, and so forth. Few natural scientists have been trained to conceptualize technical problems in an organizational framework, to see where the procedural bottlenecks lie. This is why a capacity building approach should be adopted... Otherwise, the efforts taken to improve research capacity can easily become absorbed by the nearly infinite funding needs of particular crop programs (Moris 1983a:103).

As we saw in Chapter 2, farmers themselves echo the view that formal R&D has little to offer them. To give just one simple example-- but one of paramount concern to Sahelian producers -- there is little point in generating new wonder crops that require massive inputs of commercial fertilizer unless or until a number of other problems are solved (see AED 1988 and USAID/Niger 1986:30-38) e.g.: generation of cash or credit for purchase of such inputs; relatedly, stable and profitable markets for the crops thus produced; corollary issues of adequate supply, transport, and distribution networks for both fertilizers and crops; and even relatively simple questions like translation of recommended fertilizer applications into local systems of land and volume measurements.

But research can take a cue from farmers' own experimentation in planning more practical directions for agricultural R&D. Continuing with the above illustration, for example, producers clearly appreciate the benefits of commercial fertilizers, but they need more cost-effective and less risky ways to incorporate this expensive input into their farming systems. It might behoove research to follow farmers' lead in experimenting with a variety of localized and/or critically timed applications of fertilizers, and alternative or combined uses of animal manure and chemical fertilizers.

The same can be said of farmer experiments with short-cycle millets. Insofar as possible given the many complex tradeoffs in selecting or breeding for multiple plant characteristics, research should endeavor to attend to features assigned highest priority by those for whom new varieties are intended.

Research would also be well advised to investigate indigenous agricultural practices to see how (or if) they work, and where they might be improved upon or modified through scientific analysis, so as to be returned to their original inventors in a more powerful form and/or transferred to producers in similar situations elsewhere in the Sahel.[1]

In this process, indigenous knowledge that might otherwise be lost or limited to only a few locales could be rescued and more widely disseminated.[2] At the same time, low-cost technologies could be developed which likely would have a "head start" in terms of ecological appropriateness, integration with current farming practices, ease of comprehension among users, and freedom from the manifold price, delivery, repair, distribution, consumption, and misinformation problems that so typically attach to alien, introduced technologies.

Even in the extremely brief space of the CTTA/Niger study, some possible candidates and areas for scientific attention were suggested by farmers' own experiments and practices. Interestingly, a number of these parallel current directions in or suggestions for formal agricultural R&D in Niger (AED 1988).

Where such parallels in R and F interests and experiments exist, they open the door for collaborative research and feedback. It is not claimed here that all the following examples of IAK and innovation will prove out when subjected to Western-scientific scrutiny. But they aptly illustrate directions and perspectives that should be considered.

- Experimentation with more efficient placement of fertilizer and manure was already been mentioned (see AED 1988:48), along with continuing work on short-cycle millets.

- Investigation of sesame as a striga trap for millet would seem warranted in view of the fact that "Striga is rated the

major cereal pest in Niger" (AED 1988:64) and indeed, is a serious pan-Sahelian problem (Hendry 1987). To date, research on trap crops in Niger reportedly has focused on cotton, groundnuts, and sorghum -- none of which are typically intercropped with millet, the nation's foodgrain staple.

- While significant scientific attention has at last been given to indigenous African systems of intercropping (Dommen 1988, Richards 1985), research on the role of intercropping sorrel with cereals and cowpea -- a common practice throughout the Sahel -- has been minimal. Do these species in fact serve as a living fence to divert herd-animal interlopers from primary crops, as informants claim? Or might formal research discover still other intercropping effects of this genus as yet unappreciated by Western science, e.g. in nutrient, moisture, light, pest management, or other benefits?

- Much has been written about neem leaves as a non-toxic insecticide to protect stored foodstuffs (e.g. Latum 1985). Is Anonoa senegalensis likewise effective? And what is its availability relative to neem for Sahelian farmers? What other substances as yet unknown to formal R&D might farmers be employing?

- Research throughout the Sahel (and worldwide) has shown many ethnoveterinary therapies and prophylaxes to be effective (McCorkle 1986). But technical biomedical and botanical studies in this area are astonishingly few. In view of the importance of livestock to the Nigerien economy as the "second major source of foreign exchange earnings after uranium" and a CDSS focus on animal health (USAID/Niger 1986:29, 35), scientists might consider exploring indigenous veterinary medicine as a source of appropriate technologies.

- For the same reasons, plus the fact that one of the major constraints to the adoption of animal traction in the Sahel is adequate quantity and quality of feeds, research should examine producer innovations in forage management for hints of appropriate interventions in this realm.

- Indigenous systems of soil classification and farmers' cropping decision-making according to microzone soil types might likewise prove fertile ground for research.

- For scientists interested in both pre- and post-harvest technology, ways to build upon, improve, and transfer local efforts at rodent, bird, and insect control could prove rewarding. Certainly, farmers would welcome such efforts.

- Indigenous land and forestry management practices and innovations should be a priority area for future research throughout the Sahel, given the rapidly deteriorating environment -- as

USAID/Niger has recognized in planning for a major project in natural resource management (NRMS). Farmers, too, are keenly aware of problems in this area.

Given the wealth of experimentation, innovation, and IAK recorded by a team of two social scientists in only 14 person-days of fieldwork in one very small part of the Sahel, what other intriguing possibilities for appropriate technology design might be discovered by expert agricultural scientists working closely with anthropological researchers? Can sincere efforts at development of appropriate agricultural technology afford to leave this question unanswered?

Put another way, in the race against hunger, drought, and burgeoning population in the Sahel, working from the bottom up in scientific research reduces the many handicaps with which top-down technology automatically starts (see again USAID/Niger 1986). This is not to say that one approach should be ignored at the expense of the other. But to focus on top-down technology design alone is scientifically indefensible. Important data available from the targeted end-users of such technology will be overlooked. Scientific and ethnoscientific information represent two kinds of knowledge systems and expertise which must be synergistically combined for progress in agricultural development to occur.

Combining these two kinds of agricultural intelligence can enhance the quality of research -- whether by F or R. Agricultural scientists tend to focus on only a few pieces of "the realities in our village" which lie within their disciplinary boundaries -- and even then, from an often rarified perspective. Producers themselves perforce view farming more holistically and practically.

Extension, too, must form part of this combination. Otherwise, even the best and most appropriate research efforts will be vitiated. Like research, extension can draw upon indigenous systems to improve its performance. It can tap into natural networks for transmitting agricultural information, and particularly farmer-to-farmer modes of communication, to stimulate the multiplier effect that is the key to successful technology transfer. Not even the most highly trained, motivated, staffed, and well-funded extension service in the world can singlehandedly achieve this effect -- much less the notoriously problem-ridden, heavily top-down structures of Sahelian Africa.

Figure 5 in Chapter 3 delineated how farmer-researcher information exchange aimed at the design and transfer of agricultural technology can be broadly organized. This exchange is facilitated by the communication/extension system through information gathering and translation functions.

The translation function spans more than just the obvious concerns over the accuracy of technical detail and of information presentation in appropriate dialects. It means communicating between two

distinct but equally important systems of technology development and transfer -- formal RD&E and farmers' own RD&E -- which differ in origins, purposes, and operational rules. In conceptual terms, researchers and extensionists can be as limited by their formalized, Western-derived training (and often, too, by their lack of firsthand experience at farming) as farmers are by their lack of formal education in the scientific method and limited access to technical information. Successful translation among F, R, and E of technical concepts and decision making processes are fundamental to the concept of mutuality implicit in all definitions of communication. An inability to translate knowledge leads to communication breakdown.

The poor F-R-E linkages in Africa are in part a result of a fundamental translation problem. More than the professional and natural dialects and languages these groups speak, their ways of thinking, doing, and organizing may be so radically different that improved communication will entail each group's coming to grips with the cognitive, cultural, and institutional complexities involved in effectively translating concepts and ideas related to agricultural technology.

Across the past decade, considerable academic attention has been given to this cognitive domain -- the heuristics of knowing.[3] Research in this area has been sparked largely by work on artificial intelligence. Fundamental issues and questions about knowing, understanding, decision-making, and communicating are currently under study by interdisciplinary teams of social psychologists, anthropologists, linguists, biologists, physicians, educators, and others. Their findings have profound implications for identifying obstacles to transferring knowledge. It may well be the case that F, R, and E in Africa may have such different ways of structuring, organizing, and thinking about information that the translation process may be the paramount barrier to successful transfer.

Based on the findings of the CTTA/Niger study, more specific recommendations for enhancing F-R-E integration and communication include the following.

- <u>Implement joint on-farm mini-trials</u> for which a designated F-R-E team is responsible, following guidelines like those detailed at the beginning of Chapter 2. On this team, F should play an <u>active</u> rather than a passive role throughout -- but particularly in the research design (e.g. choice of experimental variables, treatments and treatment levels, plots, planting densities).

  Both F and E should regularly monitor the progress of the trials and record basic data for periodic discussion and mutual analysis with R. Moreover, in the course of monitoring and evaluation, F and E should note any and all performance factors they consider significant. Not just yields, pest-, disease-,

drought-resistance, and etc. but also observations about any and all of the characteristics of successful innovations catalogued at the end of Chapter 2 (e.g. risk; profitability; affordability; realistic availability of the necessary inputs and complementary items in the region; labor requirements and implications for women's work; fit with current farming practices; comprehensibility; variety of needs met; and social, ethnogustatory, ethnonutritional, and other considerations).

This approach is cost-effective in that F and E serve as additional "eyes and ears" for R -- thus economizing scarce, trained scientific personpower -- at the same time that productive and context-sensitive F-R-E dialogue is maximized. It is also time-effective. In many domains, formal R&D systems can generate new, or refine existing, agricultural knowledge more quickly than informal systems. On the other hand, it is this informal system which takes the final decision on whether to use such knowledge, according to local-level conditions. This whole process can be accelerated by communication and joint research between the two systems.

- Develop with farmers "mini-kits" of seeds and inputs with which they can experiment, asking only that F communicate their observations and results to R and E. This offers an alternative or additional option to the more complex research design described above. This technique has worked well in other LDCs; and it can stimulate greater respect among R and E for F knowledge and initiative.

- Create simple, inexpensive, but interactive radio or television "farm talk" programs, as per farmers' own suggestion. In such programs, F groups and individuals can report on, discuss, and in the case of television demonstrate, their own experimentation and innovation successes and failures. Such programs almost assuredly would stimulate other farmers to experiments of their own. F participants in such programs should also be encouraged to raise problems and address specific questions to the R and E establishment. This effort could be the first step in nurturing greater F-R-E interaction and involvement.

Such programs can easily be taped in the field -- particularly in marketplaces, which are usually accessible by roads and where merchants and nomadic pastoralists can more easily participate. Also, given the endemic travel of West Africans, farmers temporarily working or visiting in the capital city can take part in such sessions. CTTA has successfully implemented such programs in Latin America.

Likewise, R and E personnel could be profiled in other programs in such a series -- responding to farmer queries, interests, and needs; sharing useful findings of their own on indigenous innovation and IAK; or sending out a call to F for information

and opinion on technologies and practices (whether endogenous, exogenous, or syncretic) that R and E personnel are pursuing. In other LDCs, CTTA has found that the status and "good press" that participation in such programs confers makes them powerful tools to motivate R and E to communicate more and better with F.

- Use such series and other modern mass media to disseminate findings and practices that have proven useful for farmers in other parts of the Sahel, as is already being done. Of course, the success -- indeed, even the possibility -- of such programming depends upon policy approval in nations where mass media are government-controlled. Considerations of linguistic diversity must also be taken into account.

- Devise more mechanisms for exposing R and E to F under real-life rural conditions as much and as often as possible. Certainly, one such mechanism should be to mount a more thorough-going search by R and E personnel for additional cases and domains of farmer innovacion, IAK, and communication networks and channels.

- Consider including F consultants in R and E units (perhaps, respectively, innovators and key communicators) to stimulate feedback and feedforward loops and to advise on R priorities and E outlets. Similar efforts have met with some success in other African countries.

To generate the multiplier effect that is imperative to successful dissemination of agricultural information, greater use of informal, semi-formal, and creative new communication conduits needs to be explored. In addition to the foregoing recommendations, examples of ways in which this might be achieved include the following.

- Feed more agricultural information to radio clubs. This long-established outlet and its system of notes, queries, and interactive radio can be used to greater advantage.

- Use marketplaces for E presentations, as well as F-R-E meetings and discussions. Many new ideas are circulated in this locale. More systematic attempts to formalize information exchange in marketplaces could have dramatic impacts at little cost. Moreover, marketplaces are particularly important for communicating with pastoralists, who all too often are ignored by both donor and national governments in their semantic focus on farmers versus producers.

- Develop strategies to mobilize women's and young people's associations to participate in on-farm experimentation, farmer consultancies, farm talk programs, and to feedback and feedforward information to R and E.

Particular attention needs to be given to women. Their under-representation in formal systems of knowledge exchange is well documented. Further, this study suggests that their access to informal networks of agricultural information exchange is also limited. However, communication strategies in this domain will have to be sensitive to the traditions of Islam as well as other cultural mores.

- Cultivate cooperatives as major conduits of agricultural information. They have tremendous potential as effective, formal "bridge ties" among F, R, and E.

- Identify ways to tap existing systems of rural literates. Like several Sahelian countries, Niger has 90% to 95% illiteracy in a national language. Therefore, bring into play the existing, Koranic network of rural literates and scribes as one of the few, realistically available conduits of printed agricultural information.

- Explore the use of cassette tapes and recorders -- again, in view of pervasive illiteracy. This medium could be used to send messages among F, R, and E. It could also feed into interactive programming and radio club strategies. If this proves a viable channel, calculate the costs and benefits of distributing cassette tapes and/or recorders to key agricultural F and E communicators in rural communities.

- Exploit rural Nigeriens' frequent travel by broadly announcing agricultural fairs and the openness of project, demonstration, and cooperative sites, multiplication centers, experiment stations, etc. to rural visitors. Likewise encourage extensionists to visit such places and events.

All of the foregoing recommendations address the aims of increasing the quality and quantity of F experimentation and innovation, of F-F and F-R-E communication, and of R and E responsiveness to F needs and capabilities -- as enunciated in the CTTA/Niger scope of work. If adopted, however, many of these recommendations should initially be piloted in a single region, while details of their implementation are worked out.[4]

However, it must be emphasized that most of these recommendations are at this point only exemplary. Indeed, the list of possible interventions could be made much longer. But these or any other strategies must be systematically evaluated in light of multiple factors in any given country and within a systematic communication plan that, at minimum, takes into account:

- existing communication infrastructure;

- existing research and extension structures, staffing, operations, equipment, and logistic resources;

- donor and national government program priorities;
- human and financial resources and investments;
- policy constraints; and of course,
- specific problems and needs in F-R-E linkages.

CTTA in Niger

Although direct investigation of many of the foregoing factors lay outside the CTTA/Niger team's immediate scope of work, it is the team's impression that, aside from certain policy issues, Niger would be an ideal site for just the kind of creative and cost-effective communication support that CTTA is explicitly designed to supply.

For example, with regard to communication infrastructure, Niger displays an impressive array of resources. As noted in the previous chapter, for Sahelian Africa it has an almost unique television network, with TV sets stationed in thousands of rural communities. Its longstanding radio broadcasting system covers the entire nation. Moreover, rural Nigeriens clearly appreciate and attend to both these channels of communication for any scraps of agricultural information to be garnered from them. Additionally, cassette recorders are ubiquitous in Nigerien villages.

However, based on statements by farmers (Chapter 3) and development personnel alike, it appears that these resources are not being well-utilized for agricultural communications. For example, interviewees within USAID/Niger commented that: market price information currently is not disseminated by mass media in the country; reports on pasture conditions are few and irregular; and relatively little farming information is released in these media, in comparison, e.g., to health and nutrition programming.

At the same time, considerable financial and human capital investments in research, extension, communication, and information systems for agricultural development have been made in Niger. Exemplifying from USAID-supported endeavors alone:

- Major inputs to upgrade the quality and capabilities of research institutions in agricultural research policy, planning, and management, as well as in critical scientific fields. Examples of recent initiatives include: collaboration with ISNAR to review INRAN operations and orientations; and renewed funding for the Purdue/Winrock FSR unit (DECOR) within INRAN. Like all good FSR, this program emphasizes off-station applied research and sustained F-R interaction and communication.

- Strategies to increase communication and collaboration among R&D entities working in Niger, including CLUSA, FLUP, ICRISAT, IFDC, IITA, INTSORMIL, IRSH, TROPSOILS, various PVO and other projects (e.g. CARE and Keita), and of course INRAN, NCR, NDD, and APS (see list of acronyms).

- Heavy investments in improving extension structures and activities within Niger, most notably through the Agricultural Support Project's (APS) Extension Support Center (ESC). Although the APS is now drawing to a close, it has laid extremely important foundations for increased communication between R, E, and F in Niger (AED 1988, DAI 1988, USAID/Niger 1986).

- A longstanding commitment to the formation of farmer cooperatives as (among other thrusts) vehicles for extending agricultural information and technology to Nigerien farmers. With time, these are to become member-owned and -managed private businesses (after USAID/Niger 1986:35).

- In recent years, funding for 28 R and E trainees to study for advanced degrees in the U.S.; several of these students are specializing in subjects directly related to agricultural communication. Most of these trainees will soon complete their studies and return to Niger.

- Significant donations to establish and equip sophisticated audiovisual (AV) and documentation centers, both in the ESC and the national agricultural technical school (IPAT) at Kolo. The ESC's AV unit has the capacity to make video and audio tapes of high quality and produce photos and posters. Moreover, it is mobile. Currently the unit is staffed by two technicians and an editor/journalist director, but is lacking a specialist in agricultural communications.

- Contributions to critical nutrition education projects that could be more tightly integrated into agricultural agendas.

- As noted earlier, plans to incorporate a large, natural resources management project which, among other tasks, will seek to extend new conservations, afforestation, and etc. technologies to Sahelian producers.

USAID/Niger has also made impressive investments explicitly in agricultural information systems that are of direct importance to the Sahel as a whole or that stand as models of agricultural information acquisition and dissemination for other Sahelian nations.

- The Integrated Livestock Project (ILP) is focusing its efforts on information systems for: bulletins on market prices for livestock and cereals nationwide; and up-to-the-minute information on pasture conditions nationwide, using state-of-the-art satellite photography. The latter has reportedly now been

perfected and ILP is actively examining dissemination strategies.

- The FEWS (Famine Early Warning System) satellite tracking system monitors data on rainfall and vegetation patterns for dissemination to donor and national government agencies.

- AGRHYMET (Sahel Water Data Management Project) meterological stations do likewise, in a sense "ground truthing" FEWS information, but with the larger aim of establishing patterns of rainfall onset, timing, and duration.

- CRED (Center for Research on Economic Development, University of Michigan-Ann Arbor) is modeling market price information systems as part of an agricultural sector policy analysis.

To the foregoing might be added the not insignificant investments in RD&E made by other bilateral and multilateral donors and NGOs, all of whose efforts would be substantially strengthened through increased, inter-agency and -project communication.

One of the four prime strategy components enunciated in USAID/Niger's CDSS is "Development of a national capability for sustained efforts in agricultural research followed by <u>technology transfer</u>" (USAID/Niger 1986:38, italics added). Moreover, USAID/Niger is considering "intensifying the extension liaison-transfer function as part of a phase II NCR beginning in 1988-89" (op. cit.:43).

With its emphasis on technology transfer, yet with many common and well-recognized organizational problems in this area (AED 1988, DAI 1988, USAID/Niger 1986), the Mission could clearly benefit from CTTA communication support. To make R and E more interactive, relevant, and effective; to encourage increased integration across projects and organizations; to maximize the investments in existing equipment, infrastructure, and human resource development -- CTTA would recommend that USAID/Niger fund a design team of 3-5 experts to spend an extended period in-country to construct a comprehensive communication support plan that would work with existing players and situations. To be most effective, this effort should be coordinated with the development of NAAR (Niger Applied Agricultural Research Project).

Based on the CTTA teams' admittedly limited exposure to Nigerien R and E structures to date, CTTA recommends that the design team construct a three-phase intervention plan, as follows.

<u>Phase I</u>. Of highest priority is to design (with farmer involvement) and initiate a program to support farmer-to-farmer (F-F) communication. This would enhance the interest and participation of farmers in a process they could help shape and point to as immediately valuable and useful. It would also help formalize the already rich network of communication channels outlined in this report.

For instance, various strategies could be tested to increase cooperatives' involvement in F-F networks. In addition, Phase I should experiment with creative communication techniques (e.g. interactive radio and television, the use of drama, introduction or more effective utilization of fairs and exhibits) with various target audiences (e.g. innovators, farmer paragons, youth, women, marabouts). Strategy formulation should be guided by farmer needs and feedback.

Focussed investigation at this level would provide R and E with useful information about indigenous agricultural knowledge, at the same time concretizing the most effective ways for R and E to capitalize on existing networks and channels and expand others to which farmers have demonstrated a receptiveness. This effort would include both process and content related to IAK and innovation.

The importance of message content must not be forgotten. Communication without relevant content is meaningless. In elaborating appropriate messages, the logical starting point is topics on which farmers expressly desire more information -- e.g. the techniques of and complex interactions among fertilizer applications, plant thinning, and spacing. These also represent logical starting places for interactive on-farm trials.

Phase I constitutes an immediate move to: involve farmers in sharing information they find valuable; enhance and formalize communication mechanisms for more effective feedback and feedforward; and pilot communication strategies that use existing government and donor resources to build upon the knowledge and interests of farmers. Activities during Phase I should be smallscale, cost-effective, and flexible, taking a trial-and-error approach to finding what works best in the Nigerien context.

Phase I activities should be designed to serve two purposes simultaneously: immediate and direct benefits to F; and compilation of a thorough-going body of information for R and E on effective message content and communication strategies. If the Mission desires, Phase I can be designed as a stand-alone effort. From its experiences and findings, subsequent longterm commitments could then be made.

<u>Phase II</u>. Phase II would begin to develop specific strategies to strengthen R-E linkages. Also, information and experience from Phase I would inform design of strategies for R and E to modify their behaviors to give stronger support to farmers. Phase II should also focus on interpersonal, organizational, and institutional communication issues related to strengthening transfer mechanisms between R and E. Further, an expert assessment of existing communication equipment and support staffs should be made during Phase II and a strategy outlined for maximizing use of these resources.

In addition, Phase II would continue the grassroots process of identifying and formalizing indigenous systems of agricultural knowledge and transfer, and move to address more complicated and sophisticated issues. For instance, market information systems and the communication infrastructure for input suppliers and other services would be fully considered at this point. Likewise, folk media, women's communication networks, and other subjects not fully explored in the present study or in Phase I would be addressed.

Phase III. Phase III would continue experimentation and codification of IAK and transfer systems at the local level to institutionalize farmer involvement through feedback and feedforward mechanisms. Phase III would also initiate systematic transmission of information from R and E through locally established channels. Essentially, the larger aim of all three phases would be to first identify and expand channels that farmers use and then fill them with information they find valuable.

Next, emphasis should be placed on assisting R and E to incorporate these findings into their efforts to build stronger transfer linkages. Finally, CTTA interventions would focus on F-R and F-E linkages. If Phases I and II have yielded positive results, III would largely be a matter of capitalizing on natural momentum, building outward from all nodes toward the others.

After the CTTA design team completed its work, USAID/Niger could decide to fund all or part of the proposed implementation plan. Since the plan would be phased, each phase could be funded as its specific goals and objectives are reached and readiness for the next stage is demonstrated. CTTA methodology recommends incorporation of formative and summative evaluation into implementation plans so that lessons learned can be documented and mid-course corrections made. Missions sometimes balk at evaluation expenses, but assessment is imperative. CTTA strives to work with Missions to conduct evaluations in cost-effective and useful ways.

Additionally, if USAID/Niger finds that it requires short-term expertise in areas of communication technology or social science analysis outside the parameters of the formal implementation plan, CTTA can provide this. The goal is to flexibly address immediate needs as they occur while still adhering to a planned, innovative approach to problems of technology transfer in Niger.

Although the present, exploratory CTTA study of farmer innovations and communication has been limited to Niger, the many similarities in ecological, economic, and even sociocultural conditions across Sahelian nations means that many of the lessons from this and any follow-up work in Niger would almost certainly be applicable elsewhere in the Sahel. Thus USAID/Niger could lead the way in developing appropriate communication for technology transfer in agriculture throughout the region.

NOTES

[1]Indeed, there is evidence that this latter process is already occurring independently. CTTA and other research in Niger and the Sahel generally suggests a north-to-south movement of native technologies and plant materials. As the Sahara advances and the era of low rainfall lengthens, peoples in the more southerly isohytes appear to be actively borrowing from their northern neighbors. A few examples include: the adoption of desert chadouf systems of irrigation in areas where they were heretofore unknown; acquisition of northern landraces of short-cycle millets; and a southern expansion of the more drought-resistant species of livestock -- goats and (possibly) camels.

[2]An apt example here is the use of neem leaves to protect stored cereals from insect attacks. While this simple -- and scientifically effective -- technology has been known and used in various parts of the Sahel, apparently it is a new idea to many Nigerien farmers.

[3]To date, however, studies on the heuristics of knowing have largely remained at the theoretical level; their implications for applied use are not yet well formulated. But the pressing agricultural problems facing USAID missions, farmers, and governments cannot wait for more conclusive research. Attempts to improve knowledge system transfer need to be informed by this research; but like Sahelian farmers, transfer practitioners must do the best they can with the information at hand to tackle the task.

[4]The CTTA team's impression was that the Dosso area exemplified many favorable features for such initiatives, e.g.: an exceptionally dynamic and enlightened extension staff; indisputable evidence of active and widespread farmer experimentation and innovation on-going; good logistics (roads, hotels) and relative proximity to the capital city and hence the many RD&E entities headquartered there; plus interesting technology exchange and communication networks with neighboring Nigeria. However, the ultimate aim would be to extend this initiative to other locations with different farming conditions, with producers conducting similar experiments -- thus providing multilocational data on the viability of innovations.

ANNEXES

Annex A: Scope of Work

To participate in a two person team in Niger for three weeks to investigate farm-level communicative processes in agricultural innovation and technology transfer among representative farmers in the Niamey and Dosso Departments.

In the context of this comprehensive investigation the team will examine, in depth, at least two technologies that are now in the process of being adopted by area farmers:

(1) the use of seed treatment to ensure good cereals germination, and

(2) the use of an improved short-cycle millet variety.

Preliminary information on additional technologies consistent with this scope of work will also be collected, and will help form the final written report.

This report will analyze in detail how knowledge of technologies has been generated and transmitted farmer-to-farmer. It will determine which farmer characteristics are most closely associated with receptivity to information from informal sources on new agricultural technologies, and identify which kinds of farmers make the most effective target groups for such messages.

It will assess why certain kinds of technologies diffuse rapidly over informal channels while others do not, and arrive at a clear understanding of what characterizes these different kinds of technologies. It should clearly demonstrate a sound understanding of how these informal channels are structured, and clearly describe how they function operationally (when, where, and how).

The report will include recommendations suggesting:

1. how such farmer-level innovation, experimentation, and technology transfer processes could be used to enhance and facilitate a reciprocal flow of information between farmers, research and extension institutes, private sector suppliers, etc. to make these entities more responsive to farmer needs and capabilities and improve the quality and quantity of their own innovation and adaptation of new technologies; and conversely,

2. how improved communication processes and technologies can help enhance indigenous farmer innovation, experimentation, communication, and technology transfer processes.

Annex B: List of Contacts

Asian Vegetable R&D Center
Anne Turner, Nutrition Specialist

CLUSA (Cooperative League of the USA)
Papa Sene, Director

CRED/MOA/DEP Policy Analysis Project
Frank Casey, Agricultural Economist
Dale Rachmeler, Agricultural Specialist

FEWS (Famine Early Warning System Project)
Sarah Gavian, Economist

ICRISAT
Jane Hopkins, Agricultural Economist
Phil Serafini, Production Agronomist and ICRISAT Farm Manager

IFDC (International Fertilizer Development Center)
John Lemers, Fertilizer Specialist

ILP (Integrated Livestock Production Project)
Albert Sollod, DVM
Renus van Den Ende, DVM

INRAN
Idrissa Soumana, Director

IPDR/Kollo
Salissou Aboubacar, Chair, Department of Socioeconomics
Brah Mamadou, Department of Agronomy

Ministry of Livestock and Water Resources
Anada Tiega, Adjunct Director, Forests and Fauna

MOA and Extension Personnel
Guisso Adamou, Extension, Dosso Department
Moussa Amadou, Extension, Dosso Department
Issa Boubacar, Chief. National Extension Service
Sani Baare, Director, Lossa Seed Multiplication Center
Kone Beri, Niamey Department
Ousseini Kabo, Director, MOA, Dosso Department
Moussa Magagi, District Agricultural Chief, Canton Center of Sokorbey
Doka Tamimoune, Student Intern, Canton Center of Sorkorbey

NCR, APS, ESC, and VPC
Hammadou Dodo, Adjunct Director, VPC
Boukar Gremah, Chief, ESC
M. Lawah, Photographer and Graphic Artist, ESC

John Mullenax, Chief of Party, APS/Labat-Andersen
Abdoulaye Ousseini, Program and Production Technician
Gonzalo Romero, Agricultural Economist and Extension Specialist
Fred Sowers, Extension Training Expert
Aminou Tassiou, Director, NCR

National Resource Management/Niger PID Team
Niels (Roy) Martin, Natural Resource Consultant
Timothy Resch, USDA Forest Service

NDD (Niamey Department Development Project)
Assoumane Baouwa, Director
Zelika Djibo
Salissou Goube
Bako Mohammed
Ken Koehn, Chief of Party, DAI, and spouse Diana
Tom Shaw, Credit and Cooperative Specialist

NGOs (Non-Governmental Organizations)
John Newby, Representative, World Wildlife Fund/Niger
Marily Knierman, Director, Lutheran World Relief, Niger

Peace Corps
Jonathan Lacknit, Programmer

Tropical Soils CRSP
Steve Geiger, Soil Scientist

USAID/Niger
Roger Bloom
James Goggin, Agricultural Economist
Marc Madland, Animal Scientist, and Project Director for the ILP
Kevin Mullally, Acting Head during the CTTA/Niger Study, USAID Agricultural Development Office
Margaret Noyes, Health Development Officer

USAID/Washington
John Lewis, TDY in Niamey
Michael Yates, S&T, TDY in Niamey

World Bank
Henrik Nielsen, Livestock Researcher

Other
Chantal Dejou, Rural Economist
Claudia Fishman, AED Anthropologist
Tisna Veldhuyzen van Zanten, Independent Consultant

Annex C: CTTA Working Interview Guide

Describe project. Be sure to emphasize that, in addition to seed coatings and short-cycle millets, the team is equally interested in other changes that interviewees have created and/or decided to make in their plant and animal agriculture.

General and Background Information

Basic Interview Information
Date
Researcher
Persons accompanying researcher
Location (e.g. in field, shop, marketplace, office)

Village Site and Demographics
Name
Geographic location
Relationship to roads and markets
Population
Ethnic mix and languages
Numbers of families by ethnicity
Literacy rates

Village Institutions
Village cooperatives and associations
Leaders of these and other groups
Mosques, churches
Missions
Markets
Flour mills
Oil presses
Schools
Government offices (police, extension, etc.)
Health dispensary, maternity wards
Shops (list type, goods, ownership)
Project activities (past and present) in village

Principal Crops
Traditional crops -- food and cash
Special and/or new crops -- women and men
Livestock types, proportion, ownership (male/female, cultivator/herder)
Specific query about short-cycle millets -- both introduced and farmer varieties
Special gardening or irrigation works

Communication

General Communication Channels
Village leaders
Marabouts
Village associations and groups
Transport service for both goods and people on roads
Number and types of vehicles in village
Travelling merchants
Shopkeepers
Marketplaces
Radios, TVs in village -- how many people and who own them?
What programs do people listen to for agricultural information?
    In what languages?
    On at what time?
    Is this information credible?
    Do people cross-check it through other sources?
    Other
Newspapers, other printed material
Type (long/shortterm) and intensity of in and out migration--
    who, from and to where?
Attendance at training centers, demonstration trials
Extension visits
Cooperative activities
PVO activities
Other kinds of visitors from outside

Other
Relatives, neighbors, and friends
Hearing about vs. seeing
What are most widely used channels?
What are most credible channels?
What is their opinion of the extension service?
For what have farmers gone out themselves and actively sought information?
"Farm talk" groups

Short-Cycle Millets

General
What different types (introduced vs. farmers') have/do they use?
    (Names of types locally.)
[Go type by type with following questions.]
Where did variety come from?

Who
Who first used it?
How did he learn about it?
Who mostly does/doesn't plant it?
    Rich/poor, e.g. with access to extra-ordinary sources of cash,

information, markets, transport
Large/small land owners
People with large/small families
Certain ethnic, sex, association (coop), other groups
People with certain water, soil, other resources
[Identify well-spoken users for followup individual interviews]

How Found Out About

How did most farmers find out about it?
Occasions
Time/place
Social relationships
What is the relation of the above factors to channels of communication already noted?
Also, what information is available on the historical order in which different socioeconomic groups adopted the technology?

Why

Did people do any limited experiments with the variety first?
If so, what? To determine what?
When do they use this type? I.e. what decides them to plant it as vs. other types?
Availability of seed
Yields
Storage features
Soil types or conservation
Rains
Birds and bugs
Taste
Labor
Various emergencies
Risks, generally
Why/how is it better than other types?
Why doesn't everyone use it?
Under what conditions would people use it more -- lowered cost, increased availability, can store own seed, if made more bird/pest/disease/drought resistant, whatever.
Has use of the variety forced them to make other changes in the organization of agricultural production?

Modern Seed Dressings

Similar questions to above.

Other Technologies to be Considered

(Ask what people are doing different from their forebears. Then, similar questions as for millet.)

Soil and water conservation techniques
Ridges
Rock contours

- Contour diking
- Tied ridges
- Catchments
- Mulching
- Demi-lunes

Fields
- Field preparation methods
- Shifts in fallow
- Plowing
- Thinning and weeding strategies

Product storage and drying techniques

Herd management
- Herd composition
- Forages and feeds -- cultivation, sales, storage
- Organization of labor
- Milk and calf management
- Fattening operations

Manure and fertilizer usage (also vis-a-vis seed coating)

Intercropping or crop rotations
- Focus on cowpeas and cowpea hay
- Addition of new crops to cycle
- Changes in planting densities

Marketing strategies

Cookstoves

Donkey carts

Dry-season gardening

Other seed varieties besides millet

Cowpeas and cowpea hay

Agroforestry innovations
- Windbreaks
- Living hedges
- Woodlots
- Establishment of trees for forage, other
- New species introduced or changes in management of existing species

Pest management (birds, insects, rodents)

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