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Report of a Seminar

Women and Agricultural Technology: Relevance for Research

Volume 1 – Analyses and Conclusions

Report from the CGIAR Inter-Center Seminar
on Women and Agricultural Technology
Bellagio, Italy, 25 to 29 March 1985

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Preface

An inter-center seminar of the members of the Consultative Group on International Agricultural Research (CGIAR) was held at the Rockefeller Conference Center at Bellagio, Italy on March 25-29, 1985. Participants included the directors-general or representatives from the international centers, the CGIAR secretariat, and the Technical Advisory Committee; the president and representatives of the Rockefeller Foundation; and experts with research experience on the role of women in agricultural development in the less-developed countries. The objectives of the seminar were to assess the current activities in the centers related to a more effective integration of women in the modernization of agriculture and to seek possible ways of improving the performance of the CGIAR system on this issue.

The seminar was co-sponsored by the International Service for National Agricultural Research (ISNAR) and the Rockefeller Foundation. It is a follow-up activity to a conference on Women and Rice Farming Systems held at IRRI in September 1983, which recommended that a meeting be organized at the senior CGIAR level to discuss how the international research centers could most effectively build upon the important roles that women play in agriculture.

The seminar's structure sought to emphasize analytical presentations and discussion. A background document, distributed to the participants well before the seminar, included papers written by each center to describe its past and current activities related to the seminar topic, and regional reviews of women-oriented research. This made it possible to begin the seminar with a limited number of analytical (rather than descriptive) presentations followed by discussion periods. A panel focused on the particular characteristics of the categories of female producers and beneficiaries of research. The participants also met twice in small groups for more in-depth discussion of specific issues and to prepare suggestions for future action. These suggestions were further discussed during the final plenary session, and the conclusions presented here were approved by all participants.

The seminar report is in two volumes. This volume includes the seminar presentations and the final statement prepared by the participants. Volume II, Experiences in International and National Research, is a reprint of the background document distributed to the seminar participants under the title "The Users' Perspective in International and National Agricultural Research".

William K. Gamble,
Director General, ISNAR

Concluding Statement

The papers prepared by the centers for this seminar confirm that the centers are already engaged in many activities that concern the female producers and other beneficiaries of research. The participants agreed that the seminar had been an opportunity to take stock and share this important information. However, there are gaps, and increased attention to women as farmers or beneficiaries of research seems to be an important consideration, recognizing that there are great differences among continents, among countries, and within countries, and that in some areas other priorities must also be considered.

The participants agreed that issues related to a changing agriculture should be approached within the framework of a dynamic process and not within a framework that maintains the status quo. Women and other potential beneficiaries of agricultural research should be given, in a situation of agricultural change, the opportunity to share fully in its benefits by presenting them with choices of suitable agricultural technology. This implies that those generating agricultural technology pay explicit, ex ante attention to the potential impacts/uses of technological options developed. Where this examination results in the conclusion that some women's opportunities and choices will be narrowed by the introduction of this technology, additional attention should be directed to ensuring that such reduction of women's opportunities is not inevitable and that women are not placed into a marginal position as a result of technological change. Eventually, alternative income-producing opportunities may need to be developed to prevent damage to some individuals, while encouraging changes beneficial to society as a whole.

From the discussion there appeared to be agreement on the following points.

A. AFFIRMATION OF THE RELEVANCE OF WOMEN'S ISSUES TO RESEARCH

1. Gender is an important variable in distinguishing among potential beneficiary groups for agricultural technology research and policy analysis in Africa, Asia, and Latin America.

2. Female farmers are far from homogeneous and can be divided into at least three categories:

   a. direct producers of crops and livestock;

   b. participants in the family farm by processing, marketing, storing, and preparing food;

   c. wage laborers.

   In addition, women form an important category of urban consumers.

3. Within these categories, women's needs and potential for change depend on their socio-economic circumstances and their unique responsibilities in child care and household maintenance. The multiple work responsibilities of women, with the resultant time restraints, may be particularly important factors in determining the acceptability of new technology. This consideration is especially relevant for Africa, where women are often primarily responsible for smallholder food crop production. In Asia and Latin America, technological choice on certain types of small farm enterprise may also be strongly influenced by the work load and preferences of women.

B. COMPLEMENTARITY OF NATIONAL AND INTERNATIONAL RESEARCH

1. The issue of women's participation in agricultural development is much broader than what can be addressed by agricultural research but the influence of the CGIAR system, while limited, can be important and should not be ignored. Specifically, there is a need for a team effort between international centers and national research organizations to increase awareness of the importance of women in agriculture by policy-makers and scientists, and a more systematic use should be made of opportunities for increased cooperation between international and national centers in the utilization of national information systems, both to make technologies and their use known, and to obtain feedback on problems.

2. Strong national organizations are a basic requirement for their own contribution to national development and for effective interaction with the international centers on problem identification and on utilization of the research product of the centers. This calls for enhancing the two-way flow of information between national and international researchers.

3. The best way to integrate these multifaceted concerns into the work of the international centers and national systems is for each center to develop a long-term strategy involving consideration of women, where possible, in all phases of its research and development works, including feedback from female farmers. For maximum acceptability and efficiency, the nature, scope, and pace of such strategy development should be tailored to meet each organization's substantive concerns and management style.

4. Specifically, the CGIAR system has a multiple role, but its various components are autonomous entities, with different mandates and approaches. What matters is to take full advantage of the comparative advantage and the complementarity among centers; especially the complementarity between the commodity centers, IFPRI, and ISNAR.

5. Assessing the impact of the centers' work at the national systems level should include attention to gender issues.

C. SUGGESTIONS FOR THE CGIAR SYSTEM

1. In order for a general concern for the status and role of women in agriculture to take a further and more permanent root within the CGIAR system, this must be linked to the technology generation and use process, starting with the identification of the problems to be researched. Attention should be directed to the interface between gender and the technology generation process, including variety/commodity choice, technology design, crop and livestock management and adaptation, and policy research aimed at breaking current constraints to technology usage.

2. While the primary function of the commodity centers is to develop germplasm and generate technology, this should be complemented by the generation of information and methodologies to enhance the use of technologies by women and other categories of producers. Collaboration with national organizations should play a major role in this generation of information and use of methodologies.

3. In general, it is the scientists who should be given opportunities to identify specific areas in which gender considerations make a difference to the effectiveness and efficiency of the organization's work, and actual plans of action should be drawn by experts on each issue. An interdisciplinary approach is important, and the social science perspective has a contribution to make to resource allocation within a center and to the identification of research priorities taking women's issues into consideration.

4. Natural and social scientists from different centers who are working on similar topics should be encouraged to exchange information and to meet regularly to present preliminary analyses and to discuss methodological approaches. Meetings of specialists to discuss specific issues in incorporating gender consideration into research plans and procedures need to be organized.

5. High-quality studies and important learning experiences in incorporating gender issues into the work of the international centers and national systems should be widely disseminated within the research and development communities, including donors. Some centers have taken a lead in the incorporation of natural and social sciences in activities focusing on beneficiaries of technology, particularly women. These centers should be encouraged to make this experience better known to other international and national centers and to share their methodological approaches.

6. In the technology transfer process, training is an area of special significance because of the need for gender considerations in extension. Both international and national centers should offer more training opportunity for women. Attention should also be paid to ways of increasing the number of female extension workers to reach farm women, thus making it possible for women to benefit from new

technology. Specific consideration of gender factors could take place as part of on-farm research or research with a farming systems perspective.

In summary, the papers prepared by the centers and the seminar discussions show that much work is already being done and that a slight shift in emphasis may make this work more effective without requiring significant extra funds. When necessary, special-project funding is likely to be available from donors.

Agenda

MONDAY, MARCH 25

19:00 Reception - dinner
followed by introduction to Bellagio.
Welcoming address: Dr. W. K. Gamble, ISNAR
Opening remarks: President R.W. Lyman, The Rockefeller Foundation

TUESDAY, MARCH 26

09:00 Session 1, chaired by Dr. John McKelvey, representing the IARCs Boards of Trustees.

Keynote Paper: The User's Perspective: Relevance for IARC Priorities and Approaches. Dr. Lowell Hardin, Purdue University.
Discussion.

International Centers and National Systems for Agricultural Research: an Institution-building Approach: paper by Dr. Eliseu de Andrade Alves, President, EMBRAPA.
Discussion.

12:30 LUNCH

14:00 Session 2, chaired by Dr. Joyce Moock, The Rockefeller Foundation

Panel on the particular characteristics of women categories of users, with comments in a regional perspective by Drs. Laurian Unnevehr (Asia), Shubh Kumar (Africa), and Jacqueline Ashby (Latin America).
Discussion

19:00 DINNER

Meeting of discussion group leaders

WEDNESDAY, MARCH 27

09:00	Session 3, chaired by Dr. Alva App, The Rockefeller Foundation User-oriented Research: a Synthesis of the IARCs' Experience, paper by Dr. Josette Murphy, ISNAR, followed by comments from the center directors.
11:15	Discussion 1 (3 working groups): common causes of successes and failures of past experiences related to: Group 1. user-oriented research and the relations between the IARCs and national research. Mr. A. von der Osten, leader. Group 2. Women categories of users and their relevance for the IARCs. Ms. E. Boserup, leader. Group 3. The role of the social sciences in user identification and in technology development. Dr. C. Farrar, leader.
12:30	LUNCH
14:00	Session 4, chaired by Dr. Wilbur Selleck, AVRDC Proposed Recommendations for Discussion, paper by Dr. M.S. Swaminathan, IRRI. Followed by discussion: identification of acceptable recommendation domains, and discussion of desirable changes in center programs, linkages to national research leaders and LDC policy-makers, and specific follow-up activities.
19:00	DINNER

THURSDAY, MARCH 28

09:00	Discussion 2 (3 working groups): Each group to draft recommendations for the centers' programs on the topic assigned for the previous day's discussion, and suggest specific follow-up activities. Group composition and topic assignment remain as for discussion 1. Discussion group leaders: Dr. J. Monyo(1), Dr. M.S. Swaminathan(2), and Dr. L. Hardin(3).
12:30	LUNCH
14:00	Session 6, chaired by Dr. William K. Gamble, ISNAR. Discussion and drafting of recommendations and specific follow-up activities. The session ends with approval of a statement to be widely distributed to the centers, national research leaders, and donors. Closing remarks.
19:00	DINNER

FRIDAY MARCH 29

Morning	Participants departure.

9

The User's Perspective: Relevance for International Agricultural Research Centers' Priorities and Approaches

Lowell S. Hardin
Purdue University*

It is appropriate that this seminar is convened at the Villa Serabelloni. It was here that leaders in agricultural development in April, 1969 set in motion a train of thought and action that produced the center system of today[1]. It was here that less than a year later a group of agriculturalists met to test concepts and chart next steps[2]. This group developed a partial framework for setting priorities that was to guide the Consultative Group for International Agricultural Research (CGIAR) in its expansion of the system for four to thirteen centers. And it is here that we are gathered today, almost sixteen years after Bellagio I, to further examine the process by which the international agricultural research centers (IARCs) determine what they do and how they do it.

In this paper I seek to provide insights into: (1) the process by which the IARCs acquire, allocate, and manage resources; (2) program determinants and user considerations; and (3) possibilities for improving the effectiveness of the IARCs by giving higher priority to user perspectives.

I THE FRAMEWORK WITHIN WHICH INDIVIDUAL CENTER PROGRAMS ARE DEFINED AND IMPLEMENTED

This is a partial framework because it is incomplete. It moves from system-wide objectives through means employed to a listing of program-related ground rules and guidelines. It draws heavily on the reviews of the CGIAR system[3] and on the work of the Technical Advisory Committee[4]. It is insensitive to the many nuances of the generalized process as employed by the management and boards of the individual centers. Because the agenda-setting process is a dynamic one, it is open to modification to incorporate suggestions arising from this seminar.

Overall Objectives of the CGIAR System

The goals of the system, and therefore the broad objectives the centers pursue, may be described thus:

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*For their helpful comments and suggestions I am especially indebted to Joyce Moock, Josette Murphy, Randolph Barker, and a group of IFPRI colleagues.

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- to contribute to increasing the amount, quality, and stability of food supplies in the LDCs and to meeting total world food needs (enhance the supply of basic foods);

- to contribute to meeting the nutritional requirements of less advantaged groups in LDCs (upgrade the diets of the less well nourished);

- to contribute to an overall improvement in the welfare of the less advantaged sectors of societies in LDCs through the development of technologies that will improve the efficiency of use of resources at their disposal (enhance well-being and incomes by improving productivity).

While the second and third objectives involve improvements in distribution, supply enhancement is the dominant goal. Increasingly, however, the system seeks ways to contribute to growth which simultaneously advance the well-being of less advantaged groups. I interpret the CGIAR's recent endorsement of the work of IFPRI (which focuses heavily on nutritional and distributional issues) as evidence supporting this point[5].

Organizational and Administrative Means Employed

While we may take them for granted, the center system does have some unique organizational and administrative features. These are designed to provide a broad base of counsel and to give each center's board, management, and scientists a substantial degree of autonomy in setting program priorities. Salient features include the following.

- The CGIAR draws on the work of the TAC, the CG Secretariat, and the advice and counsel of the IARCs and intended beneficiaries to establish overall policies, mobilize support, and monitor performance of the 13 centers in the system.

- As a part of the global network, and to provide for specialization and division of labor, each member center has its CGIAR-approved set of responsibilities as spelled out in its mandate.

- Each center, once it is created and brought into CG membership, has autonomy in its decision-making - within its defined terms of reference and the general CGIAR policy guidelines.

- Individual centers are governed by their own boards of trustees, who are in turn accountable to beneficiaries, donors (CGIAR members), staff members, host countries, other centers in the system, and the public at large.

- While centers present their programs and budgetary needs to the donors as a group (i.e., to the CGIAR) each donor makes his grant to an individual center on a bilateral basis. Thus the centers are part of a close federation of independent institutions that are financially dependent on the CGIAR. Ultimate veto power, however, rests with those who control the purse.

More important than organizational structure, perhaps, are the guidelines - stated and unstated - which influence program decisions.

Some Program-Related Guidelines and Center Characteristics

In reflecting on the role that user needs play in program priority determination, we need to place the IARCs in perspective relative to the world community of agricultural science and technology. The centers, as international or regional institutions, are but a small part of a larger global system. In aggregate their budgets represent only about 5% of the total annual expenditure on agricultural research in the developing countries. The prime users of the centers' products and services are national programs. National programs, including LDC initiatives assisted by IARCs, have the direct responsibility for interactions with end users (producers and consumers) who must make changes if CGIAR goals are to be achieved (Figure 1). The IARCs, except under unusual circumstances, do not themselves have direct access to end users. As international institutions their mandate is to work with the national agricultural research systems (NARS) and related organizations, not to bypass them. This is because (a) ultimate, ongoing responsbility for a country's food rests with the national government, not with the IARCs, and (b) a key function of the IARCs is to help NARS become stronger and more effective[6]. Linkages of the IARCs and NARS to other institutions, as diagrammed in Figure 1, are also important in deciding which institution is best situated to undertake a particular program or project.

Within the user-NARS-IARC part of the global network, additional characteristics of the centers impinge upon their programs of work.

Among them are these:

- The mandates of the centers are defined primarily in terms of staple foods (technological improvement in basic food-crops and animal production) and geographic areas.

- The activities undertaken by the centers are research, non-degree training, and outreach, but the dominant one is research.

- Centers focus on improving the production of their mandated commodities. Constraints imposed by the limitations of production factors (land, labor, capital, and management) are addressed within the commodity programs. The CGIAR system recognizes the importance of, but does not now include, centers which focus their total programs on production factors as such (soil, water, plant nutrients, pests, socio-economic groupings of people, credit, machinery, etc.). It does, however, support two non-commodity institutions: food policy (IFPRI) and institution building (ISNAR).

- In the continuum of basic-strategic-applied-adaptive research, the centers concentrate on applied work in the search for fairly widely usable results. It is expected that the more location-specific, adaptive (downstream) work will be done in national programs.

- As national systems increase their capability, it is expected that the IARCs will gradually shift more of their work upstream (to more

strategic and basic investigations). Longer run it is envisioned that IARC functions will include: defensive research to sustain productivity gains; efforts to raise current yield ceilings; contributions to research methodology; networking two-way flows of information and materials; germplasm collection, conservation, and distribution; help in establishing research agendas and in organizing and implementing training programs.

- Most center research is done by multidisciplinary, problem-solving teams rather than academic-type disciplinary departments. While commodity-center staffs consist primarily of physical and biological scientists, each has a few social scientists. The latter's perceived functions include helping: (a) to identify and assess factors (especially economic and institutional ones) constraining productivity increases; (b) to design improved research-training procedures, technologies, and institutions that may lessen those constraints; (c) to predetermine the probable social and economic consequences of technological and institutional changes under consideration; and (d) to improve resource allocation procedures within each center and throughout the system more broadly.

- The CGIAR system is not viewed as an all-purpose instrument for the solution of every kind of development-related welfare problem. Therefore, many institutional and policy issues (e.g., property rights, land tenure), while recognized as important, are not included on the agendas of the IARCs. Other organizations have greater comparative advantage for work on such issues.

Having partially described the framework within which the centers operate, we turn now to the means by which the needs and constraints of end users are identified and taken into account.

II PROGRAM DETERMINANTS AND USER CONSIDERATIONS

System-Wide Considerations in Setting Program Priorities

In a manner that is viewed as consistent with the system's objectives, the center mandates, and the resources that are available, program priorities are developed using (primarily) a commodity-based improved-technology-generation approach. Overall considerations include:

- The importance of a particular commodity, as measured by: (a) its monetary value; (b) its calorie and protein contribution to diets; and (c) trends in its production and consumption (as an indicator of future needs and opportunities). Efforts are being made to sharpen these rather gross measurements. For example, value added is seen as superior to gross monetary value as a measure of importance. Further, rather than rely on aggregate caloric values, nutritionists recommend that estimates be made of the importance of the various commodities in the diets of the poor[7]. As now used, all three measures are in a sense indicators of aggregate supply. They are not specific indicators of the impact that supply enhancement research on a commodity will have on the nutritional status of malnourished households.

- The possibility of advancing knowledge or technologies if resources are allocated to a commodity (or, sometimes, to a problem or discipline).

- The probable value to society of the new knowledge or technology if the research is successful.

- An explicit or implicit assessment of proposed activities for their:

  a) economic efficiency (cost effectivness, complementarities, and fit with the CGIAR's comparative advantage);
  b) equity-distributional consequences to low-income producers and consumers;
  c) employment and income-generation impact among groups;
  d) energy-use effects;
  e) ecological or environmental consequences;
  f) acceptability to the CGIAR (in which membership and contributions are voluntary, not mandatory).

To the extent that the above criteria are applied, and most of them are given at least some consideration, it is apparent that before a project is launched it is screened through a series of filters. The resulting technology, if its generation is the research goal, would presumably be technologically feasible, economically profitable, equitable, socially acceptable, and environmentally sound. In reality, however, progress is often made by accepting some trade-offs among the multiple and at times competing goals of the investigation.

It is with the above general considerations in mind that we next examine means by which the specific constraints and circumstances of user groups are brought into the agenda-setting process.

Users: Who They Are and How Their Needs Are Considered

From the viewpoint of the centers, their work serves three groups of users. First is the institutional group - individuals in national ministries (agriculture, trade, finance, planning, or other policy positions); in NARS; in development agencies; and in firms involved with agricultural inputs, food processing, and marketing. In this group the prime users are the NARS. The second group is the producers - men and women farmers and laborers - the end users of the centers' outputs. The third group is the consumers - urban and rural.

Within each of the user groups the range in needs, constraints, and circumstances is often great. By what means, then, may IARCs factor user considerations into the design and implementation of their programs? In a number of ways:

- by adherence to the system's stated objectives which emphasize the less advantaged as a special target population;

- by focusing on the specific needs of differing national programs with which the IARC collaborates;

- by transcending narrow commodity boundaries to become major actors in the development and implementation of farming system research methodology (working with national programs to achieve actual interaction with end users, the producers);

- in the selection of the commodities (neglected products, food of the poor, commodities produced by smallholders);

- by developing low-input technologies, as well as those requiring higher levels of production factors;

- in the choice of regions in which to work (low-potential areas, problem soils, arid or semi-arid rainfed regions rather than focusing exclusively on high-potential areas);

- by making an effort to assess the probable social and economic consequences of technical and institutional changes under investigation;

- through the assessment of trade-offs, where they exist, between achievement of economic efficiency and other goals (equity, self-sufficiency, resource conservation, employment generation, etc.);

- by emphasizing enhancement of diets of the malnourished (commodities, protein improvement, post-harvest technologies);

- by determining consumer wants and preferences and factoring them into product design and food preparation (processing) procedures;

- by generating unit cost reducing, output increasing technologies which, through reductions in the real prices of the basic food commodities, benefit the poor relatively more than the affluent;

- through the selection of trainees and staff members who are open and sensitive to the needs of users; (Policy is often shaped through the choices managers make in the people they employ. Background, gender, and attitude, as well as scientific competence, are important.)

- by sensitizing staff and trainees to end-user needs through direct exposure to households and on-farm trials; (The gap between the scientific knowledge of the researcher and the experiential knowledge of the farmer is often wide.)

- through the influence centers have on research agendas, program design in national programs, and in the work of other development agencies and institutions. (Part of the work of the centers is to help define problems; then to join in figuring out a rational approach to their solution. The actual work may or may not involve a CGIAR institution.)

All centers do not employ the full array of devices outlined above. Should they? A discussion of some of the factors involved in addressing this question follows.

III DISCUSSION

The issue under discussion might be phrased thus. In establishing program priorities, would the overall effectiveness of the CGIAR system be increased if greater emphasis were given to the diversity in needs and constraints of producers and consumers? The issue is a real one. All end users, especially women, do not have equal access to the factors of production, information, and social services. Many policies, institutional arrangements, educational programs, social structures, and production systems are unequal in their impact on different groups in society. As a consequence, resources are too often underutilized, with the result that productive efficiency and social welfare suffer[8].

The proposition that IARC research, training, and outreach programs must respond to user needs is, to my view, virtually irrefutable. Farmers, not the international centers or the NARS, produce the food. Ultimately, the success of the IARCs is measured by the changes that take place in what the farm men, women, and children (the end users) do. This is true, even though the centers reach these end users primarily through their work with national programs.

- It is because the actions of users make or break the system that the array of approaches to identifying user needs and constraints (as outlined above) is employed.

- It is because of concern for better understanding of user needs and responses that farming systems research methodology development and testing now figure so prominently in IARC programs. This has occurred despite the fact that use of this research approach requires direct access to farm people and to farmers' fields - a province of the NARS.

- It is partly because of this concern that in their programs the biological centers are making increasing use of the work of social scientists.

- It is also because of this same concern that, within the system, IFPRI is mandated to identify, analyze, and help ameliorate policy constraints; and ISNAR has the specific mission of institution building at the national level.

To varying degrees, those involved in the CGIAR system's program determination and resource allocation process are aware of the disparities associated with unequal access to resources and services. However, the tools that the IARCs have at their disposal are blunt instruments for redressing many of the injustices and diseconomies that exist. And important work remains to be done on tasks for which that kit of tools is well designed. This involves the system's continuing role in helping assure an adequate, stable supply of basic foods - food security in the supply sense. Centers have the tools to help maintain (defend) the production and productivity gains to which they have already made substantial contributions. This is essential, though not glamorous, work. They also have the capacity for pathbreaking investigations which further lift production and productivity levels. Pursuit of

non-complementary goals becomes questionable if undertaken at the expense of the system's capability to deal with the productivity priority[9].

To fully capitalize on their comparative advantage in the productivity area, the centers need to maintain a fairly narrow, mission-oriented, problem-solving approach. The cost of excessive dispersal of effort can be high indeed. To date, the strategy of focusing a relatively small but critical mass of talent (and related resources) on specific problems has served well those centers that used it.

Widely adapted technological innovations are apparently easier to come by for high-potential areas and advantaged populations than for low-potential situations and the disadvantaged. For the disadvantaged, much situation-specific adaptation is required. To do this adaptation successfully, understanding of user circumstances and constraints is essential. Because the national programs work directly with users, it is at the NARS level that this knowledge gap is most effectively addressed. Most NARS, however, would welcome assistance in identifying important constraints among end-user groups and in providing effective responses. What then might we suggest?

IV CONCLUDING OBSERVATIONS

This review suggests that the IARCs now employ a substantial array of instruments to reflect users' perspectives in the planning and implementation of their programs. Because NARS are viewed as prime (though not end) users, IARC programs are geared to demonstrated or perceived needs of national programs (research and extension). Due to the manner in which national and international research institutions share responsibilities, NARS-IARC collaborative initiatives appear to be the key to further advances in user orientation.

The instruments that, in my judgement, show greatest promise in this regard include:

1. Human capital and institutional development efforts. Hayami and Ruttan identify three interrelated stages of technology transfer: (1) direct transfer of materials (seeds, machinery, chemicals); (2) transfer of designs (blueprints, formulas, books, computer software); and (3) transfer of capacity (human capital and institutional development) so that the country can draw upon the world's scientific knowledge and embody it in technology suited to its own resources and cultural environments[10]. To my view it is in their contributions to stage 3 that development efforts can have their greatest long-run impact. Because the short-run impact of training and institution strengthening is difficult to measure, relatively excessive resources are often devoted to stage 1 and 2 transfers. All centers have a stake in the stage 3 building process. This suggests that further decentralization of center activities (through networking, in-country training sessions, workshops, and out-stationing of staffs) become strong competitors for additional resources that are made available to the centers. Some multi-commodity centers might profitably consider dropping one of their commodity lines in order to strengthen their collaborative training-networking activities.

2. Farming systems research (FSR) methodology development, testing, and institutionalization. This is a special case of instrument 1 discussed above. I do not believe that the site specificity of FSR precludes centers from direct collaborative work of this type. In fact, IARC professionals need to pioneer in investigations designed to narrow the gap between the scientific knowledge of the staff members and the experiential knowledge of farm men and women. Substantial resources are now being invested in FSR. A major reason for this donor infusion is to get scientists out of their research stations onto the farms and into the households of users. I think that there is considerable wisdom in the view that farm people know a great deal that matters that research scientists do not understand. The converse is, of course, equally true.

   If we are to learn more about the differences in needs and constraints among groups of end users, that knowledge must be acquired at the country level. It is there that differing circumstances must be studied, identified, evaluated, fed back into national systems, and dealt with. Elements of the FSR approach have much to contribute to this process (including the role of extension in feedback, as well as dissemination activities). In this process the IARCs have a comparative advantage in methodology development, testing, and factoring identified groups of user needs into technology design.

3. Policy research and analysis. Many of the constraints that women, disadvantaged producers, and consumers face are policy-related. They involve long-standing social and cultural institutions having to do with access to resources and services. It is extremely difficult, if not impossible, to overcome such impediments through production science research. Changes must occur in policies - in the rules of the game under which production and distribution take place.

   Those involved in the CGIAR system recognize that technology development, though essential, is no cure-all. Nations must get their policies right if improved technology is to be fully effective. Therefore, latitude appears to exist for stepped-up center collaboration with national institutions that do policy analyses. Especially important are ISNAR initiatives to help strengthen the socio-economic capabilities of NARS and IFPRI's capacity-building collaboration with national institutions active in the policy arena.

4. Impact assessment studies. The CGIAR-sponsored impact study now under way will speak to the system's performance. It may give us some sense of the effectiveness with which the system is reaching various user groups. Centers will undoubtedly continue to undertake impact studies (both ex post and ex ante) (a) to follow up on the current work and (b) to determine more precisely the pay-off from earlier work and to estimate in advance the probable results of pursuing alternative program agendas. These initiatives will of necessity yield additional insights into the differences within and among groups of users. In fact, it is probable that some of the hypotheses we advance in this seminar will be tested in these investigations.

5. Nutrition and information-sharing activities. In addition to the foregoing, I see two more user-related types of activities to be complementary to the stepped-up NARS-IARC collaboration we are discussing.

   The first involves the follow-up actions, now under way, on the Addis conference on international agricultural research and human nutrition. The book produced by that conference carries illustrations of several means by which nutritional goals can be incorporated into the design and planning of agricultural research[7]. Work with user groups figures prominently in these recommendations.

   The second involves information sharing. Concrete data concerning the diversity of needs and constraints of users are only now becoming available. Individuals and institutions that are not a part of the CGIAR system are likely to be the dominant actors in this arena. A special effort needs to be made so that the results of studies of women and of other user groups are shared with all of us. This suggests that a clearinghouse-cum-network type of initiative may be needed.

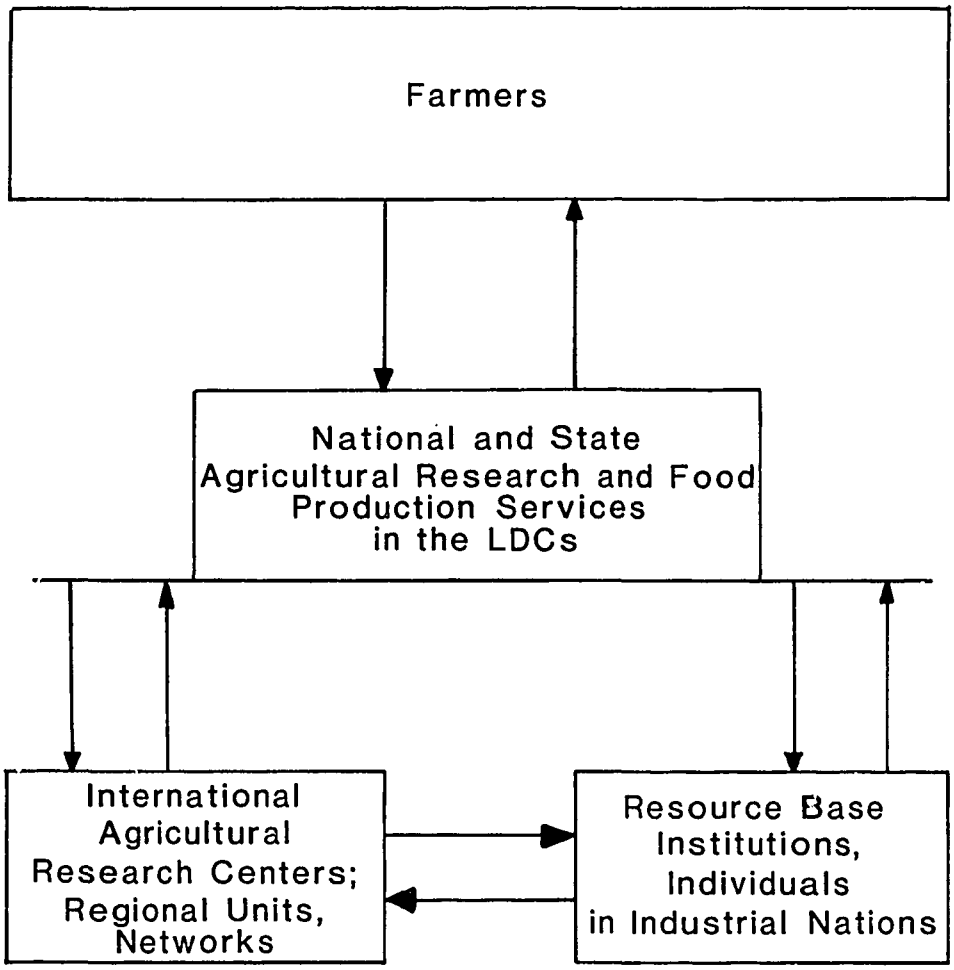

Figure 1. Schematic Diagram of the Lines of Communication Between Farmer Producers (End Users), National Agricultural Services (Primary Users), IARCs and Other Institutions.

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International Centers and National Systems for Agricultural Research: an Institution-Building Approach*

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The basic premises of this paper follow.

(a) Research is location-specific. There are cases in which it is possible to transfer technology from one country to another, but there are few examples of transferring technology from the developed countries to the developing ones. Not only is the physical environment different, but the differences in human factors, such as literacy, education, culture, and others are so deeply ingrained that the possibilities of transfer are drastically reduced.

(b) The modernization of agriculture implies the application of science to the production process, transport, storage, and marketing of agricultural products. It requires profound changes of mind and attitudes of society in favor of science. It requires that the "scientific spirit" be encouraged at all levels of government and be accepted by consumers and producers. Foreign institutions do not have much of a chance of producing these changes of attitude. Nevertheless, they can have a powerful influence on inducing change when associated with national institutions for the purpose of bringing about the transformation of traditional agriculture to a modern science-based sector.

In developing countries, scientists have two important roles: to generate knowledge and technology; and to convince society to accept the importance of science and then to support it. The two roles are equally important and interdependent. Good scientific work is an effective means of motivating society to support science, but it is not sufficient. In the case of the developing countries, the scientists must be much more active in creating a general atmosphere favorable to research. This goes far beyond laboratory work and teaching activities. It involves work with the press, government authorities (on all levels), the church, the army, farm leaders and organizations, and other institutions.

The first role can be fulfilled by scientists of developed nations working in developing countries or in the international centers, or other institutions specialized in research. Even so, the possibilities of success are small, since technology is

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*This paper expresses the author's views on the role of the international centers on the problem of developing the national systems. At no time does it intend to evaluate the work of these centers.

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location-specific, and its development on the scale needed by even a small country goes far beyond the possibilities of the institutions of the developed world.

The second role can only be carried out by national scientists. The strong sense of nationalism would not accept foreigners playing an open role in convincing a society of the value of science. This would be interpreted as one more sign of the dominance of the center over the periphery.

If the "scientific spirit" is not accepted as a method of thinking, the modernization of agriculture will not take place as a self-propelled process. There may be examples of isolated progress induced from the outside, but they do not generate a continuous flow of transformation that will eventually encompass the whole agricultural sector.

It is the "scientific spirit" that brings changes in agricultural policy. These changes include the support for research and extension, a commercial and credit policy that fosters growth and productivity; and it is interested in the well-being of rural people.

Obviously one cannot state that a country either has or does not have a scientific spirit. There is no single day or year that serves as a hallmark for the transformation. We are talking of evolutionary changes. This will not happen all at once.

Being an evolutionary process means that there are forces in favor of and against the changes. Hence, a strategy of strengthening the forces favoring modernization and, if possible, weakening those that oppose it, is called for.

The development of strong national institutions for agricultural research is one of the most important weapons in this never-ending struggle.

(c) Research is a process that never ends, since knowledge brings the need for more knowledge. Every process needs to be accommodated in institutions; in the case of research, permanent institutions of a public and private nature.

Three premises and one consequence: Any global strategy for the agriculture of the developing nations that does not have as its main objective the development of the national research institutions, when lacking, is doomed to failure.

Two levels of institution building can be distinguished, looking at the institutions from the outside or from the inside: the marketing of the products and the organization of the research system and of its production processes.

In the case of public research, society finances the production and buys the product, since technology is supplied free of charge to the farmers.

But the government finances research, and its results are appropriated by the farmers. Hence, public research institutions depend on two clients: one who pays for its work, and the other who eventually incorporates the technology generated into its production systems.

One might think that if the results of research are valuable, then the government would support its institutions. Consequently there is just one client: the farmers. One can argue further that in the more industrialized societies the consumers are also very powerful. Then one has both farmers and consumers as beneficiaries of research. If they accept research as a valuable tool for economic development, then the government follows their judgment. In the long run this is true. But not in the short run. The fact that there is a time lag between investment in research, the generation of technology, and its adoption by farmers confuses the government, the farmers, and consumers as to the real value of research. In most of the developing countries it takes time for farmers to support research. They are eager to support extension that brings the results to them, and most of the time they believe that the new technology is part of the general knowledge of humanity. They are not able to link it to research efforts. Extension gets the credit and research gets none.

There are also conflicts of interest between consumers and farmers, mainly with the large farmers who are the ones with a voice in government. In this split, research may be caught in the middle and be criticized instead of being supported.

Even if consumers and farmers are willing to encourage investments in research, the government may not give it full support. In each country there is an intellectual atmosphere, accepted by the government, as to the course of agricultural development. In general, the atmosphere is much more in favor of the expansion of the agricultural frontier than in increasing productivity. Even when it favors increased productivity, it is believed that the problem is one of diffusion of the technology that has already been generated in the country or that can be transferred from the outside.

Yet most developing countries, even when accepting the importance of agricultural research, consider it a luxury rather than essential, since the results come only in the long term. Clearly there is a confusion between projects and institutions, since a research institution that is reasonably well administered produces results each year. Some projects may bring results only in the long run. Consequently, the government tends not to give high priority to investment in research, and it is a real problem to convince the authorities to seriously support research activities.

The first level of problems for institutional building rests upon the need to create a favorable atmosphere for research, with government, consumers, and farmers. It is a complicated problem, since each country calls for a specific strategy.

The second level of problems involves the organization of the research system and its production processes. It includes the organizational chart of the institutions, development of human resources, research

priorities, programming techniques, organization of research units, carrying out of research projects, testing of research results, on-farm research, links with extension, private sector research, and universities. The objective is to make research more efficient and to make each dollar bring the highest rate of return. For the first level of problems, their solution involves increasing the research budget.

In the long term, the direct route to a larger budget is to obtain research results that are relevant to society, and to keep society well informed as to the results of research obtained and expected.

There is no doubt that even in the short term, research results are important in obtaining a larger budget. But a larger budget is crucial for the realization of research and the development of the institution. Hence, in dealing with institutional development, one must pay attention to the two levels of problems. The emphasis on one level or on the other depends on the country and on its national research system.

The availability of research results that can be directly and/or easily adapted by the national system is of great importance, since it allows the national system to come out in a smaller span of time with technologies that will give it prestige in the eyes of farmers, consumers, and the government. These results in some cases can be generated by international research centers or other institutions.

Historical Perspective of the International Centers

When the first international centers were created, the aim was to generate technology that could be directly transferred to the farmers of the developing countries, mainly in Asia, who were facing a very serious problem of food production. The research institutions of the developing countries received, at best, second-rate priority.

It was a correct decision, and it was very important to show to the developed world that research was one of the most valuable tools in increasing the supply of food. The success of rice and wheat research made a great contribution to this change of opinion. At that point in time, the developed world was heavily supporting the development of extension activities in the belief that there was enough technology and what was lacking were good extension services.

This change of opinion brought about a substantial increase in money invested by the developed world in research, to the benefit of developing countries. The international centers that have been created are an objective answer to the new trend.

In addition, the success of the international centers helped to influence the minds of the authorities of the developing world to give greater support to research activities. This has been under way since the mid-1960s and has gained momentum since the beginning of the 1980s. Now all emphasis is on research, and there may be some exaggeration in this trend.

Research and time bring about better understanding and new problems. There is better understanding that the development of the national

systems is crucial to the modernization of the agriculture of the developing world. The new problems that emerge are how to help the national systems to accomplish their goals. These problems have been a great puzzle to the donor community and to the various agencies of the developed world.

The question that comes to mind is how to make the international centers more effective in dealing with the problems of the National Systems.

In my opinion, there are two lines of thought. One is that of the international center and the donor community. The best way for the international centers to help the development of the national systems is to concentrate on the development of technology that is relevant to the developing world, to create new methods of carrying out research, and to build relationships with the national systems around research problems, most of them of a biological nature. So the idea is to take the system as given, and try to improve its production processes. It was felt that this idea was very restrictive. It neglects the organizational problems of the system and the first level of problems of creating a favorable atmosphere for research. ISNAR was created to correct this situation.

The second line of thought is more radical. According to it, each international center should aim towards the development of the national systems. The idea of ISNAR is not rejected. There is room for specialization in the two-level problems already discussed.

Two questions come to mind: Are the two lines of thought not the same? If they are different, which is better?

Certainly the two lines of thought are not equivalent. If the second had been the guide for the organization of research of the international centers, their research priorities and the multidisciplinary teams would have been very different. The second line of thought requires that the definition of problems starts at the level of the national systems, and then comes back to the international centers. It would require of the international centers a level of knowledge of the national systems far more complete than they now have.

Today an international center searches for the problems that are relevant to the farmers of the region covered by its mandate, and it builds the research program around these problems. Clearly, there are discussions with the national research leaders, but not to the point where the developing countries may have a strong voice in establishing research priorities. And the discussion of research priorities is never put in the frame of reference of national system development. It attempts to get the opinion of knowledgable scientists concerning the problems of the countries they represent. And these scientists do not always have experience with institutional development; rather, they are very good specialists in a restricted field of knowledge.

It is then generally accepted that the true role of the international centers is to create technology for the developing world. The development of national systems is a secondary issue, except for ISNAR.

The second question (which line of thought is the better one) has already been answered. The development of the national systems should be the first priority of the international centers.

The second line of thought was rejected for two reasons. First, because it is very difficult to bring about drastic changes in the philosophy of the international centers. They have been operating as such for a long time. Second, it is believed that many developing countries cannot afford to have respectable national systems. This, however, is equivalent to accepting the idea that they would not be able to develop their agriculture, if one believes that science matters. Maybe what one should try is to develop research systems the country can afford to support. To my knowledge this has not been tried. There is no doubt that the models of research in operation are very expensive for a poor and small country. However, is it impossible to conceive other models that are equally efficient and less expensive to operate?

I do not believe that the second line of thought will ever be completely accepted by the donors and the international centers community. Pragmatically, one should call for a strategy that would make the present situation conform to what was thought of as ideal. One should set in motion forces that would make the international centers consider as their first priority the development of the national systems. The rest of the paper is devoted to this problem. ISNAR will be separately discussed because of its strategic importance.

The Role of ISNAR

It is envisaged that ISNAR will take charge of designing the strategies and will help to carry them to completion in order that the CGIAR system may fulfill the goals of cooperating with the development of national systems.

ISNAR will have to study the countries, to evaluate their potential for supporting agricultural research, to evaluate the national systems to see how well they can be responsive to the demand for research, and to study the international centers to see how they can be better used to foster institutional development of the national system. The task is a formidable one, but ISNAR may draw on the work of the international center family and of other institutions. For economic problems, for example, IFPRI may be of great help.

The basic idea is to divide the countries selected for the program of institution building into groups. One strategy would be designed for each group. And each group would have ISNAR and some other international centers responsible for the application of the strategy. Clearly, some national systems might be involved with the international centers, and the same is true for various research institutions of the developed countries, and agencies such as the World Bank, FAO, etc.

More specifically, one expects of ISNAR the following.

1. To carry out studies for the classification of the developing countries as to their potential for the development of research. The

idea is to appraise the demand for research and the capabilities of the countries to meet it. The following points may be selected to be studied:

(a) the economic capacity of the country to support research institutions of the size deemed appropriate;

(b) the willingness to finance research; how society is reacting to the "scientific spirit"; it includes the farmers, consumers and other groups considered important;

(c) the structure and quality of the agriculture universities or of the faculty of agronomy;

(d) the potential for a food crisis, its nature and location; (it may be located in urban or rural areas. It may be due to the lack of employment opportunities, coupled with a poor standard of income distribution, or it may be the consequence of lack of production to meet nutritional standards. In this respect it is relevant to analyze the pattern of food imports and exports and its evolution through time. Note that a food crisis can be a powerful engine to mobilize the energies of the country to support agriculture and research, and also to obtain financial support from the developed countries.)

(e) the urbanization process: size and velocity; its causes; (Note that urbanization brings about profound changes in the power structure in favor of the urban consumers, consumption habits, etc. Urban societies more readily accept investments in research, and also, a very different strategy is required to convince them of the value of science.)

(f) the power structure needs to be dissected for the purpose of the motivational strategy to be employed to get support for research; it is very important to know which sector dominates the power structure;

(g) the size, location, and quality of natural resources of the agricultural frontier, as related to the need for increasing the food supply; (It is well known that countries with an agricultural frontier that is sufficiently large to be able to fulfill the needs of an increased food supply and which is easy to bring into production, are not the best supporters of agricultural research. This is true because it is believed that the rate of return on investment in expansion of the frontier is higher than on increase of productivity.)

(h) economic and agricultural policy for the purpose of verifying how they favor or discriminate against agriculture, and against the growth of productivity of agriculture; (It is also important to examine the export and import policies, and the price policy for the internal market. The agricultural policy may be expansionist in the sense of bringing more areas under cultivation, as opposed to an increases in productivity. It may

favor the growth of productivity, which is a rare event among the developing countries. In may respects the economic and agriculture policies give an excellent clue as to how the country perceives the value of research or reacts to the "scientific spirit".)

As a result of the studies, the countries will be classified into the following categories:

1. able to develop research needing only technical support they can pay for;

2. able to develop research, but needing technical and financial support;

3. unable to maintain research institutions that would fit their needs.

This classification has a built-in time dimension, let us say, of five or ten years.

For the third group the international centers would have to develop technologies that would be directly carried to farmers by the extension service, which is likely to be very primitive. For the other two groups, the principal role of the international centers is to help the national systems to be more effective.

In the study of the ability of the country to meet the demand for research, a close look must be given to the existing research institutions. The idea is to classify them as follows:

1. able to go by themselves and to cooperate with countries that are in a worse or equivalent situation;

2. unable to go by themselves, needing strong help both of a financial and technical nature;

3. needing fundamental reform which is almost equivalent to building another institution.

The third group needs special attention. If the country is not prepared to accept the fundamental reform, to work with it may be a waste of time and money.

The principal factors that should be studied for this classification relate to:

- budget; size, composition (personnel, operational costs, investment), and cash flow during the year;

- wage scale;

- human resource development;

- quality of management at all levels;

- buildings and laboratory facilities;

- entrance requirements, how employees are promoted, wage scales, tenure;

- age of scientists, level of training, and numbers compared to the needs of the country and to the total number of employees;

- political support of the institution and how it is held accountable.

- The strategies for helping the national systems will be designed, based upon existing knowledge or on knowledge developed by ISNAR. One can distinguish the following levels:

(a) promotion of the institution among consumers, farmers, government, and other groups; (Here the goal is to get more political and financial support. In other words, one seeks to create or to increase the market for the products of the institutions.)

(b) for improving the efficiency of the institution, looking into its structure and mode of operation;

(c) for expanding the relationships of the institution with other research systems, outside of the country, not only for receiving financial and technical support, but also for cooperating with other countries. The strategies would emcompass each group of countries and how each international center and other institutions would fit into the scheme.

3. ISNAR should also supervise the implementation of the strategies.

There is a great danger that these ideas may lead to a bureaucratic structure, unmanageable and very costly. To avoid this, ISNAR must reduce the countries that will be helped, for each period of five years, and must rely on the international centers and other institutions, including the ones of the more advanced developing countries. It is also advisable for ISNAR to have three groups of specialists: to study the countries, to design strategies, and to supervise their implementation. Some specialists may be located in international centers other than ISNAR or in the countries selected for the program.

To be effective, the strategies need the participation of all international centers in all their phases.

It is also possible to give a more prominent role in the development of the institutions of a region to a determined international center. In this case, specialists and resources would be allocated to the particular center, which also would play a coordinating role for to the work of the other international centers within the region.

The managers and scientists of national programs must receive adequate training to become able to work with society at large to get

its support for the research institutions. It is also advisable to have specialists in the national system that help the managers in the work of creating a good image for the institution. It is important to recognize that every research activity could be explored for that purpose, from the selection of priorities (Alves, 1984) to the dissemination of research results. Institution building in the case of public institutions requires a strong determination to construct a good image on both fronts: the internal and the external. It requires scientists and employees who believe in the relevance of their work for society, who love their organization, and who are always ready to defend and to promote it. But it also requires that society consider the work as important. When society and the employees support the institution, one can say that it has reached a mature state.

The Role of International Centers

The role of ISNAR has already been discussed. IFPRI deserves special discussion. It should stimulate and work towards the development of a department of social sciences in the national systems. The department of social sciences can be a powerful link between the institution and top-level government decision-makers. Researchers who demonstrate the economic and social value of research are crucial for the purpose of establishing strong links with the government. The analyses of the implications of existing agricultural policies, the design of new policies, and the reformulation of old ones, are also helpful to top-level administrators, and the department of social sciences may have substantial participation in their creation, bringing prestige to the agricultural research institution. Yet the work of social scientists is very important in establishing priorities and in the evaluation of the impact of the new technology on farmers and society. The department has a role in generating the guidelines for institution building and in training scientists located at the experiment stations.

No less important are the specialists in the area of mass communications and public relations. They should be provided with good facilities for their work and have free access to the top-level administration of the research institution.

The countries will be divided into three groups and the role of the international center discussed for each group. The recommendations that are put forward can be enlarged, because there is no intention to be exhaustive. Furthermore, there are many research activities that are the same for every research institution, no matter what its purpose and location. In addition, there are research activities that are relevant for the three groups, and they are not discussed, if mentioned only for the purpose of emphasis. Examples are: research on methods of the introduction of genes of wide application, germplasm collection, conservation, etc.

1. The countries that need only technical assistance, and to some extent can pay for it. They are supporting research, and their national systems are capable of facing the needs of agriculture.

For this group of countries, the classical model of institutional centers fits very well. This group of countries would like to see the international centers doing research that is complementary to what they are doing, as well as the more sophisticated research and those projects which demand a long period of maturation and are risky; research on methods, germplasm collection and conservation, breeding programs for complicated problems, specialized training, information and documentation, etc.

The relationship between the national systems and international centers must be cooperative, and never one-way. Whenever possible, each should pay its own expenses. Joint-venture projects are recommended, and the network model is also highly desirable. It is important to establish rules for cooperation in written documents.

One can foresee an increasing competition among national systems and the international centers. Careful planning of the relationship is needed to avoid having clashes of interests. It is important to realize that this group of countries can cooperate with the international centers in assisting other countries' research needs.

2. Countries that cannot afford to support research institutions capable of facing the needs of agriculture. The national systems are of poor quality and are difficult to upgrade. Many countries do not have research institutions that are worthy of the name. This group of countries is at the opposite end of the scale, as they have a very small capacity to absorb new technology of a more sophisticated nature. The new systems proposed for their agriculture must be of the low-input type and must count more on the resources of nature. The modern input industry is very primitive, and their participation in the international market as exporters is small, not allowing the imports of modern inputs. An extension service is also of very poor quality, although present. They lack adequate schools of agriculture.

   For this group of countries, the following are required from the international centers.

   (a) The international centers must finish the development of technology, so that it is ready for dissemination to the farmers.

   (b) They should concentrate on research of primitive systems, of the low-input category.

   (c) It is necessary to place scientists in the countries to test the technologies developed.

   (d) The training of extensionists and of people able to test technologies is very important.

   (e) An association of the countries may be tried, if they belong to the same ecological zone, to finance a research institution that would serve them all. The international centers can work with the countries for this purpose. But one should realize that this may be a very complicated political problem.

(f) Training activities to develop some research capacity, even if within the extension service, are very important.

(g) Again, research on methods and germplasm conservation are important, but the nature of the research is different. Complementarity does not, exist and everything needs to be very simple.

(h) Research results of the more advanced countries may also be transferred to this group of countries, and the international centers must seek agreements that would facilitate the transfer of technology.

(i) The international centers should stimulate agreements with the national systems of the first group of countries for the purpose of training, and other activities.

(j) With the help of ISNAR, the designing alternative models of institutions and carrying out research that would fit the possibilities of the countries should be attempted.

3. Countries that can afford the support of research systems that can face their needs, but that necessitate strong financial and technical assistance. The research systems are only of fair quality, and are not consolidated with government and public opinion. They need strong assistance of the institution-building type. They do not have a powerful urban sector. Society is still dominated by the rural sector, but transformations are underway.

The role of the international centers for these countries follows.

(a) Institutional building at all levels, as discussed, is the most important task. One should consider the creation of a public image, the organization of the institution, its research programs, etc.

(b) The division of the countries into groups is recommended, and some international centers should be assigned to each group for the purpose of working under the coordination of ISNAR.

(c) Training activities of a non-degree nature are crucial.

(d) The research program of the international centers must contemplate production systems of an intermediate level, but tending more to the low-level input category.

(e) In designing the research program of the international centers, a stronger participation of the national systems would be most desirable, as well as a division of the program so that part would be carried out by the international centers and part by the countries.

(f) It is very important to provide facilities for meetings that would bring together representatives of the national systems and

of the international centers' at the programming and management level; and also representatives of this group of the national system with the first group.

(g) The reports of the international centers must have sections dealing with institution building, presenting the results that were achieved. At Centers Week, one morning or afternoon should be devoted to this theme. This recommendation applies to all groups of countries.

(h) Since financial support to research is a crucial problem for this group of countries, they need strong help in preparing projects that would allow an increase in their budget. In these projects very special attention should be given to training and consultants. It is very important to balance graduate and short-term training; there is a tendency to disregard graduate training on the assumption that it is very demanding in time and resources. Without some top-level scientists, research enters the kingdom of fantasy!

(i) It is desirable to find routes of research that save costs for the national systems. This subject should be strongly addressed by the international centers.

Concluding Comments

In conclusion we would like to stress the following points.

1. Institution building should be the main goal of the international centers. Their evaluation must ask the question: What have they done to strengthen the national systems and how are they working to achieve this goal? Weak national systems are a signal of failure of the international centers;

2. It is important to divide countries into groups and to have a work strategy for each group.

3. We should contemplate the possibility of giving to some international centers the responsibility of working with a particular group of countries, with ISNAR doing the planning and coordination.

4. It is very important to draw on the experience of the developing countries that have succeeded in building their national systems. We strongly recommend that the international centers find ways to associate with these countries for the purpose of assisting the ones that have lagged behing in supporting research.

5. The subject of building national systems for agricultural research must be stimulated in the universities of developed and developing countries, and also deserves being discussed at the level of the international agencies that are connected with agriculture. We recommend that a discussion paper should be prepared on the subject.

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Panel on the Characteristics of Women as Users of Technology

1. Introduction to the Panel (Dr. Joyce Moock)

This panel focuses on the question, "How much do we really know about the special characteristics of women users of agricultural research?" Background materials were prepared by Dr. Laurian Unnevehr, of IRRI, for South and Southeast Asia; Shubh Kumar, of IFPRI, for Africa; and Jacqueline Ashby, of IFDC, stationed at CIAT, for Latin America.

Preparation for the panel took place in two stages. First, each reviewer was asked to draft an analytical synthesis on regional gender issues of direct relevance to agricultural research.

The papers were to provide a review of key documents regarding:

- decision-making and labor allocation issues in small-family production units;

- examples of technical and policy research which attempt to incorporate the needs of particular user groups;

- examples of negative impacts of new technology - where such impacts could be directly traced to faulty assumptions about the characteristics of user groups.

In general, the purpose of the reviews was to identify what kind of knowledge regarding household processes is necessary in order to develop technology and policy which make sense in the changing local context.

Second, in November 1984, the panelists met in Washington with several regional specialists to review the drafts.[1] These people were asked to a) comment on the outline of the drafts, b) identify additional data sets or studies, and c) help refine the conceptual approach.

These points emerged from the meeting:

a) Because of women's household responsibilities and the particular nature of their access to and control over resources, their motivations and capacities to engage in certain agricultural activities may be different from that of men.

b) We also know that at lower socio-economic levels, women's income-earning abilities are closely related to the well-being of the household and the children's welfare.

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[1]See list in Appendix 2.

c) The data base is amazingly poor. Examples are so location-specific that generalizations are difficult. Case material is often static. Farming systems, surveys, and policy work have yet to get into these issues in depth.

d) We need more evidence to show where knowledge of local systems actually made a difference in productivity and income-generation over time.

e) We need to better understand the relationship between gender as an important category in itself and gender set within a socio-economic class context.

f) We need to understand more about social trade-offs - where one group benefits at the expense of another.

g) The panel was urged to stress the importance of gender as a way of highlighting deeper questions about the significance of the user perspective, where this makes sense in agricultural research.

2. Conclusions from the Regional Reviews (Dr. Jacqueline Ashby)

Women form distinctive special user groups or beneficiary groups for agricultural technology research and development in Africa, Asia, and Latin America. Although cultural, economic, and institutional aspects of women's circumstances in relation to agricultural production differ widely from region to region, there are certain commonalities highlighted by the three regional papers. Women, as farm managers and potential users of new technology, face special constraints in access to production inputs that are related to their unique responsibilities in child care, household production, and consumption. Labor bottlenecks imposed by women's time constraints, caused by their multiple work responsibilities, may be particularly important factors determining the acceptability of technology. This consideration is especially relevant for Africa, where women are often primarily responsible for smallholder foodcrop production. In Asia and Latin America, technical choice on certain types of small-farm enterprise may also be heavily determined by the work load of women.

Technical innovation which affects labor demand is also likely to have different effects on women than men who are landless laborers when there is a sexual division of field labor operations, as emphasized particularly in the case of rice cultivation in Asia. That landless laboring women provide a major component of the income for the poorest households in Asia is quite well documented. Technology which affects employment in operations performed by women will, in this case, have the greatest impact on the welfare of landless households. In Africa and Latin America, female labor appears to be more generally unpaid and active in semi-subsistence production. The indirect effects of changed demand for female labor on household food availability, quality and stability of supply appear to be more critical, especially in the African case, than direct effects of female employment on household income.

Women as farmers are also influential in the allocation of resources for agricultural production: they often control certain inputs, they manage

certain production processes, and they may control the disposition of output. This appears to be especially relevant in certain African small-holder systems, where women have separate responsibilities from men for food production and even the feeding and support of children. However, the influence of women in farm decision-making is widely noted, though less visible, in Asia and Latin America. The importance of distinguising women as a special user group in the context of farm decision-making is that women typically face different incentive structures from men because they have different work responsibilities, and access to and control over different resources. Hence female farmers' preferences in terms of acceptable technology may be quite distinct from those of male farmers.

While the regional papers illustrate that there are some generalizable features of women's participation in agriculture that support the contention that women form special user or beneficiary groups, the empirical evidence is extremely varied in quality. In the African and Latin American cases, in particular, there appears to be substantial intra-regional variability and location specificity in the different roles that men and women perform in agriculture. In view of this, the papers emphasize the importance of integrating methods for improving understanding of how women influence choice of food production technology into programs for social science research or multidisciplinary on-farm research already existing at the international centers.

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User-Oriented Research: a Synthesis of the IARCS' Experience

by Josette Murphy
International Service for National Agricultural Research

This presentation will not be a detailed summary of the background papers prepared by the centers; the papers are included in the document which you all received a few weeks ago. Instead, I will focus on the four issues which are discussed by most centers and will raise some questions which should be addressed before we can draw lessons from the centers' experience to date. The issues are 1) the importance of placing production into a broad context, which includes both macro and micro considerations, 2) the necessity of having valid and relevant data on decision-making in the household, 3) the role of the social sciences in agricultural research, and 4) the relationships between the international agricultural research centers (IARCs), national research organizations, and policy-makers.

I. THE IMPORTANCE OF PLACING PRODUCTION OF A COMMODITY INTO A BROADER CONTEXT WITH BOTH MICRO AND MACRO CONSIDERATIONS.

Several of the centers, especially CIP, CIAT, and CIMMYT, retrace how broadening the scope of what they take into consideration when analyzing opportunities for improved technology led to an increasing awareness of users' diversity in role, needs, and potentials. This awareness in turn led the centers to diversify their research activities and to become more user-oriented when establishing their programs. Broadening the scope of what they take into consideration should not be taken as strictly equivalent to using a farming systems perspective at the farm level. It may involve placing agricultural production in context over time, beginning with management decisions taken before the selection of crops, varieties, and farming practices, continuing with actual production, and followed by processing, storage, marketing, and so on, all the way to consumption. It entails considering the effect of a number of macro-economic and policy decisions which influence the adoption of new technology. In this process, the centers are forced to consider several sources of decisions, even within the household, and certainly within the regional or national economy.

The centers' experience with user-oriented research falls into three categories, organized by level of the units of observation: the farm, the household, and the region or nation. These three categories are complementary and not mutually exclusive. At the first level, the unit of observation is the farm, i.e., land plus livestock, taken as one management unit. It involves on-farm research and varying levels of complexity of component or commodity research. This type of research provides information on constraints and priorities directly linked to the

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production process. It identifies the head of household, usually the elder man, as the decision-maker, and researchers interact with, and request information only from him. It may ignore any activity outside direct agricultural production and livestock that other members of the household may be involved in.

CIMMYT reports how using "the on-farm research procedures (it) developed obligates the researcher to take the user's perspective....the design of an experimental program, and the development of relevant technologies, depends on close communication between scientist and farmer. If women play an important role in the production process, then they will be included in the activities of the on-farm research program."(p.19). CIP points out, however, that research at this level "has tended to ignore most of the important activities after harvest when women play important roles"(p.29).

Shifting the analysis to the second level--the household rather than the farm--is clearly identified by CIP and CIAT as having led these centers to a more systematic integration of the users' perspective into their research priorities and approaches. At this second level of analysis, production of a given commodity is placed in the broader context of the household as a complex management unit. This perspective includes activities and decisions before and after actual production of a crop. It recognizes that individuals who are directly or indirectly involved in a farm have different rights and responsibilities, and that these individuals may influence actual cropping and production decisions, even if they are not actually working in the fields. CIP calls this approach the Food Systems Perspective and makes it the basis for its new thrust, which "will focus on obtaining information on priority problems and client needs in production, marketing, and utilization of potatoes in developing countries' food systems."(Annual Report 1983, p. 118). CIP reports that by "broaden(ing) the relevant themes in agricultural research, ... by including areas beyond field production, such as storage, processing, gardening, and marketing, the role of women and their technological needs become more relevant" (p.32). IITA and IFPRI also emphasize the importance of looking at the household complex and at its many tasks, from production to consumption.

Most of the centers also address a third level of analysis, where the unit of observation is broadened to the regional or national economy. This third level includes the policies that influence production, marketing, and industrial potentials, as well as factors that influence consumption preferences in rural and urban areas. Relevant policies can be very diverse, involving possibly pricing mechanisms, subsidies, marketing and import-export regulations, and availability of credit and support services. Factors influencing consumers' preferences may include questions of taste and tradition, and also relative prices, storage quality, and processing and cooking characteristics. These policies indirectly determine the likelihood of adoption of improved technologies or practices, because they influence the relative rate of return to particular commodities and their marketing opportunities, and so are taken into account by the producers when selecting cropping patterns and farming practices for each crop season.

How far an international center goes into this third level depends upon its mandate. As expected, the two centers with a non-commodity mandate, IFPRI and ISNAR, are also the two centers most active in analyses at this level. IFPRI is by definition the center most involved in "the analysis of national and international policies that influence food production, consumption, and trade." (p. 59). IFPRI studies cover a broad range of topics, which are "grouped into three component parts: i) the technology adoption process; ii) the effects of technological change on households and the distribution of impacts; and iii) the intra-household decision-making process in resource allocation."(p. 62). IFPRI includes laborers and consumers among users, and traces interactions between categories of users as well as "the differential impact of technology on various types of producers and consumers."(p. 75).

ISNAR's reviews of an agricultural research system consider national priorities and policies as well as existing farming systems. In its methodological guidelines, ISNAR specifies that the scope of work for these reviews should include a section on "the country setting" as well as sections on "contribution of research to development" and "linkages between research-extension-users". How research objectives are selected, and whether they seem appropriate to users' needs, is also reviewed. ISNAR is now developing methodological guidelines for the review of the agricultural technology management system in a country, that is, the broad array of organizations involved in technology generation and diffusion, and the policy context in which they function. The purpose of these guidelines is to help identify with minimal fieldwork those elements, whether within or outside a research organization, which determine the likelihood of adoption of the technology generated.

The commodity-oriented centers are also involved in some activities at this more general third level, usually through concern with consumption preferences and nutritional aspects of their commodity. IRRI, ICRISAT, CIMMYT, CIP, CIAT, and ICARDA are particularily active on this topic. IRRI, for example, analyzes how its success in increasing production led to economic changes (falling prices and increased demand for better quality grain) which in turn led IRRI to shift some of its research activities to place greater emphasis on grain quality for irrigated rice (p.127).

The centers report that work at any or all of the three levels of analysis discussed in this first section (farm, household, region/ country) has two related consequences: (1) user-oriented research at any level requires data beyond those directly linked to biological production of a specific commodity; and (2) user-oriented research involves multidisciplinary teams, giving an important role to the social sciences in helping identify, develop, test, and evaluate improved technologies. I will discuss these two consequences in turn.

II. DATA REQUIREMENTS OF USER-ORIENTED RESEARCH

ILCA, IITA, ISNAR, and CIAT are particularly forceful in calling attention to the insufficiencies of available data, especially at the household level of analysis. This is particularly true of data on

individual responsibilities and obligations within the household, and on the way in which the ultimate decisions regarding cropping patterns and selection of practices and technologies are made at the farm level. Women's role in decision-making and production is often underestimated because of inadequate data, especially in Latin America and possibly in Africa. The problem has two causes, one conceptual, one operational.

Conceptually, the identification of the farm as the unit of observation is a problem because it artificially isolates crop and livestock decisions and activities from other productive and social activities. Operationally, it leads to gathering information from "the farmer," typically the man with social authority over the household. The sample interviewed is often biased in two ways: the head of household may not be fully informed of actual activities and priorities of individual members of his household, and he may distort facts to emphasize his control and authority over household affairs.

The data problems are particularly evident when it comes to activities and decisions of the women members of the household, because in many regions women have specific rights and obligations regarding production, and also have off-farm activities and income. In West Africa, women are typically free to cultivate individual fields outside the household fields (on which they must work but without controlling the use of the production). The product of individual fields is used in part to supplement feeding of the woman's children, and to be sold for personal income, without fully informing the head of household. Other sources of income for the women, such as processing and trade of agricultural products or crafts, are also kept apart from the household income. The same problem of grossly incorrect information on women's involvement in production or related activities is reported for Latin America, partly because of a rigid definition of household labor in statistical surveys.

Yet women's activities influence cropping and farming practices on household fields in at least two ways: first, they influence the amount of labor available for those fields, and second, processing qualities and marketing opportunities influence decisions on cropping patterns and choice of seed varieties, <u>even if these decisions are apparently made by the head of household alone</u>. This fact explains in part why some centers were led to a more coherent integration of the users' needs into their research activities when they broadened the scope of their observations. They were brought to break down the final decision into its original components and therefore became more aware of its complexity.

At the regional or national level of analysis, data on policy and economic structure of the country and data on the needs, potentials, and preferences of traders, processors, and consumers will all be necessary to establish priorities for research. Several centers stress the lack of readily available data on the basis of which research organizations could set their priorities and specify research objectives in line with national needs and goals. This need for information outside the strictly agronomic sphere requires the involvement of many disciplines outside the biological and physical sciences, with a number of consequences for staffing and organizational structure.

III. THE ROLE OF THE SOCIAL SCIENCES IN THE IARCs

All of the centers illustrate the important role of the social sciences at every step of research programming, implementation, and evaluation. While social scientists are present in all centers, their place and role vary, although most are involved in a cropping or farming systems program. This raises important questions on staffing patterns and for the organizational structure of the IARC and of national organizations, since most centers emphasize the importance of facilitating cooperation and coordination between the social scientists and their colleagues throughout the research process, including identification of promising research topics. CIAT states that the abolition of its economics unit and the dispersion of economists into each commodity team was a positive step, which led "economists to become involved in managing on-farm trials with economic evaluation of technology. The team approach appears to have stimulated economists to focus their research on very specific objectives relevant to the team effort, and this has maximized their influence and input to their respective teams" (notes to CIAT paper, p.1). CIP's Food Systems Research Thrust "crosscuts the nine technical thrusts in order to guarantee interdisciplinary exchange" (p.29).

However, an organizational structure in which social scientists are concentrated in one department does not necessarily prevent these scientists from contributing to the selection of research topics. ICRISAT, IRRI, CIMMYT, and IITA all have separate economics or social sciences divisions; yet all emphasize their interdisciplinary approach to research programs. ICRISAT is particularily explicit in describing how its village-level studies influence program decisions.

ISNAR raises the issue of administrative structure in its work with national research organizations, which are frequently weak in the social sciences, and where a sensitization campaign is often necessary to make policy-makers and researchers alike more aware of the importance of user-oriented research and of the potential role of social scientists. The question of the structural place of the social sciences in research organizations is quickly raised, because social scientists in some countries are likely to be concentrated in the universities, while biological and physical scientists are affiliated with the Ministry of Agriculture or a parastatal research organization. The problem may be compounded when an interdisciplinary team of outside consultants is involved in research with a farming systems perspective. Administrative traditions may make it difficult for a national organization to adopt the approach used in donor-funded projects, which are not always well integrated into the national organization. The very existence of these projects may tend to reinforce the isolation of social scientists from the mainstream of decisions related to research.

IV. THE RELATIONSHIP BETWEEN IARCs AND NATIONAL RESEARCH.

The division of labor and relative places of international and national centers is discussed by every center, which all state the national organizations as their primary client. Several centers also state as their client the beneficiaries of technology, or very explicitly, producers <u>and</u> consumers (e.g., CIAT, ICARDA, IFPRI).

However, some centers warn that the IARCs should not be too narrowly focussed in their research programs, nor should they be too location specific. These centers emphasize that specificity is the responsibility of national research, while the international centers, in ICRISAT's terms, should "develop technologies with broad tolerance windows" (p. 48). Yet, after the rapid increase in production resulting from the Green Revolution, international research is now faced with developing technology tailored to less optimal, more location-specific conditions. IRRI, for example, shifted some of its activities to non-irrigated rice because of "a growing realization....that the new technology had reached one out of four farmers in Asia" (p.126).

Four roles are mentioned for the IARCs in their relationship with the national research organizations:

a. sensitization of policy-makers and researchers to the importance of including user considerations in priority setting and programming for research;

b. information to policy-makers on potential technologies and on the importance of appropriate policies that encourage adoption of research results;

c. development of methodologies for survey work, and for testing and validation of research, that take user considerations into account;

d. training of researchers in the use of these methodologies , and in programming user-oriented research.

All of the centers emphasize the importance of incorporating user-oriented considerations into research priorities and programs for both international and national organizations. The IARCs are seen as playing a role of sensitization with national researchers and policy-makers on this topic, in ILRAD's terms, to "encourage, but not replace site-specific national-level efforts aimed at fully incorporating the users' perspectives" (p.119). ISNAR, no doubt because its mandate puts it in constant interaction with national leaders, is particularily emphatic on this role, but CIMMYT, ICARDA, and others also mention it as important and necessary.

The centers elaborate on the role that the IARCs should play to make policy-makers in the LDCs more aware of the potential of agricultural technology, and of the conditions necessary for the technology to be used successfully. On the matter of policies related to the implementation of research or to the adoption of existing technology, the centers all emphasize the role of national research leaders in informing policy-makers on the likelihood of adoption, with ILCA emphasizing that "when policy constraints are a limiting factor in adoption, national agencies are in an advantageous position to encourage policy changes" (p.108).

IFPRI examines the effectiveness of specific policy options for their impact on production and on different categories of users, particularly their differential income impact. IFPRI, which diffuses its studies broadly to national, international, and donor agencies, mentions several

cases of government or donor decisions reflecting its findings. Both IITA and IFPRI emphasize the importance of making data and findings broadly known and available, and IITA is now building up a reference collection of user-oriented literature.

The centers which most emphasize the need for appropriate data and for on-farm activities usually consider that the IARCs have a pioneer role to play in the development of methodologies for data collection and analyses that take user considerations and research requirements into account. These centers also see an important role in defining either appropriate recommendation domains in a region, or more generally in defining how recommendation domains can best be identified and which variables need be taken into account, for the use of both international and national research organizations.

Finally, most centers are very explicit in the importance they place on training of national researchers and research leaders, going beyond the strict transfer of skills to emphasize awareness of user diversity and circumstances, and the understanding of how research design should incorporate user and policy information. Training in on-farm or farming systems research is emphasized as an important responsibility of the centers. Training activities are very diverse and include, in addition to the usual courses and seminars at headquarters, a diversity of in-country courses, collaborative activities, and informal contacts. Several centers also mention the useful role of regional and topical networks, which facilitate exchanges and discussions between national and international researchers. Some centers highlight the importance for the IARCs of having direct training contacts with farmers (IRRI), with female researchers and female extension agents (CIP, ILCA), and with home economics graduates (IITA).

V. QUESTIONS FOR DISCUSSION

I will not end this presentation with recommendations. Dr. Swaminathan will do so this afternoon. Instead, I will present five questions which, in my opinion, arise from the centers' papers and need further discussion.

1. <u>What is the optimal package of relevant factors to take into consideration when establishing research needs, priorities, and objectives?</u> This could well be discussed at the three levels presented at the beginning of this paper: farm, household, and region/country. It is not yet a discussion of which producers may or may not adopt a given technology, but an effort to ascertain what current conditions and practices are found in a country or region. The answer to this question is a complex blend of information on physical, political, social, historical, and economic factors, specifying which factors cannot be changed and which could eventually be modified to increase the likelihood of adoption. Here the main danger is to feel obliged to know everything. An optimal package of factors includes only those which are absolutely necessary to making the right decision.

   The other side of the problem is to appreciate the differential impact of new technology ahead of time, so that potentially negative

effects on part of the population can be identified while measures can still be taken to alleviate them. This goes beyond agricultural research, but research leaders need to bring the likely contribution of research to development to the attention of policy-makers.

2. How can national and international organizations best cooperate on matters related to understanding and integrating the users' perspective? The centers cite four roles for the IARCs: sensitization, information, methodology, training. Are the current approaches to collaborative and other activities between IARCs and national organizations filling these four roles? What would be the optimal approaches, given the IARCs' resources and mandates?

3. How can categories of users best be defined? How detailed and specific need the definitions be? Which variables are necessary and sufficient to define a user category? Does a recommendation domain always coincide with one individual category of technology users? IRRI points out that "modern (rice) varieties and fertilizer were widely adopted within irrigated and favorable rainfed environments. Adoption did not vary by size of farm or tenancy status...the benefits were fairly broadly distributed among landowners, operators, and landless workers"(p. 126). CIMMYT defines a recommendation domain as a "group of farmers whose natural and socio-economic circumstances are similar enough so that they are eligible for the same recommendations" (p. 16). ICARDA begins with ecological and agronomic zoning, then refines it for economic and management factors. Yet in areas of extreme soil diversity, a farm will typically include fields in different ecological zones. Selecting those factors which are likely to be relevant to adoption of a certain type of change, and therefore need to be included in the definition of user categories and of recommendation domains, is a key step in research, and one in which social scientists have much to offer.

4. Can women form either an appropriate recommendation domain or a user category? The three regional papers included in the background document and presented during yesterday's panel demonstrate the important role women play in agricultural production and, through various means, their influence on and participation in decision-making that influences technology adoption. Here I will discuss the place of gender in the definition of a user category or recommendation domain. First, one should be careful not to mix up a variable (gender) and a category (a group which can be treated as uniform). Even within a given culture, women are unlikely to form one uniform category in regard to agricultural technology. In a village, there are more differences than commonalities between the working day of the wife of the headman and that of the widow of a landless laborer. However, the variable gender does influence access to resources as well as rights and obligations towards the household; so it is relevant to problem identification and testing of potential solutions. ISNAR gives a clear example from Malawi, where male out-migration is very heavy; the main category of producers happens to share the variable of female gender. In the more usual division of labor by gender, either by tasks, by commodities, or a combination

of both, the question arises of how much (and how) gender may be a necessary part of the definition of recommendation domains.

It seems to me that the key issue is to obtain valid data and a correct analysis of a given situation, always placing production in its broad micro and macro-economic and social context. Once a problem and its parameters have been correctly identified, then appropriate technology can be generated without necessarily being keyed to a specific category of users.

5. Does an increased user orientation require changes in research staffing? The important role of social scientists is very clear from the centers' papers, and this group will probably want to discuss means of making it even more so. Here I wish to discuss the assumption found in several papers that female scientists are required for "women-oriented" research. I think this audience should be very careful to differentiate between designing and coordinating a research program, and gathering the data necessary for the program.

   It is very true that in all cultures, the gender of the interviewer may influence the answer of the interviewee, and that it may be improper or very distorting for a male visitor to talk with a woman. There is no question that to gather valid data on intra-household decisions and division of labor, or to train female farmers in the use of a technology, some female field staff will usually be necessary. It does not follow that only a female scientist can design and coordinate the research program. Any knowledgable and competent scientist can design an appropriate program as long as he or she is correctly informed of the situation. While first awareness of the role of women in production decisions may have come from female researchers, as reported by CIP, this may well be due to those scientists' discipline (anthropologists and sociologists) and their knowledge of rural conditions, rather than to gender. ISNAR points out that Thailand has a high percentage of female staff (34%) but that the majority are concentrated in Bangkok and are even less willing than their male colleagues to be posted out of the capital. A full use of what social scientists can offer matters more than an artificial search for female staff.

For each of these sets of questions we find the same key points: awareness of the diversity and complexity among users, and correct information on their situation. The first half of this seminar aimed at raising awareness among senior policy-makers in the CGIAR on both the relevance of the users' perspective and the particular characteristics of female users of technology. It also brought together for the first time much information on the past experience of the centers with these topics. But to be truly worthwhile, the seminar should lead to an agreement among the participants on desirable changes or initiatives in center activities. This is why, this afternoon, Dr. Swaminathan will present some concrete recommendations for your consideration, and why the remaining time in the seminar will be allocated to plenary and small-group discussions.

Proposed Recommendations for Discussion

M.S. Swaminathan
International Rice Research Institute

I. INTRODUCTION

Some historians of agriculture believe that it was women who first domesticated crop plants and thereby initiated the art and science of farming. While men went out hunting in search of food, women started gathering seeds from the native flora and began cultivating those of interest from the point of view of food, feed, fodder, fiber, and fuel. This view is strengthened by the fact that women have been traditionally seed selectors. Even today, this tradition has continued in many parts of the developing world, as for example, in Ifugao rice culture in the Philippines.

In addition to working as farm managers and farm labor, women shoulder the responsibility of rearing children and looking after the home. Thus, the triple burden of child rearing, farm work, and household duties has fallen on them since the time the domestication of crop plants took place about 12,000 years ago.

The role of women in agriculture has changed dramatically in developed countries after the advent of science and technology in farming practices and concurrent growth in the industrial and service sectors. In such countries, this has usually led to (a) reduction of drudgery, (b) improved productivity, (c) enhanced income, and (d) diversified and flexible opportunities for productive and remunerative employment in both rural and urban areas. In most developed countries, mechanized agriculture is operated and managed by a small number of men; very few women remain in the agricultural sector, except in food-processing industries and backyard livestock and vegetable production. Japan is a unique exception. Women there account for just over 60% of the total agricultural labor force and provide about 40% of labor in rice cultivation. They operate and maintain farm machinery and play important roles in farm decision-making. Thus, diversification of income-earning opportunities rather than unemployment has been the result of modernization of agriculture in developed countries.

In contrast, the experience of developing countries has been uneven. Modernization of agriculture has provided women with better income-earning opportunities in some areas but has displaced them from their traditional roles in others. The latter is particularly serious when job destruction is not accompanied by job creation in other activities, either within a diversified agricultural sector or in non-farm employment.

Such a negative impact on employment could cause much distress, particularly to families where the total family income is small and hence

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needs to be supplemented by the earnings of both husband and wife. Lack of employment opportunites for women belonging to families with few or no assets - either land and/or livestock - leads to malnutrition and undernutrition among children and women who suffer most from inadequate purchasing power of the family. In many developing countries, the female child suffers particular discriminiation, resulting in imbalances in the male-female population ratio. Therefore, there are strong linkages between the welfare of an entire family and the ability of women to enhance total family income.

Another aspect of this problem relates to technologies for tasks carried out or managed by women. In many countries, and particularly in Africa, East and Southeast Asia, women play major roles in farm and financial management. Moreover, many of their agricultural roles require considerable skills, for example, in seed selection, storage, and pre-germination testing, organic recycling, and the identification and control of pests, pathogens, and weeds. Nonetheless, many of the jobs undertaken in rural areas by women involve much drudgery and result in little income. As men's decision-making roles are more publicly visible, government policies, scientists, and manufacturers of agricultural machinery have generally tended to neglect women's technology needs. Women have also been generally bypassed by extension services. Their numbers in scientific and extension services are generally small. Consequently, they continue to remain as unskilled workers with uncertain income.

The challenge hence lies in integrating brain (technology), brawn (physical work), and bank (credit and other resources) in a mutually supportive manner so that both men and women can all play an active role in improving the productivity, profitability, stability, and sustainability of major farming systems. For achieving this goal, IARCs will have to examine their research and training programs in the context of the users' perspective.

II. RESEARCH AND TRAINING NEEDS

The following three aspects merit careful consideration:

1. Impact of new technologies on women-specific occupations

A careful study of the impact of new technologies should be undertaken in selected farming areas, taking the family as a unit. Families with assets (land and/or livestock) and without assets (landless labor dependent entirely on wage earnings) should be considered separately for measuring the impact of new technologies. Within the family, the impact on women with reference to both employment and income should be studied separately so that household data can be disaggregated for analyzing the impact of new technologies on women. The impact should be measured in terms of the additional jobs created and the jobs made redundant and thus lost following the introduction of new technologies, both at the production and post-harvest phases of major farming systems.

2. Technologies for women

There is need for compiling an inventory of opportunities opened up by new technologies for women belonging to (a) farming families and (b) landless labor families. What are the precise suggestions of scientists with regard to the technologies available for women and particulary for those seeking wage employment? A catalog of the opportunities, either present or potential, both at the production and post-harvest phases, should be prepared. It will be useful if scientists could indicate whether the technologies developed by them for reducing drudgery and increasing the energy input-output efficiency ratio could lead to a diversification of labor use and income or only to the displacement of women wage laborers from their traditional occupations. Since women will benefit greatly if there is flexibility in the timing, duration, and place of work, there is particular need for examining what efforts, if any, have been made by scientific institutions to introduce flexibility in time and place in jobs for women. Such inventories should be part of an ongoing dialogue between scientists and users so that research priorities reflect users' needs.

3. Women in technology development and transfer

Based on an inventory of opportunities for new avenues of employment opened up by science and technology, there is need to review methods of promoting the greater involvement of women, both in technology development and transfer. Existing opportunities for training will have to be carefully reviewed and appropriately modified and expanded. In particular, steps must be taken to provide women with managerial and organizational skills so that they themselves can operate new technologies such as those relating to biofertilizers, seed production, pest surveillance, biomass utilization, crop-livestock and crop-fish integrated production systems.

For gathering information on such issues, a questionnaire was circulated among all senior scientists, senior research fellows, and senior post-doctoral fellows in IRRI (Annexure A). A summary of the responses received is given in Annexure B. Examples of the studies in progress in othere IARCs are contained in the background document compiled by ISNAR. These papers give an excellent glimpse of the perception of the problem by different centers and the responses of biological and social scientists to the challenge of integrating efficiency and equity in technology development and transfer.

III. NATURE OF TECHNOLOGIES DEVELOPED BY CENTERS

The technologies generated by IARCs are not developed in isolation. They are invariably developed with the full and active participation, advice, and assistance of national agricultural research systems (NARS). The research programs of centers have both a short- and long-term time perspective. In the short term, the aim is to bridge the gap between current production and actual need for basic staples and thereby ensure the availability of food for all at reasonable prices. In the long term, the aim is to promote sustained agricultural advance coupled with economic benefits to all, regardless of gender or social status. Some

success in the first objective has been achieved in most countries of Asia and Latin America, as per capita food grain production has increased during the past 15 years. It is therefore time to look more deeply into questions of equity as judged by the relative benefits which flow to men and women, whether farmers, farm labor, or consumers. What should centers do in this regard?

There is no simple or single answer to this question. The role of women, both as users and beneficiaries of new technologies, varies widely and is influenced greatly by religious, cultural, economic, and ecological factors. Therefore, a simple prescription with regard to the policies IARCs should adopt will be both irrelevant and unproductive. There are, however, three broad areas of activity in which the CGIAR system as a whole and individual centers in particular can make a significant contribution. These are:

A. sensitization;
B. studies and surveys;
C. scientific strategies and programs.

IV. SPECIFIC RECOMMENDATIONS

A. Sensitization

"Knowledge leads to unity; ignorance to diversity." Where there is no awareness, it is futile to expect action. Hence, the first step is to arouse human consciousness of the existence of the problem.

The papers submitted to this conference clearly indicate that a great deal of information about women already exists. It is equally clear that such information needs to be more closely related to technology development and transfer. There is need to take a specific look at the implications of technologies under development for women managers and laborers. High-yielding varieties are clearly labor-using, but we do not know how different components of such technologies affect employment. For example, many labor-displacing technologies, though designed to relieve seasonal bottlenecks, may result in an increase of total annual employment. Similarly, we know that women play a major role as farm managers, but we do not know enough about what this means for technology development and adoption. Hence, issues relating to both research coverage and impact in terms of gender need careful study. A starting point for stimulating thought action and for strengthening the users' perspective in research policy making is an organized effort in sensitizing research policy makers and funding organizations, both at the international and national levels, to such issues.

Within the CGIAR, steps to promote sensitization of all concerned could include the introduction of this item on the agenda for the Centers Week presentations and discussions every year, the incorporation of equity issues in the development of research priorities and strategies by TAC, and the introduction of this item in IARC annual reports and in terms of references to the quinquennial review missions of centers. While these steps can help to sensitize the higher-level policy makers and research managers, they by themselves will not be adequate to generate the

necessary motivation and appreciation at the working scientists' level. Therefore, each institute may develop an interdisciplinary and interdepartmental working group which could continuously analyze issues of this kind and reorient research strategies and priorities to the extent necessary to achieve the objective of the well-being of the family as a whole. The Program Committee of the Board of Trustees of each IARC could play a catalytic role in this process.

IARC research is a very small component of the total research effort in progress for improving Third World agriculture. Therefore, the total impact of sensitization of IARCs on users' needs will be little, unless NARS are similarly influenced. Fortunately, IARCs are in a favorable position to accomplish this objective, since they organize periodic seminars, conferences, and monitoring tours in addition to farming systems networks. All these mechanisms of interaction between scientists of NARS and IARCs should be fully utilized in the move for achieving a greater degree of understanding of the issues involved.

B. Studies and surveys

Once there is appreciation of the concerns, the need for collecting precise data and for gaining meaningful insights into the problems arises. A carefully designed malady-remedy analysis will be necessary for assessing alternatives and priorities in technology development and transfer. For this purpose, social science institutions need to be linked up with national and international agricultural research systems. Much work on women and other types of users takes place in universities or other research institutions outside of both NARS and CGIAR. The challenge before IARCs, therefore, is the development of effective networks with agricultural researchers and social scientists in LDCs, which can help to guide scientists, extension workers, and developmental administrators on methods of combining efficiency and equity in technology development and transfer.

There is a need to develop a problem-solving approach using multidisciplinary research teams and a variety of complementary research methods. The standard surveys should be supplemented with low-cost, rapid and imaginative ways of collecting reliable and relevant data. Some IARCs have already developed innovative procedures along these lines. There is also an urgent need for developing methods of studying the problems of men and women without assets (either land or livestock). A careful study followed by an objective analysis of the data collected is essential for rational decision-making by those engaged in the development and transfer of new technologies.

Suitable survey techniques will have to be developed which can help to reveal not only the consequences of new technologies on women-specific occupations but also the constraints responsible for the inadequate transfer of relevant technologies to women. Efforts of banking institutions in the identification of credit-worthy occupations for women need study and monitoring. Public policy issues, such as those relating to land and property ownership rights, credit supply, personnel policies of R&D institutions, need particular attention. Above all, it is necessary to study the organizational and institutional aspects of input delivery and producer-oriented marketing.

C. Scientific strategies and programs

Since IARCs are primarily technology development institutions, it is essential that each research institute carefully consider its research priorities and programs from the users' perspective. For this purpose, the following questions will have to be asked:

1. Will technologies under development result in a reduction in drudgery and improvement in productivity and income?

2. Will they be labor displacing or will they result in labor diversification?

3. Will they result in equal benefits to both men and women or will they have built-in seeds of sex discrimination?

4. Will they provide some flexibility in relation to timing, duration, and place of work?

5. Will they help to make unskilled labor become skilled?

6. What steps are necessary to ensure that women managers and labor will benefit from new technologies?

The IARC social scientists should work with biophysical scientists to determine:

- the package of technology most beneficial to users, taking account of gender-related differences in needs and constraints;

- the package of services including the delivery of knowledge, credit, and inputs with reference to their relevance and benefit to women users;

- the package of government policies in agrarian reform, rural development, credit, and marketing essential for conferring equal benefits on men and women farm managers and labor.

Unless socially sound technological packages are coupled with appropriate packages of services and government policies, the fruits of scientific work will not automatically accrue to women. Appropriate women's organizations will help both to promote attention on the special problems affecting women and to ensure the flow of benefits to them.

V. CONCLUSIONS

The scientific and social dimensions of this area of research are vast. In contrast, IARCs are now functioning at a near-zero growth rate in terms of both budget and senior staff positions. Hence, there will be a justifiable temptation to take a defensive position in matters relating to user orientation in research priorities and strategies and plead that whatever each center is now doing represents an adequate response. It is essential that IARCs avoid a laissez faire approach and move positively and aggressively in the direction of assisting women dependent upon

agriculture for their well being. This is particularly important in the context of the increasing emphasis placed by IARCs on attending to the problems of ecologically handicapped farming areas and economically disadvantaged farm families. It is precisely in such situations that the value of women's labor and income to household happiness and survival is immense.

How can IARCs help in generating greater opportunities for flexible and productive employment when most of them are not concerned with post-harvest technology and the off-farm employment sector?

An effective way of responding to this challenge is to capitalize upon IARCs' single most important asset, namely access to diverse scientific institutions and political systems. By the very nature of their functioning - through networks, cooperative programs, monitoring tours, symposia and conferences, and training activities - IARCs exert an influence on national research systems which far exceeds their budget or scientific capability and infrastructure. They have equal access to the knowledge and material pool in developed countries. They can hence lead a positive movement of helping women, particularly belonging to small farmer and landless agricultural labor families, through the organization of workshops which can help to compile a portfolio of research and training tasks for each major farming system and getting interested laboratories and scientists, both in developed and developing countries, to adopt specific tasks. In addition, they can set an example in involving women scientists to a greater extent in all aspects of technology development and dissemination.

While action on the above lines is feasible and should be taken, it is important to recognize that science is not a magic wand with which gender inequalities in workload and economic returns based on gender can be made to vanish. This should be emphasized clearly as, otherwise, false hopes will be aroused about the capacity of science and technology to remove deep-seated social maladies.

In the ultimate analysis, it is only the concern, commitment, and concerted action of national agricultural research systems and policy makers that can lead to meaningful results in imparting a user's perspective in research priorities and strategies. The major role of IARCs should be to trigger a self-propelling and self-replicating pattern of involvement of NARS in R&D efforts designed to give equal attention to the needs of men and women farmers and agricultural labor. Prospects of external funding should not be the main motivating factor for the participation of NARS in networks or studies in this field. There are numerous examples to show that involvement without conviction and commitment leads to the collapse of bilaterial or multilateral donor-aided programs when the external input is withdrawn. Enduring benefits will result only when a proper blend of political will, professional skill, and people's participation is achieved within each country.

Annexure A

INTERNATIONAL RICE RESEARCH INSTITUTE
INVENTORY OF TECHNOLOGIES FOR WOMEN IN RICE FARMING

1. Name of Scientist and Department.

2. (a) Technologies already developed
   Description of new technology and its relevance to the traditional occupations and skills of women employed in rice farming systems at the production phase and/or post-harvest phase. Please describe each item of new technology separately.

   (b) Technologies in the assembly line
   Potential impact of technologies currently under development by your group on women with regard to:
   i. drudgery reduction
   ii. income and employment generation; and
   iii. new opportunities for quality of life improvement.

3. What additional training programs and management and organizational skills will be needed for women to derive benefit for both already available and emerging technologies?

4. Please provide any other information which may be relevant to the goal of ensuring that the jobs destroyed by new technologies in the traditional sector are more than compensated by the jobs created by the modernization process, so that labor diversification and not labor displacement is the outcome of our research designed to enhance the productivity, profitability, stability, and sustainability of rice farming systems.

Signature

1.23.85
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Annexure B

INVENTORY OF TECHNOLOGIES FOR WOMEN IN RICE FARMING SYSTEMS*

A. TECHNOLOGIES ALREADY DEVELOPED

The following improved technologies are relevant to the traditional occupations and skills of women employed in rice farming systems at the production and/or post-harvest phases. They will generally need to be adapted to the specific physical, biotic and socio-economic conditions of different countries or different regions within countries. In some cultures these technologies could equally well be used by men or women: the important point is not to assume automatically that they are or should be used by men, for in many cases there are strong social reasons which suggest they could be utilized more effectively by women.

(1) Variety characteristics: Criteria for breeders and technology transfer programs.

Women often share or have complete responsibility for the selection and purchase of seeds, and for seed storage and pregermination tests. They are also involved in cultivation and do most of the drying and husking. Livestock, which are fed rice by-products, are often exclusively cared for by women. It is therefore important to consult women about criteria to be used in the breeding of new varieties and to involve women in programs for the transfer of improved varieties. Women's needs, skills, knowledge and views need to be taken into account with respect to:

- varietal characteristics, both desirable and undesirable;
- seed quality of new varieties, and methods of obtaining and ensuring good quality seed (e.g., selection of best panicles, storage on the panicle, row-sowing of seeds from each panicle separately to test the seed purity);
- varietal identification;
- interaction with weeds, insect pests and pest predators, and soil condition;
- tolerance to drought, floods, temperature extremes and low solar radiation;
- drying and storage characteristics of grain, and relation to milling recovery;

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*Compiled from a questionnaire sent to IRRI scientists on Technologies for Women in Rice Farming and from papers presented to the Orientation-cum-Training Program on Improving the Income and Employment Potential of Rice Farming Systems, IRRI, 21-30 January, 1985.

- quality of by-products (e.g., suitability of straw for animal feed, roofing, fuel requirements); and

- cooking and eating preferences.

(2) Seed production

It should be possible to involve women in seed production. Seeds of rice varieties are either not universally available, too expensive, of poor quality, or contain mixtures (or all of the above). Rice lends itself well for quick seed increase: multiplication factors of 500-1000 (grams seed harvested/grams seed transplanted) are possible.

The procedure would be similar to the final part of pedigree selection:

(a) Harvest 50 (or more) panicles, from different plants with desired characteristics.

(b) Keep panicles unthreshed and put on seedbed making sure to keep them apart from each other.

(c) Plant each panicle to one row of $\pm$ 5 plants.

(d) At maturing time, monitor the rows and reject those that are heterogenous, too tall, too short, too early, too late, or damaged by pest and diseases.

(e) Harvest panicles, go to (b).

(f) Harvest remaining seeds in bulk from those rows not rejected and use as seed supply.

This procedure could be tried in some of the sites where cropping systems/economics/sociology work has been carried out already. It could blend well with a scheme to make available small quantities of top grade breeder's seed.

(3) Soil fertility and fertilizer management

In areas where manure is commonly used, for example, in the hills in Nepal, it is generally made and carried up the hillside to the fields by women but it is usually incorporated by the men who do the ploughing. Under farmer conditions women tend to apply fertilizers less regularly than men. However in some countries, particularly in the Philippines and other Southeast Asian countries, women have considerable influence in decisions about the purchase of inputs such as fertilizers and pesticides. Women's knowledge and skills therefore need improving with respect to:

(a) Diagnosis of soil deficiencies

- to recognize common nutritional disorders of rice such as nitrogen, phosphorous and zinc deficiencies, by crop observation and the use of soil testing kits;

- to assess the fertilizer requirements needed to correct such deficiencies;

- to determine the most suitable source of these nutrients (various types of chemical or organic fertilizers, used alone or in combination; rotations with legumes, green manure crops or fallow; fish deposits) taking account of relative costs and returns, technical efficiency, availability of nutrients and the availability of labor and special skills needed for fertilizer application; and

- to improve fertilizer placement and management, and to increase the use of home-produced inputs in order to maximize profit while minimizing expenditure.

(b) Chemical fertilizers

Women are already involved to a fairly limited extent in the following applications of fertilizers, which could be extended:

- deep placement by hand of nitrogen fertilizer simultaneously with transplanting. Since this minimizes the rate of nitrogen application by as much as 50%, this can be economic in labor surplus areas;

- applying zinc to the seedbeds, dipping seedlings in zinc oxide suspension before transplanting, or applying zinc sulphate on the fields. The latter two methods are less effective and require more labor;

- general application of fertilizers on seedbeds or in the fields. Women would benefit from training in methods of application (timing, quantities, water levels, methods, etc.).

(c) Organic fertilizers

(i) Straw

Women (and men) could:

- spread straw on the land for later incorporation, instead of burning it (providing it harbors no residual pest and disease).

(ii) Compost and farmyard manure (FYM)

In countries where compost and FYM are already commonly used and where chemical fertilizers are expensive or not readily available:

- technology development and transfer programs are needed to improve women's knowledge of and skills in the production processes, handling, storage and use of compost and FYM;

- sex-related constraints in the efficient use of these organic fertilizers needed to be identified. For example,

- in Nepal women carry FYM up to the hill fields over a period of 2-4 weeks (due to labor bottlenecks and a desire to spread this very hard work over time) while the men later incorporate it when ploughing. The manure remains in piles in the fields for this period, and suffers nutrient loss. The use of women's reciprocal labor groups for carrying the manure on the day the field is to be ploughed could be a possible solution worth experimentation.

(iii) Azolla

Azolla production could provide new employment opportunities for women. Its labor-intensive processes include: maintenance, multiplication, harvesting, transporting (from multiplication place to the farm), inoculation and incorporation. Except for incorporation, all other processes can be performed by women. Since maintenance and multiplication of azolla need a lot of care and patience, women can probably do it better. Azolla technology considerably reduces the weed problem but the alternative employment created will compensate for labor displaced from weeding.

Related points are:

- training will be needed, especially for maintenance, multiplication and incorporation of azolla; and

- Azolla nurseries will be needed to ensure a continuous supply of azolla starter. Given sufficient demand for azolla as fertilizer and as feeds, a commercial starter market could develop.

(d) Green manure

The green manuring technology provides more opportunities of work for women (and men) by intensifying the cropping systems in both time and space dimensions, thus exploiting the atmospheric N for economizing fertilizer N through green manures and/or dual purpose short duration legume crops like mungbean and cowpea for grains and green manure.

(4) Raising of seedlings

Women could also be trained to raise seedlings for sale for use with mechanical transplanters. These machines require younger and shorter seedlings of uniform height. Special attention is needed to produce good quality seedlings for these machines. This would be an appropriate activity for women since it would require regular but limited hours each day for a few weeks each season and could be done on the fields nearest to the homestead. Groups of functionally landless women could rent or acquire small areas of land for this income-generating activity.

(5) Integrated Pest Management (IPM)

A number of women's farming activities particularly qualify them to play an important role in IPM: women often select, purchase and store seed;

monitor and report pests and disease while weeding; take part in decisions on purchase of pesticides, crop rotations that break pest and disease build-up, etc. Depending on the cultures, women could be involved in the following IPM technology development and transfer programs:

(a) Monitoring of pests and diseases

This requires regular field monitoring visits. Women are better placed than men to do this since they are present in the fields for extended periods for weeding. It may be necessary for women (or men) to make additional weekly visits for monitoring in between the weeding operations. This will especially be the case in irrigated areas where each weeding is often done within a few days, with hired labor supplementing family labor.

Women will require training in:

- sampling and identification of pests and diseases, their patterns of build-up and the types of damage inflicted. Where local names for common pests and diseases are not in general use, suitable names should be coined and popularized through extension and training programs.

- the diagnosis of tungro disease in ratoon, volunteer and other rice stands outside the normal cropping season. This test, which provides early warning information, is being introduced to men and women farmers and technicians by FAO. It requires iodine, which is usually easily available, and is carried out before land preparation when labor is available.

(b) Pest management practices

Women (and men) will require training to improve their knowledge of and skills in:

- different pest and disease management practices, including the use of seed resistant varieties, crop rotations, synchronous planting within a region, chemical and biological pesticides;

- the relative effectiveness and costs of these different practices, including labor implications and side benefits or hazards;

- the assessment of economic thresholds for selecting between alternative or complementary methods of control; this would be in the context of improved monitoring of farm expenses and computation of farm income. (In countries such as the Philippines where women have financial control, it is crucial that women should be informed of the economic and technical viability of IPM methods.);

- how to apply chemical and/or biological pesticides. The weight of the sprayer is sometimes put forward as an excuse for training only men, despite the fact that the women usually have to fetch the water for the sprayers! Ultra-low sprayers can be easily handled by women;

- safety in pesticide use, transport, handling, storage and disposal. Women are more concerned and responsive to safety training than men, especially when children are at risk.

(c) Biological pesticides

Important opportunities exist for involving women in the development and transfer of plant derivatives such as neem seed oil, cake and crude extracts for pest control. Ripe neem fruits are collected, depulped and processed by women and children in India. Simple processing technology is already in use and has no harmful side-effects.

Greatly expanded production by women of neem oil and cake for crop protection and dried neem leaves for protecting stored grain from insect attack and spoilage could be an important seasonal activity, particularly as a means of supplementing the income of landless women and their families. Women farmers could also be taught how to use neem products for pest control in the field and in storage.

(6) Integrated weed management

Given women's predominant role in weeding, applied research on weed problems will require on-farm trials involving women. The technical aspects of this work will not be affected by sex-related factors. However, the implementation of appropriate weed control practices will be affected by women's knowledge of and skills in:

- the identification of weeds and their interactions with water levels, soil moisture, soil type, land preparation, planting dates, other crops in rotation with rice; (i.e., to identify the weeds' habitat: where they are and why);

- the technical effectiveness and cost of herbicides, used in conjunction with manual uprooting at the second weeding;

- the opportunity cost of women's labor, affecting the choice of different methods of weed control e.g., herbicides; manual weeding; line seeding (by drills or transplanters) to facilitate weeding; appropriate water levels; azolla production or dense transplanting, to suppress weed growth; and additional crops in the rotation to break the build-up of rice-specific weeds;

- women's preferences for alternative crops in the rotation, taking into account nutritional needs, and eating and cooking habits; and

- the development of improved tools, such as the rotary weeder, which are suitable for women's physique;

- correct choice and use of herbicides. For example, granular herbicide, which is recommended for transplanted rice under conditions of good water control, can be easily broadcast by women or men. For upland rice, several lighter-weight applicators including birky and micronherbi are being tested at IRRI. These require considerably less water than other applicators and could be handled by women.

(7) Water management

(a) Increasing attention is being given to improving farmers' participation in water allocation and distribution, irrespective of sex. However, in practice, farmers' water management associations often have no or few women members, even in areas where women are landowners and/or play important roles in the cultivation and management of rice farms.

Senior administrative and training staff of irrigation schemes should play a major role in ensuring that women are (i) appointed to farmers' irrigation associations, and (ii) are given the technical, managerial and leadership training needed to overcome social prejudice against women and to ensure that they are treated with respect and as equals by men farmers and junior extension staff. Separate training courses for women should not be necessary.

(b) Few data are available on women's roles in the distribution and delivery of water and the maintenance of canals and bunds, and the technologies they use for these tasks. It is likely that extension workers have largely addressed themselves to men and some women-specific needs and problems have been overlooked.

(8) Drying

The following technique could solve some of the difficult problems facing women in drying grain in unreliable weather:

- salvaging rice from submergence and wetting in rains and cyclones by immersing wet panicles in 5% NaCl solution. This inhibits sprouting, discoloration, mould development and spoilage;

- when drying rice sheaves, covering the panicles with the straw of the succeeding bundles in an overlapping manner to protect the grain from direct solar radiation, dew, mist, and drizzle;

- practising synchronous planting and harvesting and using uniform plant population densities to ensure more even drying in the field.

(9) Agricultural machinery

A number of machines have been developed at IRRI and in other countries to increase efficiency, lower costs and reduce drudgery. They are popular among male farmers. However, they are not so often used by women farmers, partly for social and institutional reasons, and partly because they are too heavy to be operated easily by women. Testing programs are needed to assess their suitability for operation by women and, where necessary, to make appropriate design changes. Social and institutional constraints to women's use of agricultural machinery require investigation and feasible solutions. Technology transfer programs should give special training to women in the operation, maintenance and simple repairs of the equipment.

Specific examples of technologies are:

(a) For production

- manual transplanters, row seeders, row weeders (generally too heavy for women who need a higher design);

- ultra-low sprayers (suitable for use by women);

- Tapak-tapak pump (probably suitable for use by women; it could open up opportunities for women's dry season vegetable production in rice fields or at the homestead); and

- reapers and threshers (the IRRI axial-flow thresher has increased the use of female labor in harvesting-threshing activities in the Philippines. The traditional manual threshing methods were too demanding on their physical strength).

(b) For domestic work

- rice husk fuelled stoves for cooking and parboiling;

- charcoal production from straw and husk; and

- biogas cooking stoves.

(10) Extension

Extension services should:

- upgrade the skills of extension workers in these improved technologies for women;

- expand recruitment of female extension agents;

- depending on the appropriateness for specific cultures, train male and female extension staff to work with both men and women farmers and compare their relative effectiveness in this;

- improve women's awareness of new production and post-harvest technologies;

- set up village-based training courses with men and women farmers, involving practical field work;

- train women in accounting, book-keeping, and management skills;

- help organize farmers and irrigation authorities where communal action is required. For example, introducing pest control measures such as synchronous planting or a rice-free cropping season; and

- develop a two-way dialogue between extension personnel and farmers. Women (and men) farmers need encouragement and "training" to extract or demand the information they need from the extension staff.

B. TECHNOLOGIES IN THE ASSEMBLY LINE

The following technologies which are now being developed could provide new opportunities for increasing women's employment and income, and reducing their drudgery.

(1) Restructuring of puddled and upland soil

Land preparation is commonly a male activity in Asia (particularly when animal or tractor ploughs are used). However, women also play important roles in ploughing, levelling or breaking clods of earth in some areas, especially in the hills of Nepal, India, Bangladesh, Thailand, and the outer islands of Indonesia.

Methods are being developed for:

- restructuring puddled and upland soils to reduce turnaround time and increase the productivity of upland crops following rainfed lowland and upland rice. If this leads to the cultivation of additional crops after rice, new employment and income earning opportunities will be created for women; and

- reducing inputs of energy (and water) to the puddling process. This would lead to some reduction in the puddling work, though a possible increase in bund building. More efficient conservation of impounded water may give increased opportunities for fish-rice systems, in which women could manage the fish culture.

(2) Rice hull or husk

- as an energy source in parboiling, grain drying, charcoal production;
- for animal feed, after fortification;
- as a source of cement (use of rice hull ash for solid and hollow blocks); and
- for making bricks.

These products could be made by men or women for household consumption or for sale. Small processing plants could also be established on a village-basis (run by men's and/or women's organizations) to take advantage of economies of scale.

More sophisticated plants, centered on the concept of a rice refinery proposed by Drs. L. Munck and F. Rexen*, could upgrade the quality of these products and add more processes thereby creating more employment for both sexes. Examples are:

(a) Rice straw:

- feed pellets

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*See various papers presented at the Orientation-Cum-Training Program on Improving the Income and Employment Potential of Rice Farming Systems, IRRI, January 21-30, 1985.

- fuel pellets
- packaging paper
- particle boards

(b) Rice bran:

- extraction of edible oil for human use
- use of rice bran oil for manufacture of soap and other products
- use of de-oiled rice bran for poultry feed
- fortification of de-oiled bran for animal feed production and number of cropping seasons, leading to more employment opportunities for women.

(3) Hybrid rice seed production

Women already play an important role in the production and processing of hybrid seeds, for example, in China (rice) and India (cotton).

Although these jobs can also be done by men, it appears that women are particularly careful and efficient in doing the work. They need training in:

- seed production processes, i.e., clipping of flag leaves, dispersal of pollen by "rope pulling" or the "stick" method; and

- cleaning of hybrid seed and its testing for viability.

Hybrid rice seed production units would need to be set up on a commercial scale, with quality controls and an efficient distribution system. Men or women could be involved in a managerial and training capacity.

(4) Direct seeding

The Philippine Ministry of Agriculture-IRRI Program for Small Farm Equipment is planning to collaborate with IRRI Engineering in the development of a seeder which
could be used in place of the broadcasting technique for direct seeding. The potential advantage of the seeder is that it would plant in straight lines, thereby enabling weeding to be done more easily by manual labor and reducing the need for herbicides.

(5) Biofertilizers

Blue-green algae (BGA) technology can provide 20-30 kg of biologically fixed nitrogen per hectare of rice per season. When the technology has been refined for widescale release to farmers, the BGA inoculum could be easily produced by women at the household level or in larger-scale specialized production units.

The procedure is to produce algae flakes as inoculum by growing algae in shallow fields or basins. These are then applied to the rice fields. The techniques do not need a sophisticated training program but the quality testing will require qualified personnel with some technical (microbiological) background.

(6) Integrated pest management (IPM)

(a) Varietal resistance

Since women are often responsible for the selection or purchase of seed, they would benefit from training in:

- Selection of appropriate resistant varieties;

- Use of cultivar mixtures for disease control or for reducing risk in variable environments. To maintain the mixture, it might be necessary to harvest panicles for each component, and then mix these for the following planting season. Women would need training to recognize the morpho-agronomic characteristics of the seeds and eliminate those which have become susceptible to the target disease.

(b) Insecticide use

- Making mudballs with seed of upland crops, plus insecticide and starter fertilizer to increase yield and save 1 or 2 foliar sprays. This would be particularly relevant to grain legumes and maize. The mudballs could be made with a simple machine in the home and planted in the field. Training of extension workers and women (and men) farmers would be necessary.

(c) Mass rearing of natural enemies - predators or pathogens

(d) Preparation of botanically based insecticides from the fruits of locally grown trees

- For example, new technologies will be developed over the next 5-10 years for small-scale neem processing plants for pyrolysis, power generation and extraction purposes. These could be situated in rural areas, to serve a number of villages.

- New jobs could be created for women (and men) in:

  - tree planting and afforestation programs;
  - fruit and seed collection;
  - seed processing;
  - village and cottage industries based on non-edible oils; and
  - other neem products.

  Training would be needed in processing and extracting non-edible oils, soap manufacture, simple formulations, use of ULV-applicators, etc. None of these would be particularly demanding on skill or physical strength.

(7) Driers and drying techniques

The on-going IRRI program on driers and drying techniques is already working with rural women. The basic philosophy is (a) to observe how men and women farmers dry their crops now and to identify their problems; (b) to improve on existing methods, where possible using low-cost local

materials and non-conventional energy sources and (c) to devise simple equipment, so men and/or women farmers can participate in the construction process and later operate and maintain the equipment easily.

Several multi-purpose driers have been developed for village- and farm-level crop drying, using local materials (coconut and mud-rice husk bricks) and non-conventional energy (wind and agricultural waste, including rice husks). These are now being tested in the Philippines (in Mindanao, Visayas and Cotabato). Training programs will later be set up for men and women farmers.

The program is also working on methods to lessen the percentage of brokens at milling caused by the large moisture variance. This is of particular concern with the spread of new varieties which have a moisture variance of 40% compared with 15% for traditional varieties. This is a research area that will be of particular relevance to women since they are: generally responsible for husking or taking rice to the mill; encounter cooking problems posed by brokens; separate the brokens from the bran; and need to control moisture levels in storage.

(8) Agricultural machinery

There are a number of technologies currently under development which could potentially reduce women's drudgery and generate employment and income for women laborers. During the design and testing stages, their use by women should be taken into account.

Specific examples are:

(a) For rice production

- direct seeding of rice
- fertilizer placement machines
- machines for incorporation of organic materials (e.g., azolla mixers)
- grain drying
- biogass generation

(b) For other productive work

- Simple milking machines to increase efficiency and protect animals from injury (common in hand milking)
- oil extraction devices, to extract oil from sunflower, groundnuts, rape seed, coconut)
- simple machines for preserving food, fruits, vegetables.

Although excellent work is being carried out by various agricultural engineering programs in Asia, relatively little attention has hitherto been given to women's post-harvest activities. Low-cost improved technologies which use local materials, non-conventional energy sources, and are easy to construct and maintain are needed for: on-farm crop drying, winnowing, parboiling, husking, storage, handling and transporting rice and other heavy crops during these operations in the home (e.g., devices similar to wheel barrows), processing and preservation of other foods (vegetables, fruits, fish), cooking and water provisioning.

(9) Biomass utilization

Women already use rice straw, bran and hulls for a variety of purposes. The quality of these products could be improved and their uses expanded with technologies now being developed. Some examples of the potential available for immediate farm-level experimentation are:

(a) Rice straw:

- as a source of manure, incorporated with animal dung;
- as a substrate for mushroom culture;
- as a source of animal feed, the quality to be improved by subjecting it to alkali digestion and enriching it with urea and molasses;
- for paper manufacture; and
- for biogas generation and subsequent composting.

(b) Rice bran:

- for animal and poultry feed.

(c) Rice-hull or husk:

- for extraction of solar grade silicon for use in the manufacture of photovoltaic cells;

- as a source of activated carbon, an important material used for bleaching oil. glycerine, etc., as carbon filter and also used in the manufacture of pharmaceuticals;

- as a source of Furfural. By distilling rice husk with dilute sulphuric acid, the pentose present in rice husk would yield three water molecules and furfural. Here also we get important by-products like methanol and acetone. Furfural is used in different forms for manufacture of cellulose acetate, nitro cellulose, shoe dyes, synthetic resins, etc.

(10) Mushroom culture

Methods of mushroom culture using rice straw as a substrate could be introduced to women. This would improve the family's nutritional balance and would be a valuable source of income to farm and landless women.

(11) Fish-rice culture

Although fish-rice culture is traditionally practised by men and women in many Asian countries, especially China, India, Indonesia and Thailand, new technologies have in recent years very considerably improved productivity and made acquaculture a highly profitable enterprise. These technologies are being developed in particular by the Freshwater Acquaculture Research and Training Centre (FARTC) in Orissa, India (belonging to the Central Inland Fisheries Research Institute which has 11 or 12 centers scattered throughout the country), the Inland Fisheries Research Institute, Agency for Agricultural Research and Development, Indonesia, and the Fresh Water Fish Research Station, Central Luzon State University, Philippines.

FARTC already has special programs for rural, particularly landless women. Farm women are also involved in the program aimed at the farm family. These programs for women which deserve support within the Women in Rice Farming Systems network and which could be expanded in India and other countries are:

- The raising of fingerlings for sale. In some cases women purchase the fry for rearing. The fry are fed on rice bran and oil cake (e.g., groundnut or mustard). One kg of fry at Rp10 can bring a return of about Rp40-50. FARTC has also trained women to induce fish to breed by giving pituitary injections to the females. Women are often better at this than men.

- Making and repairing nets. This is a traditional women's activity in the above-mentioned countries, as well as Bangladesh. FARTC has trained women in improved techniques for these activities and set up a women's cooperative near the Center where women earn Rp10-12 a day. These activities could be adapted to other areas.

- Processing and marketing. In many Asian countries women are involved in these activities. For example, in India women do about 99% of fish marketing. There is considerable scope for improving the efficiency and hygiene standards of fish processing and marketing, from which both farm and landless women would benefit.

- The profitability of fish-rice systems can be further enhanced by adding duck and pig enterprises (if these are culturally acceptable and/or there is a market demand for these products). Women could also be trained to operate such enterprises.

(12) Livestock-rice systems

These systems are traditional yet hitherto limited attention has been given to their integrated improvement. In many Asian countries the care of livestock is predominantly and sometimes completely women's responsibility. They cut fodder, use the rice hulls, bran and straw as feed (which they have often threshed and nearly always husked), make farmyard manure, water the animals, and make dairy products such as curd and ghee, etc. Any livestock-rice farming systems program must give specific attention to women's labor, skills, knowledge, opinions, needs, constraints and potentials in these areas.

Specific areas for improvement that are currently under development in three sites of the Asian Rice Farming Systems Network (Indonesia, Philippines and Thailand) are:

- development of dual-purpose (i) rice-legume rotations (for both grain and fodder, e.g., mungbean, soybean, cowpea, pigeon pea, groundnut; some pigeon pea varieties can be ratooned for fodder after the grain is harvested), (ii) rice-cereal rotations (e.g., sorghum and maize), and (iii) rice-forage grasses;

- use of forage crops, e.g., the fodder tree ipil-ipil (Leucaena leucocephala) and Napier grass (Pennisetum purpurem) grown on rice bunds or in the homestead for supplemental feeding (ipil-ipil will also provide fencing, windbreaks and fuel);

- use of crop residues as feed (e.g., rice husk, bran and straw, after fortification with urea and molasses and alkali treatment to improve digestibility);

- combinations of different types of feeds, including molasses-salt-mineral supplements, their availability, and economic assessment;

- residual effects of pesticides and herbicides on crops or crop residues used for fodder, and on livestock watering places;

- use of animal manure for field and garden crops, after treatment;

- women's livestock management skills and problems, labor constraints, sources of technical information about improved management practices, feeds, knowledge of animal diseases and recommended preventive measures, access to veterinary services, marketing information and services, provisions to pay women directly for their livestock produce and not their husbands.

(13) Vegetable-rice systems

Women commonly cultivate backyard vegetable gardens throughout Asia. Since water is often a serious constraint, particularly in the dry season, vegetables could also be grown on the bunds of irrigated paddy fields. Vegetable production (which men rarely engage in) deserves more attention in research and development programs as an important means of improving family nutrition and providing women with some additional income.

Women would benefit from training in the use of organic materials and compost, and improving garden lay-outs and methods of establishing nurseries.

(14) Sericulture-rice systems

Although sericulture is a traditional women's enterprise particularly in the slack rice cropping season, relatively little scientific attention has been given to improving sericulture within an integrated farming systems approach. Procedures are inefficient and time-consuming and in many places women are therefore only able to produce enough for family needs and cannot meet market demand.

(15) Food processing

The following Cottage industries could be developed by women for consumption and the market:

- making noodles from mungbean, a popular crop in rice-based systems;
- drying mushrooms;
- preparing bread and cakes from blended wheat and rice flour;
- making soy sauce, pickles, chutneys, jams;
- preparing puffed rice, and savories using lentil, rice and spices.

Appendix 1

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Appendix 3

List of Acronyms

AVRDC	Asian Vegetable Research & Development Center
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture)
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo (International Maize & Wheat Improvement Center)
CIP	Centro Internacional de la Papa (International Potato Center)
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
FAO	Food and Agriculture Organization of the United Nations
IARC	International Agricultural Research Center
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Centre for Africa
ILRAD	International Laboratory for Research on Animal Diseases
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
NARS	National Agricultural Research System
TAC	Technical Advisory Committee of the CGIAR

Report of a Seminar

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Women and Agricultural Technology: Relevance for Research

Volume 2 - Experiences in International and National Research

Report from the CGIAR Inter-Center Seminar on Women and Agricultural Technology

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Preface

An inter-center seminar of the members of the Consultative Group on International Agricultural Research (CGIAR) was held at the Rockefeller Conference Center at Bellagio, Italy on March 25-29, 1985. Participants included the directors-general or representatives from the international centers, the CGIAR secretariat, and the Technical Advisory Committee; the president and representatives of the Rockefeller Foundation; and experts with research experience on the role of women in agricultural development in the less-developed countries. The objectives of the seminar were to assess the current activities in the centers related to a more effective integration of women in the modernization of agriculture and to seek possible ways of improving the performance of the CGIAR system on this issue.

The seminar was co-sponsored by the International Service for National Agricultural Research (ISNAR) and the Rockefeller Foundation. It is a follow-up activity to a conference on Women and Rice Farming Systems held at IRRI in September 1983, which recommended that a meeting be organized at the senior CGIAR level to discuss how the international research centers could most effectively build upon the important roles that women play in agriculture.

The seminar report is in two volumes. Volume I, Analyses and Conclusions, includes the seminar presentations and the final statement prepared by the participants. Volume II, a reprint of the background document distributed to the seminar participants under the title "The Users' Perspective in International and National Agricultural Research", is in three parts.

Part I includes the background documents prepared by 12 of the international centers to describe their experience with user-oriented research.

Part II includes regional reviews of the literature describing women's role in agricultural production and decision-making in Africa, Asia, and Latin America.

Part III, the only one which is not an original text, reprints a paper given by Dr. Uma Lele at a Conference on Population Growth and Labor Force Absorption in the Developing World: 1960-2000. It is included here with permission because of its relevance to the seminar.

These papers bring together a large amount of information and much insight on issues of importance to the future orientation of international and national research, and ISNAR greatly appreciates the substantial contribution of the many people involved in their preparation. They are printed in this document exactly as received.

William K. Gamble
Director General, ISNAR

PART I

THE IARCS' AND THE USERS' PERSPECTIVE:

EXPERIENCE TO DATE

Identifying Special User Categories for New Agricultural Technology:

the CIAT Experience

by

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1. INTRODUCTION:

This paper is an overview of recent experience at the International Centre for Tropical Agriculture (CIAT) in identifying potential users of agricultural technology developed by CIAT research programs. The purpose of this paper is to provide background material for a subsequent synthesis of experiences with special user categories, in particular women, of all the international agricultural research centers in the CGIAR system.

The paper begins by setting the context for a discussion of CIAT experience in this regard with a brief description of the center's objectives and research program organization, followed by a short review of some important categories of women in the CIAT target region. The next section of the paper illustrates recent CIAT experience with women among user categories, emphasizing how these examples flow out of the overall process of identification of future users of new technology by the various CIAT programs. The concluding section reviews some commonalities in the approaches used by CIAT programs to implement this type of research, and some implications for research organization both within the center and in terms of relations with national programs.

1.1. CIAT's Objectives and Research Program Organization

CIAT's objectives identify a dual focus on poor producers and poor consumers in terms of special groups who may benefit from research leading to increased production, productivity and quality of food commodities included under CIAT's mandate for the American tropics. This dual focus is particularly important with respect to the relevance of women as potential users of CIAT technology because, as is discussed in detail later in this paper, a critical distinction exists among the needs of women in producer roles and their needs in consumer roles, particularly in Latin American societies.

CIAT's strategy emphasizes both increasing resource productivity on small farms, and/or expansion of agricultural production on the less fertile frontier lands to achieve more efficient use of land resources and to meet consumer demands. To address this strategy, the center is organized into four principal multidisciplinary commodity programs with responsibilities for beans (*Phaseolus vulgaris*) and related species; cassava (*Manihot esculenta*); tropical pastures (specially for the acid infertile soils of the American tropics). Each commodity is an important component in the food-budget of low-income consumers in target regions of emphasis. Improvements in the supply of rice and beef tend to be associated principally with benefits to poor urban consumers, while the Bean and Cassava programs are also associated with strategy for increasing productivity on small farms which are the major cultivators of these two commodities. Each commodity program is concerned with a variety of production systems in Latin America; moreover the Bean Program has recently developed new responsibilities in East Africa, and the Cassava Program is in the process of expansion to Southeast Asia. Research on pastures for tropical America is oriented at the development

of the less fertile lands and so concerns a great diversity of potential users, including large-scale cattle ranchers, and small-scale colonos or squatters on the perimeters of the agricultural frontier. Similarly, the rice program encompasses a broad range of potential user groups which range from small farmers without mechanization (in Brazil, for example) to large-scale, capital-intensive and highly mechanized rice producers (as in Colombia).

This brief overview of the mandate and organization of the center illustrates the complexity of the task of identifying target groups within the framework of a dual focus on poor producers and poor consumers which confronts the several commodity programs, and this has several implications for the process through which users' needs are incorporated into CIAT research activities. In order to discuss this process with respect to women, and different categories of women, it is necessary to look in summary form at some characteristics of women's roles in the CIAT target region.

1.2. Women in the CIAT Target Region

This overview of the characteristics of women as potential users of CIAT technology focuses primarily on Latin America, the center's principal mandate region, with some comparative references to other regions where new activities are being developed. Reflecting the very rapid rate of urbanization in Latin America, such that about two thirds of the population is classified as urban, most women in Latin America and most working women are urban dwellers. Upwards of 75 percent of all women reported as in the labor force in any given country for the mid-70s were active in the non-agricultural sector. These statistics reflect rates of rural-to-urban migration which tend to be higher for women than men in Latin America.

Labor force participation rates of Latin American rural women from census data are strikingly low in comparison to African and non-Muslim Asian Societies, but these figures conceal three important features of rural women's participation in agriculture. First, participation rates in field operations (planting, weeding, harvesting) differ substantially by social class. Women from landless or semi-landless rural households, estimated in 1978 as 15 million households ranging from 55 percent to 85 percent of rural households in ten Latin American countries (Lassen 1980), participate in agriculture as wage laborers, often in the large farm or plantation sector. Second, women's work in agriculture is culturally defined. When reported by male heads of household, the culture of machismo results in under-reporting of unpaid participation in family farm operations by farmers' wives and daughters. One case study found that 86 percent of women in small-farm households actually participated in agricultural work, although census estimates were much lower (Deere, 1977). A third feature of women's participation in agriculture is the sexual division of labor between commercial crop production, typically managed by men, and subsistence production for the household, almost always the responsibility of women - but seldom included in statistical accounting procedures.

In summary, the 53 million rural women in Latin America can be divided into four broad categories (Ashby, 1984). First, landless or

semi-landless laborers, whose participation in agriculture spans both the small-farm sector and seasonal or migratory labor in the plantation or large-farm sector. This appears to be numerically the smallest group of women working in agriculture according to census estimates. A second group is women who are from poor, small farms and who hire themselves out in addition to working on the family farm. Such households are classifed as "sub-family" farms, and are a majority of farms in many countries in the region. Women family workers are numerically the largest category of women employed in agriculture. A substantial proportion are household heads, that is, primarily responsible for the economic support of their family. A third category of women are defined by census estimates as "self-employed" and constitute the second largest group of women economically active in agriculture in Latin America. This group includes women who in some Latin societies are traditionally responsible for marketing agricultural produce. A fourth category of women are members of more prosperous farm households, who often do not appear as economically active in census estimates, and who do not work as hired laborers, but who are responsible for domestic food production among a wide range of farm size and income classes. These farm women are in all probability a minority of rural women in Latin America, especially in countries with high proportions of sub-family farms (such as Colombia, Eçuador, Peru, Venezuela, Guatemala, Honduras, for example). Finally, it must be noted that the empirical basis for characterizing categories of rural women in Latin America is extremely weak. To some extent this gap in current research reflects the importance of urban society as the primary locale for women's labor force participation in Latin America.

Several factors related to the urbanization of Latin America -- the trend for women who live in cities to work outside the house; the fact that malnutrition is more an urban than a rural phenomenon; and that most of the poor in Latin America depend on purchased food -- have several implications for the structure of demand for the food commodities with which CIAT research programs are concerned, and this in turn affects how research priorities are set in relation to needs of user categories, in particular women. This is illustrated in the next section of the paper, with examples of research studies from the different commodity programs.

2. EXPERIENCE WITH IDENTIFICATION OF WOMEN AS USER CATEGORIES: SOME EXAMPLES

2.1. Production Systems

Systematic research which identified bean and cassava commodities with small farmers as future users of new technology, was initiated at CIAT in the early 1970s with farm-level survey research, since periodically updated with census and survey data (Díaz & Anderson, 1977; de Londoño et al. 1978; CIAT, 1982, 1983, 1984). This research contributed to defining research strategies in which screening for improved varieties in these commodity programs de-emphasized technology suited to prime land and mechanizable agriculture characteristic of the non-traditional, large-farm sector in Latin America. In the Bean Program, for example, several characteristics of small-farm bean production systems are built into breeding strategies such as screening for disease resistance and yield stability; selection of materials adapted to associated cropping

systems; selection of drought-tolerant plant types, all of which are features attractive to small farmers (Pachico, 1984; Sanders and Lynam, 1981).

Within the ongoing characterization of small-farm production systems in these CIAT programs, consideration of potential use by women of the technology has been undertaken on occasions when women are identified in the course of on-farm research as a relevant user group. For example, on-farm testing conducted in Colombia by the Cropping Systems and the Economics divisions of the Bean Program include trials of both new maize and new bean varieties in association. In one target farming system most field operations are carried out by men. But farm women play a role in determining desired characteristics of maize varieties, a dietary staple. Hence the evaluation of new maize varieties included in on-farm trials was conducted by interviewing farm women. In complete contrast, research characterizing bean production systems in East Africa shows that bean farmers are women. As a result, women's needs are being integrated into breeding strategies from the outset by CIAT outposted staff in Rwanda. For example, women select bean seed and grow beans in mixtures of varieties in order to maintain desired seed qualities. Testing of new bean materials includes, therefore, screening varieties which are compatible in mixtures. In another instance, the CIAT anthropologist found that Rwandan women did not desire quick-cooking varieties but were concerned about keeping quality of the beans after cooking; varietal evaluations will therefore incorporate this criterion. Other research characterizing bean production systems in Colombia has involved interviewing farm women about desirable characteristics of bean varieties destined for subsistence production vs. those destined for the market.

In order to benefit small farmers who are the principal producers of cassava in Latin America, the CIAT cassava program has developed a strategy of integrated production and marketing research. Since 1981-2 an important focus of this approach has been the Atlantic Coast project in Colombia where the development of new post-harvest technology created opportunity for the expansion of cassava production. In order to understand the role of cassava production in the existing farming system, research had to consider the decision-making strategies of women as "managers" of the household food supply, specifically in terms of the role of cassava in household consumption and production. A survey of 200 farms interviewing the men on land use, and the women on household subsistence production and consumption was developed as it became apparent that women's needs and preferences in terms of feeding the family could be deciding factors in achieving the main objective of expanding cassava production. For example, research on the cassava production system showed that although women do not carry out field tasks, they have an important role in determining the balance of associated crops or intercrops in cassava fields. This occurs principally because the woman manages the flow of foodstuffs from commercial cassava plots into household consumption and the complementarities between produce from these plots and her subsistence plot. Research found that the management of cassava in relation to household food requirements would be a pivotal consideration for the design of more productive cassava cropping sytems. New cropping systems are likely to have higher capital requirements, and here again women were identified as key actors in capital generation by the small farm via

their responsibilities for raising pigs and poultry or cheese-making, which involve directly or indirectly channelling cassava into feeding livestock on the farm.

2.2. Marketing and Consumer Studies

The importance of demand studies for commodity research strategies in Latin America has prompted both the Bean and Cassava programs to undertake studies of consumer preferences. These studies help to identify desired varietal characteristics which will define the most profitable varieties for small producers of these commodities and for which breeding strategies need to aim. With the growing importance of purchases (rather than home production) of CIAT commodities in the diet of the Latin American poor, a majority of whom have lost their subsistence production base, women's needs as consumers tend to operate powerfully on research strategies in contra-distinction to women's needs as producers of CIAT commodities.

In traditional small-farm systems, even when there is considerable commercialization of crop production, the producer and the consumer needs and preferences of women are integrated in the domestic economy. However, once urbanization and large-scale commercialization of agriculture differentiate the urban woman and the rural landless-laboring woman as consumers who purchase rather than produce food supplies, from the rural farm woman as producer-and-consumer of food commodities, then important trade-offs exist among the interest of these different groups for setting research priorities. This is illustrated in the general thrust of CIAT's Tropical Pastures Program strategy, and that of the Rice Program. Technical change leading to increased production and productivity is likely to confer -- or has already done so in the case of rice -- important benefits on poor urban consumers (Scobie and Posada, 1977; Sere and Rivas, 1983). Although gender has not been an explicit category for characterizing needs of urban consumers for these commodities, implicit in a research strategy responsive to increased demand for rice and beef among urban consumers are the preferences for these easy-to-prepare foods of urban women who work outside the home. However, technical change which benefits poor women consumers may imply costs for women involved in production. In the case of rice in Colombia the evidence, although scanty, is that women agricultural laborers were displaced with the advent of new seed/fertilizer technology and mechanization of tasks which women laborers usually performed. Farm women from small upland rice farms were also shifted into a laboring status (both in agriculture and in urban employment) as the productive basis of the small upland rice enterprise in Colombia was displaced (de Correa, 1980; Hansen, 1983).

Consumer studies in the Bean and Cassava programs are concerned with analyzing quality characteristics of their respective commodities which affect consumer acceptability. Because the preferences of urban women consumers appear to be critical in price differentials among different sizes or colors of beans, for example, consumer studies to identify these preferences provide important information towards defining breeding strategies. In the Bean Program's consumer studies priority is given to characterizing minimally acceptable criteria for different varieties of beans among poor urban housewives. Desired bean characteristics change

as women lose their subsistence plots and become urban workers. For example, storage is more important for urban women than for rural women with subsistence plots. Survey research with urban women from different income classes showed that they will not purchase beans which have been stored for long, as beans become discolored and hard to cook. Therefore, screening of advanced lines in the bean program includes monitoring of this characteristic, in addition to other acceptability characteristics identified by women.

Survey research conducted in the Cassava Program also aims to identify the factors in women's decision-making which determine the relative attractiveness of different food commodities that are potential substitutes for cassava. Women managing household production and consumption, as well as women who are primarily consumers of purchased cassava were interviewed, as part of the integrated production and marketing studies referred to earlier. The results showed that urban women consumers emphasized cassava's perishability, and the inconvenience this entailed in shopping. This finding is translated into research program objectives which include improved storage technology and evaluation of stored cassava with panels of urban housewives for taste and cooking acceptability. Research on storage characteristics of cassava is also tapping into anthropological research on the indigenous technology of Amazonian Indian women for using cassava.

3. METHODOLOGICAL AND ORGANIZATIONAL APPROACH TO CHARACTERIZING USERS AMONG CIAT PROGRAMS

This section of the paper looks first at some commonalities in the approaches used by CIAT programs to implement research characterizing potential users of new technology, and then discusses some of the implications of this experience for the organization of research.

As the studies referred to earlier illustrate, research identifying women as relevant categories of users has evolved out of ongoing characterization studies of producers and consumers of CIAT commodities. Such studies are conducted by the economics research units, one of which is located within each of CIAT's four multidisciplinary commodity research programs. As an example of how such studies operate in the multidisciplinary team approach, the Tropical Pastures Program is beginning to screen materials for the humid tropics and the economics unit is concerned with characterizing farming systems where there is potential for CIAT pasture technology within this agro-ecological zone. Preliminary results indicate that such farming systems on the agricultural frontier will require an emphasis on small-farm milk and cheese production, with a probability that new technology may change the workload of women in these systems. Here then, a study of sex roles in production activities is likely to be required in future research.

Implementing such studies has typically required special research methodology from that normally used for ongoing economic characterization studies, largely because women have to be directly involved in the interviews and yet are seldom readily accessible to single-visit survey interviews. Field research has been required from sociologists and anthropologists to identify relevant sex-related factors which were then included in survey questionnaires. In order to carry out the survey

research on women, women interviewers have been hired and in some cases, it has been necessary to conduct two interviews in a household, with a member of each sex.

The research methodology for these characterization studies has therefore entailed a more intensive use of research resources in the sense that sociological field research and more interviewing within the survey framework has been introduced as sub-groups of users, such as women, have been investigated. As such studies have acquired increased importance in the economics units as a factor in clarifying objectives for breeding programs, there has been an expanded need for staff in these units who are trained for field research, and outposted for substantial periods from the center to field research sites.

In general however, this need has been met at little direct cost to the center because a major source of the additional staff required in the economics units have been one of the following: (1) associate staff, post-doctoral or postgraduate social scientists, economists and home economists who are often also trainees with support from another research institute, government, university or foundation; (2) collaboration with a national research and extension program which assigns some staff to the research. Hence such research, which includes studies characterizing needs of women, is carried out with a combination of core-funded research program resources, additional non-core sources which provide some of the field-oriented research staff, particularly in the social sciences, and the national program resources.

Information on "users perspectives" and the potential impact of new technology coming out of this characterization research feeds into different audiences, such as donors, policy makers and national research organizations, via the two main emphases of economic research. These are first, feedback to CIAT management and to researchers in other disciplines in each commodity research team; and second, development of methodology to be utilized by national programs. In the long run it is envisaged that national programs will take a major role in carrying out research characterizing potential users of CIAT technology while CIAT programs provide leadership or collaborate in studies important for developing new types of approaches. Current experience indicates that the involvement of national programs is an important step in transferring the methodology as well as the results of such studies to national program research units.

4. SUMMARY

CIAT's mandate and research strategy for the American tropics emphasize both increasing resource productivity of poor producers and/or expansion of production on the underutilized agricultural frontier, principally to meet needs of poor consumers. In the context of the rapid urbanization of Latin America and the trend for malnutrition to be concentrated among the poor who purchase their food, this strategy has required research to characterize both producers and consumers as potential users of CIAT technology. Within the framework of this ongoing research, studies specifically concerned with women are conducted when, for example, women appear to have significant managerial input into farming decisions about desirable production features of a commodity or when their preferences as consumers of a commodity are important.

This research is conducted principally by the economics units, one of which is located within each of CIAT's four multidisciplinary commodity research programs. Implementing studies concerned with women as potential users of CIAT technology has required more intensive use of research resources in the sense that there has been a need for sociological field research to identify and interpret relevant gender-related variables, in addition to survey research. An important objective of such studies characterizing potential users is to provide feedback to other members of the commodity research team about desirable features of technology, with the result that advanced lines in the breeding programs can be screened for these features. A second objective is to provide information to management towards refining overall strategy in terms of research needed to develop technology acceptable to different user groups. Research characterizing potential user groups also emphasizes improving the capacity of national programs to undertake and utilize the results of such studies, both by development of methodology and collaborative involvement of national program staff.

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CIMMYT's Experience with the Users' Perspective in Technology Development

by

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CIMMYT's EXPERIENCE WITH THE USERS' PERSPECTIVE IN TECHNOLOGY DEVELOPMENT.

CIMMYT's concern with understanding the users' perspective in the development of agricultural technology is manifested in two ways. First, CIMMYT sees its own clients (or users) as national agricultural research programs. CIMMYT's products -- germplasm, research procedures and training -- are developed in such a way that they can be accommodated to the resources and goals of these national programs. Second, CIMMYT realizes that the clients of the national programs are, in turn the representative farmers of developing countries, and that CIMMYT's products, as utilized by the national programs, should be appropriate to the conditions of these farmers.

This paper focuses on the ways in which CIMMYT takes account of the importance of including farmers' circumstances in technology generation by national programs. It reviews CIMMYT's development of a set of research procedures which can be used by national programs, examines the case of women as users of agricultural technology, and asks what more might be done to further the development of effective agricultural research which involves the users' perspective.

1. CIMMYT's PROCEDURES FOR ON-FARM RESEARCH

In the early 1970s, CIMMYT began looking for ways of better understanding the adoption of agricultural technology. Although there was already a considerable literature on adoption behavior, CIMMYT was particularly interested in the experiences of farmers with new varieties and improved management practices for maize and wheat. The result was a series of studies (summarized in Perrin and Winkelman, 1976) which showed, quite consistently, that farmers adopt technologies that are appropriate to their biological and socio-economic circumstances, and reject those that are not.

These results led to further work in two different areas. First, CIMMYT sponsored studies to help characterize farmers' circumstances. Work by Ashraf (1976) and Mwamufiya and Fitch (1976), for instance, provided analyses of labor use (including women's role) in small-farm agriculture in Pakistan and Zaire, respectively. Second, CIMMYT began to develop procedures that would help national agricultural researchers better take into consideration farmers' circumstances in the development of new technologies.

One of the first accomplishments in this regard was an increased emphasis on experimentation under the conditions of representative farmers. CIMMYT's production training began to emphasize on-farm experimentation and to develop appropriate experimental designs and procedures for this end (e.g., Palmer, et al. 1982). Simultaneously, procedures for the economic analysis of such on-farm experiments were developed which took into account the decision criteria of representative farmers (Perrin, et al. 1976).

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Progress on experimental design and analysis procedures was soon matched by work on diagnostic methods. The earlier studies on farmers' practices and adoption criteria were carried out using traditional farm survey techniques. It was soon realized, however, that such methods are often not feasible for national research programs and usually not directly relevant to technology design. Work was begun to develop survey techniques that could serve an ex-ante role in production research. Collaborative work with many national programs, as well as in Mexico, was carried out. One outstanding example of this early work is that of the CIMMYT Eastern Africa Economics Program (1977, a,b; 1978) in carrying out interdisciplinary survey work. This type of work helped lead to the development of a set of diagnostic procedures (Byerlee, Collinson, et al. 1980) featuring informal survey techniques and simple, well-focused formal questionnaires, which have found widespread application.

Later, as work progressed, CIMMYT sponsored a workshop for researchers from various national and international agricultural institutions in order to further discuss and refine procedures for on-farm research (Harrington, 1980a). At the present time CIMMYT feels that it has a distinctive, proven, and consistent set of procedures that national programs can use to carry out an effective job of production research. (Byerlee, et al. 1982).

These developments on the production side are paralleled by various research thrusts in the crop breeding programs that respond to the circumstances of those farmers most in need of improved agricultural technology. CIMMYT breeding strategies stress the improvement of yield and yield dependability in providing materials that national programs can fit to their own needs (e.g., Paliwal and Sprague, 1981). Work on early-maturing materials, drought resistance, and pest-resistance, for instance, provides national programs with an expanded range of germplasm that can be used for developing varieties appropriate to the needs of resource-poor farmers. Similarly, work in improving the nutritional quality of CIMMYT's crops, as in the development of high-quality protein maize (Vasal et al. 1982), provides additional alternatives to national programs for meeting their clients' needs.

Work continues on assuring a strong user-oriented perspective in research procedures. A key concept in CIMMYT's on-farm research is that of the "recommendation domain" (Perrin et al. 1976:1; Byerlee, Collinson, et al. 1980:10; Harrington and Tripp, 1984). This is defined as a group of farmers whose natural and socio-economic circumstances are similar enough so that they are eligible for the same recommendation. The use of the concept in an on-farm research program helps assure that work on improved technologies is directed towards a well-defined target group.

Further efforts at taking the users' perspective have included the development of guidelines for increasing farmer participation in experimentation (Tripp, 1982a), the demonstration of techniques for including dietary data in the design of on-farm research (Tripp, 1982b), and an attempt to better define the place of anthropological fieldwork techniques in the conduct of national program research (Tripp, forthcoming). A CIMMYT-sponsored workshop on the role of rural sociology in national on-farm research programs will be held in Zambia in late 1984. Procedures have also been developed for farmer assessment of recommendations (Harrington 1980b).

Besides contributing to technology generation, on-farm research can provide valuable information to policy-makers and research managers. An on-farm research program should exhibit strong interactions with agricultural policy and its implementation. This type of research can play an important role in improving the effectiveness of credit policy and input pricing and supply (e.g., Martinez and Arauz 1983). On-farm research can also provide information useful for setting national goals regarding choice of research priorities, and a project is underway at CIMMYT to develop a clear set of procedures that national programs can use in taking decisions on the allocation of research resources (e.g., Byerlee 1983).

In addition, any consideration of the policy area must take account of the impact of previous accomplishments, especially the spread of higher yielding varieties of wheat in the late 1960s and early 1970s. The debate over the "Green Revolution" has been waged in the academic literature for more than a decade, and has addressed a number of valid concerns, in particular the distributional effects of the new technology. Although the future is not likely to see technologies as dramatic as the new wheats, it is still important to address these distributional questions. The measurement of the impact of a particular technology in many parts of the world is complicated by concomitant trends in population growth and tenancy arrangements, and by urban-biased pricing and exchange policies. Nevertheless, a review of studies on the impact of the new wheat varieties (Byerlee and Harrington 1982) revealed several important points. First, although the new varieties are particularly responsive to better management, they have been adapted under a wide range of conditions, so that they now account for about 40 percent of the developing world's wheat area. Second, within any given area, large and small farmers have both benefited from the varieties. Third, the new varieties have been responsible for an increase in the demand for agricultural labor. And finally, the increase in productivity has kept wheat prices relatively low, a particular benefit to poor consumers.

CIMMYT believes that one of the best ways of ensuring that national programs continue to develop technologies which benefit the majority of their client farmers is to encourage the institutionalization of on-farm research capacity. This gives national programs the ability to identify well-defined target groups, diagnose their particular problems and circumstances, and design a research program to fit their needs. CIMMYT has thus given considerable attention to supporting on-farm research efforts in national programs (Moscardi et al, 1983; Martínez and Arauz, 1983; Kean, n.d.) and to helping them monitor and evaluate their progress (Martínez and Saín 1983). CIMMYT's training programs in crop production are designed to support this effort.

There are many examples of how this type of on-farm research has incorporated the user's perspective. In Haiti (CIMMYT/Department of Agriculture Natural Resources and Rural Development, 1984) research has led to the recommendation of high-yielding maize varieties and better fertilization practices for farmers in the Les Cayes region. The research paid particular attention to farmers' maize preferences for home consumption, and to differences in management practices between landowners and sharecroppers. In Ecuador (Moscardi et al, 1983) the

national research program has developed an earlier-maturing maize which gives small farmers a chance to intensify their cropping patterns. The research took account of farmers' maize preferences and of their intercropping practices. In Zimbabwe (Shumba, 1983) a farmer survey identified access to draft animals as a critical determining factor in agricultural practices. An experimental program has been designed which features a simple implement whose use reduces draft power requirements and achieves higher yields.

2. WOMEN AS USERS OF AGRICULTURAL TECHNOLOGY

The last decade has seen an increasing amount of attention paid to women's role in the process of agricultural technology development. There are several reasons for this concern, and they should be reviewed before considering how the work of an institution like CIMMYT might contribute to more progress in this area.

In the majority of developing countries women perform a far greater role in the production and processing of food crops than is generally recognized (FAO, 1979). The extent of their contribution is rarely acknowledged and, not surprisingly, is usually underestimated by official statistics (Dixon, 1982). It can thus be argued that if the circumstances and problems of female farmers are not properly addressed, the result will be a reduction in potential food crop productivity. If women farmers have less access than men to inputs, credit, information, and markets, then an important resource is being ignored. If women's role in both production and post-harvest activities is overlooked in the development of new technologies, then those technologies may never be used. It is therefore imperative that the female contribution to food crop production be taken into account by agricultural researchers and extension agents.

Another point to be considered with respect to women and agricultural technology development is the relationship between women's time and income, on the one hand, and child health and nutrition, on the other. The argument is that women's production and income are more valuable than an equivalent male contribution in determining child welfare; and that rural women's work load is a particularly sensitive indicator of time available for child care. This argument leads to the suggestions that there should be a bias towards women's productive and income-generating activities in rural development projects; and that technology design should always take into account the possible impact on women's time allocation. Although the general argument is sound, there is still a need for more research on these interactions in order to select possible courses of action (Carloni, 1984).

A final justification for paying more attention to women's role in agriculture is related to the issue of equity (Tinker, 1981), which is not as easy to characterize as the issues of production and child welfare. There are two points to be considered. First, it can be argued that the poorer the household, the greater the relative contribution of women to its total income; and that many of the poorest households are those headed by women. The implication is that attention to women and their activities is thus one way of targeting assistance to the poorest sectors of the population (Buvinic, 1983). Second, there is the question

of women's status. The argument here is that women are subject to various forms of discrimination, some of which may be exacerbated by technological change. Examples of discrimination can be found in access to land, to jobs, to equal pay, and to education. The implication is that technology development should try to address these issues as a way of ensuring that women are more equal partners in the development process (USAID, 1982).

Each of these issues -- production, child welfare, and equity -- are obviously not limited to a consideration of women in development. The following section examines what CIMMYT has done and what it might do in the future, to address these concerns that reflect the user's perspective in technology development.

3. CIMMYT'S ACTIVITIES WITH A USER'S PERSPECTIVE

3.1. Production

It should be clear that the on-farm research procedures developed by CIMMYT obligate the researcher to take the user's perspective. Once a research area has been delimited, scientists must determine what crops or other enterprises are most important for the majority of the area's farmers (in terms of production and income), how these are managed, and who is responsible for each operation. The design of an experimental program, and the development of relevant technologies, depends on close communication between scientist and farmer.

If women play an important role in the production process, then they will be included in the activities of the on-farm research program. In CIMMYT's workshops in on-farm research held at the University of Zimbabwe, for instance, attention is given to interviewing women farmers during the diagnostic phase. In research in Southern Africa, Low (1984) urges that recommendation domains be differentiated by household characteristics. Work on new maize varieties in Haiti and Ecuador, described above, has involved careful investigation of their post-harvest characteristics.

The procedures of on-farm research are clear, and should lead scientists to involve all of those persons who play an important role in the production process. This is not always the case in practice, however, and the question is, what more can CIMMYT do to ensure that research reaches the majority of producers? The question is not only applicable to the women's issue, but also to instances where class, ethnicity, or language impede communication during research.

CIMMYT's principal contribution here will largely come from its training activities. Instruction should continue emphasizing the importance of contacting and working with representative producers. But beyond this, the diversity of users, and the variety of institutional arrangements for carrying out on-farm research, argue for more training to be carried out in-country. Training with national research and extension services allows CIMMYT to tailor its methods to the needs and resources of particular programs, and to participate at first hand in the design of methods of sampling, interviewing, research program planning, and research-policy interactions appropriate to local situations.

CIMMYT's training in on-farm research is already heavily committed to in-country courses, and it is probable that even more resources will be assigned to this type of activity in the future. This type of collaboration with national programs also gives CIMMYT an opportunity to identify and encourage those nationals who are particularly suited to carrying forward research and extension activities with a user's perspective. Examples might include a focus on training women in extension and research in order to better reach women farmers, or the identification of personnel with particular language abilities or other experience to reach farmers or areas overlooked by current programs.

3.2. Nutrition

The previous section argued that the user's perspective should lead researchers to work with all of those who play an important part in production. The justification is increased and widespread gains in production and incomes. The argument in the present section is a bit different, for it asks researchers to place attention on certain users and certain activities out of proportion to their contribution to total production. The justification is that this strategy would have a greater impact on family nutrition and welfare, especially for children, than would a strict production focus.

CIMMYT's procedures in on-farm research attempt to address these concerns in several ways. An important part of the diagnostic procedures involves an understanding of farmers' dietary preferences, variations in food supply throughout the year, and the ways that cropping patterns respond to these factors (e.g. Collinson, 1982:50-2). In addition, researchers are asked to monitor the cooking qualities and acceptance of any new crop variety (Tripp, 1982b).

The current emphasis on nutrition in production research goes beyond this, however. Researchers are being urged to pay more attention to the question of women's time allocation and income-generating activities as important determinants of family nutrition. Besides the issue of women's role in family nutrition, other factors for consideration include attention to "minor" crops, and the relative emphasis on subsistence as opposed to cash crops. The ability to deal with these factors demands expertise that goes well beyond what can be expected from national agricultural research or extension institutions. It also demands an attention to nutrition policy and a level of field experience that, unfortunately, go beyond what can be found in most national nutrition institutions.

For this reason, CIMMYT (1984) has suggested that national institutes of nutrition begin to work more closely with their national counterparts in agriculture, participating in production research. Nutritionists and agriculturalists have an imperfect idea of each other's activities and concerns. The issues outlined above are difficult ones, requiring both careful policy formulation and the development of new analytical skills. CIMMYT believes that a first step is the establishment of a forum in which nutritionists can learn more about the conduct of production research, and agriculturalists can be made more aware of nutritional issues. Only then can the difficult trade-offs implied in these issues be addressed. Because a number of national programs have already adopted

CIMMYT's procedures in on-farm research, there would appear to be an opportunity for exploring possibilities for this type of collaboration (Tripp, 1984).

3.3. Equity

An adequate treatment of the equity issues related to the user's perspective requires reference to a policy framework. When an agricultural institution is asked to consider the selection of research areas or choice of target group for a production program, or more specific targeting to particular segments of the population, such as extension or credit programs aimed at women, some type of policy guidelines are necessary.

More attention must thus be paid to strengthening the capacities of national policy-makers, particularly in areas such as food policy and social impact analysis. This is not an activity in which CIMMYT expects to play a major role, but it can nevertheless make some contributions. As was mentioned earlier, CIMMYT is working in two policy-related areas. The first is the fuller utilization of information generated during on-farm research. Good policy is based on good information, and if the micro-level data from on-farm research can be effectively channelled they will provide a valuable contribution to policy-making. If inputs are inappropriate or late in arriving, if credit is not reaching the intended user, or if extension activities are not well directed, new technologies may not achieve their potential. There are already examples of effective feedback from on-farm research to policy, and CIMMYT plans to put more attention on this area.

The second policy-related area in which CIMMYT is working is in the development of guidelines for making decisions on research resource allocation. A series of case studies is currently in progress, and the hope is to produce a manual, similar to CIMMYT's other procedural manuals, that national personnel can use. The clients for this kind of manual are only partly to be found in agricultural research organizations. They are also in ministries of agriculture, finance, and planning, and as such begin to fall outside of CIMMYT's mandate. Thus this kind of project probably represents the limits feasible for CIMMYT's participation in policy-related issues. Other institutions will have a comparative advantage in working with the appropriate national entities in areas such as food policy, equity issues, or women in development.

4. CONCLUSIONS

It must be emphasized, at the risk of repetition, that CIMMYT sees its clients as national agricultural research institutions. Those institutions, in turn, face the challenge of increasing the productivity of their farmers, and in doing so need to consider the wide range of issues related to the user's perspective. Increasing the emphasis on certain aspects of the user's perspective, such as women's role in agricultural development, will require careful targeting. International institutions, national agricultural research organizations, and other national entities each can make contributions. But a confounding of the goals and comparative advantages of these various institutions runs the risk of involving an institution like CIMMYT in pilot projects and

special studies with no clearly defined clientele, abandoning national institutions to the demands and interests of whatever assistance agency happens to capture their attention or budget, and postponing the development of national capacity to deal with the many important issues raised by a consideration of the user's perspective.

CIMMYT will continue to work with national programs, through training and collaboration, to strengthen capacities in on-farm research in order to develop improved technologies for representative farmers. It will welcome any contributions which make these methods more effective at reaching a wide variety of users. It will also continue to explore the links between field-level data and policy formation, and will welcome the actions of other institutions to strengthen national policy-making capabilities, particularly in areas that take into account the impact of technologies on various classes of users. In following this strategy, CIMMYT endorses the belief that "the most valuable assistance that can be provided by international organizations... is that of helping countries to find and put into operation systems of research, extension, and production, using their own resources and characteristic approaches as far as possible..." (Pearse, 1980:232).

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Women and Potatoes in Developing Country Food Systems:

The CIP Experience

by

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International Potato Center

I. INTRODUCTION

A quick visit to any village in the Third World should be sufficient to convince even the most skeptical that women play important roles in agricultural production and food utilization. From selection and preservation of seeds to feeding the family from the harvest, women --complemented by the work of men and children-- are key actors in the food system. The challenge now is to go beyond this realization and take positive steps to involve women in agricultural research and development, not only at the farm level but also in national programs and international organizations. We have perhaps spent too much time pontificating about "technology", on the one hand, and about "women", on the other, and too little time actively linking up the two in laboratories, on experiment stations, in fields and stores, and in kitchens.

In this paper, I would like to present a summary of how CIP has dealt with the challenge of linking women and technology. I will discuss how far we have come and how far we would like to go. CIP has addressed the women's question at three levels of impact:

1) farm household;
2) technical training of national program personnel; and
3) management and scientific staff of CIP itself.

II. FARM HOUSEHOLD: WOMEN AS USERS OF TECHNOLOGY

In 1982 CIP decided to adopt a "Food Systems" Perspective, instead of only a production focused Farming Systems Research (FSR) methodology. This came about in part as a result of a series of farm and market-level studies directed by women investigators at CIP, mainly women from developing countries (see attached list). Our research empirically demonstrated that women were not only important elements in field production of potatoes but specialists in seed selection and procurement, harvesting, local marketing, storage, processing and - obviously - preparation and consumption. This FSR perspective has tended to ignore most of the important activities after harvest when women play important roles.*

Two additional aspects also brought to the forefront the involvement of women in potato research at CIP.

First, CIP's technology generation approach called "Farmer-Back-to-Farmer" posits that applied research must begin with an understanding of the farmer's circumstance and be brought full circle back to the farmers evaluation of the technology. According to this adaptive research model, CIP scientists and our interdisciplinary teams should be in close touch with farm-level reality. If this reality involves women as technology

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* The Food Systems Research thrust of CIP crosscuts the nine technical thrusts in order to guarantee interdisciplinary exchange.

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users, as it does in some cases more than others, then research must account for the female factor in design, transfer, and monitoring of impact. I will return in a moment with examples.

Second, CIP has had a strong, positive input from anthropologists and sociologists. This has had two consequences:

1) helps us understand how CIP technologies fit the real lives and conditions of rural people, including women; and
2) brought women scientists to our staff, given that women are represented in greater numbers in anthropology and sociology than in technical disciplines or economics.

Table 1 gives a sampling of these research projects which range from studying women's participation in production to the final storage or disposition of the crop. How have these studies been translated into concrete action affecting the design, generation, and transfer of technology? A few examples are in order.

1. Potato Consumption Research

Beginning in 1979, a woman anthropologist began a 4-year, 7-country comparative study of potato consumption and utilization. By the nature of the research, women farmers and consumers supplied the bulk of the information. These consumption studies helped CIP better understand consumer preferences and to pinpoint areas where the potato could play a crucial role in solving malnutrition. After the data were presented in papers, conference, and CIP's Internal Review, biological scientists --especially breeders-- were stimulated to rethink their ideas about the importance of consumer preferences for color, taste, shape, and cooking quality. The consumption study also emphasized the nutritional importance of dry matter content, a preference now being considered in selection of germplasm. As a result of this study, we feel this approach of working from women's kitchen pots to our laboratories helps streamline our research process.

2. Storage and Processing Technology

CIP's source research is organized around ten thrusts, one of which is devoted to post-harvest technology. By establishing a post-harvest program, CIP has recognized the importance not only of production but of post-harvest constraints. Post-harvest also happens to be one of the areas where women pay important roles, especially in household-level storage and processing as well as local marketing. Therefore, several research projects in the post-harvest area have focused on women. One project focused on women marketers in the Mantaro Valley, another on Andean village-level processing and one presently underway involves inquiring into women's roles in traditional potato storage in rural areas near Cuzco. Another post-harvest study showed that labor costs mainly affecting women and children in desprouting seed potatoes had to be taken into consideration in the design of a new technology called diffused light storage.

The above projects have been conducted within the framework of our post-harvest interdisciplinary team and the practical pay-off of this and

Table 1. Selected research projects including the Role of Women in Potato Food Systems*

Investigator	Profession	Title of Project	Dates	Funding
Elsa Bruno	Sociologist	Women Marketers in the Mantaro Valley, Peru	1978-79	CIP/IDRC
Susan Poats	Anthropologist	Potato Consumption and Utilization in Developing Countries	1979-83	CIP
Marisela Benavides	Sociologist	Socioeconomic Conditions, Food Habits, and Formulated Food Programs in Lima's slums	1983	CIP
Ann Swindale	Economist	The Role of Women and Potatoes in the Production system of Cruz Pampa, Peru	1983	CIP
Vera Niñez	Anthropologist/ nutrition education	Small-scale Household Food Production	1983-84	United Nations University/CIP
Ella Schmidt	Anthropologist	Household Strategies in Consumer Potato Storage: Cuzco, Peru	1984	CIP
Angelique Haugerud	Anthropologist	Rwandan Farming Systems, emphasizing the potato utilization of potato germplasm: Rwanda	1984	Rockefeller Foundation/CIP

*These projects represent those which involve women as a crucial analytical unit. Many other projects, such as the IDRC-funded Mantaro Valley Project, were sensitive to the role of women but did not stress this aspect.

other research has been the transfer of a new storage system to over 3,500 developing country farmers. Many of the managers of those 3,500 stores are women. In Peru, a women's cooperative built a large store, while in Kenya, the national program has worked specifically with a women's group.

A similar post-harvest project involved potato processing. Studies on the requirements of women laborers, etc. has redirected and reversed research directions in processing. Recently, results from a study of food habits and formulated food programs in Lima's slums was incorporated into a processing project involving a potato-based food mix aimed at the urban poor.

3. Seed Production and Potato Production by Non-Traditional Means

The needs as well as the special skills of women have been considered in CIP's research on true seed, rapid multiplication for seed production, and new methods of potato production. On Mindanao, Philippines, CIP scientists have given training to daughters of farm families in the techniques of rapid potato multiplication. Mindanao has a problem with virus-infected potato seed and our low-cost rapid multiplication technique can help overcome this production constraint. The farm girls returned to their families with a package of materials required to multiply virus free seed. This is an excellent example of how CIP links women and improved agricultural technology.

On the coast of Peru, we purposely conduct true seed on-farm experiments with women, since seed bed preparation, planting, harvesting and transplanting in this vegetable producing zone are normally under female management. We are attempting as well as to calculate future labor costs and impacts of this new technology to make sure it will not be detrimental to future users.

CIP is also concerned in exploring means to produce potatoes in household or home gardens which are production units normally under female management. Under a special grant from the United Nations University, a visiting researcher is conducting a study on home gardens in 4 Peruvian zones as well as experimenting with model gardens involving women's cooperation.

The above examples of linking research involving women and CIP technology are only selected examples. My point is that CIP has sought to broaden the relevant themes in agricultural research by establishing its "Food Systems" thrust. By including areas beyond field production such as storage, processing, gardening, and marketing, the role of women and their technological needs become more relevant.

III. NATIONAL PROGRAMS: TRAINING AND BACKSTOPPING WOMEN AS TECHNICAL RESEARCHERS.

Although many of the research projects mentioned above were carried out within national programs, it is in the area of specialized training that CIP has a particular comparative advantage. Farm-level research must be accompanied by training at the national level.

Individuals trained by CIP are selected by national programs, not CIP, and we cannot demand that national programs establish a quota system. However, in our specialized training, data analyzed to date shows that 25% of trainees have been women. Much of this training has involved laboratory research in such highly specialized areas as tissue culture, rapid multiplication, entomology, virus detection, etc. Three women in India and two in the Philippines are now working on advanced degrees with CIP support. In PRECODEPA, a Central American and Caribbean potato network, set up to share research and technology, a woman is leader of the tuber moth research and control project. Tuber moth is the major insect pest affecting potato production in the Third World.

IV. INTERNATIONAL POTATO CENTER: WOMEN IN CIP's MANAGEMENT AND SCIENTIFIC STAFF

Involving women as fully participating actors in the decision-making process at the level of management has also taken place at CIP. This insures incorporation of women's perspective during the planning stages of our program, not as a politically convenient afterthought. CIP has been the only CGIAR center to date to have a woman as chairperson of the Board of Trustees. The present chairperson of CIP's Program Committee, which determines the directions of our scientific effort, is also a women.

In 1982 a professional women's group was formed at CIP. The founding members were made up of 4 international female staff members and 7 Peruvian technicians who shared a mutual interest in the understanding of women's roles in potato food systems. As Director-General, I formally recognized and encouraged this group which now meets monthly. The Women's Professional Group sponsors a monthly seminar which is open to all CIP staff. The group also is collecting publications pertaining to women in agriculture and especially on women and potatoes for inclusion in the CIP library. Additionally, the group meets whenever possible with CIP management, including members of the Board of Trustees or the Program Committee, to present their views.

V. CONCLUSIONS

In our enthusiasm for "Women in Agriculture" it would be a mistake in my opinion to isolate women from the primary production units such as families or communities of which they are a part. On the other hand, to consciously or subconsciously ignore women as agriculturists is an oversight which can only return to haunt us in the future.

In this paper, I have pointed to three levels of consideration for international centers as they seek to include women: farm household level, national programs, and international agricultural organizations. At each level, however, it is no longer sufficient to simply talk about the "need" but rather to get on with the task of doing something about linking women and technology generation and use. While at CIP we have much more to do, we feel we are reaching an action state, not simply a talking stage. And the former is what development is all about.

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Concern for Clients' Agricultural Research at ICARDA

by

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International Center for Agricultural Research
in the Dry Areas

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I. INTRODUCTION

The International Center for Agricultural Research in the Dry Areas (ICARDA) is located in Syria. Its headquarters are in Tel Hadya, a 948 ha farm 30 km southwest of Aleppo.

ICARDA was founded in 1977 and had its administrative headquarters in Beirut until all offices were moved to Tel Hadya in 1981. Aleppo Province, where the headquarters are now located, was chosen as a center of research activities because it is possible to observe very different environmental conditions within a 100 km radius. For example, rainfall (long-term averages) ranges from 476 mm in the northwest at Jindiress near the Turkish border to 225 mm at Khanasser, 100 km to the southeast. The Tel Hadya site, more or less in the middle, averages 389 mm. Similar variation can be observed in soils and social conditions. For rainfed agricultural production in West Asia and North Africa, climatic variability is considered to be a crucial constraint. Aleppo Province does provide quite a suitable environment in which agricultural research for diverse rainfed conditions can be conducted.

Within the Consultative Group for International Agricultural Research (CGIAR), ICARDA currently has a regional mandate covering West Asia and North Africa. This region extends from Pakistan to Morocco and from Turkey to Ethiopia. In crops, it has the world mandate to coordinate research on barley, lentils, and faba beans. On a regional basis it conducts research on chickpeas in collaboration with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and in wheat (bread and durum) in collaboration with the International Maize and Wheat Improvement Center (CIMMYT). ICARDA also conducts research in pasture and forage improvement as well as livestock management.[1]

An important characteristic of ICARDA is the adoption of the farming systems perspective in agricultural research. The Farming Systems Program (FSP) is quite active in research in Syria and internationally. FSP is involved in interdisciplinary research. Within the multidisciplinary team of scientists such diverse fields as economics, agronomy, soil physics, soil chemistry, weed science, agro-climatology, microbiology, sociology, anthropology, livestock science, and plant physiology are represented.

These research activities at ICARDA are organized into four scientific programs:

1. Farming Systems Program (FSP)
2. Cereals Improvement Program (CP)
3. Food Legume Improvement Program (FLIP)
4. Pasture, Forage and Livestock Improvement Program (PFLP)

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[1] Livestock research activities are primarily oriented towards management with the local fat-tail Awassi sheep and do not involve breeding activities.

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In addition to these, there are a Genetic Resources unit (GRU), a Computer Center, a Training Center, a Communications and Documentations unit and various laboratories and workshops.

ICARDA is a production-oriented center. As such, it seeks to improve the welfare of client countries by contributing to increases in agricultural production. As an international agricultural research center, ICARDA's modus operandi is collaboration with national agricultural research centers. The active exchange between ICARDA and the national programs in outreach activities influences the overall research priorities.

In this paper, a brief discussion is presented on how ICARDA research addresses the needs of its clients. It is necessary to identify two echelons of users of ICARDA's research results.

1. National Research Organizations (NARCs)
2. Producers and Consumers

It must be reiterated that ICARDA produces intermediate goods and services which are utilized by the NARCs ultimately for the benefit of the producers and consumers.

II. NATIONAL RESEARCH ORGANIZATIONS

In an extensive network, the national research programs are actively involved in germplasm evaluation. Information gleaned from this evaluation is processed cooperatively so that ICARDA's breeding programs are geared to the needs of the region. National programs are free and encouraged to utilize any material they feel is suitable to their needs. To date, ICARDA has had input in a considerable amount of germplasm material adopted for testing and/or released by the national programs.

In order to make research more cost effective, ICARDA seeks research which can have generalizable results rather than exclusive location-specific research. Results from variety trials are collated and analyzed with respect to patterns according to environmental characteristics. Pooled analyses of multiple site - multiple season trials which incorporate environmental data, yield more efficient results. Hence, collection and collation of meteorological and soils data is an important activity. We feel that in a region characterized by a high degree of environmental variability (rainfall, available nutrients, etc.), parameters of this variability must be incorporated into analysis. In this way, we will have gone one step further in accommodating the characteristics of the environments our users live in and produce results adapted to their needs.

In this vein, an 'Agro-ecological Zoning Project' is currently underway in FSP.

The objective of agro-ecological zoning is to describe and delimit, on the land surface, areas of similar environmental conditions and potential for agriculture, in order to:

- facilitate the identification and quantification of targets for agricultural research;

- enable the effective generalization of location-specific research;

- provide a well-founded framework for land evaluation as a basis for land-use planning.

A comprehensive zoning scheme has to integrate all environmental variables relevant to agriculture. These variables describe aspects of climate, geomorphology, soils, flora, and fauna. Their variability in space and time forms the basis for the zoning process. It is not possible to incorporate all these dimensions into zoning and abstraction from some elements will be necessary. This necessity is observed in all scientific processes.

The values of these environmental variables are known only from a strictly limited number of sampling points such as weather stations. For each variable, therefore, a spatial model has to be constructed to provide estimates of the values the variable assumes between sampling points. Depending on the nature of each variable and our state of knowledge, these spatial models may be based on mathematical relationships, feasible for most climatic variables, or may be purely descriptive, as for geomorphic and soil variables where they take the forms of contour and soil maps.

Many variables and especially climatic ones, cannot be regarded as constant over time. In such cases, a mathematical analysis of their temporal day-to-day and year-to-year variability at each sampling point has to precede the construction of the spatial model in order to summarize the time series in a manageable set of parameters, be amenable to mathematical spatial modelling, and without losing any relevant information.

Agro-ecological zoning takes place in a sequence of four logical stages:

1. Mathematical analyses of the temporal variability of environmental variables relevant to agriculture.

2. Modelling of the spatial distribution of the environmental variables.

3. Simulation of the temporal variability of agriculture over the spatial continuum of the land surface.

   The simulation models of this stage describe the interdependence between the environmental variables and three other categories of variables: variables describing the genetic make-up of crops, response or yield variables, and variables describing management decisions and inputs. They cannot incorporate management decisions as integral parts, thus attempting to model human behavior, but they can help to analyze its effects and to optimize management.

4. Classification and clustering of the spatial continuum of probabilistic data created by the previous simulation stages delimiting quasi-homogeneous agro-ecological zones.

It is feasible to widen the scope of the exercise to include economic modelling by attaching monetary values to the physical inputs and outputs as economic variables.

The information that will be produced by this project will be valuable in itself. However, it is expected that the utilization of this information will facilitate cost-effective methods of conducting research with generalizable results.

The preferable way to make use of this exercise is to determine the values of the yield variables as a function of the other groups of variables: environment (variable both in space and time), management, and the genetic parameters of the grown cultivars. This should allow prediction of performance of cultivars, farming practices, and cropping systems not only in similar, but also in vastly dissimilar environments and thus facilitate agrotechnology adaptation and the generalization of the results of agronomy trials. A corresponding result in mapped form would consist of probabilistic land suitability maps for each considered combination of crops, livestock and management.

If, on the other hand, yield variables form part of the input into the simulation models, the values of the genetic variables which would lead to the given results from known treatments under the particular environmental conditions can be determined.

The next logical and feasible step would be to determine those combinations of genetic or management variables which result in the optimal combination of yield variables. This would lead to the definition, for any location, of cultivars, farming practices, cropping, and possibly farming system expected to show optimal performance over time. Mapped results could take the forms of agricultural land development potential maps or population carrying capacity maps.

We feel that this will lead to a more scientific determination and use of information on environments with common characteristics, or 'mega-environments' according to some of our colleagues' terminology.

This approach does not imply that we neglect the human element. The next section will provide insights into our activities in this respect. It is indicative of the concern that we have about the balance between social and technical factors in approaching agricultural research.

III. CONSUMERS AND PRODUCERS

Concern for the needs of producers and consumers has been dominant at ICARDA. In its formative years, a concerted effort was made to establish a sound basis in biological activities, in particular germplasm development. During the formative years a massive effort was also mounted to develop methods to gain a better understanding of the farming environment, socially and biologically. These activities have constituted the core of the Farming Systems Program. The philosophy of constant involvement with the issues of the producers and consumers permeates all ICARDA programs and activities. To present all such activities would take up too much time in a meeting such as this one. Here are some salient examples:

1. Village Level Studies (VLS) were undertaken in Aleppo and Hama provinces between 1977 and 1980. These studies had two basic objectives: (a) to enhance the understanding of the farming systems

in Aleppo province where ICARDA's headquarters are located; (b) to develop methods which could be used to assess and identify critical parameters of farming systems.

A major finding of these activities reinforced our belief that environmental factors (climate, soils, etc.) are dominant in determining farming systems. For example, typical systems were identified: barley-livestock systems in the drier areas (350 mm and less) and wheat-dominated systems involving rotations with legumes and summer crops in the wetter areas (over 350 mm).

The VLS also provided valuable information on input and output flows in the farming systems of the villages. The choice of the village as the target unit was valid under some circumstances but was inadequate when factors such as transhumance or off-farm employment came into the picture.

2. Subsequent to the VLS, more focused, crop-oriented survey activities were undertaken. Some examples in this respect are the barley survey, the steppe survey and the lentil survey.

   These surveys utilized sampling procedures and covered larger areas. The basic purpose of such surveys was to produce information on production practices, utilization of outputs, and related problems. Identification of issues through the surveys influenced research priorities as well as leading to further probing of the issues. Some examples are given below.

   a. Cereal straw, in particular barley straw, was identified as an important element in the diet of sheep. Farmers were as sensitive to straw quality as to grain quality. The status of straw was elevated in variety development and straw quality is screened for at advanced stages of germplasm development.

   b. Labor problems appear to cause constraints in lentil production, even though the major source of the problem is declining yields. Since mostly women are involved in lentil weeding and harvesting, a further study was undertaken in a limited area of Aleppo Province to assess the effects of technological developments on women. It has been found that with winter planting of chickpeas, increased weeding labor from the women would be required unless chemical control is introduced. On the other hand, mechanization of lentil harvesting, as a solution to labor scarcity, would essentially substitute for female labor. The same study indicates that, in terms of hours of work, women and children contribute 57% of the labor input. The results of this study clearly point to the fact that while certain technological developments are desirable at the national level, they will have effects on particular groups. Further study is necessary to see if the increased requirements for female labor for weeding would reflect adversely on the family and whether mechanization would imply loss of job opportunities for women with few alternative off-farm employment venues or whether this, aided by complementary rural development activities, would enhance the quality of life at home by allowing women to devote

more time to family needs. The field survey for the PhD research on nutrition and agriculture, mentioned in 5. below, will provide some insights in this respect. Part of this research aims to look at the relationship between nutrition and women's, in particular mothers', work patterns.

c. It was identified in the barley survey that farmers expected a high rate of occurrence of years in which low yields or crop failures would occur (20-35%). Hence, their sensitivity to the performance of varieties at lower rainfall levels has reflected on breeding strategies. Now, there is more concern for assessing the performance of varieties under stress and more emphasis is given to stability.

3. It was found that in some cases the viability of research results have to be proven to national scientists. In Syria, scarce phosphate fertilizer is not encouraged to be used in drier areas by policy. However, it was found the phosphate application in barley advances maturity, hence providing a drought escape mechanism, produces dramatic results in yield increases and, considering variable rainfall, would be expected to pay off around 80% of the time in typical barley areas. A collaborative project is now underway to demonstrate these results to Syrian scientists and policy-makers. The study is complemented by a fertilizer allocation policy study.

4. In our activities in Syria, Tunis, Egypt, and the Sudan, on-farm trials constitute the main mode of research. Farmers are involved in trials on their land in several ways. First, by following the fact that farmers rarely adopt packages but adaptively select components of technology, and effort is exerted to build on their current practices with improved practices. Their reactions to on-farm trial results are as important information as the technical results of the trials. The Nile Valley Project conducted in Egypt and the Sudan has produced impressive results in terms of adoption of innovations and training of national scientists.

   We feel that our pasture and forage research activities have to be complemented by on-farm research involving interactions with livestock. It is through those interactions that the social and economic viability of new forages and improved pastures can be assessed.

5. We are also conscious of the implications of our research for improving nutritional standards. Quality testing of improved varieties for various nutritional parameters, such as protein and fibre, is a routine activity. Taste panels and processing under consumer conditions (village bakeries, farm household cooking processes) are now accepted as the norm. In 1982, an international workshop was held in Aleppo under ICARDA/United Nations University auspices on the interfaces between agriculture, and nutrition and food science. This was followed by a regional workshop on the topic in the Sudan in 1983. In Jordan it was observed that price incentives to wheat producers may have adverse effects on producers who are net purchasers of wheat and cannot benefit from consumer

subsidies directed at urban areas. Special PhD research has been supported in ICARDA to identify how nutritional concerns could further be incorporated into our research.

6. Finally, we feel that while the economic evaluation of increased yields and higher input use is relatively easy, complications arise when technological innovations involve changes in the use of machinery or labor processes. We are currently initiating a study to look further into issues of mechanization and labor constraints as they may actually turn out to be limiting factors.

In general, we can say that problems of users have been considered as integral of farming systems. Consequently, solutions are directed to the farming systems rather than to specific user categories.

IV. CONCLUSION

ICARDA addresses itself to two sets of users:

1. national agricultural research programs as users of the intermediate goods and services provided by ICARDA;

2. consumers and producers who are the ultimate targets of agricultural research.

ICARDA is sensitive to the needs and characteristics of these user categories. This concern is exemplified in the research activities aimed at understanding the environments and the systems in which they operate. We believe that our research can be more cost effective if it is generalized. We also feel that a concern for understanding the farming systems allows us to produce more pertinent results.

It is clear that, despite our concern, our activities will not provide us with as complete information as we would need. However, we recognize the limits of our expertise and look to entities outside of ICARDA which may have comparative advantage in particular research areas. For example, we are particularly interested in obtaining aggregate and disaggregate demand parameters for the commodities we work on and this information could be forthcoming from other organizations.

Finally, we are happy to see this 'concern for clients' in the national research programs we collaborate with. We benefit from this collaboration with increased sensitivity to the needs of the users and, where constraints have prevented NARC scientists from doing as much as they wish, we are happy to be instrumental in increasing their sensitivities to the needs of the users.

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Developing Agricultural Technologies for Diverse Target Groups in the Semi-Arid Tropics

by

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and
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"It has always been the recognition of the limits of the possible which has enabled man to make full use of his powers."

F.A. von Hayek.

1. INTRODUCTION:

One of ICRISAT's tasks is to develop technologies, that after further refinement and adaptation, are suitable for adoption by small farmers of limited means working in rainfed agricultural areas of the semi-arid tropics (SAT). The objective of ICRISAT's efforts is to improve the way of life in the SAT and particularly to improve the lot of the small farmers, laborers, and their dependents.

At some point, a researcher must decide to what degree the needs of particular user groups should be considered in the development of a class of technology at a particular stage in the development of that technology.

The farmers and their dependents most certainly have different aspirations, along with different skills and management abilities. Furthermore, no two single farms have identical resource endowments and agroclimatic, economic, and institutional environments.

The uniqueness of each individual farmer calls for unique technological adaptations. However, an outsider to a farm operation is unlikely to provide an optimally adapted technology. First, the objectives of the farmer are only known to the farmer; second, not all the details of the environment under which a farmer operates can be known to an outsider, and third, the farmer is not likely to be able to fully communicate idiosyncratic knowledge of the farming environment to an outsider. Hence, the provision of technology perfectly tailored to individual farmers is extremely unlikely.

Not only is perfect tailoring of technology impossible, it would also be undesirable if it were possible. Complex technologies are amenable to modifications. Some modifications are best made during early stages of technology development, others are best made by the farmer, but rarely are all the necessary modifications and adaptations best made by either the technology developer or by the technology user.

The decisions on user orientation in technology development will be guided by:

i) the information the technology developer has about the technology needs of the potential users;
ii) the probability of success for actually developing a technology which meets the needs of the target group; and
iii) the degree to which a technology is amenable to modifications in later development stages. The modification potential is low with technologies like seeds, but high with complex compound technological packages involving seed, fertilizer, management practices, etc.

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Assuming that information on potential target groups is always incomplete and that the outcome of research and development projects is difficult to predict, it seems appropriate to target development efforts at broadly defined target groups and to develop technologies with broad tolerance windows, rather than limiting oneself to narrowly defined objectives with uncertain outcomes.

The paper provides an overview of ICRISAT's efforts to obtain information about technology needs of farm families and other research population segments. Our information collection was guided by a conceptual framework that was focused on the common objectives and needs of men and women which arise from their reliance on the family's resources, from the benefits from the division of labor within the farm-household production system, and from their desire not only to selfishly promote their own interests but those of other family members as well. This framework guarded us against giving too much emphasis in information collection to the particular objectives and needs of either men or women.

2. INFORMATION ABOUT USERS' NATURAL ENVIRONMENTS

Frequently the technological needs of large groups of farmers are determined by particular environmental variables. If such variables can be identified, information gathering about potential users' needs is greatly simplified, but by no means negligible.

Grouping farms according to soils has helped us to identify the need for several technologies. Examples include a technology which allows double-cropping on Indian vertisols that are traditionally fallowed during the monsoon or kharif season, or a technology to manage water resources on alfisol watersheds more effectively than it was possible with traditional tank irrigation systems.

Classification of locations according to rainfall probabilities has helped us to identify areas, and thus farms, where dry seeding on vertisols is potentially feasible.

More examples could be cited where information about the natural environment has helped us to identify technology needs, transfer windows for technologies, and potential recommendation domains for these technologies.

3. VILLAGE-LEVEL STUDIES AS A SOURCE OF INFORMATION ON TECHNOLOGY USERS' NEEDS

Village-level studies were initiated in India and in West Africa for two purposes:

i) to observe and document existing farm practices to help assess research priorities and potential technologies; and
ii) to generate a data base for broad-spectrum economic studies.

Ten villages were selected, two in each of five major agroclimatological zones in the SAT of India. From each village a sample of 30 farm families and ten farm labor families were randomly chosen as a panel to be monitored over several years (10 years in 6 villages and 4 years in 4

villages). In each village an investigator is stationed. All investigators have a university degree in agricultural economics, come from a rural background and speak the local language. Investigators interview panel households in short intervals according to an elaborate schedule with structured questionnaires; they also act informally as participant observers in the villages. All data are stored in a computerized data bank.

The villages under study in Africa are located in Burkina Faso (6 villages) and Niger (4 villages). The VLS program in Africa has been adapted to suit the conditions there, but is very similar to the Indian studies. Comparable data are being generated and will be given below under the appropriate headings.*

Besides the regular and scheduled surveys, several special surveys have been conducted in our VLS villages. For example, we are presently conducting a detailed survey for the World Bank on the development of farm assets over long periods. This survey also includes questions related to dowry payments. It is unlikely that we could have obtained from the farmers information on these sensitive issues if we had not established a good rapport with our respondents over a long period. Furthermore, our VLS villages serve us as locations for on-farm research where our scientists can conduct experiments under real farm conditions without having to expend much effort and costs for setting up the experiments.

Information obtained from the village-level studies which has contributed to ICRISAT's technological design efforts appropriate to particular user groups can be divided into the following study categories:

i) resource bases;
ii) production factors;
iii) labor;
iv) nutrition and consumer preferences; and
v) risk attitudes.

3.1. Resource Base

Jodha (1977) found that farm resource bases have important effects on cropping patterns and practices. This and further research by Jodha (1980) indicated that technologies suitable for intercropping systems would be particularly useful to small farmers in areas where unassured rains are poorly retained in the soil.

In West Africa, a planting strategy study found that Burkinabè farmers follow well-defined planting patterns in which different crops are sequentially sown on distinct land types as the rainy season progresses. A scenario analysis of farmers' strategies under varying rainfall patterns found that due to the scarcity of local short-cycle crop varieties, farmers had few options in late planting situations other than continued replanting of available full-season materials with consequent

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* Information provided by Dr. P. Matlon, ICRISAT.

expectations of low yields. These results point toward the development of short-cycle materials in crop improvement programs, and to the need for systematic date of planting and toposequence testing of improved materials to determine their fit and potential impact in local systems. (Matlon, 1980; van Staveren and Stoop, 1985)

An analysis of manure use in Burkina Faso shows that in traditional systems average rates of manure application to cereals are extremely low, varying between 100 to 500 kg/ha. Significantly, application rates tend to be greatest in animal traction households at nearly double the rates of non-equipped households. Moreover, due to costs of transporting manure to distant fields, manure is inefficiently allocated as a function of distance from habitation points. These results indicate that in central Burkina, substantial changes in techniques for the production, recovery, and transport of manure must occur before organic sources of nutrients can play an important role in complementing more fertilizer responsive cereal varieties in the short-run, and in maintaining soil fertility over the long-run. (Prudencio, 1983, Bonkian, 1981).

An historical analysis of the evolution of cropping patterns in Burkina Faso has found that due to increasing population pressure, cultivation in all zones is being: (a) intensified with the introduction of new soil fertility management methods to replace fallowing; (b) expanded onto fields more distant from habitations; and (c) expanded onto more marginal soils located on the upper portions of the toposequence which tend to be more drought prone and less fertile than lower slope fields. One consequence is that farmers are seeking cereal varieties with somewhat shorter growth cycles and which are relatively more stable under low fertility and drought conditions. These changes in land-use patterns are being accompanied by systematic changes in land tenure, in particular by decreasing importance of usufruct and increasingly permanent household control of land. These trends are complementary to greater willingness to invest in land improvement. (ICRISAT, 1982; Vierich and Stoop, 1984)).

3.2. Production Factor Studies

Ryan and Rathore (1978) found that factor endowment ratios differ widely between small and large farmers in the villages studied but that factor use ratios differ much less among the groups. This was interpreted as an indication that there would be little justification for developing separate technologies with different factor use ratios for the small and the large farmers among India's farms, all of which are, by most standards, to be considered as being small farms.

In West Africa, in two years of tests in central Burkina Faso, the agronomic package of light animal traction scarification and weeding in combination with a moderate dose (100 kg/ha) of NPK fertilizer increased short-run average financial returns to both land and labor, with no factor bias evident. This suggests that yield-increasing technologies are not necessarily appropriate only for land-scarce conditions. Rather, in combination with labor-saving traction equipment such technology may be appropriate for a range of factor endowments. (ICRISAT, 1980).

Farmers' tests of a range of doses of cotton complex fertilizer and area in Burkina Faso showed that at all doses average financial returns were

highest in the more humid southern villages and declined systematically in more arid areas, becoming marginal or negative in the Sahelian sites. The risk of financial losses followed a similar north-south pattern, with the probability of not achieving break-even increments greater than 50% in the north but less than 40% in the extreme south. Risks were consistently lower, and financial returns to fertilizer higher, for sorghum compared to millet. Significantly, we found that both average and marginal financial returns were highest and the risk of loss least at the lowest fertilizer level (50 kg cotton complex/ha). An economic analysis showed that upon removal of the fertilizer subsidy cotton complex fertilizer would be economic only in the southern zones when applied to sorghum at the low dose level. Urea was economic only when applied to sorghum. These results suggest that unless the absence of response curve cross-over among varieties can be demonstrated, on-station screening under low fertility conditions would be useful for sorghum, and particularly critical for millet. (ICRISAT, 1983).

Yield function analyses conducted on the farmers' test data from Burkina Faso indicated that returns to cotton complex fertilizer on sorghum can be significantly increased through: (1) use of improved sorghum varieties; (2) increased densities (above 55,000 pl/ha); (3) application on more degraded upper slope fields and on fields not recently in fallow; and (4) application to fields sown the previous year to millet. It is significant that under farmers' conditions we have observed no interaction between animal traction plowing and yield response to fertilizer. (ICRISAT, 1983).

3.3. Labor Studies

Binswanger and Shetty (1977) found that chemical weed control would be much more expensive than existing weed control practices. Furthermore, chemical control would be highly labor displacing. Women would be particularly affected because they perform 70% to 90% of the handweeding. These findings have led ICRISAT to attach a low priority to research on chemical weed control.

Ryan and Ghodake (1979) found that female wage laborers, who mainly come from small farms or landless households, are disadvantaged in two ways: not only are their wages lower than wages for men, but women also have a lower chance of obtaining employment in the casual rural labor market. The chances of obtaining employment are particularly low in the slack period from March to May. This result emphasized the need for technologies which require labor or which at least do not further erode women's wage labor opportunities.

Ghodake et al. (1981) evaluated the likely effects on labor demand of the introduction of prospective improved land-, water-, and crop-management technologies. They found that, compared to existing technologies, labor demand increased by 100% when the new technologies were introduced in alfisol areas, and by almost 400% when the new technologies replaced the old ones on deep vertisols. However, using new technologies created new labor bottlenecks, and labor demand within a cropping season would be more variable. The latter effects could, however, be attenuated if technology development allowed individual farmers to select from a variety of cropping systems those systems which suited their particular

labor availabilities and commitments. In a sequel to these studies, Ghodake and Kshirsagar (1983) found that the improved soil and water management technology developed by our Farming Systems Research Program has the potential to increase employment of female labor. However, in areas where rainfed agriculture competes with irrigated agriculture, a shortage of female labor is a constraint to technology adoption.

In West Africa, an analysis of animal traction systems in Burkina Faso shows that due to an early-season labor conflict between plowing and timely planting and due to limited power, the most common donkey-drawn traction systems were used almost exclusively for weeding, but rarely for the plowing of sorghum and millet fields. Among land-scarce households the use of such equipment tended to have small negative effect on yields nearly offset by a small increase in area cultivated. Among households with greater than average land holdings, these same effects were observed but their magnitudes were substantially increased - the yield effect was negative (50%) and the area expansion effect a positive 40% - reflecting a clear extensification impact. Traction technology was also found to substitute for labor on a per hectare basis, particularly in weeding, but to increase total labor use on a whole-farm basis due to area expansion. These results point again toward the development of shorter cycle, later planted cereal varieties to relieve the early-season labor bottleneck to permit preplanting plowing. The lack of power, however, also indicates the need for developing varieties which perform well under extensive, minimum tillage management. (McIntire, 1983).

Farmer-managed intercropping tests in Burkina Faso have shown that due to additional labor requirements in planting and weeding and due to low cowpea-grain response to increased density, high density inter-hill planting of local spreading cowpea varieties with sorghum is not significantly more profitable than farmers' traditional low-density same-hill planting patterns. The results of these farmers' tests, together with results of researcher-managed on-farm tests, indicate that more promising means of increasing the legume population in cereal-based mixtures, which should be investigated, include: (a) same-hill planting of higher density upright cowpea varieties; and (b) groundnut intercropped with short-cycle millet or sorghum. (ICRISAT, 1982).

3.4. Nutrition Studies

In our nutrition studies, which have been summarized by Ryan et al. (1984), we have found that the major deficiencies in the village diets are energy, calcium, b-carotene, B-complex vitamins, and vitamin C. This is contrary to the widespread conventional wisdom that protein and essential amino-acids are generally the limiting factors in the diets of the inadequately nourished or undernourished. This finding had important implications for our plant breeders whose initial goal was to improve protein content, even at the cost of reduced yields. The nutrition studies, however, indicated that breeding strategies emphasizing yield and yield stability have the greatest potential to improve nutrition and health of malnourished people.

Von Oppen and Parthasarathy Rao (1982) have conducted investigations on consumer preferences for grain quality characteristics. They found in double-blind consumer tests with sorghum samples that a market derived

preference index predicted well the quality ranking of sorghum varieties by consumers from all farm types except those from large farms. Given that quality can never be fully determined in objective terms, this index can help to breed for sorghum varieties which better meet consumers' subjective perceptions of quality.

Behrman (1984) and Deolalikar (1984) have measured the degree to which Indian farm boys are favored over girls in terms of food and education supplied to them. While very little potential exists to remedy this discrimination against girls by means of technology development, this information should help to generate appropriate education and extension efforts.

3.5. Studies of attitudes towards risk

In a series of gambling experiments with our VLS respondents, Binswanger (1980) measured the degree of risk aversion of farmers. He found that farmers' risk attitudes were largely independent of their wealth, farm size, age, or tenancy status. If farmers' actual behavior is similar to their behavior in an experiment, then this research indicates that there may be no need for different technologies to be developed for farms of different size classes. Women were found to be somewhat more risk averse than men.

From these empirical findings a rule of thumb has been derived which can be used to screen among technologies which are profitable on average. Farmers are likely to adopt a technology which entails increased risk if the additional risk measured in term of the standard deviation of the objective criterion is no more than twice the magnitude of the additional increment in the mean of the objective criterion.

The information on farmers' risk attitudes has been used by Binswanger and Barah (1980) and Barah et al. (1981) to evaluate genotype performance of sorghum in nursery trials.

Walker and Subba Rao (1982) estimated that sorghum yields could be increased by 80 kg/ha when farmers adopted sorghum hybrids. Since adoption of hybrids is likely to be retarded because of farmers' risk aversion, the need to breed for yield stability is again established.

4. THE IMPORTANCE OF CONSIDERING WOMEN'S NEEDS

Our research summarized above shows that so far we have found only limited information to justify technology development for narrowly defined user groups. Specific women's needs have been considered when feasible without losing promising technology opportunities.

There is one example where a targeted concern for women has led us to pursue a research policy which in the long run may turn out to have been a mistake. The importance of female labor in weeding operations was previously described. Based on our concern not to deprive women of this important income source, ICRISAT made a conscious decision not to study and promote the use of chemical weed control measures in India. Consequently, a rather labor-intensive, double-cropping technology for vertisols was developed. But our on-farm research and simulation studies

now show that the labor intensity of the new technology impedes its adoption, especially in areas or on farms where irrigation offers a more productive alternative to employment of labor than does the improved dryland technology. Thus single cropping continues and the benefits of a second crop are ignored in large areas because the dependence on female labor imposes constraints.

ICRISAT scientists and family members have initiated and pursued research projects on a personal basis whenever institutional mandate and research priorities did not permit official ICRISAT participation.

As an example, two studies were initiated to generate information on household cooking fuel requirements in a city and its surrounding area, and on the feasibility of using alternative cookers in rural and urban areas to reduce the dependence on scarce fuels. The first study (Fuelwood Markets in Hyderabad) was carried out by Osmania University in collaboration with Resources for the Future with funding by the Rockefeller Foundation. The second study (Feasibility of Solar Cookers on Urban and Rural Areas) was carried out by the Home Science College of the Andhra Pradesh Agricultural University in collaboration with "Sonnenkorb", a voluntary organization. Both studies were initiated by ICRISAT scientists.

This research documents that despite rapidly rising fuel costs and depletion of fuel wood resources, introduction of new technologies is meeting with sound skepticism by women. There is, however, room for design improvements in solar cookers, after which adoption is quite feasible. Design improvement is underway.

Although we have focused our research on rural families rather than on particular groups of family members, we have been able to gain important insights into women's needs and we have been able to guide technology development towards meeting these needs. However, it must be admitted, our knowledge of the needs of farm families and their members is still rather limited. We hope that the household studies undertaken by our economists will provide more insights and we will certainly respond whenever new technology needs are identified.

We believe that our approach to focus on farm families rather than on farmers or their wives is well suited for the identification of technology needs because a truly holistic view of farming in the SAT can neither ignore the technological interdependencies between the diverse farm and household operations nor can it ignore the interdependencies between family members' objectives and aspirations.

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User Perspective in IFPRI Research:

Relevance to Agricultural Technology and Women as Users

by

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1. OVERVIEW OF IFPRI RESEARCH

The primary focus of IFPRI research is the analysis of national and international policies that influence food production, consumption and trade. This work is highly complementary to the work of other CGIAR centers that are engaged in the development of suitable technologies to boost food production. It is well acknowledged that while the availability of improved technologies is an essential prerequisite, appropriate policies and strategies are also necessary to achieve the adoption of these technologies for increasing food production and assuring food security for all segments of the population. Implicit in IFPRI's research program is a recognition of the complex interrelationships between technological change in agriculture, and the socio-economic policies that accompany it must be analyzed and understood. This can provide a concrete and scientific basis for countries to learn from cumulative experience and to adopt the most suitable policies.

To achieve this end, there are three sets of policy issues of relevance to technology adoption that are being addressed. These are: the nature of incentives for adoption of new technologies, the impacts of adoption, and supplementary measures that can be used for using food aid or other means of improving food security.[1]

2. CLARIFICATION OF THE USER ORIENTATION IN IFPRI RESEARCH

The direct users of IFPRI research are national policy-makers and other agencies, including international organizations that influence or implement policies and programs. This is similar to the situation faced by other CGIAR centers whose primary users are the national agricultural institutions. However, for the system as a whole, the ultimate users are the producers and consumers who are affected by the changes and possibilities introduced along with the technological change. The focus of IFPRI research is also these ultimate users, the farmers and consumers, and they are designated as "users" throughout this paper.

Gender is only one of a complex set of user characteristics that are analyzed at IFPRI. While those who may directly use the technologies are the most obvious "users", i.e. the farmers, others who may be impacted upon are also "users" in various indirect ways. In the first instance, the direct users of agricultural technology may be characterized by a series of producer characteristics that require analysis for appropriate policy measures in the technology adoption process. These include area level, household level, and intrahousehold level attributes of farming households. Second, users can also be characterized by their links to the agricultural production process. This extends the concept beyond the farmers themselves to agricultural laborers, other consumers, indirect beneficiaries via production linkages, and in some instances, even farm household members other than the farmer himself (or herself) upon whom the technology adoption can impact.

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[1] See Annex 1 for more details on these three sets of questions.

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Table 1 outlines some characteristics of these two types of users and gives examples of policy measures that would influence adoption of improved technologies and related impacts for these user categories. While farmers themselves are the direct users, all others impacted upon may be seen as the indirect users.

3. THEORETICAL BASES OR UNDERPINNINGS OF IFPRI's USER ORIENTATION

The primary theoretical basis for IFPRI's user orientation derives from the capacity of technological change in foodgrain production to provide an engine for overall development via an employment-oriented development strategy (Mellor 1976, Mellor and Lele 1973). In such a formulation, the direct users of improved farming technologies are only one part of the process that is necessary for the adoption to be a success. Also, if one accepts the view that improved foodgrain technologies are employment-generated - directly in their production via a wage goods effect and through consumption linkages for non-farm products - then concentrating only on the benefits to the immediate users may provide a misleading assessment of the situation. Fully consistent with this construct is the notion that small farmers, though risk averse, are more efficient users of capital, are more likely to substitute labor for capital, and should be targets for improved technologies.

The users from this standpoint are both the direct and, more significantly, the indirect users. The research implications of this are largely reflected in the work of the Food Development Strategies Program and the Production Policies Program, much of which is conducted jointly with the Food Consumption and Nutrition Policies Program. More specifically, these studies examine impacts of technological change on both the direct and indirect users by examining changes for different segments of the population. Also in the same context, policies that facilitate this process, such as irrigation, infrastructure creation and provision of services, are also examined for ways in which the size and distribution of benefits may be improved.

An additional user perspective has been derived from the differential commodity mix for producers and consumers from different segments of the population. Accordingly, technology for "commodities primarily produced by low-income farmers and which occupy a larger share of the budget of low-income consumers" (Pinstrup- Andersen, de Londoño, and Hoover, 1976) may be most effective for expanding real incomes for poor farmers and consumers. This suggests that a more targeted approach, focusing on characteristics of low-income households in devising strategies for growth, is necessary for both production and consumption problems. Implicit in this formulation is the expectation that crops grown by the low-income producers would improve with use of improved technologies, raising their income and consumption. In addition, the reduction in unit cost of production for these crops would be transmitted to other low-income non-producing households via lower prices and lead to improvement in their real income and consumption as well. The user orientation of this approach also includes both direct (small farmers) and indirect (low-income consumers) users. The work so far has been focused more on the consumption side, but work has begun recently in semi-arid West Africa on income distribution and consumption impacts of increasing millet/sorghum production.

Table 1 - User Orientation in IFPRI Research

1. Technology Diffusion and Adoption By Farm Characteristics	Examples of Policies
Area Level	
Ecological conditions	Agricultural and crop research priorities Pricing policies
Infrastructure and services	Infrastructure investment and service provision policies Irrigation policies Private sector incentives
Household Level	
Scale of production	Price of capital intensive large scale technologies Cash/export vs. food/subsistence crop policies Agricultural and crop research priorities
Risk, capital, and other constraints	Price support policies Crop insurance Types of credit, input subsidies Integrated programs for raising productivity of labor Irrigation pricing and management Extension and training policies Location and management of services
Intra-Household Level	
Intra-household division of labor and crops produced	Consumer preferences/import policies Relative crop prices received Crop and farming systems research Extension and training policies Input and credit policies Crop technologies for local storage and processing Access to credit and labor saving technologies for women
2. Impacts of Technologies By Link of Agricultural Production	
Farm household members	Policies influencing adoption pattern
Hired workers	Labor-intensive strategies Selective mechanization policies for increasing labor productivity Food subsidies
Consumers	Food prices and subsidies
Non-farm sector enterprise	Incentives for farm-nonfarm growth linkages

The question of women as users fits into the overall framework primarily as part of the concern of reaching low-income producers and consumers. In addition, on the food consumption side, women's overriding role in child nutrition via their allocation decisions for income, food, and time has also been recognized (Kumar, 1978; Tripp, 1982). As a consequence, the study of the allocation of income and time by women is also incorporated in some of IFPRI's work on food consumption and the effects on nutrition of household production and income increments. On the agricultural and food production side, the intra-household issues are less clear cut. For the most part, women's issues are addressed in relation to their access to technology as part of the group of low-income producers or in relation to the production implications of their time allocation patterns (e.g. as a result of time required for fetching fuel-wood, water, and fodder).

4. USER ORIENTATION IN IFPRI RESEARCH AND THE TECHNOLOGY ADOPTION PROCESS

IFPRI research is broadly concerned with both the processes of adoption and the effects of technologies. Policies play a key role in the adoption of technologies and in the distribution of their effects. While a given technology by itself may or may not be neutral to user characteristics of scale, resources, farming system constraints, ecology or sex of farmer, it is seldom neutral after interaction with policies. Often policies are dictated by limited time and budgetary resources and a generally imprecise knowledge of the implications. A wide-ranging set of policies are relevant to the adoption and impact of agricultural technologies. A simple illustration (Figure 1) shows the different types of policies relevant for the technology diffusion process and its differential impacts being analyzed at IFPRI.

In order to describe the work at IFPRI that is relevant to this process which also incorporates a household or individual user perspective, the process shown in Figure 1 is grouped into three component parts:

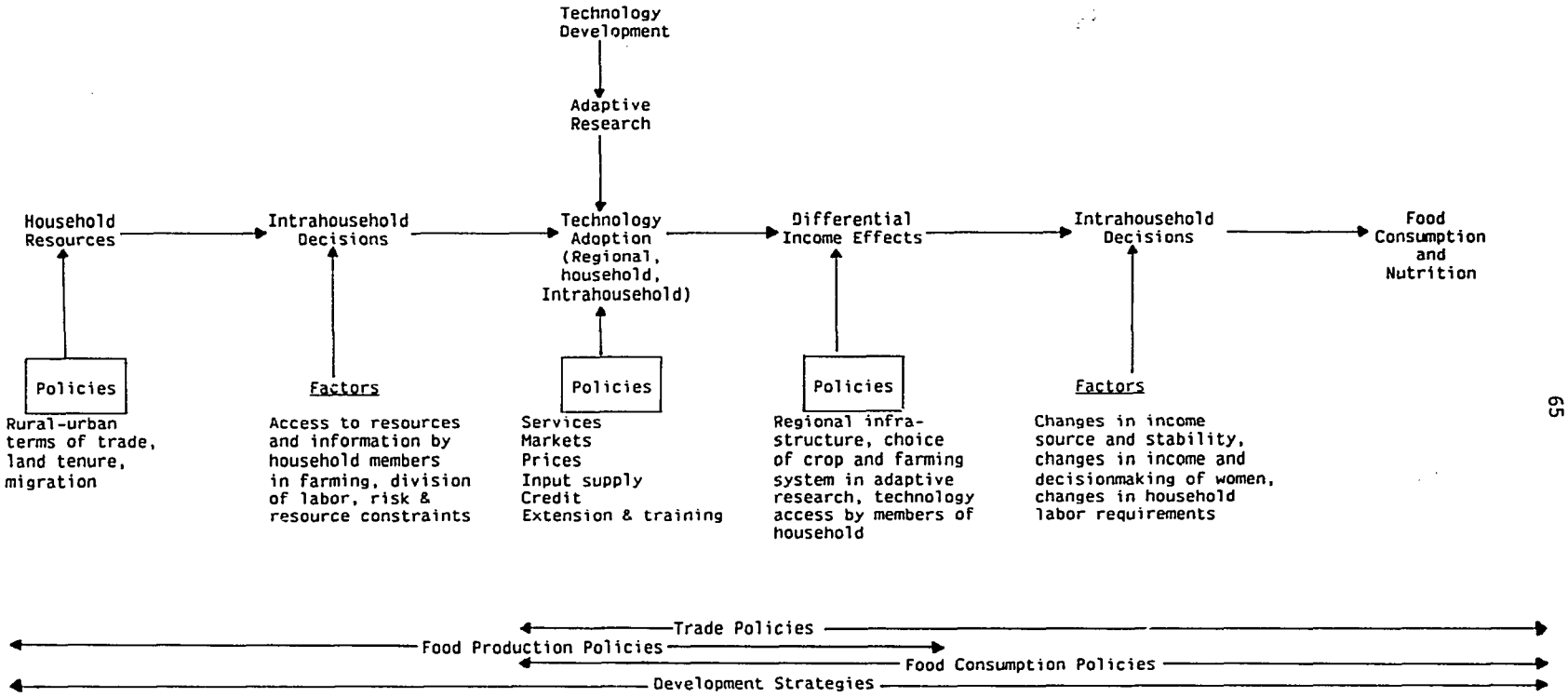
i) The technology adoption process. This includes the role of household resources, policies, and decisionmaking in the adoption and use of new technologies. In examining this process, there are three broad types of studies: the examination of specific options; the specific constraints of small farmers; and the comprehensive nature of incentives required for successful adoption.

ii) The effects of technological change on households and the distribution of impacts. These studies examine the household income, employment, and consumption implications for different types of households.

iii) The intra-household decisionmaking process in resource allocation. These studies examine the influence of intra-household factors which may accompany technological change on outcomes such as women's labor allocation, income food consumption, and children's nutritional status.

In the following sections, some examples of the nature of work undertaken to analyze these processes and impacts are given.

Figure 1 - Technology Diffusion Process, Policies and Effects in IFPRI Research



IFPRI Programs Involved

5. THE SPECIFIC RELEVANCE TO WOMEN OF THIS USER PERSPECTIVE

Two general observations can be made of the user perspective in IFPRI research of relevance to technology adoption. First, equal if not greater attention is given to the indirect "users" in terms of impact assessment. Second, IFPRI research seldom focuses exclusively on population subsections. A basic premise underlying this is that there are so many interdependencies among different groups that often changes occurring for one group - for example, employment - cannot be explained or even understood without knowing what changes are occurring for other groups.

There are two levels at which women are incorporated in the user perspective in IFPRI research. First, as members of households, and second, as individuals. At the first level, which is probably the most relevant, the research is concerned with low-income households, both landless and small farmers, and in examining changes in incomes and explicit welfare or nutritional outcomes. It is generally accepted that in most developing countries, the majority of rural women who are economically active are from the landless and smallholder categories. Time allocation studies have shown the exceptionally heavy work burden that may be faced by women in these households, as well as other household members, compared with households in higher income groups. Furthermore, households headed by women fall in these poverty groups virtually without exception. In studies conducted in areas with a high prevalence of women-headed households, in parts of Africa and Latin America, this factor is also incorporated in the analysis. Within the context of the household, the allocation of women's time has important welfare and production implications, and excessive time constraints are often an impediment for any improvements in either. All of these issues are incorporated in many of the studies.

At the second or individual level, the issues addressed concern the decisionmaking role of women and their influence on production and consumption behavior. As mentioned earlier, this is presently a much more exploratory field of investigation. Most of the work under way at this time is concerned with food consumption and child nutrition. Work is under way on both improvement of theoretical or analytical and empirical bases of intra-household decisionmaking in the allocation of resources for consumption. It is expected that as there is progress in understanding the relevance of intra-household factors to resource allocation in production behavior in different situations, this will also be reflected in the IFPRI research agenda.

6. ADOPTION OF NEW TECHNOLOGIES

The process of technology adoption involves the complex interaction of household and area level resources, policies, availability of technologies, and household or farmer decisionmaking. The work described here is only that which can be related specifically to different segments of the farming population. Even though indirect inferences may sometimes be made on the basis of aggregate analysis, this work is not discussed here. As mentioned earlier, the three types of work in this general area that can be related to categories of users are: examining specific policy options; constraints of small farmers for technology adoption

and/or intensification of production; and examining the comprehensive nature of incentive policies required for successful adoption of improved technologies.

Specific policy options that have been examined for their impact on production and different size farmers are, for example, crop insurance schemes for risk improvement in Panama and Mexico and crop storage loans in Brazil. Results of both these studies concluded that these options were not only ineffective in meeting their overall objectives but were also ineffective in reaching the small farm sector.[1]

Current work on irrigation policies, rural infrastructure, and risk management is also studying the scope of specific options in the process of technology adoption, both in the aggregate and by farmer characteristics. Where feasible, the differential income impacts of such options are also examined beyond the direct user or farmer households. A study on irrigation systems is examining the productivity of alternate forms of irrigation investment on groups of agricultural producers: their labor and input use, and the distribution of income.[2] Another study is examining impacts via the employment and growth linkage effects on incomes, food consumption, and nutrition as a result of creating rural infrastructure in Bangladesh.[3]

Several studies are ongoing which would identify the diverse nature of constraints faced by smallholders in different locations. A major effort is under way in the Sahel on constraints and incentives for millet/sorghum producers, which also incorporates the role of household food security concerns in technology adoption.[4] Earlier work completed in the Sahel determined that incremental returns from ox cultivation alone were insufficient to overcome costs of labor and capital investment in ox equipment for small farms. It highlighted the importance of additional technological measures to improve labor productivity, such as suitable new varieties, in transforming smallholder agriculture in these areas.[5] Other work is focusing on the role of differential household-level labor and food constraints as well as mechanisms for effective access to services for improving production by different types

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1 Peter Hazell, Carlos Pomareda, and Alberto Valdés (ed.), Agricultural Risks and Insurance, Johns Hopkins University Press, forthcoming; Roger Fox, Brazil's Minimum Price Policy and the Agricultural Sector of Northeast Brazil, IFPRI Research Report No. 9 (Washington, D.C.: International Food Policy Research Institute, June 1979).

2 Ongoing project: "Investment Policies for Irrigation Development in Southeast Asia."

3 Ongoing project: "Linkage Effects of Rural Infrastructure."

4 Ongoing project: "Product Mix and Producer Incentives in SAT West Africa."

5 Christopher Delgado and John McIntire, "Constraints on Oxen Cultivation in the Sahel", 1982.

of farmers. In this regard, ongoing work in Zambia has identified both labor and foodstocks as possible constraints for small farmers. It also shows that women farming independently face greater constraints and have lower yields than all other farmers.[1]

In the Asian context, which is usually seen as labor surplus, seasonal bottlenecks may also occur. These may be more critical for small farmers who have a limited capacity to hire workers. The significance of the additional labor required of women to meet needs for fuel-wood, water, and fodder with deforestation and its implications for seasonal labor available for production is being examined in a hilly area of Nepal, which is generally a food-deficit area.[2]

Several studies have been completed on the comprehensive nature of incentives required for optimum production response. While some of this work does not relate specifically to small farmers, the lessons derived are certainly relevant. A study in Bangladesh of agricultural price policies shows the combined effect of producer prices, institutions, technology, and infrastructure on increasing production. For example, fertilizer use was predicted to be five times larger when all of the factors cited were more favorable than with the influence of producer prices alone.[3] Work on the fertilizer subsidy in the Philippines showed that without credit facilities the subsidy was not effective in increasing fertilizer use by small farmers.[4] The role of institutions and services in stimulating rural development has been analyzed. A study in India concluded that government services which facilitate growth in production induce development of private trade and services in a complementary fashion.[5]

7. EFFECTS OF TECHNOLOGIES ON DIFFERENT HOUSEHOLDS

In practice the adoption of new technologies and growth are intricately linked with their impacts on different segments of the population.

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1 Ongoing project: "Food Consumption and Nutrition Implications of Maize Marketing Policies in Zambia."

2 Ongoing project: "Energy Resources, Time Allocation, and Nutrition in Nepalese Subsistence Economy."

3 Raisuddin Ahmed, Agricultural Price Policies under Complex Socio-Economic and Natural Constraints: The Case of Bangladesh, IFPRI Research Report No. 27 (Washington, D.C.: International Food Policy Research Institute, October 1981).

4 Mark Rosegrant and Robert Herdt, "Simulating the Impacts of Credit Policy and Fertilizer Subsidy on Central Luzon Rice Farms, the Philippines", 1981.

5 Sudhir Wanmali, Service Provision and Rural Development in India: A Study of Miryalguda Taluka, IFPRI Research Report No. 37 (Washington, D.C.: International Food Policy Research Institute, February 1983); Sudhir Wanmali, "Household Patterns of Service Use in Rural India: A Study of Miryalguda Taluka", IFPRI Research Report (Washington, D.C.: IFPRI, forthcoming).

Therefore, it may appear somewhat artificial to examine effects independently from the processes leading up to them. However, all studies of technological change do not examine effects, especially insofar as some of the "indirect users", who were discussed earlier, are concerned. While several of the studies mentioned in the previous section are also concerned with effects, this is the primary focus in studies mentioned in the section. However, it should be noted that in the case of these studies as well, it is impossible to dissociate the technological change process from its effects: not only do the characteristics of the process itself contribute to the effects, but the effects themselves may influence the process of change.

The work described in this section explicitly addresses the process of growth with technological change and its household level impacts, in some cases extending all the way to the consumption effects. One study which has been completed reviews post-independence agricultural policies in India and analyzes their effects on agricultural growth and on interpersonal and interregional disparities. It concludes that the new technologies helped accelerate growth in agricultural production, with landless and small farmers gaining in real income even though income disparities widened.[1] Another study integrating production and consumption implications of promoting coarse grain production in West Africa is also under way. This study incorporates the approach of Per Pinstrup-Andersen mentioned earlier and examines both the supply and demand responses by different segments of the population to predict the magnitude and distribution of technology adoption and its impacts.[2]

The effects on income, food consumption, and energy-protein deficiencies of selected technological change related projects are also being analyzed. Among these studies, there are three cases: an irrigation/double-cropping scheme for rice in Malaysia, adoption of high-yielding varieties in India, and evaluating the impacts of improved rice varieties in Colombia. In addition to assessing the ex-post effects on low-income calorie and protein deficient households, these studies will also be used to test an ex-ante assessment method for predicting consumption improvements by vulnerable households with technological change.[3] Also related to this work is the work on household food acquisition behavior, which cuts across several (if not most of the studies in the food consumption area, as well as a methodological study of demand parameters for disaggregated analysis.[4]

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1 John Mellor and Gunvant Desai (ed.), "Growth and Equity: Policies and Implementation in Indian Agriculture" (Washington, D.C.: International Food Policy Research Institute, forthcoming).

2 Ongoing project: "Substitution in Production and Consumption Between Millet/Sorghum and Other Foodgrains in SAT West Africa: Case Studies and Policy Issues".

3 Ongoing project: "Food Consumption and Nutrition Effects of Technological Change in Agriculture and Related Public Policies and Projects".

4 Harold Alderman, "The Effect of Income and Food Price Changes on the Acquisition of Food by Low-Income Households" (Washington, D.C.: International Food Policy Research Institute, 1984).

A group of studies currently under way are examining the growth linkage effects of technological change in agriculture and conditions that influence the degree to which this effect occurs. The primary intent here is to measure the degree of employment and income generation outside agriculture that can be attributed to growth in the agricultural sector, as well as their distribution within the population. Results of work completed in Malaysia suggest that the volume of economic activity generated outside agriculture may be comparable to the amount of increase within agriculture alone. However, the distribution of most of these benefits goes to the middle-income households, or those with the access to some source of capital assets.[1] Further work is under way in Africa, where initial results based on work in Nigeria suggest that there are fewer linkages between agricultural and nonagricultural sectors in Africa than in Asia.[2] The purpose of these comparative studies is to develop a fuller understanding of the prerequisites for enhancing these linkages.

Another question that is related to impacts on low-income households is that of production instability and fluctuations. The role of technology in this regard has been examined. Even though this analysis is not at the household level, indirect inferences on consequences for different household-level characteristics is possible from this work.[3] Current work planned on seasonal fluctuations would explicitly link the role of technological change to income and consumption flows for different types of households.[4]

8. INTRA-HOUSEHOLD FACTORS

Most of the work that has been undertaken either classifies households by the characteristics of the households themselves, such as assets and income, or by the characteristics of the head of household, such as occupation, education, and gender. However, in light of the increasing evidence that intra-household factors may be important in shaping

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1 Clive Bell, Peter Hazell, and Roger Slade, Project Evaluation in Regional Perspective (Baltimore, Md.: Johns Hopkins University Press, 1982).

2 Peter Hazell and Ailsa Roell, Rural Growth Linkages: Household Expediture Patterns in Malaysia and Nigeria, IFPRI Research Report No. 41 (Washingtonn,D.C.: International Food Policy Research Institute, September 1983).

3 Shakuntla Mehra, Instability in Indian Agriculture in the Context of the New Technology, IFPRI Research Report No. 25 (Washington, D.C.: International Food Policy Research Institute, July 1981); Peter Hazell, Instability in Indian Foodgrain Production, IFPRI Research Report no. 30 (Washington, D.C.: IFPRI, May 1982); and ongoing project: "Instability in Foodgrains Production".

4 Ongoing projects: "Seasonal Dimensions of Household Food Security: An Overview Analysis", and "The Impact of Seasonal Fluctuations in Food Production, Prices, and Incomes on Household Food Security in Northern Nigeria."

outcomes for different household members, it would also appear that different household members may not be equal "users" of technological change. This is still an exploratory area of work at IFPRI, and much of the current work aims at contributing toward a better understanding of this process. The processes determining food consumption and nutrition are primarily under investigation at this time and, to a much smaller extent, the intra-household factors influencing technology adoption. A clarification of issues involved in the latter area is necessary, and this seminar could conceivably contribute to that.

Studies on agricultural change in Bangladesh and Zambia and shifts from food to cash cropping in India, Kenya, Philippines, Guatemala, Gambia, and Rwanda[1] are under way, which focus on the intra-household factors or consequences in the labor allocation, food consumption, and/or nutrition of different household members. This is also accompanied by work on a more vigorous theoretical framework for incorporating intra-household factors in household resource allocation and human capital formation.

9. IMPLEMENTATION OF RESEARCH

Perhaps the most significant feature in the implementation of research with a user perspective is that the majority of it involves primary data collection and the need to obtain not just household but individual level data as well.

Almost all IFPRI field research is conducted in a close collaborative arrangement betwen IFPRI and national institutions. This cooperative nature of research is of importance not only in ensuring the content and quality of data but also for the use of results which are described in the following section. Many studies involve a three-way collaboration which also includes other specialized international centers[2] and other CGIAR centers in addition to national institutions.

The precise nature of data required obviously depends on the research questions, but income and employment (including labor or time use) by individual are also important. It has been commonly observed that this individual level information, though it often forms the basis of the household figures, is often not retained in final data sets. The problem in this case, therefore, is not so much data collection as data management, which becomes more cumbersome the more disaggregated the form in which it is retained. Other individual level data, such as budget allocation and decisionmaking, food consumption, and nutrition, need

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[1] Ongoing projects: "Production and Distributional Implications of Dairy Development Projects in Selected Indian States"; "The Food Consumption and Nutrition Effects of Shifts from Semi-Subsistence Maize to Sugarcane Production in Kenya and Philippines"; "Economic and Nutrition-Related Program and Policy Implications of Increased Commercialization of Semi-Subsistence Agriculture in Guatemala, Gambia, and Rwanda".

[2] For example, an in-depth study investigating intra-household impacts of agricultural policies in Guatemala includes collaboration with the International Center for Research on Women (ICRW).

varying degrees of additional survey effort, and choices need to be made depending on the hypotheses, costs, and feasibility of obtaining reliable data. In many instances where intra-household issues are unclear, input by anthropologists is being used by IFPRI to assist in the investigation. In one case - the Guatemala study of shifts from subsistence to cash cropping - the anthropological study precedes the full-scale survey and helps to establish the precise issues and data collection requirements to address these in a larger study.

One of the main problems with conducting this type of intensive field-based research is the need for large research budgets for primary data collection and all associated costs, such as travel, data processing, and support for national personnel to participate in the research. Since IFPRI core is unable to cover most of the out-of-station costs, special project funding has been sought for practically every study mentioned here in order to cover part or all of the costs involved. Inevitably, this means that often choices in content, scope, methodology, and location of studies may be influenced by the avialability of special project funding. Even though this does not necessarily have to occur, there is potential that relatively narrowly defined or short-run concerns may dictate special project funding and influence the research programs. In order to reduce the need for special projects and still carry the present volume of work by the research staff, a rough estimate would indicate that an additional $2 million annually in core allocation would allow 16-20 in-depth studies in three years by the present staff without need for special project funds.

10. USE OF RESULTS

Dissemination of IFPRI research utilizes several direct ways, in addition to the published research reports, abstracts, and newsletters, to encourage discussion of results with policy-makers, research scientists, and administrators. This is carried out both in-country where the research is conducted and through international seminars for policymakers and advisors. In addition, several research networks have been established to help incorporate lessons from IFPRI research and exchange of ideas with developing country scientists. The objectives are: to draw the maximum utility from the research results for policies and future research implications for the country in question, to extract policy implications from groups of studies that would be relevant for other countries to consider, and finally, to facilitate similar research in countries and by institutions where IFPRI cannot directly undertake research. Given the high cost of conducting in-depth studies, each of these is considered essential.

National consultations are an integral part of most studies and it would be difficult to describe all of them. The discussion and dissemination of research results at the national level is greatly facilitated by the collaborative nature of the studies with national institutions and researchers. As a result of this, in several instances research results have been incorporated into policy and program measures even prior to the final report preparation.

An ongoing process of consultations with policymakers has led to the incorporation of results from a forthcoming research report[1] on household patterns of service use into planned programs in the Indian state of Andhra Pradesh. The study recommends selected mobile services to better reach the weaker sections of the population (e.g. small farmers and those in ecologically poorer areas). This finding was analyzed and extended by the state planning department for application in all districts of Andhra Pradesh for the seventh five-year plan period beginning in 1985. Thus, presence of a local capacity enhanced the ability to utilize research results effectively. Use of results is also often made by non-governmental agencies, including donor agencies, in their country programs (for example, by USAID in Egypt). The general observation at this level is that the user perspective is extremely well received.

Several policy seminars and conferences have been organized by IFPRI as a means of directly utilizing research results. These usually focus on selected policy issues and are based primarily on several studies completed here, supplemented with selected pieces of commissioned research by non-IFPRI researchers. While distributional questions may be more significantly featured in some of these (e.g. "Growth and Equity: Policies and Implementation in Indian Agriculture" and "Consumer-Oriented Food Subsidies"), they remain an integral though smaller element in the primarily growth-oriented conferences (e.g. "Accelerating Agricultural Growth in Sub-Saharan Africa" and "Agricultural Price Policies"). Both household and some intra-household level issues represented in IFPRI research have been successfully incorporated both at national and international level policy discussions.

Also significant are the research networks, including those with other CGIAR centers (e.g. on Nutrition and Agricultural Research) and national research centers (on Food Consumption and Nutrition Effects of Shifts from Subsistence to Cash Cropping). A similar network with the International Commission on Anthropology of Food led to a symposium on Household Food Distribution at the International Congress of Anthropological and Ethnological Sciences in 1983. Though some of these

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[1] Sudhir Wanmali, "Household Patterns of Service Use in Rural India: A Study of Miryalguda Taluka". Research Report (Washington, D.C.: International Food Policy Research Institute, forthcoming). Experience by Dr. Wanmali has also shown that an ongoing dialogue between researchers and policymakers leads to a gradual reduction in the lag time between availability of research results and their practical application. Two previous studies by Dr. Wanmali in Andhra Pradesh were incorporated into the state's programs during the 1975-80 and 1980-85 plan periods. Local institutional capacity was a key factor in the effective use of results. Since most in-depth studies are limited to small samples, the use of results to cover larger administrative areas requires an extension of the analysis (in this case, from a single district to the entire state of Andhra Pradesh), involving either a minimal replication or qualitative analysis for other areas not covered. This follow-up was done by the state level planners with some guidance by the researcher.

networks are in their initial stages, they have demonstrated a means for effectively utilizing and incorporating IFPRI research results for further work. Other forums are also used to disseminate IFPRI research approach, methodologies, and results. An example of our active involvement of particular interest to this workshop may be a keynote speech and panel presentation by IFPRI staff at the Women in Development Conference of 1983.

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ANNEX-1

(Abstracted from "The Role of IFPRI Research in Reaching the Overall Goals of the CGIAR", by R. Ahmed and R.H. Adams, 1984)

IFPRI Research and the Role of Technological Change in Agriculture

IFPRI's research program is based on the recognition that if the food needs of the developing world are to be met, the complex interrelationships between technological change in agriculture and the socio-economic policies affecting such changes need to be examined more thoroughly. Policy analysis at IFPRI provides at least three important ways to maximize the socio-economic benefit of the technologies being developed at other CGIAR centers. First, policy analysis at IFPRI relating to the character of incentive structure, institutional development, and investment can play an important role in accelerating the spread and dissemination of new technology. Second, the effect of this technology on different socio-economic groups has to be evaluated in order to protect the status of disadvantaged low-income groups. And third, policy analysis at IFPRI provides the means to study those areas that are more indirectly related to the problems of the new technology, yet are vitally important to the solution of the food problems of the developing world. Each of these relationships between policy and technology will be examined here.

IFPRI Policy Analysis and the Spread of New Technology

Policy analysis aimed at facilitating the spread and impact of new technology must deal with several problems. One of these is: How can this new technology be made profitable to farmers? In the short run, higher profitability is perhaps assured in the sense that any technological improvement in the factors of production reduces the costs of production. But in a dynamic world, this increased profitability may not last. Over the long run, technologically-induced changes in input and output prices, and extraneous changes in these prices as well, may reduce net profitability.

Policy analysis has a wide range of instruments at its disposal to increase the profitability of new technology. In the external market, export, import, and foreign exchange policies can encourage - or discourage - the adoption of new agricultural technology. Research at IFPRI has shown that these policy instruments have economy-wide implications. For example, Research Reports 24 and 36 show that, trade and exchange policies in Colombia and Argentina have generally slowed the rate of technological change in agriculture. This has retarded the growth of Argentinian and Colombian agricultural production as well as the rate of growth of their economies as a whole.

In the domestic market, farm level incentives, stocking policies, and public marketing mechanisms can also stimulate the spread of new technology. A good deal of IFPRI research has focused on the use, and the impact, of these policy measures. For example, Research Report 27 found that in Bangladesh farm-level price incentives must be carefully

integrated with other policy measures - including infrastructure and institutional development - in order to stimulate technological change in agriculture. Similarly, Research Report 38 on India called attention to the interaction between domestic stock policies, procurement and issue prices, and farm level incentives. Citing the high cost of Indian foodgrain stock policies, this report emphasized the need to balance producers' incentives with a concern for the welfare of low-income consumers.

A second problem that policy analysis must address in this area is: How to make farmers aware and convinced of the need to adopt new technology? Institutional mechanisms - agricultural extension and credit institutions - can plan a pivotal role in solving this problem. Yet since effective research on these and similar mechnisms needs to focus on local institutions, IFPRI generally leaves such research to the national institutes. But in the broader area of the provision of rural services, IFPRI has been able to do useful work. For example, Research Report 37 pinpoints the need for the public sector to lead in providing a wide range of rural services, including transport, marketing, and the development of infrastructure. According to this report, the government's provision of such services encourages the private sector to grow and invest in the countryside, thereby facilitating the broader processes of rural socio-economic development.

A third problem that policy analysis must address in facilitating the spread of new technology is: What kind of inputs are needed to complement the use of this technology? Past research has shown that expanding the supply of fertilizer, water, and other inputs is crucial to accelerating the rate of adoption of new agricultural technology. Much work at IFPRI has, in fact, focused on the importance and complementarity of these inputs. Research Report 31, for example, analyzes the factors affecting the growth of fertilizer use in the developing world. Stressing the supply side factors which influence such growth, this report notes that domestic fertilizer production needs to be increased sharply, and local-level distributional channels expended and upgraded. Other IFPRI woirk emphasizes the need to expand the amount of irrigated land throughout the developing world. Research Report 20, for instance, states that the extension of irrigation systems contributes significantly to the type of growth in cropping intensity that is needed to sustain a high rate of technological change in agriculture. Concern with the effect of such expanded irrigation systems on different types of farmers led IFPRI to join forces with IRRI and the Asian Development Bank in the collaborative research project on irrigation described above.

Policy Analysis Needed for Technological Evaluation

Policy analysis is needed to evaluate technology in order to identify problems in the process of generating technology and to assess its overall impact. IFPRI is evaluating several different levels of technology.

A first level relates to mechanisms for generating new agricultural technology. National and international research centers require adequate

funding, manpower, and institutional support in order to generate new technology. In an important collaborative work, mentioned above, IFPRI and ISNAR evaluated the status of national agricultural research systems in 51 developing countries. The results of this work suggest that while the amount of public resources allocated to agricultural research is slowly rising in the developing world, the distribution of these allocations remains quite uneven. According to this study, 62% of all expenditures on agricultural research in the developing world is concentrated in just five countries. Other IFPRI research pinpoints the need to improve the management and the funding of national agricultural research systems in the developing world. Research Report 17, for instance, shows that problems of poor research management, staff inadequacy, and high personnel turnover have greatly hindered the performance of the Nigerian research system.

A second level of evaluation relates to how the new technology is actually performing. In recent years IFPRI has been evaluating the effect of the new seed-fertilizer technology on aggregate production and yield variability. Research Reports 25 and 30 show that aggregate production instability in foodgrain production in India has increased since the introduction of the new seed varieties. Comparison with data from the United States and other major food producing countries yields similar conclusions. The new technologies are partially responsible for this increase in instability, but probably more because of their role in increasing yield correlations between farms and regions than because of increased variability at the farm level. IFPRI is currently analyzing these and similar questions in more depth, in order to identify policies that can reduce these production variabilities.

A third level of evaluating new technology focuses on the critical question of the direct socio-economic impact of this technology. How has the adoption of new technology affected aggregate production, and what type of socio-economic groups have benefited from the spread of that technology? Of particular importance here is the differential impact of technology on various types of producers and consumers. Over the years IFPRI has in fact paid much attention to this problem, as its work on food subsidy programs shows. In many developing countries subsidy programs often represent the most effective means of protecting those poor consumers who lack purchasing power in either a technologically dynamic or stagnant environment. For example, Research Reports 8, 13 and 40 analyze the important effect that food subsidy programs have had in protecting the nutritional status of the poor Bangladesh, Sri Lanka, and Egypt. Yet results from some of this research suggest that the efficiency of several existing subsidy programs could be improved. For example, Research Report 32 shows that present food subsidy policies in Brazil are not the most efficient in increasing the calorie intake of poor consumers. According to this report, if the goal is to increase the calorie intake of the poor without increasing government costs, the present subsidy on wheat should be replaced by one on rice.

A fourth level of evaluation - one not commonly analyzed - is the size of the indirect effect of new technology on overall growth and equity. Given its concern with broad questions of agricultural and rural growth,

IFPRI is attaching much importance to this analysis. Past research indicates that the direct and indirect growth linkages effects of technological change in agriculture are quite large. For example, Research Report 33 found that a 1% increase in the growth rate of Indian agriculture raised the industrial growth rate by 0.5%. Similarly, IFPRI work at the regional level in Malaysia showed that each dollar of income generated among farmers by an irrigation project generated a similar amount for the region through indirect linkage effects, mainly of household demand for consumer goods. In addition, current IFPRI research is evaluating the distributional consequences and the direct and indirect income and employment effects of high-yield varieties of rice in India.

Complementary Areas of Policy Analysis

The previous sections have attempted to demonstrate the salient role that IFPRI policy analysis has played in maximizing the socio-economic benefit of the technologies being developed by other CGIAR centers. Yet it should be recognized that the search for policies to solve the pressing food problems of the developing world encompasses questions not directly related to the use of the new agricultural technology.

For this reason, IFPRI policy analysis is geared to a broad definition of the food problem. For example, food aid, world trading arrangements, and special food security schemes may have a substantial effect on food production and availability throughout the developing world. It therefore seems useful to present some of IFPRI's work in these areas under the heading "complementary areas" of policy analysis. Work in these "complementary areas" focuses on those policy measures that are not directly related to questions of the new technology, yet are equally important to the solution of the food problems of the developing world.

Policy analysis can make an immediate and lasting impact on the magnitude of the world food problem. A good example of IFPRI policy analysis on the global problem is its food security work. IFPRI Research Reports 4 and 18 played an important role in identifying the character of the food security problem, and in demonstrating the inadequacy of traditional solutions (for example, international grain reserves) of this problem. Other IFPRI research showed that variability in the volume of food imported - and not the world price of food - explained most of the variability in food import costs for developing countries. As demonstrated in the IFPRI reprint "The Role of Research in Policy Development: The Creation of the IMF Cereal Import Facility", these and other pieces of IFPRI research ultimately played an important role in the creation of the IMF cereal import facility.

IFPRI has also analyzed the effect of developed-country policies on the character of agricultural performance in the developing world. Research Report 14, for example, examined the effect of domestic price policies in wheat exporting countries on price and supply fluctuations in the international wheat market. This report noted that, although the sharp rise in international wheat prices in the early 1970s was not caused by the policies of developed-country, such policies contributed significantly to the size and duration of this crisis.

IFPRI's work on trends in the production, consumption, and trade of the major food commodities has done much to identify the magnitude and location of emerging food gaps in the developing world. Certainly, IFPRI Research Reports 2, 3 and 11 helped establish the pressing need to do more research on the unique character of Africa's food production problems. The findings of these reports also paved the way for IFPRI's recently concluded conference on agricultural policy in Africa, a conference that was attended by researchers from a large number of CGIAR centers.

In many developing countries the food gap problem takes on an added dimension because of the inability of local economies to absorb the high costs of commercial food imports. The policy analysis of food aid becomes particularly relevant to these countries. On the one hand, food aid is generally viewed as an important short-term tool for alleviating the problems of starvation and malnutrition in the developing world. Yet at the same time food aid has often been accused of having a strong disincentive effect on domestic agricultural production. IFPRI is currently examining the effects of these forces in order to improve the character of its recommendations to policymakers.

In the poorest countries of the world, food aid in the short run and technological change in agriculture in the long run may represent the most effective way to increase food supplies. But what policies can facilitate the delivery of these food supplies to the poorest members of society? This is a formidable question, one that arises even in those countries not experiencing a net increase in food supplies. At the crux, it is a question that focuses attention on the need to provide food and income supports to those members of society who are bypassed by the income-multiplying effects of technological change in agriculture. Several IFPRI studies on the ability of food subsidy programs to protect the nutritional status of the poor have already been cited above. Yet others should be noted. Research Reports 7 and 13, bring out the significant finding that the consumption and nutritional effects of food subsidy income on the poor are significantly larger than most other forms of income. Research Report 8 demonstrates that even though a larger proportion of the subsidized food in Bangladesh goes to better-off urban areas, the nutritional status of the poor would be much lower without such a program. In February 1984 the results of these and similar pieces of IFPRI research will be shared with other CGIAR centers at a workshop on incorporating nutritional goals into the process of international agricultural research.

Women and Agricultural Technology

Critique and Program Strategy

by

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1. IITA AND THE SCOPE OF ITS MANDATE

Established in July 1967, the International Institute of Tropical Agriculture (IITA) has a worldwide multicommodity-improvement mandate for cowpeas, soybeans, yams, sweet potato, cocoyams, plantains and bananas and for farming systems in the humid and subhumid tropics with the CGIAR SYSTEM and regional responsibility for maize, rice and cassava. On the basis of this mandate, the programs of IITA are organized into three groups: Crop Improvement, Farming Systems and the International Cooperation and Training Program. The crop improvement programs consist of the cereal improvement program which emphasizes the improvement of maize and rice for various environments in Africa, in cooperation with CIMMYT and IRRI; the grain legume improvement program which emphasizes cowpea and soybean; and the roots and tuber improvement program, in which priority is given to the improvement of yam and sweet potato worldwide and cassava in Africa in cooperation with CIAT. Included also are plantain and bananas. No other CGIAR institution has the complexity of IITA, either in terms of number of mandated crops or the supporting systems required technology. In the presentation to International Centers Week (Washington D.C., 9 November 1984) on EVOLUTION AND CHANGE AT IITA - THE WAY AHEAD, IITA Director General E. Hartmans explained that "the Institute's past research and achievements have brought it to the beginning of a new era of influence and impact in Africa - and this at a time when its work, and that of its sister institutes within the CG system are acknowledged to be critically important for the future of food production in the continent." (Hartmans, IITA 1984).

2. PRIORITY ON THE AFRICAN REGION

International news headlines focus on the famine, on the food aid requirements and not on the potential of agricultural development in the region. Africa is receiving the priority. Of the 38 countries listed by FAO's Global Information and Early Warning System on Food and Agriculture, 27 are African states (FAO, 1984). The World Food Program forecasts that yearly food output will drop below 100 kilos per person for 1984, whereas the requirement per person is about 145 kilos. However in some countries, food shortages are regional rather than national. Three Sahelian countries - Niger, Mali and Burkina Faso - have experienced bumper harvests in some regions, while suffering ruined crops in others.

One however cannot underestimate the serious food shortage, considering that during the 1970's, food production per person in the African Region dropped by more than 10%. The present situation is exaggerated by (1) population growth versus increases in crop production, (2) cereal imports and (3) food aid. Africa's population increased by 3% annually during the 1970's but food production rose by an average of only 1.8% a year. (FAO, 1983). Further constraints include a lack of trained personnel and supporting infrastructure. Over the past two decades, food consumption dropped below nutritional requirements and there is increasing dependency on food aid in some regions. The cereal import requirements for 1985 are

now projected to be 5.3 million metric tons, 65% more than the previous season. Export earnings are increasingly utilized for food purchases. In Sub-Saharan Africa alone the cereal import bills in 1979 and 1980 were equivalent to 30% of their total agricultural export earnings - while in some countries, these bills accounted for nearly all of these earnings. The result is that Africa has to depend heavily on foreign aid, especially food aid, to the extent that the region - despite having only 15% of the population of the developing world - now receives about 30% of offical development assistance. Africa is also the largest recipient of food aid - receiving some 50% of all food aid flows to the developing world - a figure which has dramatically risen within the past few months (Economic Commission for Africa (ECA), 1984). All these factors - the drop in food production, the long term impact of nutritional deficiencies on efficiency and productivity in ensuing years and a possible dependency on food aid have major implications on "users categories" to accept new technologies.

The mandate of IITA as the only CGIAR crops research institute headquartered in Africa and the dedication of the scientists is based on the positive and potential factors of agricultural development in Africa. The FAO Study of Land, Food and Population shows that with new developments at the intermediate level of technology, the continent could feed up to five times its population by the year 2000. This prediction is significant, given the fact that the continent's population will double by that time. The intermediate technology level introduces limited use of improved varieties and agricultural chemicals, reduced fallow; animal traction as well as manual labor; some conservation measures and optimum crop mixes on half of the land (FAO 1983). Although FAO maintains that Africa has this potential by the year 2000, we realize that the interim task will depend on the development of supporting infrastructure, training and the promulgation of women's activities. It is difficult to imagine such an increased production level in 15 years, considering that in 1985, 85% of the land clearing done in Africa is completed with a short handled hoe, only 2% of the farms utilize mechanization and 13% animal traction.

The land on which IITA has a mandate in Africa is one dominated by shifting cultivation. In Africa, the area under shifting cultivation represents more than 30% of the estimated total exploitable area. The problem of land resources is unique to tropical Africa. Approximately 30 African countries are in the shifting cultivation areas with a population of about 300 million people (FAO, Tiffin, 1984).

IITA's audience is the traditional farming system, a complex situation in which the farm and household unit is made up of several component systems consisting of food and cash crops, compound/homestead garden, and animal production systems, with several non-agricultural activities (Okigbo, IITA, 1984). It is with this background of IITA's mandate, the seriousness of the African food situation and the complexities of a multiple crop farming systems so different from Asia that general constraints for "user categories" are presented. The last sections deal with IITA's experiences and future program strategies.

3. CONSTRAINTS FOR A MORE ACCURATE REFLECTION OF ALL USERS' CATEGORIES

3.1. Farming Systems/OFR has not adequately included gender variances

Much of the farming systems research has not adequately considered the role of women as decisionmakers and agricultural producers nor the household unit as part of the total farm perspective. The recording of work units, the development of recommendations domains and nearly all reviews, guidelines and methodologies for farming systems research have not considered sufficiently gender and resource variances. Data collection continues to be designed around the man as the head of the household. All male teams tend to concentrate on the work of the man in the field and "his" constraints to more efficiently adopt a technology. Some center staff have argued that factors related to gender should be considered only at the diagnostic/exploratory survey stages. Women's role still tends to be considered within the social categories without any economic value given to their contributions or an evaluation of potential negative consequences for women with the introduction of some technologies.

For instance, the issue of gender was not unanimously supported at the recent Inter-Center Consultation on Farming Systems Research in Eastern and Southern Africa (ILRAD, 18-20 October 1984, Nairobi). However, after considerable discussion it was finally decided that the final report could include this statement:

> "There was agreement that trials should be evaluated by farmers and researchers using agronomic, economic and social criteria, such as household and nutritional factors, and the role of women." (CIMMYT, 1984).

Farming systems, in general, has not been sensitive to women's major input to agricultural production nor has an economic value been placed on the last three stages of the food system perspective - the post harvest, the food distribution and the food preparation and consumption stages. Yet extensive data regarding women's work in agriculture present a clear picture as to their contributions. In sub-Saharan Africa, women represent 46.2% of the official agricultural labor force (Dixon, 1983). Approximately 22% of the rural households in the same region are de-jure headed by women. In areas of high out-migration of males, the percentage of household heads which are de-facto headed by women is much higher, reaching 63% in one Southern African country (Buvinic, and Youssef, 1978).

With the introduction of new agricultural technologies, there are unintended consequences and many are negative consequences which increase women's work load, decrease independent capabilities for women's use of family income or limit the range of food crops for consumption at the household level. The introduction of technological change also affects the division of labor by sex. For instance, studies have indicated that to date more rice technologies have been introduced for men with negative consequences for women. In Madagascar mechanized ploughing has reduced men's labor input in this task and permitted an expansion in the area under cultivation which has in turn increased demand for labor in transplanting and weeding. Dey has written that the swamp rice development project in the Banfora region of Upper Volta (Burkina Faso)

imposes substantially more intensive cultivation practices (line transplanting, fertilizers, careful weeding and water control). Since rice production is entirely the women's responsibility, this has considerably increased their workload (Dey, 1983). The study by Burfisher and Horenstein indicates the additional work load for women in a development project among the Tiv in Nigeria. The project envisages an increase in productivity of nine major crops (including three coarse grain crops) in the hopes of raising the level of home consumption and of marketed surpluses. The crops are already grown by the Tiv with well demarcated divisions of labor and income for each of the crops. The study finds that while the annual labor requirements of the total farm are expected to increase by 14%, a disaggregation of the total farm indicates that women's annual labor requirements will increase by 17% while men's will increase by 6% (Burfisher and Horenstein, 1982).

Farm mechanization also can have a negative impact upon women's work load. A study in Sierra Leone found differential effects of varying technologies on male and female labor inputs in the sex-specific nature of some farm activities. In the Bolilands, mechanization almost completely eliminates the land preparation undertaken by men but increases farm size so that there is an increase in the demand for labor. In this case, females worked 50% more in the households utilizing primarily mechanized cultivation than in those using primarily hand cultivation (Spence and Byerlee, 1976).

As part of an IITA research program, Heather Spiro completed research on women's involvement in agriculture in two Nigerian villages. She concludes that the reasons of the continued "invisibility of women" are their involvement in food crops which biases their total contributions (Spiro, IITA, 1980). Ay and Nweke give another reason in that research findings in social studies still reflect the dominance of researchers and publications from industrialized countries. The authors conclude that the social background of these researchers is reflected in the descriptions of African societies often ignoring the different social structures (Ay and Nweke, IITA, 1984).

Adequately planning a multi-disciplinary and male/female OFP interview team is sometimes difficult. However, the relevancy of any on farm adaptive research - both for the design and application - must include women and men in all stages of design, implementation and evaluation. IITA has recognized this necessity. To address the imbalance and paucity of information concerning women, the IITA female socio-economists and several female counterparts were members of the IITA on farm research multi-disciplinary team which recently completed diagnostic surveys in five villages, Oyo State.

3.2. On-Farm Research Tends to Under-Estimate Women's Multi-Faceted Work in both Household and Agricultural Production

On-farm research has tended to under-estimate women's multi-faceted contributions. The emphasis remains on the field and usually one commodity. The reality is different. Time for household and agricultural work by season, by task and by family assignment is specific and ensures a delicate balance to maintain the multiple cropping system

which is predominant in the shifting cultivating/bush fallow system of African agriculture.

In general, most labor force statistics have a built-in tendency to underestimate women's contribution to production. Efforts to evaluate subsistence work carried out by women in the household have been the exception, rather than the rule (Beneria, 1980). However, these are recent endeavors to better define and value household production. Goldschmit-Clermont proposes that a monetary estimate be placed on the income in kind generated by the household. The value added being the "Expense forgone by the household as a result of producing instead of purchasing." (Goldschmidt-Clermont, 1984). Another approach is the "New Home Economics Model" which assumes that if a household member works in the household rather than in the market, it is because returns from unpaid household work are perceived as equal to or higher than those from market work. IITA is assessing these models for appropriate inclusion in a farming systems strategy for the necessary balance between field and household and a value for work inputs in both the production and consumption cycle.

4. IITA'S EXPERIENCES WITH IDENTIFICATION OF USERS' CATEGORIES

IITA has considerable experience in identifying users' categories. Studies include a "Manual for Identifying Innovations for Small Farmers" (1979) which outlines a methodology and a proposed questionnaire for the testing of innovations which are the most acceptable to the farmer. A 1979 study on "Unit Farms and Farming Systems Research" specifies five unit farms corresponding to five different levels of technology for profit maximization. Another document highlights "A Farming Systems Approach to Tropical Agroforestry" (1980) with emphasis on smallholders. Two other documents focus on farming systems in various ecological zones - an overview on "Farming Systems in the Humid Zone of West Africa" has been undertaken by Kenneth Menz and "Farming Systems of the Nigerian Savannas" by J.B. Raintree. An excellent study by F. Nweke and F. Winch is on "Bases for Farm Resource Allocation in the Smallholder Cropping System of Southeastern Nigeria: A Case Study of Awka and Abakaliki Villages" (1980). A multitude of other studies have been crop specific, including "The Potential of Soybeans in Nigeria" (Knipscheer and Ay 1982) and "Cassava Bench-Mark Study" (Ezeilo, Flinn and Williams, 1980). Other studies have looked at multiple crops - "Benchmark Surveys of Three Crops in Nigeria - Wheat, Millet and Sorghum" (Knipscheer, Menz and Khadr, 1980) and "Survey of Food Crop Farming Systems in the ZAPI-EST", East Cameroon (Atayi and Knipscheer, 1980) (Complete listing - Appendix 1). Nearly all the studies were financed by core budget and undertaken by staff of the Agricultural Economics Unit of IITA. Most of the studies placed users' categories within the framework of (a) residency in an ecological zone or site, (b) one or a multitude of crops, or (c) a farm unit categorized by size or resource level. For the most part, little attention was given to gender factors or specific needs of female producers. In many of the earlier studies there was a major deficiency in the value given to women's agricultural work. Female work was often times calculated to be less efficient and transformation factors were utilized to estimate total labor input per unit area. One study on rice farming in the Plateau State of Nigeria clearly showed that a transformation figure of less than one for female labor was not

applicable within the "mandays and manhours" categorization. A closer assessment would have shown that women's work was equal and perhaps more efficient than male labor in tasks of seeding, transplanting, harvesting and marketing. Only a few studies have recognized women as independent owners of land and managers of much agricultural production and all marketing. Another major gap is the assessment of the household work as well as decision-making between men and women as to the type of crops grown, period of harvesting and quantities of food sold and consumed at home. Women's empowerment for compound/household crops, including multi-use trees, as well as the uses and nutritional importance of indigenous fruits and vegetables in traditional farming systems has been given little attention.

Several doctoral theses done in collaboration with IITA have focused more specifically on women's role in agricultural production and acceptance of new technologies. These include The Role of Women in Farming and Trading in Oyo State, Nigeria (H. Spiro, IITA, 1980) and Yoruba Smallholders Farming System (Zuckerman, IITA, 1973). Based on extensive interviews by the authors, a discussion paper on "Women in Food Production and Research" gives an excellent overview on women's work and status (Ay and Nweke, IITA, 1984).

5. IITA'S STRATEGY FOR MORE APPROPRIATE USERS' CATEGORIES

5.1. Institutional/Organizational

A user-sensitive approach to institutional and family acceptance of technologies is one of the objectives of the Socio-Economic Unit at IITA Farming Systems Program. An expanding unit, the staff consists of four socio-economists including two production economists, a social scientist and a social anthropologist. By the end of 1985, eleven socio-economists will be included as members of inter-disciplinary IITA Farming Systems teams in six African countries. As endorsed by the April 1984 Technical Advisory Committee (TAC), top priority is being given to the decentralization of IITA activities. The unit is one which aims to direct and assess research in IITA's Crop Improvement Programs and provide linkages and collaboration between staff in the Farming Systems and Commodities Programs.

A strategy for user approaches is now being developed for IITA's On Farm Adaptive Research. Until now, the emphasis has been on the agronomic factors of On Farm Research (OFR). Closer links between the OFR group and the Socio-Economic Unit, particularly for diagnostic/exploratory surveys has resulted in a broader focus on socio-economic features within the methodology. Early in 1985, an IITA manual/guidelines on OFR will be developed. Increasing attention will be given to gender and resource factors as well as household production.

5.2. Network Facilities

Networking is being recognized as an efficient means to make the best use of limited funds. Duplication and redundance is avoided, scarce resources are utilized to the optimum and the communications between national staff and international centers can accelerate the transfer of technologies.

Two African agricultural networking groups have been assisted by IITA. One is the West Africa Farming Systems Network (WAFSRN) which is a seventeen-country network with plans to establish regional collaborative trials on cropping systems and to organize a series of workshops. 1985 workshops are planned for Cameroon, Togo and Senegal with a regional workshop planned for November, 1985. The other network is the West Africa Regional Cooperative for Research on Plantains which coordinates the activities of scientists engaged in research on plantains. Collaborative experiments include tissue culture, off-season production, weed control, plant nutrition, mulching, black sigatoka control, multiplication techniques and socio-economic analysis. In addition, IITA plays a major coordinating role for the International Association for Research on Plantation and other Cooking Bananas (IARPCB).

The strategy for a greater concentration on women's role in agricultural research and development has been to review the existing IITA-supported networks, their national and international affiliation and membership, source of donor support and to suggest a reorientation for a more balanced perspective within network membership and workshop/conference themes. One such example is the International Conference on International Cooperation for Effective Plantain and Banana Research scheduled for May 1985 in Abidjan, Ivory Coast. Additional funds have been obtained for a Roundtable on Women and Plantain and Banana Production and Utilization at the conference and to specifically invite women participants.

Most of the existing networks concerning women and development have not adequately considered agricultural research and certainly most of the agricultural research networks have not considered women. Therefore, emphasis is being given to the introduction of gender issues within agricultural research programs and agricultural research themes within women and development networks. With estimates of over 100 international networks in agriculture (Plucknett and Smith, 1984) IITA will be making an effort to sensitize and introduce gender factors for a more balanced "users' categories" within those networks related to IITA's mandate.

Linkages are being strengthened between IITA and the United Nations and several specialized agencies. With IITA representation at the African Regional Intergovernmental Preparatory Meeting for the World Conference to Review and Appraise the Achievements of the United Nations Decade for Women (Arusha, Tanzania, 8-12 October 1984), the following mandate was approved in the section on Agricultural and Food Production:

> "The Consultative Group on International Agricultural Research (CGIAR) should give greater attention to the applicability of their research on household production for food crops and particularly the role of women in decision-making and in the process of technology transfer."

IITA has requested a Roundtable session on Women and Agricultural Research and a display at the Forum (Nairobi 8-17 July 1985) for the World Conference to Review and Appraise the Achievements of the United Nations Decade for Women (Nairobi, 15-26 July 1985).

Collaboration is being developed between IITA and the ECA Women's Training and Research Center for the dissemination of documentation on women and agricultural development to national institutions and researchers.

5.3. Linkages with National Institutions

During the past 10 years, IITA has collaborated with 31 national agricultural research programs in Africa; there are memoranda of understanding for on-going research and training with 12 African national programs, and with 9 universities worldwide. Increasingly, these agreements include the outposting of IITA scientists. There are decentralized activities in 7 African countries, and in Brazil and Southeast Asia, which together employ 27 staff. With the outposting of IITA teams and the increased staff in the Republic of Benin, Cameroon and Zaire, the total staff in those programs will be nearly 50 in 1985. The new center in the People's Republic of Benin is a major move into Francophone West Africa. Fifty hectares have been allocated for research and training facilities on the land of the University of Benin at Cotonou. A major training initiative in Eastern and Southern Africa will be possible with a multi-disciplinary farming systems team in Tanzania in agreement with the new Sokoine Agricultural University at Morogoro. Collaborations with national institutions have involved multilocational testing programs. The International Cooperation and Training program has strengthened relationships with a number of regional programs. These include the Semi-Arid Food Grain Research and Development (SAFGRAD) project with headquarters in Burkina Faso in which an IITA maize and cowpea scientific team has participated since 1978.

Several major activities are being undertaken immediately with existing resources, including (1) the training program; (2) assistance to the African Home Economics Association; and (3) documentation and information program.

(1) A shortage of well-trained persons ranks as one of the most serious handicaps for the staffing of institutions to absorb the technologies and to be sensitive to appropariate user categories. Therefore, training is a top priority within the Institute's effort to strengthen national programs. Since 1970, there have been 3,238 graduates of IITA courses. Certainly these graduates have influenced national research and development capabilities. But there have been few women and every effort is now being made to increase their participation, both within the training courses and as masters and doctoral students affiliated with IITA's projects. In 1984, there were 445 IITA trainees, of which only 32 (7.2% of the total) were women.

(2) A major review and reorientation is required of the home economics institutions with an introduction of more balanced home economics/agricultural curricula and in-service training in the agricultural fields. An assessment needs to be made on the levels and requirements of home economics extension staff in Africa - they form the largest cadre of female extension staff. Their numbers are in the thousands (Nigeria 5,000, Ethiopia 540, Uganda 405 and Kenya 635) yet their training is not equal to that of

their male agricultural extension colleagues. IITA is assisting the African Home Economics Association for an improved network facility and linkages with international donors for fellowships, particularly in the agricultural sciences and research fields.

(3) For any institute to be sensitive to appropriate user categories, there must be available documentation at the institute's library and facilities to disseminate this information to national institutes and outreach staff. Given the shortage of necessary foreign exchange and funds for the purchase of books, provision of appropriate abstracts and articles can provide an invaluable service to cooperators and institutions throughout Africa. For that reason, IITA is increasing the number of socio-economic references at the library. Two thousand new entries on women and agricultural research are being abstracted and placed in the computer system. Priority will be given to the dissemination of this information to agricultural research institutes and agricultural colleges/universities as well as women and development national machineries/units, in collaboration with the ECA Women's Training and Research Center.

5.4. Major Trends of Special Program Areas

There are several major areas and shifts of emphasis within IITA's overall program which will shift attention of user categories. Most of this work will require additional resources and staff.

A. Compound and Homestead Utilization

There is nutritional importance and major potential for the development of indigenous fruits and vegetables within traditional farming systems. In the publication, "Tropical Leafy Vegetables in Human Nutrition", Oomen states that "the total number of wild tropical plants used as edible greens including 'weeds' collected in the field exceeds 1,500 species. Some 50 to 200 species in each area may be traditionally known, but they do not contribute more than 10% of the leafy vegetables actually consumed, because the knowledge of these wild plants is getting lost and their contribution to people's diet is decreasing". (Oomen, 1977).

In IITA-conducted interviews with female extension staff in Uganda, they assessed that the survival of many rural households was possible with intensified compound utilization - "household gardens", as they described them and a sudden emergence of traditional plant foods that had not been produced or consumed in years.

Surveys are being planned by IITA to further document the compound utilization - the structural composition, productivity, use and economics of homestead gardens and compounds. The preliminary and preparatory phase of this work will also identify the utilization of multi-use trees and shrubs.

Of continuing importance will be IITA's alley cropping food production method which is essentially an agro-forestry system which involves growing of food crops in alleys formed by hedges of trees or shrubs (Kang, Wilson and Lawson, IITA, 1984). The alley cropping maintains the

basic positive features of bush fallow. Research in the use of "food shrubs" and trees in alley cropping systems, with Leucaena, is considered a stable system for tropical agricultural production.

Since there are other international centers and institutions involved with compound/homestead utilization and alley cropping, it provides some collaborative work with International Center for Research on Agroforestry (ICRAF), ILCA, CIP, FAO and IDRC.

B. Appropriate Farm Equipment and Tools

The IITA agricultural engineers have developed some farm machinery suitable for no-tillage in the tropics. This equipment has included the farmobile which has been designed for small farms operating less than 5 ha, the rolling injection planter which is suited for the rough cleared forest and humid tropical conditions and simple hand-operated corn shellers. The economic assessment of this machinery has proven to be efficient and the technologies are being tested with on-farm experiments (Garman, Ngambeki and Navasero, IITA, 1982-83). A further assessment of this equipment will include its acceptability by women. Attention will also be given to the design of other equipment (machinery and tools) for women's agricultural work, as well as food processing, storage and marketing.

C. Women and African Food Crops

IITA should be initiating studies of women's role in both agricultural and household production. The perspective should be the total production cycle - from field to household and/or market for each of the mandated food crops. All stages within the food system perspective should be considered, including (a) food production, (b) post-harvest, (c) food distribution and (d) food preparation and consumption (Presvelou, 1982). Emphasis is to be given to women's empowerment on land access and use, decision-making as to household consumption or marketing and a monetization of work done in the household on that particular food crop. This approach will allow for a hopeful inclusion of gender and household factors within on-farm research with more quantifiable information on that food crop. Another factor to be studied in the methodology is the nutritional impact of a shift from subsistence to cash crops (Kennedy, IFPRI, 1984).

D. Utilization of IITA-Mandated Crops

At the World Cowpea Research Conference (4-9 November 1984), IITA was mandated to expand its cowpea utilization program. Priority attention is to be given to both cowpea and soybean utilization at the household level with an identification of traditional and improved methods of processing, preparation and storage.

Roots and tubers utilization should be further investigated. Roots and tubers are a major source of calories for over 35% of the population in Africa. New varieties of disease-resistant sweet potatoes have made dramatic production increases. Thirteen African countries are largely dependent on root crops for their food supplies (Gebremeskel, IITA, 1984). Participants attending the IITA East and Central African Regional

Root Crops Workshop (10-15 December 1984, Kampala) discussed the need for increased training, particularly designed for women, on roots and tubers production and utilization.

IITA welcomes the organization of this meeting by ISNAR on Women and Agricultural Technologies for a more effective "users' categories" research program. We hope the meeting will determine priorities and specify collaborative inter-center programs.

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Development of Agricultural Technology for Different User Categories: Some ILCA Experiences

by

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1. INTRODUCTION

ILCA's mandate is to carry out research, training and documentation activities to assist national efforts to increase African livestock production. Research is conducted within a farming systems framework which provides an appropriate context for examining specific issues concerning women and agricultural technology and different categories of technology users.

ILCA's position, as the only CGIAR institution addressing livestock as a multifaceted commodity, and its location in Africa, which includes a wide variety of farming systems and ecological zones, provides the center with an exacting challenge in terms of technology development. Livestock are not only a source of food and income, but also provide hides or skins, draught power, fuel and fertilizer. Technological innovations must address themselves to the primary and subsidiary uses of livestock in a particular system, to the mix of animals present and their individual contributions to the system, as well as to the complementarity between livestock and cropping systems.

The centre's organizational structure is one of research programs in the field supported by central research units at headquarters in Addis Ababa. The field research programs work in close cooperation with national institutes and conduct on-station research and on-farm studies. These programs are located in the major agro-climatic zones of sub-Saharan Africa as shown in Figure 1. They cover both pastoral and mixed crop-livestock systems. Three of the field programs are in West Africa - the arid and semi-arid programs in Mali and the humid and subhumid programs in Nigeria. The Ethiopian, Kenyan and Botswana rangelands programs cover livestock production by pastoralists in east and southern Africa. The field work of the highlands program is carried out in the Ethiopian highlands.

2. ILCA'S EXPERIENCE WITH IDENTIFICATION OF USER CATEGORIES, THEIR NEEDS AND POTENTIAL

ILCA, like many of the international centers, has adopted a farming systems research (FSR) approach which seeks to:

- understand the components of a given farming system and their linkages;
- identify the constraints to agricultural production within that system;
- design and carry out research aimed at removing these constraints;
- test potential improvements through on-farm (or on-range) trials; and
- monitor the adoption of improvements.

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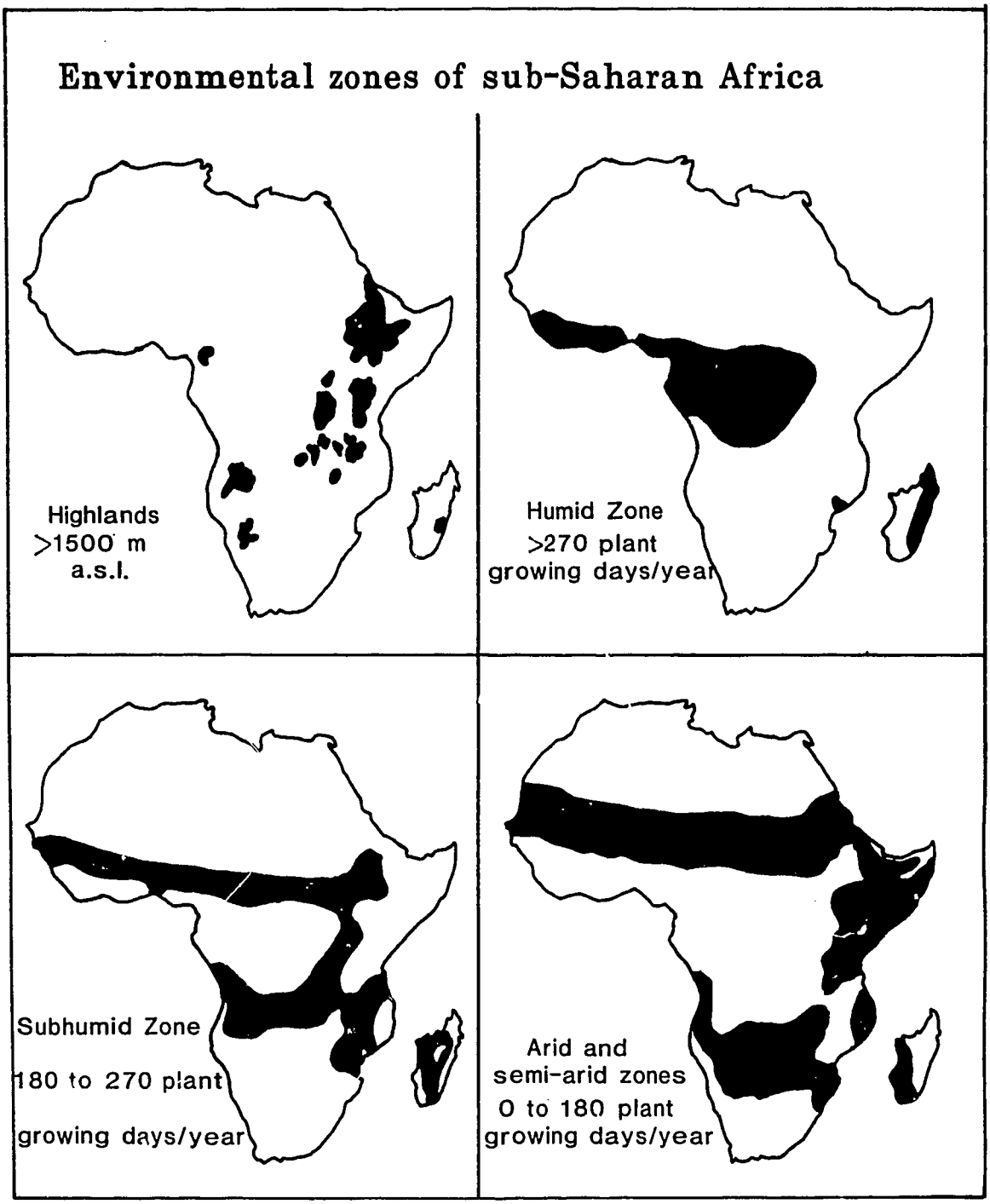

Source: ILCA, 1983.

These aims are accomplished through a four-stage process, each stage of which overlaps with others. These are the diagnostic, design, testing and monitoring stages. The diagnostic stage has been the most important for ILCA in defining user categories, though refinements are added based on the lines of research pursued. This stage includes both a rapid initial baseline survey (of less than three months duration) and longer term ongoing surveys (3-4 years) to describe the existing livestock production system in order to determine the ecological, technical, economic and social context in which improvements are to be identified. (Gryseels et al, 1984). Several sources of information have contributed to the initial identification of population strata including informal and later formal surveys, data from previous research and national level data, and agricultural staff working in a proposed research area.

Most country programs began diagnostic work in the late '70s and have now completed this stage of FSR. These studies have highlighted the diversity of livestock production systems in environment, livestock types, production functions, management principles and human interactions. Five classes of livestock production systems in Africa are distinguished by Jahnke (1982): pastoral range-livestock production systems, crop-livestock production systems in the lowlands, crop-livestock production systems in the highlands, ranching systems and landless systems. Different problems and potentials are presented by each system. For example, the concentration of pastoral systems in the arid areas leads to a focus on water utilization and management, while the prevalence of tsetse flies in the sub-humid lowlands makes this a dominant concern in the crop-livestock production systems found there. While classifications along ecological lines and in terms of production systems have many advantages in analysis, livestock producers constitute a broad spectrum of socio-economic diversity which significantly affects their attitudes towards technological innovations and their ability to adopt them. Inequalities exist in land and livestock holdings, labor resources and capital assets which place farmers in disparate socio-economic categories, with consequences for the impact of technological innovations on them.

Analysis of baseline data collected on livestock holdings among pastoral people in the Kenya and Mali programs, where land is communally owned, showed that the size and the composition tended to reflect socio-economic differences within the population. Among the Maasai in Kenya and the Tuareg in Mali, poorer families have a larger smallstock-to-cattle ratio than richer families. Incomes, household consumption, and risk aversion strategies vary accordingly.

While land is generally considered to be a major constraint for increasing production in Asian agriculture, labor supplies are frequently a more serious barrier in Africa. A salient feature of crop and livestock systems in Africa is the seasonal nature of the demand for labor. While considerable attention has been given to this characteristic of cropping systems, it has also been shown to be important in livestock systems as a factor limiting herd size and the effectiveness of management (Jahnke, 1982).

Although it is generally believed that pastoralists increase their labor input in the dry season, a seasonal analysis of labor data from ILCA's work with Maasai pastoralists in Kenya showed a 19% increase in time spent on livestock management per worker in the wet season. Increases were evident for all categories of workers. Women spent 39% more time or an additional 0.5 hour/day on livestock, men 30% more time or an additional 1.8 hour/day, and children increased their labor by 13% or 0.8 hour/day (ILCA, 1983).

The seasonal increase in demand for labor is a key factor in the adoption of technology requiring an additional labor input. The source from which this increment is expected to come is critical. The division of labor between men and women often means that they have different labor supply curves (Burfisher and Horenstein, 1983). It follows that those households having a larger supply of laborers of the appropriate sex and age or resources to hire labor are in a more advantageous position to adopt technology requiring additional labor.

Land too is increasingly emerging as a major constraint to improving livestock production in Africa. Opportunities for expanding production by bringing more land into use are declining. Consequently, access to land is likely to become an increasingly important determinant of adoption of technologies requiring land intensification or changing land-use patterns.

Differential access to land, labor and capital largely defines categories of users. However, gender differences and intra-household processes - relations between members of a household - are increasingly being recognized as important determinants of response to technology. Though the contribution of women to African agriculture was discussed in early descriptions of African farming (Bauman, 1928; Richards, 1939; Kaberry, 1952), much of the discussion has centered on cropping systems rather than livestock and more research is required in the latter area. Though ILCA's diagnostic studies have shown that women are involved in many activities related to livestock, the implications for the design of technology have not always been clearly drawn out. Social scientists in most of the country programs have attempted to delineate women's contribution to the livestock sector more clearly (Waters-Bayers, 1983; Youdeowei, 1983; Okali, 1983, 1984; and Whalen, 1983, 1984). These studies, however, need to be more fully integrated as part of farming systems research.

Women, like men, are a heterogeneous group. Variations exist among them which affect their responses to innovations and the impact of innovations on them. Differences in age, marital status, number and age of children, and educational status are all important variables in analyzing the relationship between women and technology (Okali, 1984).

For the most part, rural African women lack access to land, capital and technology. Their needs and potentials have often been overlooked, sometimes with detrimental consequences for increased production in the crop and livestock sectors. The fact that women have domestic as well as farm production responsibilities means that there are some basic differences between men and women in their use of labor and thus in their needs and potential in terms of adopting agricultural technology.

Inter- and intra-household processes concerned with labor input, access to income, decisionmaking and availability of land are important issues in understanding the relationship between farmers and agricultural technology. ILCA's studies on decisionmaking have shown that women and men make a large number of joint decisions about livestock but that there are areas where women or men have more influence. Women, for example, among the Fulani, do not milk the cows but decide on the distribution of milk between household and sales (Waters-Bayers, 1983). Such separate areas of influence initially identified in diagnostic studies have been followed up with short, focussed surveys to analyze more clearly the implications of such household relationships.

Both men and women acting together are necessary to increase livestock productivity in Africa and recognition of their heterogeneity, hence their different potentials and needs, can result in the design of technology which is responsive to various resource bases and conditions.

The information gathered in the diagnostic stage and refined through increased contact with farmers are critical steps in defining different categories represented in the farming population. The following sections detail two case studies of defining user categories which highlight many of the observations previously made and which discuss the processes through which this focus was constructively used.

2.1. The Single-Ox Plough In Ethiopia[1]

Diagnostic studies of mixed crop-livestock systems in the Central Ethiopian highlands began in 1976 with the objectives of studying ways of improving the overall productivity of mixed smallholder farms by increasing the technical and economic efficiency of livestock enterprises (Gryseels and Anderson, 1983). Livestock censuses in ILCA's study areas have shown a large number of Ethiopian farmers have one or no ox. This parallels data from the Ethiopian Ministry of Agriculture which shows that 29% of Ethiopian farmers have no oxen, 34% have one, 29% have two and 8% have three or more (reported in Gryseels 1983). While arrangements exist for securing oxen based on exchange of labor or payment of grain, these arrangements reduce the amount of land planted, and thus have a negative effect on production. Table 1 shows the relationship between area cropped, cropping pattern, and number of oxen owned by farmers in one of ILCA's study areas.

Farmers with sufficient ox power are frequently among the poorest sector of the rural society and are most in need of productivity-increasing technology. Additionally, they represent a significant percentage of the farming population. Consequently, ILCA's highlands program sought to alleviate this constraint to production through developing a suitable yoke and harness and modifying the local wooden maresha plough so that cultivation can be done using a single ox.

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[1] The description relies heavily on G. Gryseels (1983) On-farm animal traction research: Experiences in Ethiopia with the introduction of the use of single oxen for crop cultivation, paper presented at the Third Annual Farming Systems Research Symposium, Kansas State Univ., 31 October to 2 November 1983.

Table 1. Impact of oxen ownership on area cultivated and cropping pattern at Debre Zeit (1980).

Farmer categories	Average area cropped per farm (ha)	Average area sown to cereals (%)	Average area sown to pulses (%)
Owning no oxen	1.2	54	46
Owning one ox	1.9	44	56
Owning two oxen	2.7	67	33
Owning three or more oxen	3.6	92	9

Source: Adapted from Gryseels, 1983.

On-station trials were conducted in 1982 and showed that adequately fed single oxen could cultivate some 60-70% of the area ploughed by a pair in a day. ILCA then organized field days for farmers surrounding the two ILCA stations to demonstrate the new technology. Local government officials, extension workers and farmers attended. ILCA staff first demonstrated the procedures after which farmers were encouraged to try ploughing at the station with the single ox. Farmers were then invited to use the technology on their own farms at their own risk and expense with technical advice and training being provided by ILCA.

Test farmers were visited twice weekly and data collected on land holdings, cropping patterns, inputs and outputs by plots, cultivation details and feeding levels for the work oxen. Farm assets, personal data and livestock inventories were also recorded (Gryseels, 1983).

Though this technology was targeted at a particular category of users, initially all farmers who volunteered to plough with a single ox were accepted, irrespective of the numbers of oxen they owned. The strategy has been to have as many farmers as practical as test farmers at an early stage in on-farm testing. Satisfactory results are expected to encourage farmers with several oxen to reduce their numbers, thus decreasing feed requirements and pressure on land.

The program collaborates closely with technicians and extension staff of the Ministry of Agriculture in on-farm tests of innovations to facilitate the introduction of new technologies to farmers in the study areas and other locales where farmers confront similar production constraints. Demonstrations have been organized at the request of the MOA in several provinces. Dissemination of the technology is advancing and though it is too early to quantify the impact of the innovation, it is expected to have substantial effects on the welfare of a large segment of Ethiopian farmers.

2.2. Women and Men, Sheep and Goats

In ILCA's humid zone program in Nigeria, efforts were made to identify different categories of farmers to whom innovations with small ruminants would be attractive and to examine intra-household processes which impinge on the adoption of these innovations. The program was particularly concerned with fostering rural women's participation because many of the goats are owned and reared by rural women. Additionally, they provide much of the care for their husbands' animals. A Ford Foundation grant supported efforts to study more closely women's ability to participate actively in and benefit from these efforts.

The goal of the small ruminant program is to develop improved sheep and goat production systems that can make a significant contribution to income and to overall farm stability (Okali and Sumberg, 1984). The initial diagnostic work began in 1979/80 and concentrated on village flock studies but has since evolved to an emphasis on individually owned sheep and goats. This particular effort includes vaccination against the disease, peste des petits ruminants (PPR) and a one-third hectare alley farm planted with Leucaena and Gliricidia which was adapted from IITA's efforts to reduce fallows while preserving soil fertility in the forest zone. The model provides for the majority of producers in the humid zone, who are tree and arable crop farmers with up to 4 hectares of land and two to four small ruminants (Okali, 1984).

Long-term trials began in 1982 with alley farming and led to the initiation of a pilot project with the Livestock Project Unit of the Nigerian Federal Livestock Department in November of 1983. The major objective was to have a single site where the impact of a program designed for a large number of small-scale producers could be assessed. ILCA accepted technical responsibility for the project and helped to choose the site which was selected primarily on the basis of interest in arable cropping.

Earlier experience with farmers in southwest Nigeria helped to clarify the client population sought for the project. These were identified as all year residents, individuals rather than groups, active arable crop farmers and women as well as men. (Okali and Sumberg, 1983). It was also considered that potential alley farmers should have long-term access to land. (Youdeowei, 1983).

The Ford Foundation provided the funds to help foster women's participation and to monitor their involvement in alley farming. Women were actively encouraged by ILCA staff to participate and factors which affected their participation were studied intensively. An interview schedule was initially designed and used but was found to be inadequate for providing the kind of detailed data required from the women which they were willing and able to give.

Supplementary data were then collected through market price surveys, on-farm visits and observation. In considering how to monitor women's participation in the pilot project, the realization that formal interviews only were an unsatisfactory means led to the use of several methods. A traditional survey schedule was first used to compare

different categories of people. Age, marital status, citizenship and occupational status were examined for possible explanation of constrasting behavior observed (Okali, 1984).

Provision was also made for a detailed, continuous review of how the alley farm fit into the farming system as a whole and how different individuals, households or groups managed the trees. Actual observations of the farm were used for this review. This monitoring process is continuing.

A year's review (Okali and Cassaday, 1984) of women's participation showed that of 17 women who agreed to plant, only eight actually did. A large number of these were widows. Conflicting demands for labor may partially explain this limited participation: the program began at the same time as palm nut processing in which most women were involved. Women's limited access to land and the requirement to obtain their husband's permission may also have been factors. The sharing of browse between husbands and wives which had been an area of uncertainty appeared to be a feasible and preferred option as there were few difficulties encountered with sharing.

The features of the client population for the innovation have now been more clearly established as well as methodologies for obtaining better data on women and intra-household processes. There is a plan to investigate further the securing of women's land-use right in addition to their access to browse on their husbands' farms.

Several relevant conclusions emerge from this research which have larger applicability to efforts to view women as a potential user category.

1) Female access to land is generally restricted. Widows may have greater access than married women, more independence in decision making about land use, and more incentive for using productivity-generating innovations.

2) Women's domestic and farm labor responsibilities must be considered in the design of technology in order to avoid labor conflicts which inhibit women's participation.

3) Knowledge of intra-household processes is important in defining how women obtain resources such as land. Married women in the study primarily obtained land from their husbands and consulted them before agreeing to plant their alley farms.

4) Special efforts may be needed to encourage women's participation in technological innovations wherever cultural and historical factors have operated against this. It cannot be expected that efforts to encourage women will garner an immediate response. A more gradual process is to be expected.

3. OPPORTUNITIES FOR STRENGTHENING THE USERS' PERSPECTIVE

The descriptive and diagnostic stage of FSR is pivotal in providing accurate and representative data on the different categories of farmers and the constraints which are most important to them. There is a need

for disaggregation of data by socio-economic strata and gender, and for an examination of inter- and intra-household processes, particularly in the spheres of decision-making, responsibility, labor input, and ownership of livestock and their products. (Men may own the cows, but women own the milk). Inter-household processes are emphasized because of the importance of the extended family and community support systems in Africa. Questions are being raised within FSR concerning the appropriate unit of analysis (Kerven, 1984), an issue which must be addressed if improved and acceptable technology is to be designed.

That the population studied in the descriptive stage be sufficiently representative of the farming population in a target area is an accepted axiom. However, the methodologies for achieving this objective should be examined closely. A rapid rural appraisal method has been proposed by ILCA in Kenya (Grandin, 1984). Other methods also need to be studied.

A single technology is seldom appropriate to all categories of users, nor necessarily should it be. The one-ox plough was designed for and intended to benefit poorer farmers. An essential point is that the target group is identified and the implications for other categories of farmers, both positive and negative, are assessed. In some cases, modifications can be made to expand the applicability of a technology or lessen unwanted side-effects. An ex-ante impact study which analyses potential adopters, beneficiaries, losers, intra- and inter-household relations, gender-related issues, additional resources required (land, labor, capital, credit, management skills, etc.), their likely source and likely income flows could be a helpful exercise among team members in the design stage of research. Both technical and social scientists need to be involved in this effort, which can produce additional benefits in increased understanding between disciplines of the disparate resource bases and priorities of farmers.

The analysis of gender and intra-household relations in ILCA's small ruminant research in Nigeria demonstrates how critical gender may be in the ability to utilize technological innovations. The shortcomings in the methods of data collection were also illustrated and one of the significant results for ILCA was a clarification of relevant methods.

One approach to improving understanding of women as a category of users is a more precise quantification of their activities related to livestock in sub-Saharan Africa. The data collected in the descriptive stage of ILCA's field research could be re-analyzed and the information on women extracted. Gaps in the data could then be filled through short, sharply focused surveys. The resulting data could serve as a guide in the design and implementation of research as well as in pinpointing problems and opportunities in particular farming systems.

Women's lack of access to land, limited labor availability and management opportunities remain as major impediments to their participation in agricultural innovation. The importance of access to land was illustrated in the ILCA small ruminant research as was their limited labor availability. Technological changes frequently require an increased labor input, and an understanding of the sexual division of labor can help to determine which sex is likely to contribute the additional labor and whether, given their present labor demands, such an

increase is feasible. Though task ascriptions are not immutable, they do tend to change very slowly. The ex-ante assessment of an innovation suggested in the previous section should take into account women's labor and access to land and the processes through which they obtain them.

The outcome of technology depends not only on the characteristics of a technology but on institutional and policy considerations. The same technology will have varying results, according to government policies on such factors as land, marketing, and inputs. National research organizations and governments play a central role in determining the opportunities for different socio-economic groups and for women to participate in and benefit from a specific technology. When policy constraints are a limiting factor in adoption, national agencies are in an advantageous position to encourage policy changes. This requires close collaboration between policy-makers, national research agencies and international institutions in identifying workable solutions to institutional and policy limitations. ILCA works closely with National Agricultural Agencies and relevant Departments of Ministries of Agriculture. Additionally several ILCA country programs work in an advisory capacity to pilot projects concerned with various technologies being evaluated by the extension services. (Gryseels, et al 1984).

The basic framework for implementing the users' perspective exists. There are opportunities for strengthening the emphasis as detailed in the previous section. Additional resources of staff time are required.

An extraction of the data already collected on women by ILCA's country programs and its compilation would require considerable time. The benefits to ILCA, however, could be substantial. Additionally, there is a need for women to be more clearly integrated into farming systems research and not function as an appendage.

Other opportunities, such as the ex ante study of technology design, closer interaction between technical, social scientists and farmers, more emphasis on intra-household and inter-household processes are not new additions to country programs; rather a stronger concentration on them is desirable.

Social scientists will play a key role in expanding several of these activities. Though the value of non-economist social scientists is acknowledged, their contribution to FSR needs to be more clearly defined. Within ILCA this subject is being examined in a forthcoming meeting which will consider the social science input into the institution. Of some importance at this meeting also will be a discussion of the mutual benefits the country programs, the Livestock Policy Unit and the Systems Research Unit can derive from close collaboration. The meeting also presents and opportunity to discuss research methods and analytic techniques that can improve social science research at ILCA. Thus it covers a number of topics discussed in this paper which should provide a better base for expanding the users' perspective.

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Women and Agricultural Technology:

Understanding the Needs of Both the Direct Users and the Ultimate Beneficiaries of ILRAD's Research

by

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I. INTRODUCTION

Over the last 15 years, development specialists have been paying increasing attention to the effects of development programs on recipient populations. The earlier assumption that the effects of national economic development would trickle down to the needier segments of the population has been seriously questioned. It has been realized that a special, conscious effort is required to improve the lot of the neediest of the population. As more experience in the determination of basic needs has been gained, a number of special topics have emerged as being of particular relevance. Among these, a high priority is being given to the question of the role of women in economic development.

In the past decades, numerous examples have come to light of women being excluded from the development process. Development has been designed with little or no consideration of the role of women or of the possible negative effects of an intervention on women, both as persons and as mothers (Tinker 1976). Although for example, there was ample ethnographic information detailing the important role of women in agriculture throughout most of the African continent (see Fig. 1), this role was largely ignored (Nelson 1981). In many African production systems, more so in agricultural than pastoral societies, women have their own fields and/or their own sources of income and have specific and often substantial contributions to make to family provisioning. Yet agricultural interventions were designed as if the family in Africa was provisioned in the same manner as the traditional family in the West, with husband/father as the bread-winner and women having only domestic responsibilities. This mistaken assumption has, for example, led to irrigation projects being designed which provide only men with fields to be used largely for cash crops and depriving women of their fields and kitchen gardens critical for subsistence production (Broch-Due 1983, Conti 1979, Dey 1983). Provision of credit has been made almost exclusively to males, ignoring these independent female occupations in intact households, as well as the high proportion of female-headed households, estimated at over 20% on the African continent (Carloni 1984, Tinker 1976).

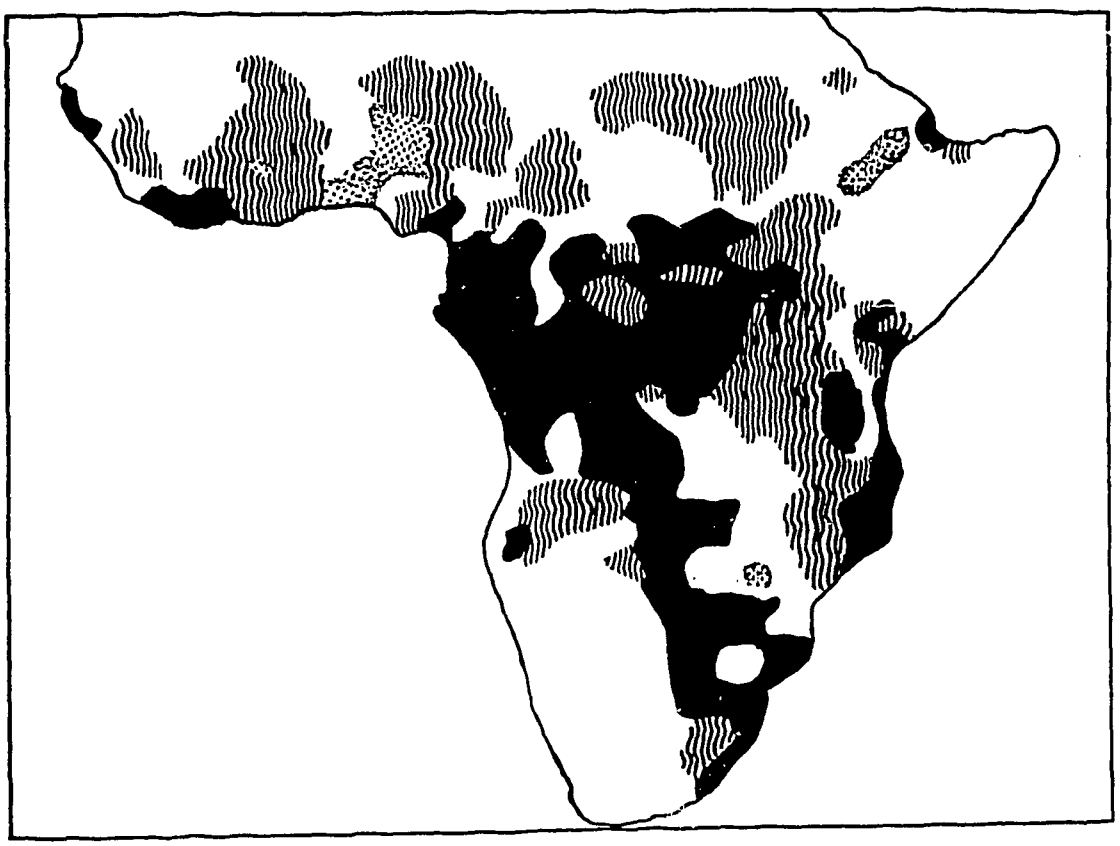
In view of the increasing attention being paid to the specific effects of development interventions on women, it is fitting that, at this time, the CGIAR centers consider their activities, past and proposed, in the light of the accumulating knowledge about the users' perspective, and particularly about the important role women have to play in development.

II. ILRAD'S MANDATE

While ILRAD is well aware of the important issues relating to women and development, its mandate does not provide for direct involvement in these issues. ILRAD's mandate, as established by the Memorandum of Agreement signed with the Government of Kenya states in part:

> "The purpose of the Laboratory will be to serve as a world centre for research on ways and means of conquering as quickly as possible,

FIGURE 1

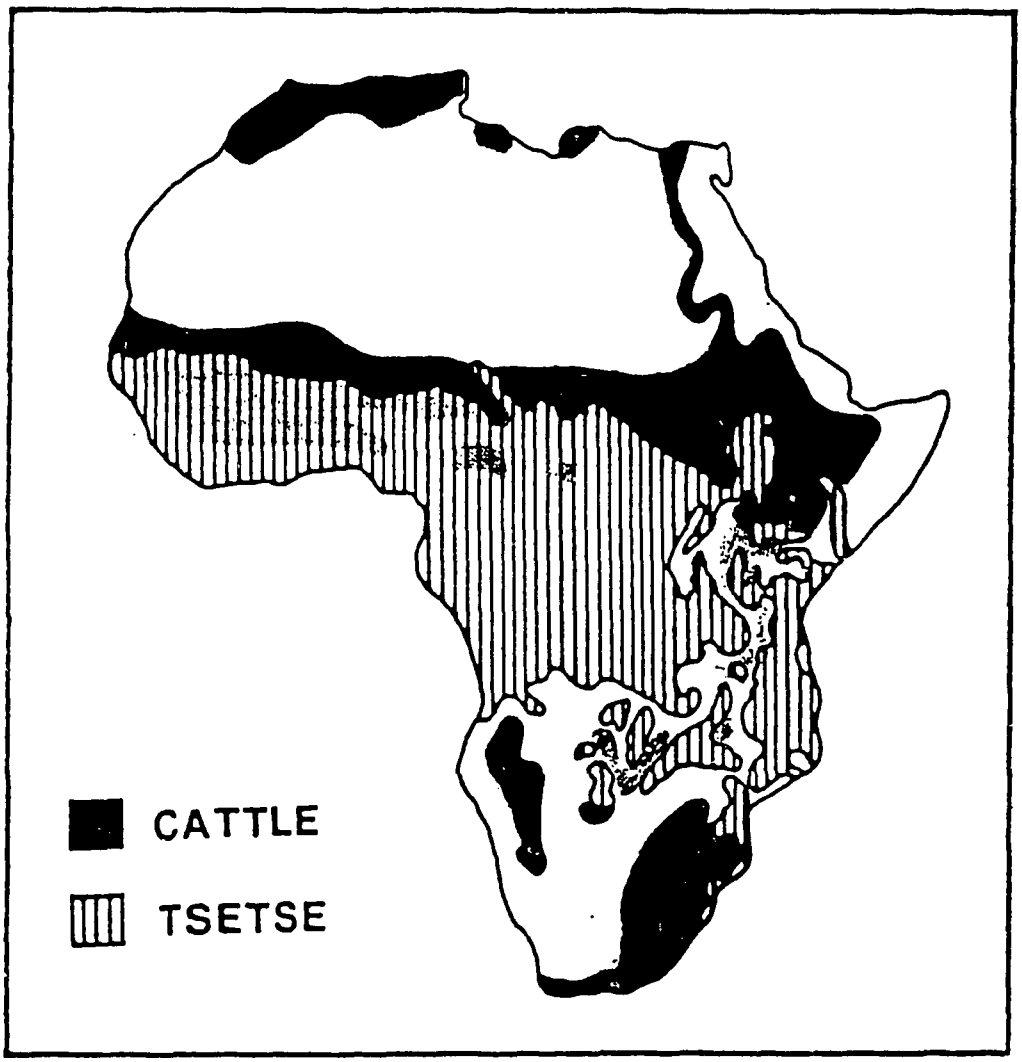


Men only prepare ground, women do all the other work
Men do most of cultivation
Men take part in cultivation, but women do most of it
Not available

Note:

The map is taken from Boserup (1970:18). As she notes (1970:17) "This map was prepared forty years ago by H. Baumann, a German expert on African subsistence farming". Thus it represents a period of time before there was significant cash cropping or migration to urban areas. Nevertheless, it can be viewed as representing a cultural tradition which still plays an important part in the contemporary division of labor. Boserup goes on to discuss the continuing importance of females in African agriculture. She states (1970:22) "Thus, the available quantitive information about work input by sex seems to indicate that even today village production in Africa south of the Sahara continues to be predominantly female farming".

FIGURE 2



Major cattle-production areas and tsetse-infested zones in Africa. There is little overlap except in the regions of West and Central Africa where trypanotolerant N'Dama and West African Shorthorn cattle are kept.

> major animal diseases which seriously limit livestock industries in Africa and in many other parts of the world. The laboratory will concentrate on intensive research concerning the immunological and related aspects of controlling Trypanosomiasis and Theileriosis (mainly East Coast Fever).... In carrying forward its program, the Laboratory will develop close linkages with governmental and regional organizations undertaking research on the same or related disease problems."

In this context, it is critical to distinguish between the direct users of ILRAD's research findings, e.g., national research centers, veterinary departments, regional organizations, and the ultimate beneficiaries, the client populations who will eventually benefit from the results of ILRAD's efforts together with those of the direct users. It is clear from ILRAD's structure and rather unique mandate, that a large part of its research can be described as basic.[1] ILRAD must rely on contacts with its direct users to provide the necessary information about their needs and the needs of their ultimate clients. ILRAD was clearly never intended to be primarily a field-oriented research organization.

We believe that this special role of ILRAD is well in keeping with expectations for international centers. As noted by TAC (TAC Priorities 1979):

> "As clearly indicated at the 1977 Bellagio Conference, the trend is for national programs to request international research to carry out activities which may be different from their own, in particular those which they are not ready to undertake at present either due to lack of sufficient funds, staff and facilities or because they consider these activities as having a <u>longer-term perspective</u>; for example some aspects of <u>path-breaking research</u>..." (our emphasis)

Nevertheless, as an international agricultural research center, it is incumbent upon ILRAD to be aware of the potential benefits and other effects of its research on the ultimate beneficiaries.

III. THE ULTIMATE BENEFICIARIES OF ILRAD'S EXPECTED TECHNOLOGIES

ILRAD is researching various ways of controlling trypanosomiasis and theileriosis, primarily through the development of vaccines, the improved use of chemotherapy and the exploitation of existing genetic resistance in certain breeds of domestic livestock. These diseases were chosen by TAC and ILRAD's Board because of their overwhelming importance. In Africa alone, these diseases are believed to be responsible for the deaths of 3 million head of cattle a year; in addition they cause substantial productivity losses. Trypanosomiasis has effectively

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[1] According to the second review of the CGIAR, research can be classified into four categories: basic, strategic, applied and adaptive. According to this classification, ILRAD's work can be viewed as essentially strategic (i.e. designed for the solution of specific problems); however, given the specific immunoligical approach which the center was asked to pioneer, a significant proportion of its efforts have had be to devoted to basic research.

precluded the keeping of livestock on approximately 7 million square km of land, which could otherwise support approximately 125 million head of cattle (Murray and Gray 1984) and contribute substantially to alleviating Africa's ever-increasing protein deficit. Thus, in considering the potential beneficiaries of ILRAD's research, one can distinguish between producers who currently live in livestock producing zones and those who live where domestic livestock production is virtually non-existent.

(A) Current Livestock Keeping Areas

Over 90% of the domestic ruminants in Africa are owned by small holder farmers and pastoralists; by Western standards, these animals have very low productivity. This is partially because producers do not often attempt to maximize production per unit animal; but it is largely due to high incidence of disease and low development of veterinary infrastructures.

In proposing possible applications of improved methods of disease control, ILRAD must consider, with its national collaborators, the possibilities available for the delivery of the necessary veterinary services. Whereas in the developed world, access to veterinary drugs, vaccines, etc., is solely through licensed personnel, in much of the developing world, both veterinary services and producers apply modern veterinary treatments. Decisions on the supply and application of veterinary materials are matters of national policy, but whether vaccines or drugs are applied by the Veterinary Department or producers themselves, they need to be simple, safe in application, and be easily distributed through the existing infrastructure. We rely on our contacts with national organizations, especially veterinary departments, to determine the feasibility of introduction of improved methods of control of trypanosomiasis and theileriosis.

An important consideration in developing control measures for disease is the cost of implementation. A conscious effort must be made to produce vaccines/drugs which are affordable by the average producer who keeps low-yielding animals. In the long term, it might be possible for higher yielding, improved animals to be introduced; but in the medium term, this is unlikely to happen throughout many areas of developing countries.

In considering the eventual beneficiaries of ILRAD's research into trypanosomiasis and theileriosis, both inter- and intra-household differences among end users must be kept in mind. In each area, there are rich and poor households which will have different problems and differential access to resources. Recent experience has also shown that within households there are divisions of labor responsibility, and benefits between men and women.

Inexpensive disease control measures will be of particular advantage to the poorer producers. Risk aversion is particularly strong in households at the margin of subsistence. High disease incidence, in the absence of workable controls, makes poor producers reluctant to invest in livestock even when they have capital to do so. In addition, as smaller farmers have proportionally fewer animals, the loss of an animal through disease has a much greater impact on his welfare and that of his family, than it has for the richer farmer with more animals and more surplus capital.

When we consider that the bulk of households in Africa that are headed by women fall in the poorer stratum, the importance to them of cost-effective disease control is obvious.

Livestock in Africa fulfill a variety of important functions. They may provide milk, occasionally meat and are often an important source of cash income. In addition, cattle have a direct impact on crop production through the provision of manure and traction. Livestock also serve important investment and store of wealth functions. In different production systems, the relative labor input and benefit derived from animal keeping varies significantly within the household. In some systems, livestock are exclusively owned by men, while women have important roles in their care. In other systems, especially where women have independent sources of income, women individually own and care for their own animals, and benefit directly from the proceeds of sales. Women, usually, are more likely to benefit directly from increased milk supply, whereas men are more likely to benefit directly from increased draft power. For pastoralists, lower disease incidence will mean more milk for women, and more cash income for the family. Such income is usually controlled by men, but separate intra-household economies are less well developed in pastoral societies. Clearly, there is great complexity among production systems in Africa, which national-level organizations must take into account in their policy decisions on the provision of veterinary drugs and services.

(B) Areas Where Trypanosomiasis Currently Curtails or Precludes Ruminant Livestock

Large portions of Africa are affected by trypanosomiasis to such an extent that livestock keeping is virtually non-existent. Fig. 2 shows the distribution of trypanosomiasis and cattle keeping in Africa. Approximately 7 million km^2 are devoid of cattle because of trypanosomiasis. It is interesting to note that most of this area includes production systems in which most of the agricultural work is traditionally done by women (see Fig. 1). ILRAD is working very closely with ILCA, at sites in a number of African countries, to determine the nature of the resistance to trypanosomiasis found in some breeds of domestic livestock. It is hoped to determine levels of productivity under different levels of trypanosomiasis challenge, identify suitable genetic markers, and thus eventually to be able to selectively breed animals of sufficient resistance to survive and produce well in these areas. It is not within ILRAD's mandate or resources to determine the eventual micro-level impact of the introduction of trypanosomiasis-resistant animals to these areas. However, through collaboration with ILCA, national governments and other regional and international bodies, these issued will be fully addressed.

IV SUMMARY

ILRAD is well aware of the need for eventual adaptation of proposed new technologies to specific user groups. It views this as a long-term national responsibility. Through various training activities and other collaborative efforts with national-level organizations, ILRAD is developing the cooperation which is essential for the eventual support of site-specific work. To enhance that possibility, even now, at this early

stage of our strategic research, ILRAD is cognizant of, and takes into account, the situations of both its direct users and the eventual end-users, especially in terms of (1) infrastructural constraints (e.g. to production and delivery of vaccines, introduction of new or improved breeds of livestock, and (2) the need for cost effectiveness of the final product.

Nevertheless, ILRAD must be circumspect in acceding to potential national demands. As the second review of the CGIAR has noted, many less-developed countries "would like the Centres to develop technical assistance activities in their own countries and could easily over-extend the management capacity of Centres and divert them for their main research programs". ILRAD, in conjunction with its sister institutions must encourage, but not replace, site-specific national-level efforts aimed at fully incorporating the users' perspectives.

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Technology Users' Needs and Research Priorities at IRRI

by

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TECHNOLOGY USERS' NEEDS AND RESEARCH PRIORITIES AT IRRI[1]

We have been asked to write about "experiences with identification of categories of technology users, their needs and potentials, and the incorporation of this knowledge into center activities". Understanding users' needs and communicating them to biological scientists and research administrators is the responsibility of the economics program at IRRI. The first section of this paper outlines the role of economics and other social sciences at IRRI. The second section then reviews three examples of how user issues have been incorporated in research goals:

1) the allocation of research efforts across production environments;

2) the development of integrated pest management;

3) screening varieties for better grain quality.

The paper concludes with a discussion of IRRI's past and current efforts to consider women users.

THE ROLE OF ECONOMICS AND OTHER SOCIAL SCIENCES AT IRRI

IRRI's mandate as formulated in its Articles of Incorporation is "to conduct basic research on the rice plant, on all phases of rice production, management, distribution and utilization with a view to attaining nutritive and economic advantage or benefit for the people of Asia and other major rice growing areas". In recent years, research on rice-based cropping systems has been added to IRRI's responsibility. Dissemination of research findings and training of rice scientists for developing countries are other important components of IRRI's mission.

The economics program has been designed to support and complement the biological research. Four closely related research objectives that meet this criteria provide the framework for IRRI's economic research.

1. Identify the factors that impede rice production increases and rice-based cropping systems production increases, and assist in designing technology that might overcome those factors.

2. Assess the social and economic viability of newly developed or proposed technological improvements designed to increased production.

3. Identify restrictions that impede the adoption and effective utilization of new technology.

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[1] This is the IRRI background paper for the Inter-Center Seminar on Women and Agricultural Technology. It was prepared by L.J. Unnevehr with assistance from C.C. David, J.Day, and J.A. Litsinger. The first section draws heavily on an earlier paper by R. Barker and R.W. Herdt.

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4. Assess the impact of new technology on production, prices, incomes and income distribution, and evaluate policies that may improve those impacts.

The primary targets for IRRI economic research are the biological scientists at the Institute and the administrators who influence the activities of those scientists. Identification of factors impeding production is the first step in designing a biological, agronomic or technical innovation to overcome such factors. This requires a description of the environmental and economic conditions facing farmers - conditions which scientists sometimes do not accurately perceive. Economists are often asked to understand and explain why certain techniques or technologies are unacceptable to farmers. Given the reasons, biological scientists may then be able to redesign innovations to make them acceptable. Certain potential innovations may have consequences that will be unacceptable. If these can be identified in advance, research resources can be more usefully directed.

An example of interdisciplinary research with biological scientists is the intensive agro-economic research effort aimed at understanding the potential yields possible using new rice technology on farmers' fields and the reasons why farmers apparently are not achieving those yields. The experiments and associated surveys for this project have been jointly designed by economists and the biological scientists involved.

The second audience of IRRI economists are the economists in rice-producing countries. To some extent, IRRI economics provides them with information to help them better understand modern rice technology. However, the main objective is to encourage them to focus their attention on the kinds of problems that can make the greatest contribution to increasing rice production. Thus, IRRI economists encourage their colleagues in Asia to undertake research with broad objectives similar to IRRI's own. Much of the training, conference and network activity falls in this category, and so it is difficult to separately identify the resources used for training from those used for research.

The small size of the economics staff, the large size of the geographic area in which rice is grown, and the nature and magnitude of the problems that need attention dictate that the effectiveness of the Agricultural Economics program depends on building and maintaining a wide range of contacts.

The general approach is to undertake initial research on a problem here in the Philippines and to encourage similar research elsewhere through informal contacts, graduate training, seminars, workshops or formal collaborative agreements. An important means of communication is through regular mailing of departmental research papers to about 250 researchers and libraries. Graduate student research plays an important role in generating linkages to researchers in other countires. IRRI economists also maintain close informal contacts with agricultural economists located in regional universities.

Current economic research projects are classified in five categories, although the division is somewhat artificial and projects in one category provide information answering questions raised in other categories.

These categories are:

1) constraints to adoption and high rice yields;

2) consequences of new rice technology;

3) economics of rice-based cropping systems;

4) water management and irrigation economics;

5) economics of small-scale mechanization.

Constraints

The major objective of the economics research in the collaborative agro-economic constraints project is to: (a) measure the economic benefits of new technology under farmers' conditions to identify economically optimal levels of technology and (b) determine whether farmers are using economically optimal levels and if not, why they are not.

Consequences

The main objective of research in consequences is to understand the impact or potential impact of technological change. Past research in this area has examined the impact on demand for fertilizer, irrigation and labor, the impact on distribution of income among laborers, farm operators, landlords and purchased inputs, the impact on land use, and the impact on incomes of small and large farmers.

Cropping systems economics

One of the important dimensions of IRRI's cropping systems research is to develop a feasible organizational pattern and procedure that is capable of developing improved cropping systems adapted to particular, local, environmental sites. The economic component of cropping-system research has a corresponding dimension - developing "field-level" techniques that can be used at sites having particular characteristics.

Irrigation and water management

Research findings of many scientists throughout Asia indicate that the lack of good water control is probably the major factor keeping rice yields low. IRRI water research includes work on soil-water-plant relations and irrigation system management. Economics has contributed evaluations of the costs and benefits of irrigation by various methods.

Economics of small-scale mechanization

The major activities in this area include identification of potential machinery demand, evaluation of the impact of mechanization on employment and labor demand, and evaluation of the post-production rice handling system to identify losses and inefficiencies.

EXAMPLES OF TAKING USERS' NEEDS INTO ACCOUNT

Research efforts across production environment

In its third decade, IRRI's resources are directed more towards rainfed and deepwater environments than efficiency (i.e. expected benefits) alone would dictate (IRRI, 1982). Equity considerations justify the concern to develop technologies to increase incomes in the favorable environments. This decision represents the culmination of discussions within IRRI and the donor community about the impact of modern varieties (MVs) in irrigated environments.

Barker and Herdt (forthcoming) describe the situation in the early 1960s:

> "The new seed-fertilizer technology was developed in experiment stations of Asia which were favored by fertile soils, well controlled water and other factors suitable for high production. There was little perception of the complexity and diversity of the physical environment in rural South and South East Asia. In retrospect this proved to be a mixed blessing. If the modest research resources available to the international agricultural research systems in the 1960s had been concentrated on the less favorable environments, no major breakthrough would have been made. However, the scientist frequently saw his job and responsibility as ending at the experiment station gate. The failure of farmers in many areas to adopt to modern rice technology was attributed initially to peasant conservatism and backwardness and to the failure of extension to do its job in disseminating the technology."

Later studies in the Economics program addressed the "Constraints" to use of new technology on farmers' fields and the "Consequences" of technology for production and income. Briefly, the Constraints studies found that lower yields on farmers' fields were primarily due to their rational response to economic incentives (IRRI, 1977; Herdt and Mandac 1983). Consequences studies showed that MVs and fertilizer were widely adopted within irrigated and favorable rainfed environments. Adoption did not vary by size of farm or tenancy status. Furthermore, because the new technology tended to increase demand for hired labor, the benefits were fairly broadly distributed among landowners, operators, and landless workers (IRRI, 1984; Barker and Herdt, forthcoming). The new seed-fertilizer technology definitely expanded rice supply; it also seems to have raised incomes in irrigated areas.

There was a growing realization, however, that the new technology had reached only one out of every four farmers in Asia. Thus farmers in non-irrigated environments were identified as a "special user group" that required particular research focus. The shift away from research on irrigated environments was the response to this identification.

Development of integrated pest management

High yields and multiple rice cropping spurred by irrigation led to rice pest epidemics soon after the Green Revolution. Severe pest damage to MVs in the Philippines and Indonesia in the early 1970s raised concern about the stability of high yields. Because of a perception that small

farmers could not afford insecticides, breeding efforts were focused on development of varieties with multiple pest-resistance to broaden the arsenal of control weapons. IR36, resistant to three insects and three diseases, was released in 1976 and is now the world's most popular rice variety.

Resistance alone cannot solve the pest problems and pesticides' role remains as the course of last resort. In addition to the need to reduce the insecticide costs, it was also recognized that farmers often misuse pesticide. Such misuse is not only expensive but may actually exacerbate pest problems by killing beneficial parasites and predators. As part of the cropping systems program at IRRI, a program was started to develop and teach an integrated pest management strategy to farmers which focused on using pesticide only when needed (economic threshold levels reached) and thus to spare natural enemies. The program was successful in teaching farmers to correctly diagnose and quantify pest problems and to thereby use insecticides judiciously and economically (Litsinger, 1983).

It should be noted that in developed countries integrated pest management is approached in a very different way. Varieties are not commonly bred for pest resistance and farmers hire consultants to monitor pest levels and advise on control measures. IRRI recognized that small-scale farmers in Asia would need a lower-cost strategy. The response was to develop pest-resistant varieties and a program to extend pest management information.

Screening varieties for better grain quality

In addition to considering producers' needs, IRRI also considers rice consumers when selecting rice varieties. The MVs first released by IRRI and national research programs in the 1960s had a reputation for poor appearance and cooking quality. The semidwarf parents of IR5 and IR8 gave them a chalky "white belly", low head rice (whole grain) recovery, and a hard cooked texture. Grain appearance and milling recovery were improved by selection of translucent grain. Beginning with IR20 in 1970, all later varieties have acceptable physical quality, but most still have a hard cooked texture. High yields and pest resistance were the most important plant breeding goals and the best lines had poor cooking quality. The sacrifice of cooking quality was seen as necessary to meet the growing demand for food in Asia. Thus an implicit decision was made that consumers would prefer more rice and a lower real rice price instead of further quality improvements.

Asia rice production grew faster than population from 1965 to 1980 as a result of MVs, irrigation and fertilizer. The real price of rice declined in world markets and several Asian countries between 1975 and 1983 (Flinn and Unnevehr, 1984). Greater supply and falling rice prices have increased consumer demand for rice grain quality and national program concern for quality improvement. Improved cooking and eating quality is one of the main goals of IRRI's breeding program for irrigated environments in the 1980s.

The Agricultural Economics and Cereal Chemistry departments at IRRI have undertaken studies to extend our understanding of consumer preferences for cooking quality. Past studies have established the quality measures

used to screen material in breeding programs. Current studies test whether Asian consumers in different countries have similar preferences for rice grain quality and thus whether quality improvement should be undertaken by national or international breeding programs.

Women as users of rice technology

Women provide one-half of the labor in South Asian rice cultivation and one-third of rice labor in many South East Asian countries (Unnevehr and Stanford, 1983). Asian farm women also supervise agricultural labor, select and store rice seed, and market the rice crop. In the Philippines, where IRRI is located, studies by the Agricultural Economics Department show that women play a more limited role in rice field labor than in most other Asian countries. They provide only about 12% of labor in Iloilo (Res 1983) and 19% in Central Luzon (Gonzales and Guino 1979), the two major rice-growing areas of the Philippines. Smith and Gascon (1979) found that wives and children in Laguna farm families have never contributed significantly to farm work, either before or after adoption of MVs. Res (1983) also reports that vegetables and livestock are much more important sources of women's income than rice cultivation. Thus in the environment immediately surrounding IRRI, rice is of limited importance to women and vice versa, even though rice is a very important source of income for women elsewhere in Asia.

Although IRRI's consequences program has produced a large number of studies of the employment and income distribution effects of new rice technology, it was clear that our understanding of the implications for women was incomplete. Therefore IRRI organized a seminar on Women in Rice Farming Systems (WIRFS) in September 1983 that brought together 78 participants from 27 countries. The substance of this conference is reviewed in the Asia regional background paper for the Inter-Center Seminar on Women and Agricultural Technology. The inter-center seminar is in fact one of the recommended follow-up activities of the WIRFS conference.

IRRI is currently developing a proposal for a research network on women in rice farming. The challenge will be to develop a framework to bring together social and natural scientists to promote development of rice technologies most appropriate to women's needs, in terms of both welfare and production goals.

General Remarks

In the above examples, "users" have been very large categories: farmers in adverse production environments, small-scale farmers, and rice consumers. This broad approach is appropriate for setting research priorities at IRRI, because technologies developed here must be appropriate to large areas. It is the responsibility of national research programs to tailor technologies for more specific physical and socio-economic environments. IRRI social scientists can work together with social scientists in national programs to demonstrate how social science work can answer questions about the needs of particular groups, and how such information could be useful in setting research priorities.

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National Agricultural Research and the Users' Perspective: ISNAR's Role

by

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ISNAR'S ROLE AND MANDATE

ISNAR was developed within the Consultative Group to help national agricultural research systems improve their ability to plan, organize, manage and execute research more effectively. Its main objective is to "strengthen national systems by helping them to identify problems and take steps to overcome them, to formulate research strategies and policies, to develop research facilities, and to manage better their research programs"[1]. ISNAR's position in relation to the national programs is somewhat different from that of the other CG centers:

a. it is a service to national agricultural research systems and its role is defined by the organizational and managerial needs of these systems;

b. since its principal clients (NARS) have commodity interests which go beyond the food crops which are the preoccupation of the CG centers, ISNAR must be prepared to deal with the functioning of the entire system, not just the food crop institutes and programs.

ISNAR exists to assist the NARS to become able to plan and execute a research program based on national priorities. It cannot define national priorities for a country, but it can assist a country in specifying selection criteria and in designing programming procedures that help to design a research program compatible with whatever priorities have been established by the appropriate authorities.

While ISNAR shares the concern of the other CG centers with small farmers and food crops, it must, if its recommendations on the functioning of the national agricultural research system as a whole are to be realistic, study and understand the forces at work. In many cases economic and political forces bias priorities towards serving larger farmers and non-food crops.

From its first days, ISNAR adopted a broad definition of "agricultural research" as stated in "Some Critical Requirements for Productive Agricultural Research":

> Agricultural research needs to be focused on three types of problems:
>
> - how to increase the production of individual farm commodities and the productivity of total farming systems;
> - how to improve the rural agri-support services that provide farmers with the facilities they need in order to increase their production;
> - what changes in national policies would increase farmers' incentives to increase production.

Thus, in this paper, by "agricultural research" we shall mean all systematic efforts to develop (a) more productive farm technologies, (b) organizational forms and operating procedures for agricultural support services, and (c) national policies that can accelerate agricultural growth[2].

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ISNAR will be prepared to assist a country upon official request from a competent government authority where there is evidence of commitment to taking action to improve agricultural research. During a preliminary visit, an ISNAR representative will explore the nature of the problems facing the national agricultural research system, assess the likelihood of ISNAR's making an impact, and discuss the possible terms of reference for future action. ISNAR prefers to begin with a review of the national system which identifies the strengths and weaknesses of the system. The review of the system, however, is not the final product; it is ideally the beginning of continuing activities with that country designed to assist in planning and following up the implementation of recommmendations from the review mission.

The discussion of ISNAR's assistance to NARS in taking account of users' needs is developed in the following sections:

1. ISNAR's "systems approach" and the development of methodologies to assess the way systems determine priorities and the impact of policies on particular classes of users;

2. attention to users' needs in the reviews of national systems;

3. sensitization of researchers and policy-makers to the needs of user groups through training, conferences, and human resource planning;

4. building the users' perspective into continuing activities, through assistance in planning and programming and the promotion of on-farm research in a farming systems perspective.

As a relatively new institute with only four years of operation behind it, ISNAR is just now moving into "continuing" or "follow-up" activities with individual countries. Such activities will bring it closer to the issue of serving particular client groups as it begins to implement recommendations for training, research programming, and reorganization of the national system.

1. THE SYSTEMS APPROACH

ISNAR works within a systems perspective as described in its Guidelines for ISNAR Reviews and Evaluations:

> A standard definition of a system is "a set of parts coordinated to accomplish a set of goals". In attempting to define a particular system, it is most helpful to first think of its purpose and then of its structure. An agricultural research system is more than the various organizations that conduct research. The system also includes the mechanisms through which the programs and operational means and procedures of these organizations are determined, as well as the linkages among them and between them and other entities which contribute to or utilize the research activities. Within the country, these entities can include research sections in universities, private or semi-private organizations, services involved in the dissemination of improved technology, and producers. The system also includes linkages between national entities,

including planning, policy, extension or marketing, and with foreign or international research organizations such as the International Agricultural Research Centers.

The boundaries between a system and its environment are not fixed but depend upon the purpose of a particular analysis. Thus if the purpose of reviewing a research system is not limited to making the system function more smoothly but involves modifying its priorities so it becomes more appropriate to its context and therefore more likely to facilitate improvements in the agricultural sector, then the scope of the review must be broadened to include priorities and policies in any part of the economy which influences the selection and implementation of research activities as well as the dissemination and adoption of research results[3].

This concern with the wider system has led ISNAR's research program to look at the way agricultural research systems are structured, the way they are governed, the way they determine what research will be undertaken, and the web of supporting policies that will ratify the results of that research.

In taking this "macro" perspective, ISNAR has had to recognize that the national agricultural research system exists in a form of social contract with the society at large and that it really responds to several diverse clients, among which we find:

- the government, with its need for properly interpreted research results upon which sound plans can be based;
- educational institutions, which train the upcoming generation of agricultural specialists;
- official development agencies or production programs;
- bilateral and multilateral donors, who provide resources for programs targeted at certain classes of beneficiary;
- diverse groups of agricultural producers belonging to different recommendation domains.

What at times may seem like a frustrating lack of attention on the part of the system to the "micro" level (represented by the final class of users) may in many cases reflect the need for the system to balance the competing claims of user groups.

We have noted above that the national agricultural research system (NARS) is wider than just the publicly supported research institutes. It may include research in universities, by producer organizations, or by private individuals. It is necessary to understand the relationship between a national agricultural research system and the society in which it exists. It is not always safe to assume that the system has evolved in a rational way to meet the needs of society. Even where the structure, elements and processes of a system have evolved out of some historical reality, we may presume that they were designed to meet the needs of that particular time. They are not necessarily the best formats to meet the problems of today. In Africa, we see single-commodity institutes working on export crops during the colonial era; national research institutes emerging at the time of independence which tended to centralize research; and recently, regionalized organizations have been

appearing to deal with problems of intensification of farming systems on marginal lands because of population pressure or drought. In Asia we see attempts to create coherent national strategies out of a collection of federal centers, semi-autonomous commodity institutes, and state research programs, each with its different source of funding. The tendency to set up agricultural research councils, rather than unitary authorities, in these countries, represents a "minimum disturbance" way of adjusting the system to new realities. The role of donor support and the biases that they may introduce into the system cannot be ignored. What is clear, however, is that the structure of the system and the way it is governed and funded are not independent of the client groups that it is designed to serve.

Private-sector participation in agricultural research has been identified as one of the most important characteristics of the evolution of Latin American NARS in recent times. This phenomenon implies important changes in the function of the national institutes of agricultural research which, over the last 20-25 years, have been the main sources of supply of new technological knowledge. Research under ISNAR's Project on Agricultural Research Organization in Latin America (PRCAGRO) seeks to describe the ways in which private-sector participation in the technology generation and diffusion process takes place and to analyze its implications for national policies and the working of the national agricultural research system. Of course the boundary between the "public" and the "private" components of the national agricultural research system cannot be finely drawn: private research may be funded out of foregone tax revenues by the government, and governments may fund research which could logically be supported by private beneficiaries who capture the benefits through quotas, subsidies, and the like.

ISNAR is just beginning a study of "agricultural technology management systems" in Latin America which proposes to look at the factors which determine the nature, magnitude and payoff to agricultural research in Latin American countries. The basic hypothesis is that the demand for new technologies on the part of farmers, consumers, input suppliers and other users is influenced by the perceived pay-off of those technologies. The pay-off depends on the quantities of new technology available (scale), their return per unit cost (efficiency) and their appropriateness (distribution). These elements of payoff are influenced by the socio-economic structure. The actual payoff, in turn, may bring about changes in the socio-economic structure and thus change the nature of the demand for further new technologies. The project proposes to develop and test a research design which will improve our ability to analyze agricultural technology management systems and the management activities which affect the size, distribution, and payoff to research. Whereas our initial systems reviews have concentrated on the technology-generating system, this project will require investigation of the policy-making systems and the links of research with the technology diffusion systems.

It is hoped that this initial work will lead us in late 1985 into research on what ISNAR has called the "policy environment". This includes not only the level of commitment and financial support to agricultural research but also the willingness to implement policies (credit, prices, exchange rate, transportation, marketing) which are

necessary to make research productive. This work will lead to a consideration of research benefiting particular target groups. Scientists working on individual commodities have come up againt these issues as exogenous constraints on the achievement of their goals: the research proposed by ISNAR hopes to "endogenize" some of these political variables at least as far as our analysis and ability to advise NARS is concerned.

2. ATTENTION TO USERS' NEEDS IN SYSTEMS REVIEWS

The need to take both a macro and a micro perspective during the system reviews is fully reflected in the Guidelines for ISNAR Reviews and Evaluations. This document provides a series of checklists designed to find out what the national priorities are (either explicit or implicit), whether or not the programs are compatible with these priorities, and, if not, how the programs can be made more compatible with priorities. Evaluations by ISNAR may take place at the level of the national system, at the level of a given research institute, at the level of a research program, or as ex-post impact evaluations.

For evaluations of programs at the national level we find the following questions as a standard part of the review:[4]

1. Is there a mechanism for program formulation which includes user representatives? Do the existing research programs match the identified needs?

2. Are these mechanisms (ones) by which programs relevant to national and individual needs can be formulated?

Essentially the same types of questions are asked at the level of the individual institute or program:[5]

1. What are the institute or program priorities and how are they determined? How are needs articulated? Prioritized? To what extent are constituents involved? How? Describe the kind and amount of consultation with policy-makers, research community, private sector producers and distributors, extension representatives, and farmers.

2. Are the needs and priorities of all relevant parties (government policy and planning offices, intended beneficiaries of the institute or program, etc.) well articulated?

3. To what degree is the institute or program responsive both to the farmers' needs and the national plans?

In carrying out impact evaluation of a system, the Guidelines call for answers to the following questions:[6]

1. Who are the principal beneficiaries of the results? Who receives the products or services? Are they the intended beneficiaries envisioned in the institute or program mandate?

2. To what extent have the needs of the intended beneficiaries been met?

In most of its systems reviews ISNAR has called attention to a lack of attention to the particular needs of "small farmers". In some cases, the terms of reference of the ISNAR review have called for an evaluation of the impact of research on smallholders, but in most terms of reference no specific target groups were mentioned. If we take small farmers as an example, however, we find that the lack of attention to their problems by the system may be due to several things:

1. a lack of concern for their particular problems on the part of higher authorities (hence the need to study how research priorities are determined and how to sensitize policy-makers to the situation of client groups);

2. the political weakness of the reseach system itself and its inability to promote research benefiting target groups having no political power;

3. a lack of basic data on the magnitude of the problem of small farmers and their appropriateness as a recommendation domain;

4. a lack of capacity to generate the data and understanding of the problems of particular client groups.

The ISNAR report on Fiji illustrates a case where potential client groups have to be identified before priorities can be determined:[7]

> A systems approach by a multidisciplinary team is required.
>
> While more is needed to support commercial farming operations, the larger group of subsistence farmers is being served less well. Research for this subsistence group is demanding, individual commodity improvement generally is not enough. The categories of farming systems within the subsistence group need to be analyzed before research priorities can be determined and research carried out to seek answers to the central problems.

The ISNAR team permitted itself to recommend an order in which Fiji should allocate resources:[8]

> In light of limited present staff, the review team recommends that work be carried out to classify the several groups of Fijian farmers into meaningful economic-social-cultural categories. The major problems or production constraints of each group would then be analyzed.
>
> Short run emphasis could be directed to those problems where a solution will give the highest return in relation to national agricultural policy; the second priority could go to solve problems that reach across more than one category of farmers. In the longer run the emphasis may be placed on developing packages of techniques to meet the needs of each group.

The practical recommendation recognized that the NARS had to gain commitment by policy-makers through achieving some conspicuous successes. This implied starting with research that offered a high payoff. Concurrently, the system could identify particular classes of farmers and the nature of the constraints facing them. In the resource-scarce situation of Fiji it would have to define its recommendation domains rather broadly by combining classes of farmers, but with additional resources it could focus research more finely on successively smaller groups.

The Kenyan national plan espoused "alleviation of poverty" as its goal and identified particular target groups. Using the criteria of low incomes and lack of access to opportunities, the plan identified pastoralists, small farmers, and landless rural workers as target groups. However, in the Kenya report, the ISNAR team noted:[9]

> There was no convincing evidence that major emphasis is being placed on the development of production technology for the smallholder farmer. The most appropriate step would appear to be for the regional research stations to orient their research programs within the framework of a farming systems approach that would generate appropriate production technology for smallholder farmers in the specific agro-ecological zone in which they are located.

The ISNAR report warned that population pressure would continue to push agriculture onto land of lower potential. This movement would make research needs increasingly location specific. Thus the battle to maintain per capita productivity in less favorable circumstances would depend increasingly on a farming systems approach carried out by local researchers.

It is not necessary to cite all the countries studied by ISNAR to demonstrate the importance that small farmers have had in the recommendations. However, the case of Malawi is worth mentioning because the terms of reference of the mission included an investigation of the "relative attention by research to estate and smallholder agriculture and its appropriateness". At independence, Malawi adopted policies that favored production by estates. The production results were good. However, the estate-bias of the policies held back smallholder production, in many cases artificially. The ISNAR report observed:[10]

> The clients of agricultural research in Malawi include farmers, traders, processors, and government policy-makers. The farmer clients within an agroclimatic zone also form several groups that have varying circumstances affecting what technology they can use. Some research objectives, trial evaluation criteria, and discussions with researchers and extension staff indicate that researchers often focus their attention on the production of a commodity and give little consideration to either the various groups of clients they serve or the specific and varying needs of those groups. What is needed is a set of activities by researchers and extension staff that a) efficiently brings to researchers an understanding of their clients' circumstances so they can produce needed and usable techniques and b) trains the extension staff in the application of the new techniques and in interpretation of client response to proffered technology.

The Malawian case underlines the need for researchers to be in close contact with both the farmers and the extension workers in developing improved technologies. In an internal review of its first ten systems reviews, ISNAR staff discussed the large number of female-headed farm units that were found in Malawi and the fact that men and women did not share the same economic interests with regard to agricultural production. Given the special circumstances of male emigration, Malawi presents a case where gender becomes an important element in determining a recommendation domain which is large enough to support a special program.

The definition of appropriate recommendation domains, and an evaluation of the importance of gender in determining them, is something which ISNAR could appropriately bring to national programs. CIMMYT points out the usefulness of the concept in putting the farmer at the center of the research effort:[11]

> Recommendation domain has already been defined as a group of farmers whose circumstances are similar enough so that they are all eligible for the same recommendation. It should be emphasized that the domain is a group of farmers, not a geographical area or land type. Domains are composed of farmers because farmers, not land types, take decisions on new elements of technology. Defining domains in terms of groups of farmers underlines the possible importance of socio-economic criteria in domain identification.

It is also useful in explaining research to policy-makers:[12]

> At any point in the on-farm research process the use of recommendation domains allows researchers to be able to spell out for which groups of farmers they are working, approximately how many farmers are in each group, what are their principal practices and problems, and what types of recommendations are likely to be produced. This is a great help in developing good relations between researchers on the the one hand, and institution or national policy makers on the other. Not only does this kind of information help researchers in the allocation of their own research resources but it also gives them useful information to offer to those who set research policy.

Even though researchers may have identified classes of farmers for whom it may be both feasible and economic to develop recommendations it may still be necessary to sensitize policy-makers to the importance of doing so.

3. SENSITIZATION OF RESEARCHERS AND POLICY-MAKERS

ISNAR's training and conference program has devoted a significant part of its effort to preparing materials and developing course materials which will sensitize participants in its conferences and workshops to the needs of users and the opportunities of learning from users.

A number of case studies have been prepared for use in workshops, of which "Rice self-sufficiency in the Dominican Republic" is a good illustration. The study documents the effort of the government to

promote double-cropping of dwarf rice and the responses of individual farmers at different ends of the technological spectrum. At one end is a traditional farmer who refuses to abandon ratooning of a local tall variety. "I get 460 sacks from the ratoons ..... I never get more than 390 sacks from a single crop cycle"[13]. At the other end of the spectrum is a commercial farmer who claims to have outperformed the research station in a yield competition:

> The Research Center recommended fertilizing before using herbicides. This is nonsense. Since a herbicide retards growth, fertilization should be after the herbicide. The Research Center recommended 15 cc of herbicide per gallon of water. We used a rum bottle cap to measure the herbicide. The first bottle cap was too big so we drank the rum and bought a smaller bottle whose cap was just right. As to insecticide, the Research Center used a half-liter of insecticide mixed in a 50-gallon drum. This is too much. A 50-gallon drum needs only enough insecticide to fill a sardine can.[14]

Through highly readable cases, which sacrifice none of their rigor of analysis for being readable, ISNAR is able to reach its audience effectively.

In its management workshops, ISNAR has also had good results with a simulation game, the Green Revolution Game. This commercially available board game simulates the interaction of old and new agricultural technologies, the physical environment, and the processes of social and economic differentiation in an Indian village. The game is described as follows:[15]

> The core of the game is based on the production of a staple food--rice--for family consumption and marketing. Families which accumulate surplus capital can choose between a variety of inputs to improve production. Inequalities in landholdings and family size, food deficits and surplus provide the driving force for interaction between players, and the boundary constraints within which negotiation takes place.
>
> In taking on the roles of farmers living in a traditional village, participants discover the uncertainties and choices which face such people in reality, and they can experiment with strategies and roles as they wish. This is the main aim of the game: to bring alive to participants something of the life of a small farmer belonging to a dynamic society in a developing country. The game also demonstrates the complexity of decision-making in even a simple model of an agricultural society.

Role playing can be easily introduced into the simulation. For example, women could be responsible for the actual farming and application of inputs, and men responsible for decisions on the hiring or offering of casual labor; alternatively, the farm could be a female-headed unit. The net result of the simulation is a greatly enhanced sensitivity to the limitations and perceptions of small-scale farmers faced with new technologies.

ISNAR is also involved in assessment and planning of human resource development in a number of countries. In order to assess or plan human resource development, however, a country must first answer the question "Human resources for what purpose?" Responding to this question usually brings out the inadequate capacity of the current system to investigate user needs, carry out farm-level studies, and provide a social science input to the research design.

Attention to staffing patterns raises the question whether increased training of women researchers will lead to a greater attention to and understanding of the problems of women farmers. ISNAR research on the conditions of service for agricultural researchers (in a number of countries for which data are available) documents, as a general rule, the very low proportion of female researchers in the total. However, in Thailand, the country for which the proportion of women agricultural researchers is the highest (34% and rising), analysis of the data raises two potential points of concern. First, the proportion of women researchers concentrated in the capital city is much higher than for men at all grades in the hierarchy and reaches 100% at mid-career. Second, at mid-career the women fall behind the men in salary and administrative responsibility. Both of these facts suggest that increasing the number of women researchers in the system may not ensure greater attention to women farmers in the countryside (through more women researchers) nor does it necessarily increase the power of women to influence policy in the capital.

4. BUILDING ATTENTION TO USERS INTO CONTINUING ACTIVITIES

4.1. Assistance in Planning and Programming

During its initial mission review ISNAR may note several weaknesses in a country's knowledge of client groups or in its procedures for programming research to meet those client needs. It is in the "continuing activities" phase that ISNAR can begin to have an impact by helping those countries establish procedures, and in some cases criteria, for meeting client needs.

Various ISNAR reports stress:

a) the importance of socio-economic research which generates the basic data for the allocation of resources at a macro level as well as the identification of research problems and recommendation domains at the micro level;

b) the need for better planning structures, procedures and linkages to policy-makers which enable the NARS to respond to the needs of its various categories of users; and

c. the need for on-farm research in a farming systems perspective which identifies the constraints facing particular groups of producers and verifies proposed modifications in their system.

At the macro level, ISNAR is concerned about the lack of basic information about the research system itself that planners and policy-makers need in order to assess their resources and determine

priorities. In a recent ISNAR/IFARD Survey of National Agricultural Research Systems we are discovering that many countries simply do not have the data which are needed to analyze their national system and to program research. Eventually, collaboration between ISNAR and countries participating in the survey may take the form of assistance in establishing data collection and management systems for planning, monitoring, and evaluation of agricultural research programs.

A recognition of the need for better socio-economic analysis for planning purposes does not mean that research organizations are quite sure about how to build it into their structures. Since the needs go from the macro level down to the micro level, it is clear that the socio-economic input cannot be confined to the farming systems program nor isolated in a "social science program". ISNAR has sought to identify in each case the best way to build a social science component into the system without being prescriptive. However, where suggestions for the reorganization of large organizations are requested, ISNAR has tended to recommend a matrix organization with discipline-based departments and multidisciplinary programs, (e.g., Morocco). This will allow a maximum of interaction among the social and biological sciences at all levels of planning and research.

It was stated above that as ISNAR moves into the continuing activities phase of its collaboration with various countries, it will be moving closer to direct involvement with programming the needs of client groups. Current activities in Madagascar are indicative of this involvement in programming and planning. Within the context of a World Bank loan ISNAR has outposted an advisor in programming and planning with the responsibility, among other things:[16]

a. to design and implement a system of programming and evaluation of agricultural research at the National Center of Applied Research for World Rural Development (FOFIFA), to coordinate FOFIFA programs with other research programs, and to follow-up these activities;

b. to provide, in connection with other technical assistance agencies, advice for deciding on an approach and identifying program components in farming systems research.

One of the objectives of the programming exercise is to be able to identify for each project proposed the expected output of the project and the beneficiaries. A standardized "fiche programme" (program card) is being introduced for each program which records the following information:

1. Title of program
2. Program code
3. Development objective
4. Outputs already obtained
5. Present users of outputs already obtained
6. Potential users of research results already obtained
   Linkages:
   - with a specific project (underway or programmed)
   - with an objective or major theme of national development
   - with a development prospective problem
7. Outputs expected from proposed research

8. Potential users of these outputs
9. Geographic area in which results will be applicable
10. Content of program
11. Starting and termination dates
12. Present personnel working on project.

In responding to the question about the expected users of the output, researchers are to choose among four classes of users:

A. Producers:
   1. development company
   2. state farm
   3. development project
   4. extension operation
   5. agri-business company
   6. large plantations
   7. medium-sized farms (10-100 ha)
   8. traditional unsupervised paysannat
B. Agricultural planning agencies
C. Centers of agricultural education
D. National and international scientific community.

The choices were purposely closed to force the researcher to specify likely beneficiaries. This will allow the planners to relate programs to priority objectives and costs to expected benefits.

Particular attention was given in the cases of Morocco and the Dominican Republic to the governance structures and programming procedures to ensure that users' needs were taken into account. In Morocco, it was recommended that the Regional Agricultural Research Centers establish regional committees with representatives of provincial planning authorities, agricultural development services, professional groups, farmers and research staff.

In the Dominican Republic proposal, users are to be present at both the governance and programming levels. At the governance level the proposed Board of Directors (la Junta Executiva) includes representatives from the crops sector, the livestock sector and the association of landowners. At a more technical level, the programming structure has three levels: technical program committees, regional program committees in each center, and a national programming commission. Representative of "producers" are suggested for the first two committees where programs are formulated before transmission to the national programming commission. Obviously the sensitivity of the producer representatives to the different categories of producers will be an important factor in determining the nature of the programs which they put forward.

4.2. The Organizational and Managerial Implications of On-Farm Research

The recognition that the ultimate test of a new technology is its adoption by thousands of individual farmers has led national programs as well as the international centers to devote a large portion of their resources to "farming systems research". National research institutes should have a comparative advantage in carrying out FSR, however it is

defined. It is location-specific, requires access to local farmers, and involves close collaboration between social and biological scientists both able to interact with local farmers. International centers have, in an initial period, a comparative advantage in developing methodology and training national scientists for FSR but in the long run national programs will have to develop their own capacity to do on-farm research.

Because of its role in assisting the NARS, ISNAR has a strong interest in the organizational and managerial implications of introducing FSR into national programs. In a proposal submitted to a donor organization, ISNAR has proposed a study of experiences with on-farm research in a number of countries. The project will generate information on the following areas of concern:[17]

1) description of the evolution of on-farm research within the national agricultural research system.

2) identification and analysis of changes related to organization and management made to accommodate on-farm research. These will include any changes in:
   - staffing and training patterns
   - objectives, planning, organization and management of on-farm activities
   - technical, financial, logistical support to on-farm activities
   - linkages and communications with on-farm researchers and between them and other researchers, farmers, extension and other services and research planners.

3) Analysis of the role of the extension system or other government agencies or private organizations in on-farm research and their relation with researchers. Identification of the mechanisms for dissemination of on-farm research results and for evaluation of its effectiveness.

In a practical sense, ISNAR has come up against the organizational and managerial implications of incorporating a "farming systems perspective" in research without necessarily creating a special "farming systems unit". Farming systems units, often foreign funded and in many ways autonomous from the national structures, have in many countries carried out excellent state-of-the-art research which remains foreign to the country because they are not considered part of the national structures. Few will survive the withdrawal of foreign funding. It is necessary to build the farming system perspective into structures which fit into the national agricultural research system.

In the case of Madagascar, where the research structures retain a basically French organization and benefit from backstopping from French organizations, it made sense to recommend the establishment of a "Département de la Recherche-Développement" within the national agricultural research institute, FOFIFA, rather than adopt a proposal from donors to set up a Farming Systems Unit along the lines proposed in many CG/World Bank programs. This department is the link between applied research in FOFIFA and development (extension and production) operations. It is the official point of contact between research and the

"Service for Support and Liaison-with-Research" of the Ministry of Agricultural Production and Agrarian Reform. Its functions are described as follows:[18]

> "Initiating, animating, and coordinating, within the framework of farming systems research, all aspects concerning the links between research and extension. It intervenes in particular in the following sectors of activity:
>
> - experimentation in rural areas, including the study of traditional systems of production and the development of new systems of production
> - evaluation of the impact of the diffusion of research innovations on development
> - study of methodologies for experimentation and extension in traditional milieux.

The creation of the Département de la Recherche-Développement was recommended by ISNAR in the expectation that on-farm research would be supported better by both national organizations and foreign technical assistance if it took the familiar French structure of a department linking research and extension in determined geographical areas. FOFIFA has a program of rice production systems (which has the status of "department" for historical reasons) but it will be the Department of Research-Development which calls upon the collaboration of the rice production systems program to develop and test technologies at the farm level. This case is cited to underline the necessity of recognizing certain structural constraints, and then creating the necessary procedures to function within those constraints when designing recommendations for a system.

THE USERS' PERSPECTIVE: CONCLUSION.

ISNAR's mandate as a service to national agricultural research systems brings within its purview all problems which impinge on the ability of the national system to plan national research programs, generate improved technology, and analyze the changes in support services and policies needed to promote the adoption of the new technology. Taking a systems approach, ISNAR usually begins with a wide-ranging review of the NARS designed to identify the strengths and weaknesses of the system. From its analysis will come recommendations that may touch on the organizational framework within which research is carried out (structures), on the specific institutions and plans that compose the system (elements) or on the processes (planning, resource allocation, and management activities) which determine both the way the system functions and the results it produces. By carrying out a continuous review of its experience, ISNAR improves its understanding of the functioning of NARS and their problems.

At the level of the national system, ISNAR has been concerned with the forms of organization and governance which make a system "fit" its environment and enable it to respond to the needs of society as its client. Some systems may be stable, well-supported, and successful in introducing new technologies for certain categories of privileged clients while excluding other categories of technology-users. Other systems, in

spite of being poorly funded, may be successful at generating technology for poor farmers but not see this technology adopted because of inadequate support services and policies. Thus ISNAR is required to look at the overall policy environment which affects the way technology is generated and diffused to users.

Starting at the level of the national system, ISNAR attempts to analyze the nature of imbalances which may exist in the system:

- between the type of technology the government professes to want and the type of technology being generated by the system;
- between the tasks assigned to the system and the quantity of resources allocated to it;
- between the structures and outputs of the research system and the structures and outputs of the policy-making system.

Each of these imbalances will have an impact on certain categories of user. The objective of the system review is to suggest a mixture of procedural or structural changes which will bring the system into balance.

If the articulation of the system at the national level is not the problem, ISNAR may undertake an examination of the specific institutions and their processes for the planning and execution of their programs. In its continuing activities with a national system, ISNAR may become involved in helping to develop appropriate national structures for data collection and management for research planning and evaluation, identification of target groups, programming of research, and the carrying out of on-farm research designed to identify and meet the needs of users. Where ISNAR does not have its own capacity to assist with a given technique, it can help the national system obtain help from an appropriate source which will work well with the national structures.

After four years of operation and 17 system reviews, ISNAR is aware that there are no standard organization models which can be applied without local adaptation. The more finely the national program defines its users the more location-specific becomes the research and consequently the greater the need for a national capacity to plan, execute, and evaluate its activities. ISNAR's contribution to the users is in its assistance in building such a national capacity.

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Women and Technological Innovations in Rice Farming in West Africa

by

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1. INTRODUCTION

The role of women in agriculture

African women are noted for the significant role they play in agriculture, particularly in foodcrop cultivation for household subsistence. As crop cultivation becomes more and more commercialized, their role tends to diminish. Apart from the farming objective, the participation of women in farm work is influenced by several other factors such as:

i) The nature of production system: For example, in the Gambia and Liberia, swamp rice cultivation is considered as work for women, and men generally avoid this type of rice cultivation.

ii) The nature of crop: Commercial production of vegetables is generally left for women. The cultivation of some other crops are also shunned by men. For example, in the Atebubu area of Ghana, groundnut is considered a women's crop, therefore men stay away from its cultivation even though it is grown for the market. On the other hand, crops such as millet, sorghum and maize, although produced for household subsistence, are cultivated mainly by men in the Sahel countries.

iii) The nature of farming activity: Although, in general, there is no gender labor specialization in agriculture in West Africa, women are noted to participate less in land preparation and more in all the activities which follow, namely, planting, weeding, harvesting and processing of the crop. In other words, men undertake the more strenuous work while women do those requiring less physical strength.

iv) Urgency of the work: In some areas where female labor is less utilized, they are sometimes called upon to contribute a little more than usual where the task being performed needs to be completed as a matter of urgency.

v) Inavailability of labor: In many areas where farm-labor supply is decreasing, due primarily to rural-urban migration, women are noted to be participating much more in some activities which were traditionally dominated by men, e.g., weeding millet and sorghum farms in the north of Ghana.

vi) Social factors: The role of women is greatly influenced in various ways by social factors such as religion, ethnicity, culture and tradition. The Moslem religion in particular, restrains women from participation in field agriculture because of its laws of seclusion of women. However, the extent of enforcement of the laws varies among Moslems with different ethnic backgrounds. In the Gambia for example, the Moslem women, particularly those of the Mandinka tribe, not only participate but actually dominate in almost all phases of rice production.

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Their counterparts in the coastal areas of Guinea are also substantially involved in mangrove rice cultivation. However, in Mali and Northern Nigeria, women are generally not involved in rice cultivation. The degree of enforcement of the seclusion laws appears to be highest among the Fulani tribe members who raise livestock, mainly cattle.

It is hard to generalize about the role of women in agriculture in Africa, due to differences that occur within and between cultures, environments, crops cultivated, etc. In some parts of West Africa, the gender division of labor follows crop enterprise lines, while in other areas it is usually along activity lines, with women performing the jobs demanding less strength, and men concentrating on the more difficult and strength-requiring jobs.

2. WOMEN'S ROLE IN RICE CULTIVATION

Rice in West Africa is cultivated on small plots of land most of which are 1 to 2 ha. In many of the special rice projects, participating farmers are usually limited to 0.25 to 1.00 ha plots per family. The role of women in rice cultivation in the region remains crucial, especially as the crop continues to be cultivated mainly for household subsistence.

Like in Asia, women undertake most of the work involved, not only in cultivation but also in the post-harvest processing of the crop. In Liberia, it is a common saying that a woman can cultivate rice all by herself but a man cannot, he will have to solicit the help of a woman. As already indicated in some areas in the region, for example in Liberia, men avoid swamp rice cultivation which they regard as suitable only for women.

The total labor supplied by women for rice cultivation in the region ranges from about 3% for floating rice cultivation using animal traction in Mopti area of Mali, to about 80 to 100% in mangrove swamp rice cultivation in the Gambia and Liberia.

3. TECHNOLOGICAL INNOVATIONS

Although rice cultivation in the region can be described generally as still traditional, the use of modern methods and technologies is spreading quite rapidly. Strictly traditional methods are practised in a few places in the region and mainly on small family subsistence farms, e.g., floating rice cultivation in Northern Nigeria. The traditional methods involve the use of non-mechanical and very simple tools, notably the hoe, cutlass and sickle to prepare the land, cultivate and harvest the crop. The system is labor intensive. The water for plant growth is uncontrolled. Chemical and other forms of fertilizers are not applied to enrich the soil. When soil fertility is too low to support a good rice crop, or weed problem becomes severe, the field is abandoned for several years, while cultivation is shifted to fields which have fallowed for several years. The varieties cultivated are usually unimproved and planting is usually by broadcasting. In several places, the crop is planted mixed with other crops. The traditional system generally results in poor paddy yield of less then one tonne per hectare.

In most areas of the region however, various degrees and items of traditional and modern methods and inputs are combined in cultivating rice on both small and large fields. As implied in an earlier statement, traditional methods and inputs are employed more on small fields, and particularly those cultivated by women, than on large fields.

The modern rice-farming system in the region involves:

i) mechanical land preparation, using tractor and the accompanying implements on relatively large fields, ox-plough on small fields and single-axle power tiller for fields in mangrove swamps;

ii) mechanical seed drills and transplanter;

iii) chemicals as well as mechanical land preparation to control weeds;

iv) chemical fertilizers to increase soil fertility;

v) planting seeds of improved varieties;

vi) water supply and control through irrigation facilities;

vii) mechanical harvesting with unitary or combine harvesters.

Although not intended, most of the modern technologies, particularly the introduced machinery, which have spread more in rice growing areas of the region, tend to benefit men more than women as they have reduced the workload of men and somehow increased that of women as a result of increase in the area of farms cultivated. The most mechanized aspect of rice cultivation in the region is land preparation, and this is usually done by men. This situation however, has some benefits for women where the machinery introduced has enabled large farms to be cultivated, and consequently has offered them job opportunities such as weeding, harvesting, gathering of the harvested rice and carrying it to the mills in the villages and other collecting centers. However, it is noted that wages paid to these women laborers are often low compared to the earnings of their men counterparts.

Social norms and practices as well as the operation of extension services in the region have also contributed greatly in preventing women from benefiting fully from introduced technologies and modern methods of farming. For example, in some parts of Ghana, a married woman cannot take a loan for any activity from any source without the consent of her husband. But for the many poverty-stricken small-scale subsistence women farmers, credit is essential in order to enable them to adopt some of the modern technological innovations in farming.

The extension agents in the region are predominantly men and in some places, social norms and courtesies prevent the agents from talking directly to women farmers, particularly where they are married and are not heads of the households, which the majority of the women are not. Yet, it is the women who take the day-to-day decisions and manage the family subsistence farms.

The use of modern methods and inputs including machinery in the region is concentrated mainly in special rice or agricultural development projects. Direct participation of women in these public projects is insignificant to say the least. Women are, to a greater extent, left out in project participation by farmers even where they were the majority before the projects were implemented. For example, when irrigated rice project was implemented in the Gambia in the early 1970s, men took over that system of cultivation although they generally participate very little in rice production. A partial failure of the project is attributed to the exclusion of women participation in the project, except as providers of wage labor or assisting their husbands or male relatives on their assigned fields.

4. IMPROVED TECHNOLOGY NEEDS OF WOMEN

Technological innovations needed by women in rice farming should include those that would reduce the drudgery of the work they do; improve their productivity; and eventually, increase their income earning capacity. As indicated earlier, women contribute the greatest in traditional rice farming, particularly, planting of seeds and seedlings, weeding of the farms, bird-scaring and harvesting of the crop. In the swamps, they participate significantly in land preparation. As mentioned earlier, power tillers have been introduced in the region for swamp land preparation. However, they are found to be too heavy for the women to use. The power tiller needs to be redesigned to make it lighter for the women.

With regard to planting, mechanical seed-drills and transplanters developed elsewhere are available in the region. However, their use is not widespread and are mostly available to farmers who participate in the special rice projects. There are no policies and strategies to enhance the spread of seed drills and transplanters in the region to enable farmers generally, who are outside the projects, to adopt them. The seed drills and transplanters can be handled by women. There is, therefore, the need to study the economic use of these on small-scale subsistence farms and the design of extension strategies to spread them.

The drudgery in manual weeding using traditional tools such as hoe and cutlass can be reduced by the use of weedicides. Research work in the region has identified some of the most effective weedicides which include Stam F34, Gramozone, Basagram, Glyphosate, etc. Also, proper mechanical land preparation can reduce quite considerably weed infestation of rice fields. Row tillers for upland rice and single row weeders for irrigated rice will also reduce women's drudgery in weeding.

WARDA had modified the lance of a knapsack sprayer so that it can be used to apply liquid urea by injection, 15-20 cm below the soil surface, in mangrove swamps. The knapsack sprayer which is normally carried on the back of the operator is light and can be used with ease by women. The use of this simple equipment will increase the drudgery of applying fertilizer in mangrove swamp by women. However, applying fertilizer by the injection method increases yield by about 50% compared to the 25% yield increase by broadcasting method.

Women and children spend several hours each day during the period before harvesting, to scare away grain-eating birds from the rice fields. WARDA collaborating with United Nations Development Program(UNDP)/FAO, Organisation Commune de Lutte Anti-Acridienne et de Lutte Anti-Aviaire (OCLALAV) and Comité Permanent Inter-Etats de Lutte Contre le Secheresse dans le Sahel (CILLS) has initiated a research project in Liberia aimed at finding solutions to the problem. The preliminary findings of the research indicate that the further the site of rice cultivation is from villages, the less the damage, as the grain-eating birds tend to locate their habitat near human settlements. It is also observed that the most important grain-eating bird in the region (weaver), is closely associated with both relative distribution and abundance of oil palm and coconut plantations which it uses for nesting. The findings suggest that rice fields should be located away from human settlements and from oil palm and coconut plantations in order to reduce the birds' damage. Thus, proper location of the rice fields would reduce the many hours women and children spend to scare away grain-eating birds.

The available machines for harvesting are not suitable for the scattered and small subsistence farms. The large combine-harvesters are only suitable and economical on large farms. The use of small harvesters and threshers, e.g., the Kubota type which are appropriate for small farms, is not widespread in the region. This is due partly to its cost, which the small-scale farmers cannot afford, and the lack of credit facilities to assist them.

Currently, women use sickle to harvest r . An improvement on this simple tool has been made in India, and will be studied for adoption in the region. The improved one is called "Naveen" sickle. In this improved sickle, the curve has been reshaped to harvest the crop at a better angle and reduce the need for frequent sharpening when the sickle is constantly used.

The handle of the traditional sickle which is hard and rough and therefore causes blisters when it constantly slips in the palm has been given a restraining stub at the rear of the handle to reduce the problem. It is estimated that the improved sickle gives 10-20% higher output than the traditional one.[1]

Although WARDA is mainly concerned with rice development, it does make its expertise available to women and other farmers cultivating other crops in the region. In 1983, for example, FAO requested assistance from WARDA for the design of simple, inexpensive and easy to operate irrigation facilities for women cooperative farmers who cultivate vegetables in Bandeja village in Liberia. The women use buckets to fetch water from a nearby creek to water the one-half of a hectare farm. The facility designed would cost $4,500 to construct and would be financed by FAO.

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[1] Srivastava J.C. (1983) "Harvesting Technology for Eliminating the Drudgery of Rural Women Engaged in Rice Production, Processing and Utilization", a paper presented at a conference on women in Rice Farming organized by IRRI, 26-30 September, 1983, at Los Banos, Philippines.

5. IDENTIFICATION OF FARMING CONSTRAINTS

The identification of socio-economic, technological and other environmental constraints of small-holder rice farmers in the region is among WARDA's priority activities. The systematic information gathered through surveys of target farmers is used to guide development and identification of improved and appropriate technological packages which would fit into the broad working environment and conditions of smallholder rice farmers in the region.

The constraints identification forms the first phase of WARDA's improved Technology Assessment and Transfer (TAT) program which was started in the early 1970s but formulated into a program in 1980. The other four phases of the program are:

Phase II: Selection and assessment of appropriate technological packages through adaptive farmers field trials;

Phase III: Designing and testing strategies for extending improved technologies to target farmers;

Phase IV: Liaison with national extension agents to transfer improved technologies;

Phase V: Conducting studies to assess the adoption and impact of improved technologies.

The main objective of the TAT program is to ensure that new technological packages introduced have a better chance of adoption by farmers. In other words, the program aims at increasing the adoption rate of new improved technologies introduced to small-scale farmers who dominate the rice cultivation scene in the region.

Through the constraints identification surveys, WARDA hopes to identify, in some detail, the major technological constraints of women in rice farming in the region. This would enable the appropriate women-oriented research among the other small scale rice farmers to be carried out, and the design of appropriate extension strategies to enable women and other resource-poor farmers to adopt and effectively use improved technological packages.

6. STRATEGY TO ENHANCE THE ADOPTION OF IMPROVED TECHNOLOGY

Due to the poor financial position of the dominating smallholder, subsistence rice farmers in the region, the Association anticipated difficulties in the adoption of improved technologies that involve relatively heavy initial investment. A case in point is the recommendation of the use of single-axle power tillers to prepare rice fields in mangrove swamps. It became necessary, therefore, for the Association to try a "Group Ownership Scheme", a form of farmer cooperative, and assess its performance before recommending it to national extension agents for implementation.

In this connection, three pilot farmer cooperatives were set up in 1983 in the mangrove swamp areas of Sierra Leone to test an appropriate

extension strategy that would facilitate the adoption of fertilizer injectors and single-axle power tillers for mechanical land preparation and puddling. Each cooperative was to group about 25 farmers to cultivate a minimum of 24 ha, an area which would ensure an economic use of one power tiller per season. The farmers were to pay a membership fee of Le50.00 each (equivalent of $20.00 at 1983 exchange rate). This provided about 35% down payment for each power tiller and 4 fertilizer injectors. The membership fee was however used as a revolving fund for the purpose of providing a repair facility and purchasing a stock of fast moving spare parts. Credit was arranged for the cooperatives for the initial cost of the equipment. In using the equipment, each farmer paid a fee of Le173.00 ($69.00) per ha cultivated. Each Cooperative selected its own chairman, secretary and treasurer, and also nominated people who were trained by WARDA to operate the power tillers. The farmers themselves were trained to use the fertilizer injector.

A few modifications were made to the strategy by the farmers themselves when the program was implemented. In one case, fewer farmers than recommended got together and paid a higher membership fee. In another case, the farmers decided to rent out their tiller to non-members who paid a higher rental charge. Of the total farmers who used the power tillers in the first year of the experiment, 35% were non-members of the three cooperatives. This has created a demand by many farmers to start their own cooperatives along the line of the Group Ownership Scheme.

7. DISSEMINATION OF INFORMATION ON IMPROVED TECHNOLOGY

WARDA disseminates its research findings to national research scientists, public decision-makers, donors etc. through several channels which can be summarized as follows:

i) several regular and occasional publications;
ii) conferences, workshops, seminars and particularly the annual and now biennial rice review meetings;
iii) project documents prepared by WARDA for member countries.
iv) training programs;
v) demonstrations, field-days, farmer contacts, etc.;
vi) special request for technical assistance;
vii) coordinated variety trials, etc.

The mandate of WARDA, an intergovernmental organization of 16 member countries, does not allow the organization to enforce the adoption of a new knowledge in rice development made available to the member countries by the Association. However, it is observed that new knowledge disseminated to the member countries is given due consideration in their efforts to increase rice production.

8. TRAINING OF FARMERS

Training is an essential requirement for the use of modern technologies. As mentioned earlier, WARDA organizes special training programs for farmers to enable them to use improved technologies extended to them. This type of training is provided mainly at our four Regional Research Stations located at Saint Louis, Senegal for irrigated rice research, Mopti, Mali for deepwater/floating rice research, Rokupr, Sierra Leone

for mangrove swamp rice research and Bouake, Ivory Coast for upland rice research. The training offered at these places has mainly local farmers participating. The training is easier where the target group have had some formal education. Unfortunately, the proportion of small-scale farmers with even the minimum level of formal education in the region is negligible and the situation is worse with respect to women farmers. The negative effect of this on the participation of women in WARDA training programs is quite conspicuous. The proportion of women who have taken courses in the WARDA training programs is less than 1%. WARDA can design and offer special training courses for the illiterate women farmers upon request of the member countries.

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PART II

REGIONAL REVIEWS OF WOMEN'S ROLE IN AGRICULTURAL PRODUCTION AND DECISION-MAKING

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Women in Agriculture in Sub-Saharan Africa: Implications for Agricultural Research and Technology

by

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1. INTRODUCTION

The purpose of this paper is to examine the role of women in agriculture and the rural household in Africa in order to draw possible implications for development programs, in general, and agricultural technology, in particular, that would facilitate their fuller integration and contribution in the development of African agriculture. As far as technologies per se are concerned, in all the voluminous literature there is practically no example of a technology that women as such are incapable of using. The only exception may have been the case of the rotary weeder, too heavy for use by women. In all of the cited cases where women either could not use the technology or were adversely affected by it, the factors responsible were primarily derived from the underlying social, cultural, and economic conditions which were often compounded by insensitivity in program implementation. Therefore, insofar as the CG system is concerned with not just the development of new technologies but their effective application as well, the user concern at the household and intra-household level would be relevant. A concern for the participation of rural women in the use of and benefits from technological improvements needs to start with examining the experiences and underlying factors in this process.

A great deal has been written on this subject, and analysis reveals three major sets of interrelated concerns. First, development programs have the capacity to radically change the distribution of resources by allowing those already favored in traditional and evolving structures to capitalize disproportionately on the benefits of growth. In the past this has largely been addressed as a between-households problem. It is, however, becoming increasingly evident that similar processes of change may also operate for within-household distribution of resources. Second, if it leads to a marginal ratio of women in production control and decision-making, it may result in both welfare and efficiency losses in the system. Third, stemming from the above and from the higher labor intensity usually accompanying technological change for small farmers, are increasing labor demands on already overburdened rural women.

In traditional African societies, women have had a significant and acknowledged role in contributing to the wealth of their families. Because women's contribution was considered so central both in the agricultural division of labor and for reproduction, traditional structures of resource allocation have provided them access to the basic factors of production in agriculture. Thus, despite the fact that women remained socially subordinate to men, there were mechanisms for their resource access and control, decision-making, and productive contribution. However, this finely balanced system is basically derived from (a) the perceived value of women's contribution, and (b) the traditional structures of authority and resource allocation. Development programs can produce drastic changes within the households by altering both these conditions.

Within the general context of development, two opposing effects have been observed for the change in women's role - one with capital growth in the

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non-agricultural sector (or large-scale commercial farm sector) and the other with technological change in the agricultural sector. While the first process is seen as capitalizing on women's subsistence production role by allowing industry to obtain a work force at reduced expense, the second expects little more of them than a source of labor, both for the short-run and through child-rearing activities for the long-run.[1] The consequences of both these processes for agriculture and rural households have been discussed in the literature, and raise important questions for appropriate agricultural strategies and the precise role of international and national agricultural research systems in facilitating this.

In order to examine the available information, three sets of issues are explored in this paper. First, what are the consequences for production and welfare of an inadequate consideration of women's decision-making roles in the generation and use of new agricultural technologies? Second, what are the characteristics of women's role in agriculture in Sub-Saharan African countries, and what, if any, are the generalizations that can be drawn about the nature and consequences of changes in agriculture? And third, what is the experience of efforts that have been made to integrate women's roles or to analyze the needs for successfully achieving that objective?

2. INTRODUCTION OF NEW AGRICULTURAL TECHNOLOGIES: CONSEQUENCES FOR WOMEN

Practically, all of the evidence on the consequences for women of the introduction of new agricultural technologies in Africa stems from two underlying factors - women's traditional obligations towards contributing to food and subsistence needs and their need for a supplemental independent income source. While these underlying factors will be examined in detail later, some of the main consequences of the failure to incorporate women's roles in agriculture that have been cited and are discussed below are : (i) lower production impact due to either nature of technology, their access to it, or their access to returns from adopting it; (ii) an inequitable impact within the household, with possible negative welfare consequences for women; and (iii) failure of agricultural development schemes to recognize women's traditional independent roles in production.

Changes in the organization of production resulting from introduction of new technologies are probably the most frequently cited reason for increasing inequity within and between households. To some extent, these effects appear to parallel those that resulted in the first generation concerns with the "green revolution" during the late 1960s and early 1970s in Asia - for example, displacement of farmers with insecure rights and capitalization of benefits by those with larger and more secure rights. It may be that, just as it was in Asia, a combination of new technology characteristics and, perhaps more importantly, favorable policies for research, extension, input delivery, and output marketing environment will be required for broadening the base for adoption of new agricultural technologies.

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[1] See Achola Pala, "The Role of African Women in Rural Development, Research Priorities", Discussion Paper No. 203 (Nairobi: Institute of Development Studies, 1974), for discussion of these processes.

At the household level, there are numerous observations on the changes in production organization. These changes are most apparent where there had been a relatively clear-cut division of labor between crops in the household. In an extensive review of literature on changes in rice farming, Dey (1983) found that with improvements in rice technology, in every case where women had originally been responsible for the household crop, rice had shifted to being controlled by men even though in two out of five cases the main cultivator remained the woman. What are the household and intra-household level welfare implications of these shifts? On the surface, it would appear that the women's workload would substantially increase in all the cases. Though household incomes would increase, there are some indications that this may not be so for welfare. It is claimed that while the role of women in production may be altered in the short run, the same may not be true for their perceived obligations; reduction in their capacity to fulfill these obligations may have serious consequences for their welfare. Dey concludes that the failure of most of these schemes is due to lack of adequate returns to women who need to provide the labor. The inability to recognize these factors has also contributed to the lack of improvement in those sectors where women have a major role within the household division of labor. Numerous reports of such "blindness on the part of male and urban and foreign planners toward the important role and activities of rural African women" are available.[1]

When there are technologies which could help women to work more efficiently, they are not necessarily able to use them even if they were made available to the household. This may be partly due not only to their lack of knowledge and ability resulting from not being included in training and extension, but also to the relative autonomy of their activities within the household, such that they may be required and unable to pay for the use of the "household" resource.[2] These provide examples of how assumptions made about the structure of households and of women's roles can be translated into a weakening of their relative or absolute economic position.

Resource constraints, in particular a labor constraint, has also been noted for woman-headed households. In conjunction with their low-economic status, this often makes it difficult for them to adopt technological improvements requiring a higher intensity of labor input.[3] As shown in a later section, the resource characteristics of

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1 Yvette Stevens, "Technologies for Rural Women's Activities - Problems and Prospects in Sierra Leone"; and Eugenia Date-Bah, "Rural Women, Their Activities and Technology in Ghana: An Overview", in Rural Development and Women in Africa (Geneva: ILO, 1984).

2 Marilyn Carr, "Women and Technology in Rurally Oriented Projects", Notes on Women in Development No. 13 (World Bank, 1981), cites recorded examples from Senegal, Tanzania, Gambia, and Niger of the women's inability to use improved inputs or equipment for one or both of these reasons.

3 This has been demonstrated in a study in Malawi by G.H.R. Chipande(1984).

female-headed households vary, and it is the characteristics that are necessary to consider and not the fact that they are female-headed in examining their constraints for technology adoption.

In an irrigated rice scheme in Kenya, women were reported to have increased their labor input in agriculture but at the cost of reduced production of the staple food crop. As rice was primarily produced for sale, food security was believed to have deteriorated in the process but at the same time incomes increased.[1] It is not clear to what extent the nature of the rice technology - i.e. taste, storage or processing characteristics - prevented the increase in the diet and to what extent the constraints imposed by the program - i.e. requirement to sell, area-level inadequate market response for supplying the traditional staples, or in staple production - affected the reduced food production and security in the area. Also, it is not clear why the shift of women's labor to rice took place at the cost of staple food production in the first place.

An alternative or, in some cases, a delayed response to the negative consequences of new crops or technologies for household food security has been the rejection of new methods. Three cases have been cited by Migot-Adholla and Pala-Okeyo[2] where the changes introduced in crop production required a reduction in women's labor in food production, but their compensation did not make up for the loss and as a consequence the schemes were not successful.

It may be crucial to emphasize the underlying factors that determine why certain changes take place more than the change itself. One study which attempted to do this was on changes with adoption of irrigated rice production in Cameroon.[3] In this study area, women traditionally contributed to household food needs with the product of their sorghum cultivation. While the man of the household may also have grown sorghum, his output was not primarily used for household food but for exchange purposes. When rice cultivation was introduced, women's labor input was required though its proceeds were controlled by men. As a consequence, there was reduction in sorghum produced by women, but it was more than compensated for by the quantity of paddy retained for home consumption. This was chiefly accounted for by the compensation that women received from their husbands for their labor in rice, which was more than the returns from sorghum cultivation. The difference in this experience from that cited earlier in Kenya with introducing a similar technology

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1 Ingrid Palmer, "Rural Women and the Basic Needs Approach to Development", International Labor Review, Vol. 115, January-February 1977.

2 "On-Farm Grain Storage in Western Kenya", draft, Population Council, 1984.

3 Christine Jones, "Bargaining Processes Among Members of Agricultural Production Units in North Cameroon", paper presented at the Joint Rockefeller Foundation/Ford Foundation Conference on Intra-Household Contractual Arrangements and Farming Systems Research, Bellagio, March 1984.

underlines the need for a better understanding of the factors determining the women's roles in production, the changes in these roles, and the welfare consequences. Without this, the capacity for specific action is severely limited.

Processing of agricultural products is an activity in which women from diverse areas have been found to spend nearly as much time as in production activities. This has been shown to give them an additional right to the crop or its proceeds. Despite that this is an activity almost entirely conducted by women, technological improvements often appear to have either bypassed them or not been suitable. The larger and more centralized the scale of operation, the lower are the benefits likely at the local level. Several success stories reported had two features in common - a design appropriate to the local needs and constraints, and the involvement of women in its adoption and use.[1] On the other hand, a hydraulic palm oil press introduced in Bendel State, Nigeria, was found to be initially popular but in a year's time its use fell drastically. This was because the fiber by-product which was traditionally a good source of fuel was no longer available to the women, and the design of the machine was also claimed too difficult for the women to handle.[2]

Very often, though the technology may be suitable, the assumption of complete "fungibility" of knowledge and resources between household members may tend to exclude women from access to extension training and improved inputs. Efficiency and even direct welfare losses in such circumstances may be expected and have been noted. A study of maize storage in Nyanza district, Kenya, found that though women are largely responsible for grain storage, chemical insecticides were made available for improved storage only to men who also received instructions on its use. As a result, only 4% of women knew how to correctly apply the chemical and there was a high risk of its misapplication.[3]

Labor demand for crop processing should increase with increasing crop production unless labor-saving devices are used (centralized processing can also shift tasks out of household to some extent). However, the lack of effective demand for and availability of small labor-saving crop processing devices, as well as its link with the low resource base of women who are primarily responsible for these tasks, has also been observed.[4] Recognition of these problems clearly has implications for

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1 Irene Tinker, "New Technologies for Food-Related Activities: An Equity Strategy", in R. Danber and M.L. Cain (editors), Women and Technological Change in Developing Countries (American Association for the Advancement of Science (AAAS) Selected Symposia Series, Westview Press, 1981).

2 Jadesola O. Akande, "Participation of Women in Rural Development - Nigeria", in Rural Development and Women in Africa (Geneva: International Labor Organization, 1984).

3 Migot-Adholla and Pala-Okeyo, "On-Farm Grain Storage in Kenya", draft, Population Council, 1984.

4 Carr, 1981, op. cit.

both the choice of suitable technology and the organization of its dissemination and other program components.[1]

3. WOMEN'S ROLES IN THE ORGANIZATION OF AGRICULTURAL PRODUCTION IN AFRICA

It was Ester Boserup, in her classic work on women in agriculture, who first drew attention to the distribution and variations in division of labor in African agriculture and to its implications for development strategies. This early work also makes reference to the gradually changing patterns of labor input that were evident and the underlying factors that were responsible. In particular, the trend appeared to be one in which men were gradually taking on more responsibility for agriculture (especially in the growing cash cropping sectors) at the same time that women's workload and status in general appeared to have deteriorated.[2]

Organization of household production is the result of both socio-cultural norms and practices and the prevailing agro-ecological conditions and needs of the agricultural production systems. Cultural norms are probably central in the organization of household activities, in the patterns of authority, responsibilities, rights, and obligations assigned to the members, and consequently in defining their productive role as individuals. Clearly, this is not a static phenomenon and would be modified by externally induced changes. Several writers have emphasized the need to focus analysis on the dynamics of the organization of production by households and division of labor. This can lead to a better understanding of the underlying factors contributing to it, in particular of the interactive processes in the division of labor whereby role allocation results from negotiation between partners rather than described by sex.[3] It may be argued that shifts in both opportunities and demands imposed externally lead to shifts in the organization of household production, and this is mediated by changes in relative levels of resource access and decision-making capacity of individuals.

The evidence on the variety and intricacy of the individual's community and household links is quite voluminous and any generalizations are risky. It is clear, however, that in order to understand gender relations, one needs to go beyond the economic component of domestic relations between household members. Cultural variables may be crucial in determining the range of permissible variation in roles that may be negotiated by individuals:

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[1] Carr, 1981, op. cit. The pattern of adoption of crop-processing equipment in the more highly stratified Asian countries, e.g. Bangladesh and Indonesia, shows that these are preferentially adopted by households as a cost-saving device (displacement of hired workers) than as a labor-saving device (when unpaid household workers perform the tasks).

[2] Ester Boserup, Women's Role in Economic Development (New York: St. Martin's Press, 1970).

[3] Diane Kayongo-Male, "Dynamics of the Household Division of Labor", paper presented at workshop on Conceptualizing the Household Issues of Theory, Method and Application, Tufts University, November 1984.

> "The critical aspect of women's disability in household production is that they are systematically disadvantaged both in the market, and in the particularistic politico-kinship relations which together form the locus of reproduction of the rural production system.[1]

In this context, a relevant question is posed by Henn:

> "Anthropologists have shown that African women's range of economic choice is drastically curtailed by custom and patriarchal power. Could this be why economists so frequently ignore women's role in food production?" (Henn, 1983)

The question may not be entirely rhetorical and points to the need for a careful analysis of the issue so as to be better able to incorporate it into program and policy analysis.

Another factor central to the organization of household production is the interdependence of members of the household, which is primarily responsible for the existence and form taken by the unit. Apart from any psycho-social benefits, household membership is seen to give access to critical economic resources. Since these are usually significantly different for men and women, this can influence their respective need for self-provisioning.

One consistent observation across various systems is the distribution of responsibility for the tradeables versus non-tradeables in household production. For women, this means first and foremost reproductive and directly survival-related activities such as fetching fuel and water, as well as food processing and preparation. Additional productive activities, whether agricultural or otherwise, can be seen with few exceptions as an extension of women's basic role in subsistence and production.

The predominant role of women in food farming[2] has been noted for a long time. In a survey of 140 ethnic groups in Sub-Saharan Africa, published in 1928, Baumann documented that women carried a major responsibility for food farming in 85% of the communities and did all the work except clearing the land in 40% of them. Several authors have traced this to patterns of traditional obligation of men and women to their household and community. Furthermore, during the decades prior to and since independence in most African nations, two additional factors have been operating that may have accentuated the contribution of women to food farming. Both the colonial policies of drawing men away from the villages and the nearly singular policy emphasis on export/cash crop production in many African states is expected to have further drawn women

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[1] Ann Whitehead, "Beyond the Household: Gender and Kinship based Resource Allocation in a Ghanaian Domestic Economy", paper presented at Workshop on Conceptualizing the Household, Tufts University, November 1984.

[2] This means production for the household food supply, and may be less ambiguous than crop-based dichotomies, such as food/subsistence or cash crop, in discussion of women's role in agricultural production.

into the production of household food supply.[1] An additional contributing factor which is not often mentioned is the continuing need for local production of food in the presence of the fragmentary marketing structure in rural areas, which may also impede their growth potential for producing surplus food.[2]

In Sub-Saharan Africa, women's relatively independent and major role in agricultural production has drawn a lot of attention by anthropologists. Pala (1976), in a review of the evidence on traditional and modern (or pre- and post-colonial) patterns of the organization of production, concludes that in most systems that were based on agriculture or in the transhumant pastoral types, women seem to have been largely responsible for subsistence agricultural production.[3] However, the labor input of men appears essential, even if at a minimum for clearing. It is not clear to what extent women had disposal rights on surplus production beyond the immediate subsistence needs of the family. However, what is clear is that their rights, if any, to the surplus were secondary to men's in all patrilineal systems. In pastoral systems, men controlled cattle and women's rights were largely limited to consumption needs, and they could seldom inherit or dispose of cattle. Small animals, such as goat and sheep, however, could be owned by women in both East and West African pastoral systems.

The most clearly recognized primary rights of women within the households are for agricultural output to meet subsistence needs, whether it is from her own production or from her husband's. In addition, when women retained usufructuary rights in their own kinship, then their need to make transfers to the group were also acknowledged but needed to come out of own production. The precise pattern of the obligations of men and women to the spousal unit and to the kin varies (Guyer 1980, Hemmings-Gapihan 1982, Burbisher and Horenstein 1983, Schildkrout, MacCormack 1982, Kossoudji and Mueller 1983, and Spiro 1980 a,b). Men's primary focus in the exchange economy and surplus accumulation, usually in the form of cattle, it related more to longer-term economic security. This may often be translated partly through the exchange of cattle for additional wives, and consequently the labor force, and partly through sale of cattle in times of crop failure.

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1 Jeanne Koopman Henn, "Feeding the Cities and Feeding the Peasants: What Role for Africa's Women Farmers?" World Development, Vol. II, 1983, pp.1043-1055.

2 Jane Guer, "The Women's Farming System: The Lekie, Southern Cameroon" (Yaounde: National Advanced School of Agriculture, 1977).

3 The only major exceptions being in the so-called male agriculture, predominantly found in West Africa, where women engage in trading as they do not have primary responsibility for agricultural production. However, recent studies have confirmed that women do provide a significant labor input in production in most of these systems (Spiro, 1980a; Guyer, 1980).

Within this general form of organization, there are recognizable common and independent spheres of production activity. The common sphere is represented by one or more household plots which may be farmed predominantly by the man or woman with assistance from other household members, the output from which is collectively owned and goes toward meeting basic household needs. In addition to this, individuals can operate individual plots which are used for fulfilling longer-term goals, individual consumption needs, and often for meeting individual independent obligations to the household. For example, women's obligation to provide relish ingredients in parts of Zambia requires them to have an independent groundnut plot, from which they may also realize some income from sales. Similarly, men frequently are obliged to provide for schooling costs of children. Some estimates of the degree of independent production activity have been made. In an area of Upper Volta which has a relatively high population density, women are reported to have traditionally farmed 15-20% of total area planted as private fields.[1] Similarly, in an area of Northeast Ghana, in addition to the collective farming enterprise for meeting both food and basic cash needs of the household,

> "all adult men and most adult women have land use rights for private farms on which they may grow such crops as they wish. The acreage that women farm is however very small (less than 1 acre), while men's farms range from 3-20 acres in size" (Whitehead, op. cit., 1984).

The author traces this difference in size of private fields to a combination of land access and time constraints for women, as well as their limited access to mobilizing labor. This is a frequent observation in patrilineal communities. Under such circumstances, women sometimes obtain land for farming from their own patrilineage if it is logistically feasible for them to cultivate it.

It is important to note that both the nature of women's obligations to the household and their needs for an independent income source stem from the nature of the conjugal contract which provides the basis for the very existence of the household. Whitehead's analysis links very well the nature of this implicit contract and its implications for women's roles in production. Some generalizable characteristics from this analysis are: (1) marriage recruits women as unfree laborers, (2) husband's rights to wife's labor (and vice versa) are not open and work is often remunerated in some form, (3) agricultural intensification places increased demands on women's unfree labor, and is an area of struggle between the sexes, and (4) division of labor is highly variable and cannot be interpreted "via a naturalistic view of the sexual division of labor."

Furthermore, there is a separation between short and longer term economic concerns which can be traced to characteristics of the household

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[1] Della MacMillan, "The Role of Longitudinal Case Studies in Evaluation of Household Effects of Large-Scale Development Planning", Paper presented at Workshop on Conceptualizing the Households, Tufts University, November 1984.

extremely "variable in their incidence and form." These characteristics include:

> "the flexibility of residence arrangements, with the absence of conjugality as a necessary basis for the domestic group; the existence of polygyny, giving varying degrees of concentration of wives amongst men of different ages and socio-economic or political status; the likelihood and rates of divorce, and the asymmetrical relation of marriage to the kinship status of children (the 'lineality' of the kinship system). All these more structural features emphasize the non-corporate character of the spouses' interests and the potential separation of their life courses" (Whitehead, 1984).

While the geographical variation in patterns of agricultural organization and women's roles has received considerable attention, the question of cross-section variations within communities has been relatively neglected. This probably stems from the assumption of a relatively unstratified homogenous rural society, which may be so only in comparison with parts of Latin America or Asia. This cross-section variation in women's roles, most readily evident in a comparison of female-headed and joint production households, suggests a strong link between socio-economic class and gender roles. At this cross-sectional level of comparison, many specializations of crop or activity by gender tend to break down substantially.

Detailed anthropological studies in areas as diverse as Burundi and the Central African Republic[1], both with origins in feudal patriarchal systems, show a remarkably hierarchical social structure with a concommitant variation in women's roles. Recent literature also makes reference to the increasing inequality between households with increased opportunities for development of agriculture.

One aspect of the cross-section variation in women's role which has received considerable attention is in the difference between female-headed and joint households. These differences may be quite important, as there is evidence that women-headed households are not only widely prevalent in rural areas but also likely to be the most disadvantaged. Even in a Hausa area of Nigeria, where social mores indicate relative seclusion and dependence of women, Polly Hill found that about one-fifth of households were headed by women, "many of whom were the dominant household decision-makers whether or not a married son were living with them; as proportionately more women than men household heads were in charge of large two-generation joint households, nearly a quarter of the whole population actually lived in these women's households".[2]

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[1] Ethel Albert, "Women of Burundi: A Study of Social Values"; and Anne Laurentin, "Nzakara Women", in Women of Tropical Africa (edited by Denise Paulme), University of California, 1963.

[2] Polly Hill, Dry Grain Farming Families (Cambridge University Press, 1982), p. 112.

In contrast to the previous case where there was no apparent evidence of a resource constraint in women-headed households, a study in Malawi found that nearly one-third of rural households on a countrywide basis are headed by women, and these households were at the bottom of the income scale.[1] They were also the most labor-constrained and, as mentioned earlier, were therefore disadvantaged in adoption of the technological package being promoted which required increased intensification in agricultural production.

A study in Western Kenya found that 40 percent of farms were female-managed, many as a result of male out-migration. An examination of the activities performed by women in this group showed that

> "many female managers absorbed men's responsibilities and coped with peak labor periods without the assistance of another resident adult. In the sample, half of the female managers were also responsible for cattle care" (Staudt, 1984).

Here, as in Malawi case, the majority of women farm managers had a low economic status. Significantly, the overall managerial characteristics and economic status of the low-income female and jointly-managed farms were found to be similar.[2]

4. CHANGING PRODUCTION WITH TECHNOLOGICAL CHANGE

There are numerous examples of changes in women's production roles with technological change in agriculture. The reports include many impressions, anecdotes, and some careful studies. In this section, some of the most in-depth work done has been selected in order to illustrate the effects on women's roles and welfare with two of the major types of changes reported:

i) women's loss of crop production role to men with technological improvements;
ii) improvement in crops grown by men (or not previously grown by women) which potentially required additional women's labor input in agriculture.

These and other changes are examined for three types of technological improvements. The improvements examined are introduction of a food-cash crop (irrigated rice), and export/cash crop (cocoa), and mixed dry-land farming. In the first two types, the experiences with different roles of women in production are also examined. It should be noted that, as is invariably the case, irrespective of the type of improvement or existing production organization, all of the improvements were effectively accessible directly only to men. The following table illustrates the types of situations being reported and the general nature of their consequences.

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1 G.H.R. Chipande, "Innovation Adoption Among Female-Headed Households: The Case of Malawi", paper presented at workshop on Conceptualizing the Household, Tufts University, November 1984.

2 Kathleen Staudt, "Agricultural Policy Implementation: A Case Study from Western Kenya", draft, Population Council, 1984.

Table 1:

Case studies on possible effects of technological changes on Women

Original Organization of Production[a]	Type of Improvement		
	Irrigated Rice	Cocoa	Mixed Dry Land
Women responsible for food farming	I. Additional requirement for women's labor (Cameroon)	III. Additional requirement for women's labor (Cameroon	
Men responsible for food farming	II. Additional labor requirement conflicts with women's off-season crop (Ivory Coast)	IV. Shift of labor out of food production (W. Nigeria)	V. Loss of women's subsidiary economic activities (Volta Valley)

[a] These categorizations are obviously oversimplified. In both types of cases, the spouse provides some labor for production and a supplementary food or income source.

Case I -- Irrigated Rice Introduction in Cameroon[1]

Traditionally, women spent 95 % of their time growing sorghum on their fields assigned by compound heads and had a minimal obligation to either work on their husband's or the collective field. Grain from the woman's field was the first source of food for her domestic unit (signifying the sub-compound unit of woman, man, and children). When her supply was exhausted the man's supply was used, and access to grain from the collective field was the last resort.

With the introduction of irrigated rice, which is managed by men (even when women are assigned rice plots by the irrigation authorities, the proceeds are controlled by men),[2] the pattern of labor organization in the household changed dramatically. Because of its higher labor requirement, the rice required joint cultivation by members of the domestic unit, in contrast to sorghum which was pretty much grown individually. Since the labor requirement for rice conflicted with sorghum cultivation, a loss in sorghum production was entailed.

The new pattern of crop disposal was as follows:

i) Following the paddy harvest, grain was retained for home consumption. This was intended to compensate for the loss in sorghum by both men and women with the shift in production;
ii) In addition, men gave their wives a lump sum in cash following the sale of paddy.

In appears that the total value of grain retained plus the cash payment to wives roughly equal the returns to women's labor valued at market wage rates. The principle that appears to be enforced here is one which was present traditionally, that it is primarily the women's responsibility to feed the household. However, it is also evident that wage rates for rice are extremely high due to labor shortages, and the returns from any of the alternative uses of women's labor would be less than what they received from rice production. It does not appear that women were free to choose the option of wage labor, and if they were, the wage structure may not have been as favorable anyway.

It would be useful to compare the quantity of grain and cash at women's disposal under the two modes of cultivation and its welfare consequences.

Case II -- Irrigated Rice Introduction in Ivory Coast[3]

The area is the savannah region of Korhogo in Northern Ivory Coast. Men were primarily engaged in production of rainfed maize, yams, and rice,

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[1] Christine Jones, "Bargaining Processes Among Members of Agricultural Production Units in North Cameroon", Joint Rockefeller/Ford Foundation Conference on Intra-Household Contractual Arrangements and Farming Systems Research, March 1984, Bellagio

[2] This is believed to be consistent with tradition.

[3] Jennifer Dey, "Women in African Rice Farming Systems" (Los Banos, Laguna: International Rice Research Institute, 1983).

with labor input from their wives and other household members. Women also planted an independently transplanted rice crop in dambo areas (shallow depressions which retain moisture in the dry season and accumulate water in the rainy season) during the early rains after harvesting the men's dry season crops grown there. The introduction of irrigated rice cultivation was expected to increase double cropping beyond the dambo areas. "However, of a total of 11,000 hectares developed for double-cropped rice in 1982, only 1,466 hectares were cultivated in the dry season (February to June) and 5,164 hectares in the wet season (August-November)." Dey traces this anomaly partly to the reluctance of women to provide the additional unpaid family labor when they did not perceive additional returns from it, and its harvesting also conflicted with the planting of their own rainy season crops.

Case III -- Introduction of Cocoa Cultivation in South Central Cameroon[1]

Traditionally, Beti women performed most of the farm work. In practical terms, however, men controlled the production process since it was their work in the initial clearing that defined the field size and length of fallow. Access to land became a major issue only with the advent of the cocoa economy. Cocoa cultivation became men's work, and "this was not entirely due to the machinations of colonial government." As in all cases, land clearing was by men. In addition, since cocoa cultivation constituted a form of permanent occupation, which as in other patrilineal societies is vested solely in men (as opposed to usufruct rights of women), women's work was extended along the lines of the previous division of labor but involved implicit bargaining about remuneration. A separate food system was retained in which women supplied 84 % total work and which provided 80 % of food consumption by value. The workload of women and also of men was increased. It was noted that the absence of a diversified economy and fragmentary market structure put considerable pressure on women to remain in subsistence production.

Case IV -- Introduction of Cocoa Cultivation in West Nigeria

Most of the farm work here was done by men. In comparison with the previous case of the Beti in Cameroon, the food processing, storage, local trade, and manufacturing (especially cloth) techniques among the Yoruba here were quite elaborate, and it was in these activities that women were engaged. In addition, women helped with planting, harvesting, and transporting the produce. As in the Beti, cocoa cultivation became men's work -- in this case, being an extension of men's role in cultivation. Again, the women's traditional obligation to provide labor was extended to cocoa, which is also accompanied by implicit bargaining and remuneration. However, a much greater reliance was placed on hired labor in cocoa production by men. Again, as in the previous case, a parallel food economy was maintained. Women provided only 17 % of labor in food production, and this appears to be less than was previously the case here. In particular, their labor in planting appeared to have

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[1] Jane I. Guyer, "Food Cocoa and the Division of Labour by Sex in Two West African Societies", Comparative Studies in Studies in Society and History, (22) 1980, p. 355. This comparative paper provides the observations for both Cases III and IV.

declined. Women spent a substantial amount of time in food processing, home industry (cloth), and trade. Self-subsistence in food declined to 32 % (from an earlier 70-80 %), and an active food trade in the cocoa belt developed, suggesting that although food production declined, food security did not. Guyer concludes that "the fact that the food supply was quickly commercialized was made possible by, and reinforced, the existing system of women's processing and marketing".

Case V -- Volta Valley Authority Development Project (AVV)[1]

This project involved the settlement of farmers in a relatively fertile river basin upon control of river blindness. The intent was to promote a package of intensive cultivation methods by the settlers. The project also provided extension, credit, input distribution, and marketing facilities. By 1978, 1,700 families were settled in the project areas. Settlers were drawn from surrounding high population density, plateau areas. In the settler's home villages, land had been cooperatively worked to provide for the household requirements but women had traditionally farmed 15-20 % of the total areas planted as private fields, from which they provided relish ingredients with cowpea and peanut cultivation and were also involved in trading activities.

In the settlement schemes, women lost their traditional rights to land and, therefore, lost the ability to fulfill their household obligations. In a study conducted shortly after the initial settlement, it was found that the new production scheme entailed major changes in household production. One of the early findings indicated that there was a negative effect on women's income. Also, their crops which provided necessary dietary components were not included in the AVV crop rotation. Despite this, however, women were given informal authority by their husbands for cultivating a part of the bush fields, which appears to have been the traditional distribution mechanism.

A follow-up study in 1983 found that family organization and production patterns had changed considerably more since the immediate aftermath of settlement. The initial phase had required relatively more heavy work in the fields, and little time or money was available for private production or trade by either men or women. By the fifth year, settlers had accumulated stores of grain and paid off initial debts, family size had increased with immigration of additional members, settlers' cash income was seven times higher, and grain yields were two to three times higher than in the home villages.

These changes had not been evident in the first few years. Although aggregate grain production was up significantly, sales were only slightly

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[1] Josette Murphy and Leendert H. Sprey, "The Volta Valley Authority: Socio-Economic Evaluation of a Resettlement Project in Upper Volta", Purdue University, Department of Agricultural Economics, 1980; and Della McMillan, "The Role of Longitudinal Case Studies in Evaluation of Household Effects of Large Scale Development Planning", presented at the workshop on Conceptualizing the Household, Tufts University, November 1984.

higher and large retentions were made to protect consumption as well as provide a means for hiring labor. Though time allocation data is not available, many of these changes, especially the increase in hired labor, would suggest that women's common field labor requirements may have decreased. This is confirmed by the widespread expansion of private grain fields for women as well as their greater involvement in trading and livestock activities. Other findings include: male household heads assumed responsibility for many expenses which had traditionally been borne by women; grain produced by women or received by them for working in other fields was sold by them and not kept for family food. "These and other changes in the internal distribution of income within families suggest that the actual impact of the AVV on women was less negative and more complex than originally appeared."[1]

Nearly identical observations have been made for a settlement scheme in West Nigeria, which also demonstrated the need, drive, and initiative of women to re-establish their enterprise despite the fact that development activities may have totally ignored it.[2]

5. ISSUES ARISING FROM CASE STUDIES

Introduction of a similar technology can be seen to have varying effects. In addition to all the household- and area-level factors that we are familiar with, the household organization of production and its interaction with area-level factors also modified the degree of success in technology adoption and its effects. Though limited in number, the in-depth studies attest to the complexity of household analysis given the varying degree of flexibility in its organization, division of labor, and obligation of household members. The research issues to be dealt with are, therefore, also complex, and further examination of these is necessary. Uma Lele[3] has identified some of the broader research issues in this area, which could be taken as a starting point in determining research needs specifically in the realm of the CGIAR mandate.

In many cases a labor constraint, perhaps especially for "women's tasks", may have become an obstacle in the successful adoption of the technological package. The two notable cases where this was overcome was when either wage labor was available (cocoa in West Nigeria) or what appears to be a fuller package of services and the immigration of family labor was available (AVV scheme in Upper Volta). The alternatives available for overcoming these labor bottlenecks is probably a critical issue. The capacity for access and use by women, rather than its physical availability, is of specific relevance to technology.

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[1] Della MacMillan, op. cit.

[2] Heather M. Spiro, "Agricultural Development Strategies - The Experience at ILORA", Workshop on Women in Agriculture in West Africa, ILCA/IITA, Ibadan, Nigeria, May 1984.

[3] Uma Lele, "Women and Structural Transformation", Conference on Population Growth and Labor Force Absorption in the Developing World: 1960-2000, Bellagio, July 1984, reprinted in Part III of this document.

6. EXPERIENCES WITH IMPROVEMENT OF AGRICULTURAL TECHNOLOGY FOR WOMEN

The main observations on the need, availability, and access to improved technologies by women are: (i) women perform a wide range of tasks in agricultural production, processing, and household maintenance and this creates the primary need for technologies to alleviate their time constraints; (ii) their primary roles are in the non-market sector and this is linked to their generally poor access to household resources; (iii) leading from the first two points, the major problems with respect to technologies for women are in the choice of technologies for dissemination and their access by women, rather than in their availability per se. The reviews by Marilyn Carr[1] and the International Center for Research on Women[2] have shown this very clearly. Relevant and related to this is the potential for increased productivity that is lost as a result of the lack of improvements in this area.[3]

These observations point to the need for greater attention to the institutional and organizational needs for a better identification and dissemination of suitable agricultural technologies. In this respect, some of the experiences and lessons of small farmer problems could be brought to bear. For example, it has been shown that it is often organizational inefficiency and bottlenecks for essential inputs that are particularly responsible for the adverse effects of new technologies on agricultural laborers and small farmers.[4]

The two major issues of relevance are therefore: (i) the choice of technology or the technological package that is made available, and (ii) the organization of its dissemination to ensure an adequate access to women who are engaged in a managerial capacity in activities for which the technology is appropriate. Research on and application of the first set of issues can be largely dealt with using the present links between the international and national research centers. The second set of issues, however, requires use of the further link between the national research centers and national agencies, ministries and other organizations implementing agricultural programs and policies.

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1 Marilyn Carr, "Appropriate Technology for African Women", UNECA, 1978; and "Technology and Rural Women in Africa", ILO World Employment Programme Research Working Paper, Geneva 1980.

2 Marguerite Berger, Virginia Delancey, and Amy Mellencamp, "Bridging the Gender Gap in Agricultural Extension" (Washington, D.C.: International Center for Research on Women, 1984).

3 Peter Moock, "The Efficiency of Women as Farm Managers: Kenya", American Journal of Agricultural Economics, 58 (5) December 1976.

4 Grace Goodell, "Bugs, Bunds, Banks and Bottlenecks: Organizational Contradictions in the New Rice Technology", Economic Development and Cultural Change, 1984.

The choice of technology and the technological package requires considering the labor bottlenecks imposed by women's time constraints. This is particularly relevant in Africa, given the high involvement of women in smallholder agriculture. Furthermore, in order to address this effectively, labor-saving technological options for a broad range of activities performed by women may need to be incorporated in a complete technological package. At a minimum this would include post-harvest processing and storage, in addition to the crop production activities.

It is noted in this context that the focus of the IARCs on food crops is especially apropos from the standpoint of the concerns being discussed here.

The dissemination processes for technologies, education, inputs credit, and extension also need to consider the full range of women's activities and constraints, in particular their low resource base.

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Asian Women as Users and Beneficiaries of IARC Technology

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ASIAN WOMEN AS USERS AND BENEFICIARIES OF IARC TECHNOLOGY*

One reason for establishment of the CGIAR system was to redress the past lack of research on tropical agriculture, which remains the major source of income for the world's poor. The first centers were established with the broad goal of increasing income and food supply for the poor in LDCs. In the past, IARC technology was intended for a broad and vaguely defined user group: the LDC small farmer. More specific user targets were not needed as the major technological breakthroughs in wheat and rice were adopted under a wide range of prices and institutions. The 1981 Quinquennial Review of the CGIAR system notes that "The problems now being faced by the Centres are much more difficult than those faced initially, and they are being tackled against a smaller background of relevant knowledge." (CGIAR, p. 40). Technological breakthroughs now require a clearer focus on the intended clientele and economic environment in order to ensure that technologies are appropriate and will be adopted.

In this paper, a technology user is defined as the farm manager who decides to adopt the technology. Understanding the needs of technology users will help to ensure that technology is adopted, and hence that research has greatest possible impact on agricultural production and income. Besides the farmers who adopt it, there are two other groups affected by new technology: laborers employed in food production and food consumers. These groups are beneficiaries of new technology. Understanding how different groups can benefit from new technology helps to ensure that research benefits those who have least.

This paper considers how a concern for women as technology users and beneficiaries is helpful for ensuring that technology increases output and income, and that it benefits the poor. The following questions are answered:

1. Why consider women as separate technology users and beneficiaries?

2. What impact can IARC technology have on women?

3. What are the implications for research policy?

The paper focuses on women in South and Southeast Asia, and on evidence regarding the impact of new rice technology on their welfare.

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1. WHY CONSIDER WOMEN AS SEPARATE TECHNOLOGY USERS AND BENEFICIARIES?

There is now a large body of literature from Asia documenting the major role that women play in all aspects of agriculture. For example, in cultivation of rice alone, women rarely provide less than a third of total labor input and provide more that one-half in Nepal, southern India, Sri Lanka, and Java (Table 1). Their proportional contribution does not decline with development, as it is still 30 to 40% in Malaysia, Japan and South Korea. As rice is about one-quarter of cultivated land in South and Southeast Asia, women's participation in rice represents a substantial contribution to Asian agricultural labor as a whole.

Women participate heavily in the cultivation of other crops as well. They provide roughly half of agricultural labor in the semi-arid tropics of India, where millet, sorghum, groundnuts and chickpeas are major crops in addition to paddy (Ryan and Ghodake). In Nepal, women provide 60 to 90% of labor in cultivation of millet, corn, wheat, and oilseeds (Acharya and Bennett). In the cassava-based systems of upland Java, 30 to 45% of total labor is female (Roche).

Two generalizations about women's labor emerge from the Asian literature. First, women's participation increases with greater intensity of land use. Cross-section studies find that irrigation and double-cropping are associated with greater female labor input in China (Croll) and India (Sen; Rosenzweig and Schultz). It seems that women provide the additional labor when labor use per unit of land increases. As modernization of Asian agriculture is generally equated with technologies that increase intensity of land use, women's participation in agricultural labor can be expected to increase with agricultural growth.

Second, hired wage labor accounts for much of women's agricultural labor. Female labor is 60 to 90% of hired labor in the semi-arid tropics of India (Ryan and Ghodake). On Java, women provide most of the labor in transplanting, weeding, and harvesting of rice, and virtually all of this labor is hired (White). In Indonesia and rice-growing areas of India, women from landless households depend on agricultural labor for their livelihood (Stoler; Mencher and Saradamoni). Rice harvesting alone provides over one-third of women's income in southern India (Acharya and Parker). Thus women's labor contribution is not limited to the family farm. Landless women in Asia participate heavily in agricultural wage labor, and this income is important to them. Women are therefore among the potential beneficiaries of new technology.

Women are also technology users. Within farm households, women are farm managers who supervise agricultural labor and make decisions about purchase of inputs, although the intra-household pattern of decision-making varies widely across Asia. Where men migrate to urban areas as in Malaysia, women may be the sole household decision-makers (Yap). In Nepal women play a major role in all farm decisions and particularly those concerning subsistence crops (Acharya and Bennett). Indonesian women are responsible for contracting, hiring and paying of farm labor (Stoler) and participate in decisions regarding purchase of inputs (White). Women in India travel to the fields to supervise labor and to check on pests and weeds (Saradamoni). In southeast Asia, women generally market the crop output (Chandratat, Watson).

Table 1. Women's Participation in Rice Cultivation.

Country	Seed Selection	Seedbed	Land Prep.	Transplanting	Crop Care: Weeding	Crop Care: Fertilizing	Crop Care: Insect & Others	Harvesting	Threshing	Other Post Harvest	Marketing	Total
Nepal (Hill System)	X		0	64	72			52				54
India												
Andhra Pradesh			7	78	73	8	3	63	25			48
Tamil Nadu			0	69	85	39	8	64	41			55
Sri Lanka (Kandy)												
Irrigated			0	100	80	0	0	49		46		n.a.
Rainfed			0	91	80	0	0	37		67		n.a.
Bangladesh	X									X		
Thailand	X		16	29		33		73			61	n.a.
Malaysia	X	19	6	55	27	19		46	24	76	15	37
Indonesia (Java)				100	53			73				51
Philippines (Central Luzon)			0	45	7			15				19
China		X		X		X		X				33*
Korea	33	27	2	48	23	12	24	34	34	43		36
Japan												40

Percentage of total labor in each activity, where available
X indicates that women are involved in the activity

*Total farm labor in southern region

Sources: Paper presented at IRRI Conference on Women in Rice Farming Systems.
Nepal - Pradhan (1983)
India - Agarwal (1983)
Sri Lanka - de Alwis (1983)
Bangladesh - Abdullah & Zeidenstein (1983); Aziz (1983)
Thailand - Chandratat (1983)
Malaysia - Yap (1983)
Indonesia - White (1983)
Philippines - Sison, et al (1983)
China - Croll (1979); Xue-bin (1983)
Korea - Lee (1983)
Japan - Yoshida (1983)

The fact that Asian women participate in agriculture is a necessary, but not sufficient, condition to consider them as separate technology users or beneficiaries. There are two reasons for considering women's interests separately. The first arises from the frequent observation that women form a disproportionate share of the rural poor (Buvinic). Because of the need to earn a minimum subsistence level of income, women in landless households continue to work even when returns to additional labor are declining (Hart). Women's wage labor participation is then inversely related to household income. Women therefore contribute a greater share of cash income in the poorest households. They contribute about half of household cash income in Java, Bangladesh, and India (Table 2). Because poor women have a greater cash income earning role and continue to have responsibility for household production, they work longer hours in both wage labor and household production than men (Table 2.). Thus women provide crucial support for the poorest households in Asia, both through wage labor and household production activities.

The proportion of rural households that are landless and dependent on agricultural work is increasing in Asia. It is estimated to be 27% in India, 41% in Java, and roughly 12% for the Philippines and Sri Lanka (Barker and Herdt). While growth in industry provides some job opportunities outside agriculture, evidence from the Philippines (Castillo, et al) and Indonesia (Collier, et. al.) indicates that children of farm households are moving into the best-paid urban sector jobs. Landless households do not have the resources to invest in education and thus remain dependent on opportunities in agriculture or the informal urban sector for their income.

Agricultural labor is often the most rewarding type of work open to landless women who are otherwise forced to work for small returns in the informal service sector. Yet women frequently earn less than men and are more often involuntarily unemployed (Lipton). Women's poor earning opportunities stem from their limited mobility and inadequate access to education or even nutrition. Household studies in India and Bangladesh reveal that families do not invest in the health and human capital of their female children (Rosenzweig and Schultz; Chen et. al.).

These "stylized facts" regarding Asian women in the poorest rural households suggest that any concern with increasing income for the poor should include a specific concern for landless women. As women's wage labor participation is inversely related to household income, an increase in women's wages will benefit the poorest households most. Although women in landless households already work long hours, they will benefit from working less only if their subsistence needs can be met from other sources. As long as they are dependent on labor income, increased demand for their labor will benefit them through ensuring that wages do not continue to fall with population growth. Without technological change, increasing population pressure on limited land resources will mean declining wages and increasing returns to land, leading to a deteriorating distribution of income. Technological change that increases both output and demand for labor can offset this trend and slow down the decline in wages. This will raise the income that landless women can earn through wage employment.

Table 2. Women's Work Day and Contribution to Household Income.

	Hours Work Day[a] men/women	Percent Household Cash Income From Women	Percent Full Household Income From Women[b]
Landless Households			
Bangladesh	10.2/10.9	43	n.a.
India	n.a.	53	n.a.
Java	8.8/11.3	44	n.a.
All Rural Households			
Philippines	8.2/10.0	20	38
Nepal	7.5/10.8	27	44

Sources:
- Bangladesh - Halim and McCarthy
- India - Mencher and Saradamoni
- Java - Stoler; Hart
- Philippines - Evenson and King
- Nepal - Acharya and Bennett

[a]Includes household production and wage labor.

[b]Full household income includes value of production on farm and in the home.

Consideration of the rural poor in setting research goals could therefore include concern for women's earning opportunities. Improving women's overall welfare through better access to education and health care requires policies and projects at the national and local level and is certainly beyond the mandates of the IARCs. It should be possible, however, to consider how technology could affect the labor income of poor women. It will be demonstrated below that IARC technology can have a substantial impact on Asian women.

The second reason for considering women as a separate technology user group is because of their role as decision-makers in farm households. Although this role is well documented in the Asian literature, it is not yet clear how it may influence adoption of technology. There is evidence from the African literature that suggest women's managerial role is an important factor in adoption decisions. Although economists traditionally view the household as one decision-making unit, this often is not a good model. Jones finds that household resource allocation is determined by bargaining between husband and wife. This means that the adoption of new technology is not dependent on the decision of a single profit-maximizing farmer. The decision to mobilize household resources for the use of new technology will be more complex than a simple weighing of costs versus returns.

Another important theme from the African literatature is that extension programs and projects tend to ignore women even though they do most of the farming (Dey; Staudt). The result is that technology programs are not successful and that the majority of agricultural producers (who are women) remain less productive.

Asian households differ substantially from African households in the degree to which household members conduct separate economic enterprises. And within Asia, established social institutions governing intra-household allocation of income and decision-making vary widely. For example, women in Java can own land (Wijaya) and control household financial resources used in marketing (Stoler). In contrast, women in Bangladesh devote a significant amount of time to caring for bullocks, but have little control over decisions about when to sell the bullock or how much to sell it for (Abdullah and Zeidenstein). Similarly, women's access to information about agricultural technology also varies widely, as indicated by differences in female literacy rates and extension representation (Table 3).

Nevertheless, there is some evidence indicating that the African issue of recognizing women as separate economic agents may also be important in Asia. For example, Res reports bargaining between husband and wife to determine the method of rice crop establishment in a rainfed area of the Philippines. The wife preferred wet-seeding over dry seeding because the former would suppress weed growth. She did not want to spend time weeding, as her preference was to devote time to vegetables and livestock which provide her with income over which she has direct control.

Another example of women's decision-making role is in Nepal. Acharya and Bennett found that women play a major role in agricultural decision-making (Table 4). Women make the decisions regarding use of organic fertilizer, but the extension program introduced chemical fertilizer and

Table 3. Women's Involvement in Agricultural Education and Extension

Country	% Women Literate	%Women Enrollment in Agricultural Colleges	% Women of Extension Workers
Nepal	5	0	0
India	19	1	n.a.
Sri Lanka	68	28	33
Bangladesh	9	19	n.a.
Thailand	70	26	24
Malaysia	48	n.a.	19
Indonesia	45	20	n.a.
Philippines	81	49	58
China	n.a.	n.a.	n.a.
Korea	81	11	5
Japan	97	n.a.	17

Source: Country Reports and Population Reference Bureau.

Table 4. Farm management decisions in Nepal.

Type of Decision	Sex Male	Female	Both	Total
Labor Allocation				
Arranges Exchange Labor	35.2	35.7	29.1	100.0
Arranges Wage Labor	42.4	29.3	28.3	100.0
Decides Others Work Outside Home	56.2	43.8	-	100.00
Decides Own Work Outside Home	51.7	48.3	-	100.0
LABOR DECISIONS	46.2	39.4	14.4	100.00
Agricultural Decisions				
What Crop to Plant?	18.0	30.2	51.8	100.0
Own or Improved Seed?	20.7	60.4	18.9	100.0
Amount & Kind of Fertilizer	32.5	39.7	27.8	100.0
ALL AGRICULTURAL DECISIONS	25.3	42.1	32.6	100.0
Seed Selection				
Who Does Seed Selection?	10.8	81.2	8.0	100.0

Source: Acharya and Bennett.

credit to men. Acharya and Bennett argue that given women's managerial role, agricultural extension should not be directed solely to men. Unfortunately they did not measure the productivity impact of male-oriented extension, but their results convinced that Nepali government to start a special program to train women extension workers in order to reach rural women.

These examples suggest that even in Asia studies of farm households' willingness to adopt new technologies should include explicit attention to women's role as separate decision-makers. Understanding the role that women play in allocation of household resources can help in the design of technologies that are more appropriate to household needs and thus will have greater impact on agricultural production.

This section has presented some evidence to suggest that women should be considered separately as both technology users and beneficiaries. Farm household women are potential users, and their decisions will influence adoption of new technology. Landless women form a distinctly disadvantaged group among the poor and provide substantial support for poorest rural households. They should be considered explicitly in any discussion of employment impact of new technology.

2. WHAT IMPACT CAN IARC TECHNOLOGY HAVE ON ASIAN WOMEN?

Contradictory statements are often made in the Women in Development literature regarding how technological change will benefit women. On the one hand, there is a call for technologies to eliminate drudgery or to reduce women's work burden. Yet on the other hand there are warnings against introducing technologies that will reduce women's employment opportunities. All writers agree that it is beneficial to raise women's labor productivity, because this raises the returns to their labor.

The confusion arises because an increase in labor productivity is not always accompanied by an increase in labor demand. Where there is a growing supply of landless women's labor, women will only benefit from productivity increases that are accompanied by increased labor demand. Figures 1 and 2 illustrate three types of technical change and their impact on labor use. In Figure 1, point A is the combination of factors used with the old technology. Three new isoquants, representing labor-saving, neutral, and labor-using technologies all allow the same output to be produced with fewer inputs. In all three cases labor productivity increases because the same output can be produced with a smaller amount of labor. The factor proportions vary, however, and thus the demand for labor also varies.

Figure 2 shows the changes in total labor use for the individual farm or household. With a given set of prices, labor amount L_0 is used under old technology. With either a neutral or labor-using shift in the response function, it will be profitable to employ additional labor to produce more output. With a labor-saving technical change, however, the total use of labor declines. Any technical change will increase labor productivity, but only neutral or labor-using change will increase total labor use as well.

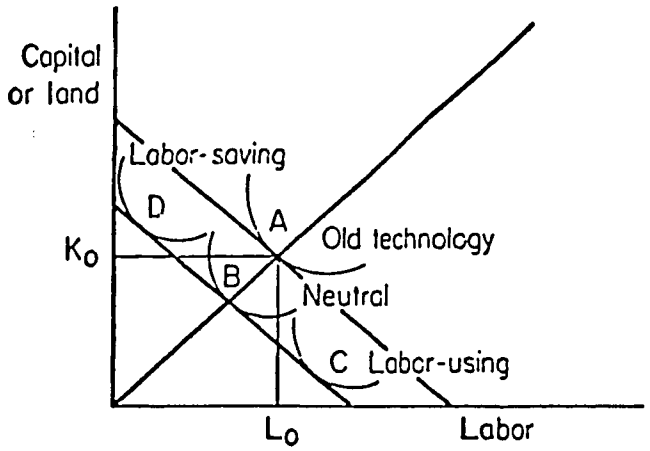

Figure 1. Technical change and factor proportions.

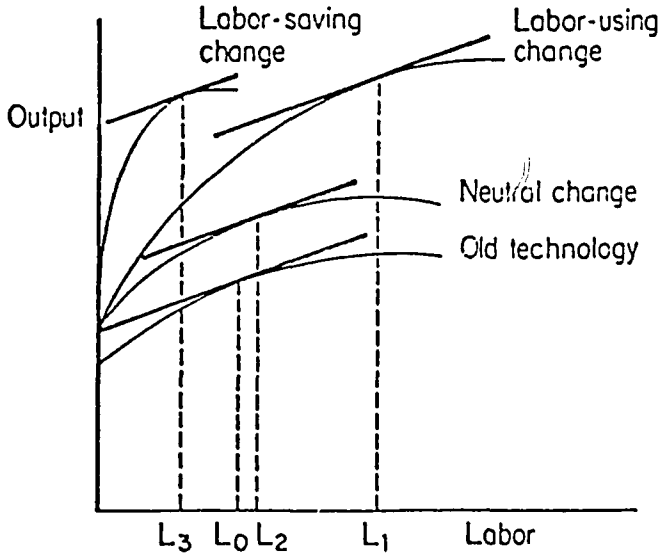

Figure 2. Technical change and labor use.

Whether technical change benefits women also depends on their control over resources. Women in farm households who have some control over the income from land will benefit from any type of technical change in agriculture. This is because they will reap the returns from increased productivity of both household labor and land (ignoring intra-household distribution). Women in landless households whose only resource is labor benefit only from technical change that raises demand for their labor productivity.

As women provide most of the labor in transplanting, harvesting, and weeding of Asian rice (Table 1), labor demand growth in rice production can benefit landless women. Past experience in East Asia suggests that the rice seed-fertilizer technology is neutral or labor-using (Ishikawa). Increased amounts of labor can be applied per hectare and per crop, and at the same time the average amount of rice each worker produces increases. Thus development of improved varieties for the tropics was expected to provide employment in countries currently developing.

In the mid-1960s short-statured, fertilizer responsive modern rice varieties (MVs) for the tropics were introduced by IRRI and national programs. They have been widely adopted by farmers in irrigated and favourable rainfed environments, because their yield advantage is greatest where water management is good. MVs are most widely grown in the Philippines, Indonesia, Sri Lanka, and India (Table 5). They are less widely adopted in the rest of South and Southeast Asia.

MVs generally require more labor than traditional varieties because they require more weeding (due to increased fertilizer use) and the increased yields require more harvest and post-harvest labor. Barker and Herdt review 20 village studies of labor use both before and after MV adoption throughout Asia and find that in 13 cases labor use increased, and in another 3 cases remain unchanged. These findings show gains in labor productivity as well as labor use (Table 6). Increased labor has generally been used in women's tasks: intensification of crop establishment (transplanting in straight rows) and crop care (weeding and fertilizing), and harvesting and processing the additional yield. Furthermore, increased irrigation and shorter-duration varieties lead to increased cropping intensity and more regular demand for labor throughout the year, as demonstrated by long-run trends in Taiwan (Barker and Herdt). As the increase in labor demand is principally for women's tasks, new technology has expanded their employment opportunities.[1].

The adoption of MVs has also been accompanied by increased use of hired labor. In a review of 21 studies of hired labor use after MV adoption, Barker and Herdt found an increase in 16 cases. Not only are the seasonal demands for increased labor met through hiring in, but family labor also declines. In particular, women in farm households shift to more lucrative marketing or sideline activities and provide supervision rather than labor in farm production (Stoler; Illo; Res). Thus, the adoption of MVs not only increases total labor demand, but increases hired labor demand, which should benefit women in landless households.

Comparisons of labor use before and after MV adoption are relatively rare, and studies that disaggregate the data into male and female labor

Table 5. Levels of irrigation, modern cultivars, and fertilizer used on rice in Asia, 1960s and 1970s.[A]

	Irrigation (% area)	Modern cultivars (% area)	Irrigation (% area)	Modern cultivars (% area)
South Asia				
India	38	7	40	37
Pakistan	100	10	100	46
Bangladesh	7	2	12	16
Sri Lanka	61	1[C]	66	56[C]
Southeast Asia				
Malaysia	65	3[C]	67	18[C]
Thailand	28	0	24	10
Philippines	40	22	42	70
Indonesia	65	3	70	55
Burma	15	1	17	12[C]
East Asia				
Japan	100	100	100	100
Taiwan, China	100	100	100	100
Korea, Rep. of	84	0	92	51[C]
China[E]	89	16	89	66

[A]Sources: Modern cultivars data from Herdt and Capule, 1983.
Fertilizer and irrigation data from Palacpac, 1982.

[C]Narrow definition of modern cultivars.

[D]% in indica-japonica crosses.

[E]Includes all provinces except Taiwan; data are assumptions as spelled out re Barker and Herdt (n.d.).

Table 6. Increase in labor, labor productivity and hired labor use with MV adoption, selected locations in Asia.

	Labor use ratio MV/TV (days/ha)	Rice/Labor ratio MV/TV ((kg/day)	Hired labor ratio MV/TV (days/ha)
Indonesia			
West Java	1.6	1.2	1.4
Central Java	0.8	1.6	1.0
East Java	1.1	1.2	n.a.
Bangladesh	1.4	1.1	1.6
Philippines	1.2	1.2	1.7
Thailand	1.4	0.9	n.a.
S. Korea	1.1	1.2	n.a.
Sri Lanka	1.3	1.2	n.a.
India			
W. Godavari	0.9	n.a.	n.a.
Ferozepur	1.0	n.a.	n.a.
Kanpur	1.2	n.a.	n.a.
Palamau	1.7	n.a.	n.a.

Source: Barker and Herdt, forthcoming.

are even more unusual. The ability of new technology and agricultural growth to benefit women laborers is supported by two recent studies in India. In three major rice growing states, Andhra Pradesh, Tamil Nadu, and Orissa, adoption of MVs is associated with greater labor use, and most of the increase is supplied by hired female labor (Agarwal). In West Bengal, areas with greater agricultural intensity and growth in output also have higher female wages and employment relative to that of males (Bardhan).

The above example of how rice technology has benefited women shows that even a very general innovation such as a new variety can have gender specific effects. Thus the biological technologies that form the core of IARC activities can have an impact on women.

3. WHAT ARE THE IMPLICATIONS FOR RESEARCH POLICY?

Most of the IARCs have social science programs to provide feedback about the suitability and impact of new technology.[2] The organization of these programs varies. Some programs are fairly independent of the biological sciences, and consider the broad macro impact of technology while others are closely integrated into the process of technology development and consider micro level determinants of adoption. The goal of all the programs is to institutionalize what Hayami and Ruttan called "induced innovation". This means that new technologies increase the productivity of the scarcest resources and relieve the most pressing economic constraints to production.

Hayami and Ruttan provide the following description of the process of induced innovation through agricultural research:

> "Farmers are induced, by shifts in relative prices, to search for technical alternatives which save the increasingly scarce factors of production. They press the public research institutions to develop the new technology... perceptive scientists and science administrators respond by making available new technical possibilities and new inputs that enable farmers to profitably substitute the increasingly abundant factors for increasingly scarce factors, thereby guiding the demand of farmers for unit cost reduction in a socially optimum direction...the response of research scientists and administrators represents the critical link in the inducement mechanism." (Hayami and Ruttan, p. 57-58).

Social science programs facilitate the critical link between farmers and researchers.

The above discussion of how women form a distinct group of technology users and beneficiaries suggests that it may be appropriate to consider women explicitly within social science programs of IARCs. A research agenda on women would be an extension of existing concerns of social science programs in IARCs. Two questions are suggested by the above discussion of why women constitute a separate group.

First, will the farm household allocation of decision-making influence the adoption of technologies? We need to understand the extent to which

women are separate economic agents within the farm household and their specific managerial control of crop production. We need to understand the constraints on their ability to utilize new technology and whether these arise from their responsibility for household production or their limited access to resources. Such research might fall with the "farming systems perspective" as defined by Byerlee et al of CIMMYT. This perspective considers the complex environment in which small farmer decisions are made, including the heterogeneity of labor resources within the household and multiple objective function of the farm household (Byerlee, et al).

The second question is: what impact could technology have on the earning opportunities of Asian landless women? In order to ensure expanded employment opportunities for landless women of Asia, more agricultural research on labor-using technologies is needed.[3] There is underinvestment in research on labor-using technologies relative to research on labor-saving technologies (Anderson). Because returns to development of labor-saving technologies accrue to private machinery or chemical industries, private research is undertaken by industry. Labor using technologies, such as new varieties, are public goods. Thus research to develop these technologies must be supported by public funds. Because governments tend to underinvest in agricultural research (Akino and Hayami), less labor-using technology is developed. The end result is that farmer's opportunities to substitute capital for labor are greater than their opportunities to substitute labor for capital.

Ryan and Ghodake of ICRISAT sum up the importance of Asian women for agricultural technology design in labor abundant areas:

> "Women, especially landless women, have less chance than men of finding daily wage employment, particularly in the slack agricultural seasons. If this situation is to be improved and not aggravated, new agricultural technologies for these regions must be designed to enhance demand for the tasks generally reserved for females. A large untapped reserve of female labor appears to be able and willing to engage in more market-oriented activities in slack seasons, and it may even exceed the sizeable male reserves. There would thus seem to be excellent scope for designing technologies that would capitalize on this reserve." (Ryan and Ghodake, p.183).

The IARCs are only part of the global agricultural research system. They work with national programs and respond to national program concerns. Although most national agricultural research programs have not considered rural women in setting research priorities, the women's issues discussed above have frequently been identified by national researchers. These individuals are usually in universities and not part of the national agricultural research system, narrowly defined. It should be possible and even desirable for IARC programs to have working relationships with a variety of research institutions in LDCs. As social science work is not usually a major part of national agricultural systems, IARCs might play a role in establishing links between national systems and existing social work in other national institutions.

4. SUMMARY AND CONCLUSIONS

Women participate heavily in agricultural labor and management in Asia. This participation is a necessary, but not sufficient, condition to consider women separately among technology users and beneficiaries. This paper has presented evidence that women do form a group with special needs and interests that are relevant to technology development.

Women in Asia are often farm managers, conducting separate economic activities within the farm household. As potential users of new technology, they face unique constraints arising from their responsibilities for home production and limited access to outside resources. Understanding the role that women play in allocation of household resources can help in the design of technologies that are more appropriate to household needs and thus will have greater impact on agricultural production.

Landless women in Asia participate more in wage labor than women from farm households, and landless women's cash earnings are a major source of support for the poorest households. An increase in wages or employment opportunities for women will therefore have greatest impact on landless households. Any concern for increasing income of Asian poor should include a specific concern for the employment of landless women.

Women participate more in agricultural labor where intensity of land use is greatest. The introduction of modern rice varieties increased the productivity of land and increased demand for labor in transplanting, crop care, and harvesting. Use of hired female labor seems to have increased after the adoption of rice MVs. This should have benefited women in landless households by offsetting the decline in wages caused by population growth. Future development of technologies that increase output and demand for labor will have a positive impact on Asian landless women.

Most of the IARCs have social science programs that are concerned with why technology is adopted by farm managers and how it affects agricultural laborers and food consumers. Such programs provide feedback for setting research priorities, so that research will have greatest impact on production and welfare. As women in Asia form a separate group among technology users and beneficiaries, IARC social science programs should consider them explicitly.

Footnotes

[1] It should not matter whether tasks are rigidly sex-specific. As intensification of land use is associated with greater female labor use and as women have higher unemployment than men, an intensification of land use such as MVs will tend to increase employment for women more than for men.

[2] In this paper, social science includes Economics.

[3] This is not to say that labor-saving technologies would not be appropriate in other regions or parts of Asia where there is little landlessness. Where labor is scarce relative to land, labor-saving technologies may benefit women in farm households.

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Women and Agricultural Technology in Latin America and the Caribbean

by

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1. INTRODUCTION

The existence of widely variant incentive structures faced by farmers in low-income countries which cause different rates of adoption of new technology among them is well recognized. Thus, differentiating small farmers into "special user groups" among the farm population and assessing technology in terms of its appropriateness to their special needs is an integral component of agricultural technology research and development, as testified by the growth of on-farm research or farming systems research programs which address this objective. More problematic, however, is the general issue of how public sector research organizations serving farmers in developing countries can identify and set priorities among different client groups who are often powerless to communicate their needs. Without the intervening mechanism of the market to signal the relative importance of such groups and the particular nature of their needs for agricultural technology, special research must often be undertaken even to identify their existence. Women, as the "invisible farmers" of the Third World, are a case in point. Research documenting their direct participation in agricultural field crop production and in other components of the food system of the rural poor has shown women to be potential users of agricultural technology. Women have also been identified as victims, and sometimes beneficiaries of technical change in agriculture. The thrust of ex post facto studies of technology adoption which examine gender-related issues is to conclude that there are often hidden costs and inefficiencies in agricultural research which fails to take into account the special interests of women as potential clients or user groups. Nonetheless, very few examples exist of agricultural technology development which includes gender as a criterion for ex ante analysis of technology design options.

In Latin America, cultural and socioeconomic definitions of sex roles in agriculture tend to make women particularly invisible and difficult to isolate into sex-specific interest groups for the purposes of agricultural technology design. At the same time women represent a pervasive influence in farming decisions and important beneficiary groups which must be taken into account when evaluating strategies for technical change in agriculture. This paper discusses the relevance and implications of gender-related features of agriculture in Latin America for agricultural research and development within the mandate of the CGIAR system of International Agricultural Research Centers (IARCs). The general objective of the paper is to review what is known about the role of women in agriculture and the food system in Latin America, and to assess the adequacy of this information for defining objectives and strategy in agricultural research programs. First, key issues for agricultural technology research and development are outlined in terms of the effects of sex roles on food production and welfare of the rural poor in low-income countries. These relationships are considered specifically in terms of IARC mandates and objectives. The next two sections of the paper review the evidence on participation rates of women in Latin American agriculture, and what these imply for identifying women as special user groups for agricultural technology. Key research areas are

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identified where new information is needed to evaluate the relative importance of such groups in terms of CGIAR system research priorities and strategy.

2. IMPLICATIONS OF GENDER FOR CGIAR OBJECTIVES: AN ANALYTICAL FRAMEWORK

The three main objectives of research on technology for developing countries by the CGIAR system can be summarized as follows:

1. to contribute to increasing the amount, quality, and stability of food supplies in low-income countries;

2. to contribute to meeting nutritional requirements of less-advantaged groups in low-income countries;

3. to take into account "the need to improve the level of income and the standard of living of the less advantaged sectors...(specially rural) which determines their access to food, equity in distribution of benefits from research and efficiency in use of agricultural resources" (Technical Advisory Committee (TAC), 1979, cited in Pinero and Moscardi, 1984).

These objectives specify several outcomes which potentially depend on the effect of gender-related variables on agricultural production and the adoption of new technology. It must be stated at the outset that the empirical basis for testing such causal relationships in the Latin American context is extremely weak. Nonetheless, research evidence that gender has similar effects on these outcomes in other regions of the world tends to lend support for such isolated findings as do exist, while the available research on sex roles in Latin American agriculture indicates that these are not so different from non-Latin cultures in some important respects as tends to be popularly assumed.

The argument that gender is a factor in the amount, the quality, and the stability of food production, as well as the access to food and nutritional standards of the poor, is based on causal relationships summarized in Figure 1. Especially in the Latin American context, these causal relationships must be termed hypotheses, drawn from case studies, in view of the extreme paucity of empirical research for Latin America that includes gender as a variable. This section of the paper reviews these relationships with particular reference to the available evidence from Latin America, with two objectives: (1) to provide a general analytical framework for the subsequent discussion of women's participation rates in agriculture in the region, and (2) to highlight the deficiencies in research that must be addressed in order to identify women as special user groups for agricultural technology.

Figure 1 outlines several features of structural change in Latin America which affect rural women's work roles on the farm and off-farm employment opportunities. The allocation of women's time among these different activities has implications for three important functions of the rural household (termed intervening variables in Figure 1): the management of food consumption (food preferences); decision-making roles in agricultural production and household expenditures; and for reproduction

(child care and fertility). Gender affects the way in which these activities are organized within rural households, and these activities in turn influence the adoption of new technology and other related outcomes, shown in Figure 1.

The relevance of gender to agricultural technology adoption and food production in the Latin American context must be assessed in the context of the dual structure of the agricultural sector. Salient features which affect rural women's work roles and time allocation are summarized in Figure 1 under the heading of "structural changes in the rural sector." In brief, two major trends - the declining size and stagnant labor productivity of small farms, in tandem with modernization of the large-scale, capital-intensive estate and plantation sector - are seen as contributing to a process of "proletarianization" of small holders and near-landless minifundias. This process is significant for rural women's work roles in that it entails an increased dependence on off-farm earnings and the migration of surplus labor from the family farm (de Janvry, 1981; Deere and de Janvry, 1981; Garcia, 1980; Leon de Leal, 1980; Ossandon and Covarrubias, 1980; Jaquette, 1983).

Estates (haciendas) and plantations increasingly dispense with permanent laborers in favor of temporary wage laborers who often migrate from harvest to harvest. Some studies suggest that the resultant increase in underemployed male wage laborers has displaced women from what were once female tasks, so that women have been increasingly relegated to the status of unpaid workers on family plots. The evidence is contradictory, probably reflecting local labor market situations in different Latin American countries, and differences in sex-typing of agricultural tasks such as rice planting, coffee harvesting, or cotton picking. For example, when temporary wage labor is paid by piece work, this encourages women and children to join men in the seasonal labor force (Deere and Leon de Leal, 1982; Medrano, 1980; Garcia, 1980; Young, 1978; Sautu, 1979, 1980).

Traditional peasant agriculture in Latin America has been conventionally characterized as a prototype of the "male farming system" in which most of the field labor in agriculture is done by men (Boserup, 1970). However, the major thrust of recent evidence from microstudies is to show that a trend towards the "feminization of farming" exists, and that in general the participation of Latin American women in agricultural production has been substantially underestimated.

The de facto female-headed farm, where men are seasonal migrants or primarily engaged in off-farm labor, is an extreme case of the tendency for women to be more heavily involved in agricultural production activities as farm size decreases, and as the importance of off-farm wages to household income increases (Buvinic and Youssef, 1978; Deere, 1982). The magnitude of this trend for the region and its significance for farm management in the small farm sector is impossible to estimate from available information. However, some important implications are indicated by microstudies of the "feminization of farming", for how rural women allocate their time, and what this in turn implies for farm decision-making and family welfare.

There are few published studies of rural women's time allocation for Latin America which enable one to estimate how much of their time on a daily and annual basis is devoted to specific agricultural tasks, taking into account important regional, cultural, and socioeconomic differences. Although time budget studies are increasingly recognized as important by women's research organizations in Latin America, the reports are not published or available in a form which brings their findings to the attention of a wider scientific research community (Saint, 1984). However, it is widely stated in the ethnographic literature that the agriculturally-related work (food processing and cooking for field hands; gathering fuel and fetching water; cultivation of gardens and subsistence plots; care of small animals; and small-scale marketing activities), which constitutes rural women's traditional work in Latin America, entails onerous, repetitive tasks which occupy most of their waking hours. There is some sparse evidence to suggest that as women's participation in agricultural field tasks as unpaid labor on family farms and as their employment as wage laborers increases, and as cash wages become the major component of household income, then women's time allocated to subsistence food production and food preparation declines. As women's time for domestic food production becomes a scarce commodity, food preparation preferences change in favor of purchased quick-cooking commodities which may be detrimental to nutritional standards, especially of children. For example, women substitute rice and wheat for coarse grains and legumes (Carloni, 1984; Stavrakis and Marshall, 1978). One study in Colombia found that subsistence "garden" plots tended by women were a feature of the better-off strata of small farms, not found among the very poorest farms (Janssen, 1984).

Decreases in women's time allocated to managing subsistence food production and generating small amounts of cash may contribute to changes in patterns in household consumption because there are different male and female preferences for how expenditures are made. Many studies observe that in Latin America farm products reserved for household consumption are traditionally managed exclusively by women (Borque and Warren, 1981; Ember, 1983; Stavrakis and Marshall, 1978; Chayney, 1983; Deere and Leon de Leal, 1982). Women's time allocated to so-called domestic activities can involve a significant managerial input to determining the balance between subsistence and cash crop production on small farms, and the balance of expenditures on food versus other goods. One study notes that women produce almost all food consumed by small farm families where men are engaged in cash cropping in Argentina (Sautu, 1979). Another found that patterns of intercropping were related to how women manage food consumption. The relationship between food supply from a woman's subsistence plot and from fields allocated to the cash crop affected the balance of secondary crops for household consumption intercropped with the main cash crop (Janssen, 1984).

Small-scale marketing, and the feeding and selling of small animals are means of capital generation and savings on small farms. One study notes that women generate on average one third of household cash income from these activities and up to 40% of cash income in well-to-do peasant households (Deere, 1983:120). Observers have noted that this income can be viewed as "women's" income, used by women for incidental expenses of their children such as extra food, clothes, medicines, or school supplies (Schofield, 1979; Young, 1978). There have been no empirical studies

which attempt to trace sources of income and expenditure in relation to gender in the rural household in order to document the relative influence of women's consumer preferences. Some studies of Latin cultural definitions of sex roles emphasize the complementarity of male and female work roles and how this entails mutual interdependence and power-sharing, others point out how men override women's preferences (see Borque and Warren, 1981, for review of this literature). Since both instances occur, it is dangerous to generalize about the influence of women's preferences in farm decision-making.

The "feminization" of farming, as men engage mainly in off-farm labor, implies an increase in women's decision-making over production inputs including choice of technology. In one example where survey research attempted to measure participation by sex in decisions about farm inputs, the incidence of women's decision-making about farm input use did increase as farm size decreased (Deere and Leon de Leal, 1982). Table 1 reports findings from this study which show that in "near-landless" and "smallholder" farms, women were the principal family members charged with decisions about what to plant, where, and when, in the majority of households. Only in the wealthier strata of farms was women's participation in such decisions restricted. The same pattern occurs among farm strata with respect to inputs. Women were the principal decision-makers about seed and fertilizer inputs in 52% of the poorest farms and 27% of the wealthiest. Over 32% of households allocated the responsibility for inputs primarily to women, and women shared in these decisions in a further 35% of households. Studies of technical change in Latin American agriculture which attempt to trace choice of technique on the small farm to gender-related preferences are nonexistent, and such information of this nature that exists is anecdotal. However, because they have different work responsibilities, rural women in Latin America do face different incentive structures from men, which may influence adoption of agricultural technologies on small farms where women participate in decision-making about input use.

Labor requirements of new technology have different implications for men than for women who do domestic tasks as well as agricultural field labor on the home farm, while men work off the farm. Some studies find that farm women in Latin America do not customarily contact hired labor and have difficulty in doing so or in exchanging labor with men (Deere and Leon de Leal, 1982; Borque and Warren, 1981). In several cases, hired labor appears to substitute for farm women's field labor rather than to complement it (Sautu, 1980). Hence women who do field tasks and also play a significant role in farm management probably face stringent time constraints which may cause male and female acceptance of technical change to differ.

One study in the Caribbean observed a direct decline in agricultural production on female-managed farms as traditional male tasks were neglected: land went out of cultivation, terraces and irrigation systems deteriorated, and production fell back into that level of subsistence manageable with women as a principal source of family labor (Chayney, 1983). Not only time availability, but also the multiple nature of rural women's work roles may cause their preferences for farming techniques to differ from those of men. An example of this is given by Mintz (1964) who shows that a short-season bean variety was preferred by Haitian women

farmers because it provided rapid turnaround on a small amount of capital which they would then invest in marketing other commodities at harvest-time.

The access of a woman, in the absence of a husband, to credit, cash for purchased inputs, and extension assistance tends to depend on her access to male kinfolk to mediate such transactions. For example, some credit systems in Latin American countries require both husband and wife to sign loan documents.

On the other hand, rural women in Latin America are more likely to find urban employment, albeit at very low wage rates, than men, and in certain groups have a higher rate of rural-urban migration than men (Singh, 1980). The effects of different rural and urban labor market opportunities on male and female preferences for farm household resource allocation are not known, but one implication is that female preferences may tend towards the short-run, as opposed to long-run investments in improving farm productivity (de Janvry, 1981; Elmendorf, 1976; Borque and Warren, 1981).

Research for Latin America on the causal relationships outlined in Figure 1 is fragmentary and does not provide any basis for estimating the importance of gender-related effects on food production and welfare outcomes relative to other variables which also are related to technical change in agriculture. In this context is is important to note that technical change in Latin American agriculture has been primarily responsive to private sector investment and to government policy, such as that subsidizing capital costs of mechanization (Pinero et al, 1979; Trigo and Pinero, 1981). Two broad questions have to be addressed in order to begin to identify the relative importance of gender as a determining factor in the adoption of new agricultural technologies. First, what is the sexual division of labor or who does the work in agriculture? Second, are the benefits of different types of technical change in agriculture likely to be distributed differently between the two sexes? The next two sections of this paper examine the evidence for addressing these questions.

3. SEX ROLES AND THE PARTICIPATION OF WOMEN IN LATIN AMERICAN AGRICULTURE

Sex roles in Latin American agriculture must be interpreted in terms of cultural ideals about appropriate behavior (popularly described as "machismo") and objective performance of role obligations, which are not necessarily congruent. Cultural ideals cause male and female self-perceptions of the work they do in agriculture to designate men's work as field work and women's work as "house work". However, detailed studies of the tasks women and men actually take part in shows that the division of labor (either domestic or agricultural) is not necessarily demarcated into exclusive sex-specific tasks. This flexibility in the performance of sex roles in Latin American peasant agriculture is related to cultural factors (the strength of Hispanic versus Indian traditions); social class (whether income comes primarily from land or wages); and the degree of market integration of the peasant economy. There is, therefore, great heterogeneity in the work roles performed by women in agriculture. This section of the paper discusses the evidence on women's

participation in the agricultural labor force in Latin America with the objective of illustrating some of this diversity and its implications for agricultural technology research and development.

The aggregate picture of women's participation rates in the agricultural labor force in Latin America, given by census estimates, supports the use of the term "male farming system", interpreted as agriculture in which men do most of the work. As the figures summarized by region in Table 2 show, women appear to form a small proportion of the total agricultural labor force in Latin America although there are substantial regional variations. Only a small proportion of women defined as economically active are employed in agriculture. However, these estimates must be interpreted with extreme caution. Numerous microstudies find much higher participation rates for women when they take into account several conceptual problems in counting agricultural work done by women which result in underreporting. Such problems include cultural perceptions of what work women do, which cause women as well as men to report a woman's primary occupation as "housewife" even though more detailed interviewing discloses other agricultural employment. For example, one study in Cajamarca, Peru, found 49% of households reported female employment in agriculture, but detailed interviewing showed women engaged in farm work in 86% of households (Deere, 1978). Other factors which cause underenumeration in Latin America of women's agricultural labor force participation are census definitions of what constitutes economic activity by unpaid female workers, minimum hours of work required by census definitions, time reference periods of census interviews, and the seasonality of female work. Some authors argue that changes in census classifications may account for the apparent drop in the number of women enumerated as economically active in agriculture in the region since the 1950s (Lopez and Leon de Leal, 1977; Deere, 1978; see also Dixon, 1982). FAO's 1970 agricultural census counted numbers of persons engaged in agricultural activities on a holding, regardless of the time involved or whether paid or unpaid. The results showed higher female shares of the agricultural labor force than found by International Labor Office (ILO) and census estimates in 32 countries. For Central and South America, the FAO-estimated proportion of females in the agricultural labor force is 19% and for the Caribbean, 54%. For the region, rates were on average three times higher than those for Latin America reported elsewhere (Dixon, 1982:550-5). Studies by FAO in Colombia, Chile, Honduras, Paraguay and Peru indicated that, depending on the dominant crop in the country, between 35% and 65% of women work throughout the year on agricultural tasks (Jimenez de Barros, 1983).

Microstudies of women's participation in smallholder agriculture in Latin America consistently report involvement of women in planting, fertilization, weeding, irrigation, harvesting, threshing, fodder collection, and animal care (see for example Borque and Warren, 1981; a review of microstudies from the Andean countries in Deere and Leon de Leal, 1982; case studies in Colombia in Leon de Leal, 1980; Rubbo, 1975; Alberti, nd.). In most cases, the data are not analyzed in such a way as to enable one to identify a clear-cut sexual division of labor, except with respect to land preparation with the plough (or tractor), which appears to be almost exclusively a male activity. To illustrate this diversity of findings, Table 3 reports data from one of the few studies which quantifies and disaggregates participation rates by agricultural

field task. The percentage of women who participate in any given task, such as planting in Table 2, varies substantially from one community to another.

One of the major shortcomings of microstudies of the sexual division of labor in Latin American agriculture, from the point of view of agricultural research, is their neglect of crop-specific variations in the tasks done by men and women. If participation rates in agriculture were disaggregated by sex, field operation, and crop, it might then be possible to interpret some of the diversity of findings. Moreover, several studies show that important differences in participation rates occur by farm size strata, so that this variable must also be controlled for when interpreting participation rates by sex. For example, Table 4 compares the percentage of total labor days by field operation contributed by women from two farm size strata in two different crops, maize and tobacco. These data come from another study of one of the Colombian communities, El Espinal, for which aggregate female participation rates were shown in Table 3. It can be seen that aggregate participation rates shown in Table 3 do not reflect consistently the picture shown in Table 4 for different crops. There are substantial differences in the proportion of labor days contributed by women to maize cultivation in the two farm size strata. Women do a higher proportion of the work, and most women's labor in maize is family labor on small farms, while women are hired for maize operations by medium-sized farms. In tobacco cultivation, the pattern is quite different. Women still do more work in tobacco on small farms, but most of the female labor is hired and women participate in all field operations. In contrast, all female labor for tobacco is family labor on medium farms and female input is specific to certain field tasks. These data illustrate the heterogeneity of women's involvement in agriculture in Latin America, and the difficulty of extrapolating from the available data to derive implications for the design of commodity-specific agricultural technology.

Another consideration is that the sexual division of labor in Latin American smallholder farming systems appears to be such that men and women participate in the same field operation - such as planting potatoes - but planting techniques are broken down into components, which may be sex-specific. For example, men make the holes or furrows and women place the seed. Borque and Warren (1981:123) argue that there are key tasks within broad categories of work which are reserved to men and thus function as a mechanism for excluding women from access to critical resources:

> "Women participate in a broad range of agricultural activities, sometimes side by side with men, on other occasions in a fashion that complements men's work. Yet women's status appears to be more clearly shaped by those tasks from which they are excluded. Women plant, irrigate, and harvest; they do not break up hard earth with pointed metal rods, plow fields, open irrigation channels, or tie sacks of the harvest on burros. Because women are excluded from tasks such as soil aeration and plowing, they cannot directly open up new private landholdings or extend communal fields. Nor can begin the agricultural cycle on old fields without assistance. Because women cannot load the harvest on pack animals, they are

dependent on men as a link in the chain of events which establishes the value of crops women produce alongside of men." (Borque and Warren, 1981:122).

A similar observation is made in another study which shows that the use of tools or implements draws cultural boundaries on the tasks in which women engage, and that this extends to the use of tractors, or sprayers for fumigation (Deere and Leal de Leon, 1982:61). Women tend to participate in all agricultural tasks in primarily subsistence crops, but only in nonmechanized tasks in industrialized crops such as irrigated rice, cotton, coffee, sugarcane (Gonzalez, 198[illegible]).

To this point, the focus of this discussion has been the question, "Who does the work in agriculture?" The available evidence is that in Latin America women cannot be ruled out a priori as participants in any of the agricultural field tasks entailed in smallholder production. The extent to which women participate and the sex specificity of tasks depends on several variables:

1. the role of a given crop in the household subsistence and cash economy;

2. farm and nonfarm employment opportunities for either sex;

3. the availability of male labor (family or hired) to substitute for the labor of farm women;

4. cultural perceptions of what are key tasks reserved exclusively to men.

In summary, two major characteristics of the sexual division of labor in Latin American agriculture stand out. Industrialized crop production in the large farm sector involves a division of labor which is quite sex-specific. Women are hired as wage laborers for tasks such as coffee harvesting and cotton picking that have not been mechanized, or they work alongside men as members of migrant labor families doing piecework. Regional differences in the tasks men and women perform depend on the local supply of male and female wage labor, and the substitutability of male and female labor in the large farm sector. In smallholder agricultural systems, the division of labor is structured around interdependent sharing of tasks by the sexes when men work on the farm alongside the women. The sex-specificity of tasks appears to be diverse, and flexible or responsive to changing labor market relations. When men work off-farm, women have higher rates of participation in tasks that are male-dominated on farms that hire in labor. The interdependence of the sexual division of labor on small farms suggests that identifying women as special users of agricultural technology, in terms of "who does the work in agriculture", is extremely exacting in requirements for detailed data on the sexual division of labor on a case by case basis. For the purposes of technology research and development, it is also critical to characterize women as special groups in relation to who will benefit from technical change. The next section of the paper addresses this issue and outlines a typology of rural women in Latin America.

4. A TYPOLOGY OF RURAL WOMEN IN LATIN AMERICA

This section of the paper outlines a framework for distinguishing distinct groups of rural women in Latin America who can be viewed as potential users of technology or beneficiaries from technical change in agriculture. To provide a context for the issue of who benefits from technical change, it is important to recognize that most women in Latin America are urban residents (Table 5) and that rural women therefore represent a minority of potential beneficiaries in the region. The 53 million rural women in Latin America can be divided into broad categories which combine gender-specific and class-related situations. Census estimates must be interpreted with caution as discussed earlier; however, the figures in Table 6 indicate something of the magnitude of different categories of economic activity. Unpaid family workers represent proportionately the largest group of women workers in agriculture. The second largest group is "self-employed" women, which in some countries such as Bolivia reflects the importance of traditional artisanal and marketing activities carried out by women. Women wage laborers, the third largest group, amount to approximately 22% of women employed in agriculture according to census definitions.

These figures provide a rough indication of the relative size of different groups, but not a sufficiently accurate one to provide guidelines in setting research priorities. This is particularly important because a more detailed characterization of different groups of women shows that these may have competing interests. Difficult trade-offs may be involved in designing research strategy which takes their needs into account.

A typology of rural women must take into account three major variables which define their status: access to and control over land, time allocation, and marital status. Figure 2 summarizes the major social class divisions, types of farm enterprise, and related labor relations which provide a framework for dividing rural women into distinct groups. In Figure 2, women in the landed elite and middle class are assumed to be mostly absentee, part-time residents on farms, or wives of farm managers. The following discussion is concerned only with women who are farm residents in the small farm sector or laborers.

Farm "Housewives"

Women in this group are members of relatively prosperous families with smallholdings, which engage in commercial crop productions, and are large enough farms to employ family labor year-round as well as to hire in seasonal wage labor. Farm wives and daughters in this social group appear to spend most of their time on so-called domestic work, which includes postharvest processing, seed selection and storage, as well as tending food gardens and caring for livestock. They tend to do very little fieldwork. These women typically have an important managerial role in farm decisions, although they may not visibly participate in farm work. While they may have little direct input into choice of technology, they are influential in deciding how resources are allocated among different enterprises of the household. One observes, for example, that education of children is an important priority for women and that women in prosperous families may want the family to migrate from isolated rural

settlements to small towns where medical and educational facilities are better. Such preferences affect the objectives of the small farm organization, and indirectly influence decisions such as technical choice. This group of women is significantly underenumerated by census estimates of unpaid family workers.

Farm Domestic and Field Workers

These women are members of "subfamily" farms which do not generate enough income to support the family. Although the men work off-farm some of the time, the farm is still managed as a joint enterprise by husband and wife. Subfamily farms produce a mix of cash and subsistence crops, and women participate as unpaid family workers in field operations, in addition to their usual domestic work. These women are most likely to have multiple work roles as subsistence food producers, laborers in cash crops, artisans involved in handicraft production, and petty traders. Young women from subfamily farms are likely to migrate to cities, leaving older women to run the farm, and they may send remittances to the family in the countryside. Women on these farms may be entrepreneurs, investing small amounts of capital in "new" crops such as vegetables, in small livestock, or in marketing. It is among this group that women's time allocation considerations and expenditure preferences are likely to enter directly into decisions about agricultural technology on the small farm.

Women on "Minifundias"

These women belong to the "near-landless" class of cultivators in Latin America for which wage labor is the principal source of income and land may be primarily a means of subsistence food production, although a small amount of produce is marketed. In this situation, women who are members of a stable marital union take charge of the farming and marketing of farm output while men are almost wholly employed off-farm. Agricultural production may be managed by these women as an extension of the woman's role in the food system with its principal objective to provide a year-round supplement to the family diet for which staples are purchased. However, these women are also likely to engage in wage labor, as domestic help on wealthier farms, as migrant labor in the planting or harvesting of certain crops, in handicrafts, in petty trading, and in seasonal work in agro-industries. As a result the subsistence food garden may be abandoned. Technical changes in agriculture are likely to be most significant for this group of women in terms of employment effects and their effect on the price of staple foods relative to wages.

Women Wage Laborers - the Female "Underclass"

This group of rural women is distinguished from the women from minifundias discussed above by their lack of stable access to land and absence of a stable marital union. Consensual unions without legal ties between men and women are an accepted social institution in traditional Indian cultures in Latin America, viewed as a type of trial relationship (Gutierrez, 1975). However, the traditional viability of this institution depended on a network of kinfolk which either ensured that marriage took place once children were conceived, or undertook their economic support. Among the poorer rural social strata, such support mechanisms no longer function, creating an "underclass" of poor women who

are in a more precarious economic position than women in stable marital unions or even male wage laborers. Members of the female underclass are impoverished widows, single mothers who have no access to land, or illegitimate female children with no land rights (Borque and Warren, 1981). The absence of a male partner may effectively block a single woman from access to land because of inheritance customs or land reform legislation, which in some countries denies single and married women the right to their own parcels and assigns these to the head of the household, or requires male authorization for a woman to administer property (FAO, 1979). Many such women are urban residents who go out into the countryside to find work (Garcia, 1980).

Survival strategies for landless rural women include migration to cities, prostitution, domestic service, agricultural fieldwork, or pairing up with a man who can provide her with access to land. Biographical studies of such women suggest that investment in their children is the most compelling concern that motivates their decision-making as members of an unstable agricultural producing unit (Borque and Warren, 1981; de la Rive Box, 1984). The implications of different female and male incentive structures for farm management decision-making in households based on unstable consensual unions has not been studied in Latin America outside the Caribbean. However, many authors suggest that this type of situation is an underlying factor in the "feminization of farming", when women are abandoned by men with a small parcel of land - to which the women have no legal rights - for their support and that of the children.

In summary, rural women in Latin America can be differentiated into several distinct interest groups. Those directly involved in smallholder agriculture who are potential clients or "users" of technology developed by public sector and IARC research are:

1. farm housewives, who will evaluate benefits of agricultural technology in terms of its effect on their overall household expenditure patterns and desired life-style. These women will have an input into adoption decisions because of their influence on farm management objectives;

2. farm domestic and field workers, who will evaluate agricultural technology in terms of its direct effect on their time allocation as well as its implications for farm income and expenditure. These women may be influential in rejecting technology that requires additional work on the small farm unless it generates sufficient income to enable male family labor or hired labor to meet the need for more labor time. These women are also clients for low-input technology that can be integrated into the subsistence food garden without increasing labor inputs significantly;

3. women on <u>minifundias</u> may also be clients for low-input technology compatible with the <u>minifundia</u> subsistence food garden, but they may benefit more from technical change in agriculture that increases the supply of food staples that they purchase, or that they would purchase if prices fell. This group, like landless laboring women, are most likely to be directly affected by the implications of technology for labor requirements in the small farm sector, which may increase or decrease their employment opportunities.

These interests of different groups of women in terms of agricultural technology development are not therefore necessarily congruent, in some instances they may directly conflict. Determining just what these interests are and the relative importance of the different groups of women they represent are critical issues that must be addressed in order to determine the relevance of gender as a criterion for technology research and development.

5. NEEDED RESEARCH TO ASSESS THE RELEVANCE OF GENDER-RELATED ISSUES FOR CGIAR OBJECTIVES AND RESEARCH STRATEGY

An overview of the evidence on women's participation in Latin American agriculture suggests the following conclusions.

1. The macrostatistical picture showing low rates of women's participation in agriculture is fundamentally misleading because of conceptual problems of measurement of women's work in agriculture.

2. Microstudies indicate higher rates of participation, although quantitative estimates are few and are an inadequate basis for generalization about trends and participation rates.

3. Rural women's work roles in Latin America involve extremely heterogeneous activities.

4. The sexual division of labor appears to be more rigid in estate and plantation agriculture, where women's roles are principally those of wage laborers in specific tasks, often on a piecework basis.

5. In smallholder agriculture the sexual division of labor appears very fluid: women are excluded from some tasks more than others, but examples exist where they take part in almost all agricultural field operations; women's participation may be in sex-specific tasks that are interdependent with tasks performed by men.

6. Women's participation in field tasks varies by the social class, techniques of production in a crop, and the crop's role in the economy. Microstudies almost universally neglect to disaggregate participation rates by crop. Participation rates of women in smallholder agriculture appear to be highly responsive to labor market conditions, in particular the availability of male wage labor as a substitute for labor of farm housewives in field tasks.

7. Women may contribute to a significant proportion of capital generation in farm households and may influence expenditures and investments as a result.

8. Women play a significant managerial role in smallholder agriculture under certain conditions:

    a. where subsistence food production managed by women is an important component of total farm production;

    b. where male labor is engaged in off-farm employment and women take primary responsibility for farming decisions or participate jointly in them because their time is a critical input.

9. Three distinct groups of women can be identified as potential clients or user groups for technology development and research in Latin America, but their interests diverge and may conflict.

10. Certain groups of women (see Figure 2) face different incentive structures from men which may influence acceptance and impact of technical change because:

    a. male and female work responsibilities and time availability differ;

    b. male and female control over resources such as land, labor, and cash differ and their preferences and benefits may differ with respect to new relations among these factors of production due to technical change;

    c. access to institutional resources such as technical assistance and credit are different among men and women.

Although a review of the available evidence suggests that technology adoption, food production and welfare of the rural poor in Latin America are influenced by the participation of women in agriculture, the data base is so weak that the relative importance of gender for agricultural research priorities of the CGIAR system in Latin America must be treated as an empirical question. Furthermore, adequate information on the sexual division of labor on a commodity specific basis is not available to undertake ex ante analysis of the implications of gender differences for technology design. In order to accomplish these tasks two different types of research needs must be addressed.

First, a broad assessment is needed of the participation of women in agricultural field tasks and in farm management decisions for specific commodities in regions of major importance within the Latin American IARC mandates. This study must also provide estimates of the size and relative importance of different groups of potential users or beneficiaries from new technology, including men, women and children, on a regional and commodity-specific basis. An informed judgement about the relative importance of different classes of women as special user groups for IARC-generated technology in Latin America can only be made on the basis of such a study. Moreover, this research will provide the foundation for determining the relevance of integrating women's needs into technology design for specific IARC mandate commodities.

The second type of research must address the issue posed at the beginning of this paper, of how public sector research organizations such as the CGIAR system, can inform themselves of the special needs of clients designated as significant target groups. In terms of research strategy within the CGIAR system, the issue is essentially one of developing research models and methodologies which integrate the assessment of women's needs into the design of technologies within the IARCs and which strengthen the capacity of national programs to adapt and deliver such technologies to special user groups, such as women.

In Latin America, several international research organizations (CIAT, CIMMYT, CIP, IFDC) and several national programs (Instituto de Ciencia y

Tecnologiá Agrícolas (ICTA), Guatemala; Instituto Colombiano Agropecuaria (ICA), Colombia; Programas Nacional de Investigacion Agropecuaria (PNIA), Honduras, for example) have at different times developed research approaches which address this issue with reference to the small farm client group (Byerlee, D., M. Collinson et al., 1980; Hildebrand, 1981; Rhoades and Booth, 1982; Ashby, 1984). Several steps need to be taken to integrate the assessment of sex-specific needs into such already institutionalized research programs. These include, for example:

- network-building by the IARCs with experts in women's studies in the region to ensure that the often "fugitive" research on rural women informs agricultural researchers;

- inclusion of women trainee staff into on-farm research programs to establish access to rural women, often "invisible" to male researchers because of cultural barriers to communication between the sexes;

- disaggregation by sex of primary data collection on farm labor, both family and hired, routinely undertaken for on-farm research purposes;

- earmarking resources for basic research on time allocation and resource flows among household members in different types of rural household (see Figure 2). Such studies are required to evaluate empirically the implications of different sex-related incentive structures for the adoption of technology, for food production, and for other CG system research objectives related to the welfare of the rural poor.

Table 1. Women's Participation Over Decision-making

Principal family member charged with activity, percentage of all households by land-size strata, Cajamarca, Peru

Activity	Mother or Mother and Children	Mother and Father or All Family Members	Father or Father and Children	Total
	(%)			
Decides What is to be Planted, Where, and When				
Near-landless households	23	46	31	100
Smallholder households	18	43	39	100
Middle and rich peasant households	4	17	79	100
TOTAL (N = 104)	15	38	47	100
All Inputs				
Near-landless households	52	20	28	100
Smallholder households	31	20	28	100
Middle and rich peasant households	27	26	47	100
TOTAL (N = 230)	32	35	33	100

Source: Deere and Leon de Leal (1982), Appendix.

Table 2. Census Estimates of Women's Participation Rates in Agriculture for Major Latin American Countries and Regions

Region or Country	Women as Percentage of Total Agricultural Labor Force	Number of Women Employed in Agriculture	Percentage of all Employed Women Active in Agriculture
Brazil	9.6	1,257,659	20.3
Mexico	5.2	266,654	10.8
Tropical South America	6.0	342,125	8.9
Central America	2.6	69,264	7.3
Caribbean[a]	32.4	640,291	45.1
Temperate South America	5.6	105,410	3.6

[a]Excludes Cuba
Source: ILO Yearbook of Labor Statistics (1977)

Table 3. Percentage of Women Participation in Agricultural Field Tasks in Three Smallholding Communities, Latin America

Field Operation	Community Case Study		
	García Rovira, Colombia	El Espinal, Colombia	Cajamarca, Peru
	(%)		
Field preparation	10	14	24
Seedling preparation	29	21	NA
Planting	30	16	48
Transplanting	7	32	NA
Weeding	4	31	47
Cultivating	4	20	24
Harvesting	46	52	62
Threshing	NA	NA	66
Processing	51	36	NA

Source: Adapted from Deere and Leon de Leal (1982), Table 7.

Table 4. Participation of Women From Two Farm Size Strata in Field Tasks in Maize and Tobacco Cultivation

Crop	Farm Size[A]	Women's Labor as Percentage of Each Operation					Percentage of Female Labor	
		Land Preparation	Planting	Cultivation	Harvesting	All Tasks	Hired	Family
Maize	Small	12	23	20	23	21	12	88
	Medium	0	8	7	6	6	100	0
Tobacco	Small	33	50	30	49	38	79	21
	Medium	0	0	34	15	21	0	100

[A]Small farms: 0.31.00 ha; medium: 3.01-10.00 ha.
Source: Adapted from Motta de Correa (1980), Table 8.

Table 5. Urban-Rural Distribution of Female Population in Latin America by Region

Region and Country	Percentage of Femal Population		Total Number Rural Women
	Urban	Rural	
Brazil	69	31	18,508,758
Mexico	66	34	11,285,516
Tropical South America	63	37	12,673,582
Central America	43	57	6,267,103
Caribbean	56	44	3,294,812
Temperate South America	84	16	1,151,862
Total Latin America	65	35	53,181,633

Source: United Nations, Demographic Yearbook (1982), Table 6.

Table 6. Distribution of Women Economically Active in Agriculture by Occupational Category in Latin America

Region and Country	Percentage of Women in Agriculture		
	Semi-Employed	Employers and Laborers	Family Workers
Brazil	35.7	17.1	47.2
Mexico	35.4	44.0	20.1
Tropical South America	53.7	18.9	23.8
Central America	14.1	64.0	19.1
Caribbean	18.0	11.4	64.5
Temperate South America	30.2	43.0	24.9
Total Latin America	32.5	20.9	44.5

Source: ILO Yearbook of Labor Statistics (1977)

Structural Changes in the Rural Sector, Latin America	Rural Women's Work Roles	Interviewing Variables	Outcomes for Rural Poor
Declining size and stagnant productivity on small farms.	Women's domestic work (includes postharvest processing).	Women's food preparation preferences	Adoption of agricultural technology
Mechanization of capitalist agriculture.	Women's subsistence production (crop and small animals).	Women's control over farm output, income, and expenditure.	Household food availability; home produced versus purchased food
"Proletarianization" of peasant class.	Women's marketing activities.	Women's control over farm management (production inputs).	Household savings and expenditure patterns.
Outmigration.	Women's unpaid labor on family farms.	Women's childcare and fertility control practices.	Child nutrition, health, mortality, and education.
Female-headed farms.	Women's employment as agricultural wage laborers.		
	Women's nonagricultural wage labor.		

Figure 1. Schematic Diagram of Causal Relationships Between Gender-Related Factors, Food Production, and Welfare of the Rural Poor.

Social Class	Types of Farm Enterprises	Farm Labor Relations	Types of Women
Traditional landed elite	Haciendas (precapitalist estates)	Employ permanent *minifundista* labor force	Absentee or wives of farm managers
Capitalist landed elite	Estates and plantations	Employ mainly seasonal wage laborers	Absentee or wives of farm managers
Rural middle class	Capital-intensive farms	Employ permanent and seasonal wage laborers	Absentee or part-time residents or wives of farm managers
Well-to-do smallholders	Small commercial farms	Use exchange labor, wage labor, family labor	Farm "housewives"
Peasants	Mixed commercial-subsistence	Family labor, hire out some labor for wages	Farm domestic and field workers
Rural proletariat	*Minifundias* (near landless)	Hire out most labor for wages and farm in slack periods	Women *minifundistas*
	Landless	Hire out all labor	Women wage laborers: "female underclass"

Figure 2. Types of Rural Women in Latin America Related to Social Class and Type of Farm Enterprise.

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PART III

GENERAL ANALYSIS

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Women And Structural Transformation*

by

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ABSTRACT

This paper focuses on an examination of the extent to which and the circumstances under which gender affects economic behavior, thereby influencing women's participation in the process of structural transformation. A review of development literature relevant to women's role in agricultural production and economic development under different social and production systems brings to bear analysis from several major approaches to these issues: the study of agricultural growth and technological change, distributive and demographic factors as they interact with women's economic role, sociological and anthropological literature, and analyses of the impact of government intervention on women in agriculture. A brief summary of trends in agricultural production and overall employment is then developed, particularly with a view to examining its implications for women including substitution of male and female labor, and women's differential access to factors of production and social services in different stages of development and under diverse social situations. In the treatment of these issues, the paper points out policies that are detrimental to productive efficiency and social welfare, that affect the legal framework, the institutional capacity and educational programs of the developing countries. Reform of such policies would contribute to increased societal awareness of the losses implicit in women's unequal access to resources and their consequences for women's participation in economic activity as structural transformation occurs.

1. INTRODUCTION

Concern about women's participation in the process of economic development is relatively new. It has been prompted by a combination of positive analyses and normative judgment. The frequently debated questions are: Do women have an adequate opportunity to participate in the productive processes and welfare benefits in the course of economic development, or are they the beasts of burden who bear a major share of exploitation?[1] And, what factors influence alternative outcomes with regard to women's participation? Conceptualization of the way gender affects participation in economic development is at a relatively early stage (Boserup, 1970; Becker, 1981). Analysis is still quite rudimentary of the women's role as economic actors as distinct from that of the labor force in general.[2] The extent to which and the conditions under which

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[1] Exploitation may be defined in several ways, including unequal wage for equal work among males and females, overt or covert barriers to entry or to upward mobility of female labor, unequal access by females to factors of production, technology information, and to social and family resources, legal rights to property, etc.

[2] The notable exception is Gary Becker's work (Becker, 1981). By mostly surveying the theoretical and the U.S. empirical literature, Mark Killingworth observes that "analytical models of dynamic behavior...are also still fairly rudimentary.... Life cycle relationships between fertility, labor force participation (including in particular, discontinuities and gaps in labor force participation, a 'cycling' between the market and the home), and wage rates for married women...do not... emerge readily from available formal models of dynamic optimization" (Killingsworth, 1983, p. 444).

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gender may influence a variety of economic outcomes are not well researched. The nature and the extent of segmentation of economic activity between males and females and their changing roles in different socioeconomic settings and during the course of economic development are inadequately investigated in economic literature (Smith, 1980). Consequently, whether the efficiency and welfare losses from women's low participation in economic activity are significant in static and dynamic contexts is inadequately articulated. The simultaneous and rapid changes in incomes, technology, demography and tastes with regard to women's role make the implications of the dynamic factors for public policy at once very significant but complex to analyze in developing countries. Even where policy implications are obvious from the existing limited research however, these have not always been effectively incorporated by governments in their actions.

This paper first summarizes the major themes of the various types of literature relevant to understanding women's role in primary production and economic processes in developing countries. It then reviews briefly the overall trends in production and employment in developing countries over the last two decades with a view to examining their significance to women's participation. The paper then turns to its primary objective, namely to explore women's distinguishing role as economic actors in traditional societies under quite different social and production organization systems. The paper explores women's likely distinct influence on production by examining the degree of substitution between their own labor in agricultural production and other activities, between labor and capital, and between male and female labor under different production, organization and social conditions in static and dynamic contexts. It then examines the implications of women's differential access to factors of production and social services on their individual and family welfare at various stages of economic development and in differing social circumstances. Finally, the paper examines policy implications of existing knowledge and identifies areas where further research is critical for improving the understanding of women's role in development and for policy formulation.

2. LITERATURE RELEVANT TO WOMEN'S ISSUES

There are several quite different strands of literature relevant to the subject of the way gender affects participation in economic development. One major body concerns the relationship of agricultural to overall economic transformation even though the treatment of gender-related issues in much of this literature is quite tangential if it exists at all. This literature explores issues of growth and differentiation among households. Contributions to it have come primarily from academic economists trained in the neoclassical tradition (Ohkawa, 1956; Johnston and Mellor, 1961; Mellor, 1966; Ishikawa, 1967). Its assumptions about the automaticity of the trickledown effects of agricultural growth between households caused a backlash of literature prompted by technological change, which more explicitly treats the issues of employment and income distribution (Frankel, 1971; Griffin, 1979). The major theme of this later literature, namely that the green revolution had an adverse effect on employment and income distribution, among households, led in turn to a more articulate conceptualization of the conditions affecting the effects of technological change on household

employment and income generation (Hayami, 1978; Lele and Mellor, 1981; Hayami and Kikuchi, 1982). These conditions include both the institutional structures and economic policies affecting direct and indirect employment effects. The central tendency of further analysis consequently shifted from assessing whether technological change was "good" or "bad" to an evaluation of how to manage its social effects in the short and the long run.

Whether and by what means these social effects can be managed, with what implications for public policy, and over what time periods are still outstanding questions. Answers to them must inevitably be sought in the context of the particular socioeconomic circumstances of each case. By drawing on this literature we will explore the implication of these issues for women's role in the process of structural transformation later in this paper.

Demographic and poverty-related literature constitute other important areas of research relevant to questions of women in development. The central question in this case is how do intrahousehold decisions affect women's welfare and efficiency? Household benefits may be classified in two categories: domestic income in cash and kind, and access to social services. The poverty related literature directly addresses the questions of intrahousehold resource allocation by gender and the way such distribution affects family welfare and demographic factors (Lipton, 1977 and 1983). The evidence of domestic resources - especially food - going to male and female household members is quite limited and variable. The Narangwal study (Taylor, 1979), one of the most detailed, indicates lower access of female children to household food resources, and higher female child mortality in India.[3] Bhalla on the other hand reports other survey data from India and the Philippines to indicate no significant difference in terms of caloric intake (India) and of weights (Philippines) between male and female children (age 0-6) (Bhalla, 1980). Available infant mortality data for some selected countries show a lower rate for females than for males while the opposite is true for children (age 1-4) (Bhalla, 1980). A. Sen and Sengupta provide contrary evidence in their field work in India, with systematic sex bias reflected in higher deprivation of girls vis-a-vis boys (A. Sen and Sengupta, 1983). Case studies on India also show lower access to domestic food by adult females in relations to their workload and caloric requirements in comparison with males, who are observed to receive larger than their "fair" shares (Agarwal, 1983, p. 43). Evidence on education consistently shows lower female access to education (World Development Report, 1983 - hereafter WDR - pp. 196-197), although the rate at which access to education has been growing is frequently faster for females than for males. Women are also frequently concentrated in relatively lower-paid types of skills (Psacharopoulos and Loxley, 1984). Data on female access

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[3] In these studies, it is important to control for access of members of household to any outside food in kind. Lower domestic consumption of certain family members may well be a result of their greater access to outside sources, i.e., school-feeding programs. It is unlikely however that this effect operated in the Narangwal study as the age group considered is pre-school, and females have lower access to outside sources.

to health and water supply are far more limited, and male and female mortality rates show quite different and not very generalizable patterns (UN Demographic Yearbook, 1982). Rosenzweig and Shultz explain lower female access to household resources as being a response to market forces (Rosenzweig and Shultz, 1982). According to this interpretation, until economic incentives change, distribution of resources among genders may not change. However, economic incentives are both influenced by and influence social norms and th : s from the viewpoints of welfare concerns or policy implications the Rosenzweig and Shultz analysis does not go far enough.

Models of household behavior which address women's fertility, labor supply, saving, access to education, consumption and investment behavior are still very rudimentary. Further, while adding to rigour their excessively neoclassical orientation greatly limits their enquiry. They assume that household members maximize a joint utility function and respond to market forces. Becker for instance outlines how under certain neoclassical assumptions one can explain the altruism of family members towards each other and especially of parents towards children, as also the lower market wages for married females than married males, and the gains derived from polygamy by women (Becker, 1980). While this type of analysis is useful as far as it goes, it is not helpful in identifying the relative role of some of the underlying non-market forces vis-a-vis market forces which together influence outcomes with regard to women's participation. Other more dynamic and more empirical work on female labor supply in the U.S. has reflected the high fixed cost of married women's entry into the labor market, but otherwise largely bypassed the causes of these high fixed costs and the circumstances in which they will affect labor supply, focussing instead on the measurement issues related to female labor supply given these factors (Killingworth, 1983; Smith, 1980). Recent literature, especially on developing countries, has however begun to explore these market and non-market interactions. It points out, for instance, that the male and female household members may each, not only have quite different roles, but also different security needs and preferences with regard to household decisions. These may in turn be greatly influenced by social norms (Cain, 1984) leading to a variety of influences on family preferences, for instance, as regards male and female children. These may in turn affect family size and have demographic implications. Further, these various factors can be expected to alter in a dynamic context as gender-based roles adjust in the course of development.[4]

Discussion of institutional factors affecting household behavior are, of course, abundant in social and anthropological works. The "Women in Development" literature has reinforced these concerns by emphasizing that explicit attention be given to understanding women's role in intrahousehold decision-making and in public interventions directed at

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[4] Evidence suggests for example that girls born into families where girls are in majority are significantly more likely to die before age five than girls born into families with more boys than girls. On the other hand, for boys born alive the chance of survival to age five does not depend on the sex composition of the families (Ben-Porath and Welch, 1976).

"households." The incorporation of their concern in the mainstream of economic development and policy analysis has been slow in coming, partly because the strong normative judgments contained in some of the earlier feminist literature have not been broadly shared and partly because a great deal of these works are of a descriptive nature. Also, many of the interpretations contained in this literature, especially at earlier stages, disregarded the diversity of social norms and traditions indeveloping societies, well recognized in anthropological research, which affect economic choices (See Buvinic, et al, 1976). The consequence was a unidimensional projection in some of this literature of women's worsening status in the course of modernization, attributing it mainly to Western influence (see for example Tinker, 1976).

As with other scholarship on development, the feminist literature has, however, come of age. A movement away from plain advocacy to the exploration of the more complex issues of women's relationships within the household, and to the development processes in general, is taking shape. These enquiries address women's role as economic agents, examining their bargaining position within and outside households, their access to resources and the size of benefits they derive. Contributions from the African continent have been particularly significant in this regard. When so analytically geared, the women's literature is indistinguishable from other intellectual enquiries of the developmental process (Banerjee, 1983), but a great deal more systematic analysis needs to be done to incorporate women's issues in the main stream of development literature.

The final body of development literature relevant for women's issues consists of investigations of the impact of planned interventions as distinct from autonomous processes of social change which can influence woman's position. Here as in the case of the feminist literature, contributions from the African continent are significant. While most of these works relate to project (and program) interventions, some small amount has begun to examine the political processes affecting choice of policies and programs and the way it influences the size and distribution of their impact. This literature challenges the earlier assumptions about governments as benevolent and relatively efficient actors with an unlimited capability to direct public interventions to benefit those with limited assets and access to factors of production (Bates, 1981 and 1983; Lele, 1974). Evidence of significant inefficiencies in public sector management, of interest group capture of seemingly well-intentioned government interventions, and of overtly predatory motivations behind others have raised questions as to the appropriate balance of public and private roles in pursuing even a broadly-accepted set of growth/equity objectives. The pendulum has also swung in favor of growth because of the disenchantment with the ineffective government interventions carried out in pursuit of equity in the 1970's (Coulson, 1982; Lele, 1984). These various concerns about the efficacy of government intervention temper enthusiasm for public interventions targeted to redress grievances of designated groups in the short run, as distinct from pursuance of enlightened public policy in support of broad social reform in the long run. By changing the mix of legal institutions, education and economic incentives, public policy can make a significant difference to social choices affecting female members of traditional households over time.

3. AGRICULTURAL DEVELOPMENT AND LABOR ABSORPTION

To understand women's role in agriculture requires an appreciation of the role of agriculture in structural transformation. Further it needs to be recognized that overall growth in employment is a necessary condition for increasing women's income-earning opportunities, although it is by no means sufficient. The choice of development strategies must thus be a significant focus of attention for those concerned with women's role in economic development. Agriculture's overwhelming importance in the transformation of low income economies is well recognized in the development literature; agriculture is the major provider of employment and income as well as the primary source of food and raw materials for the urban/industrial sectors, exports, revenues for the public sector, and demand for the goods and services produced in the rest of the economy (Johnston and Mellor, 19612). Increasing agricultural productivity is thus critical in facilitating economic transformation of traditional economies by releasing resources for the development of the non-agricultural sectors.

Developing countries reached various stages of structural transformation if the 1960 to 1980 period is considered. While annual growth rates of agricultural production reached 3.8% in Southeast Asia, 3% in Latin America and 2.2% in South Asia in the 1970s, as a region, Sub-Saharan Africa was well behind in initiating its agricultural transformation, with growth rates of only 1.3%.[5] Not only was African agricultural production growth slow in the 1970s, but, unlike the rest of the developing world population growth rates had accelerated in Africa, reaching close to 4% annually in some countries during this period.[6] Consequently per capita agricultural production declined in many parts of Africa.[7]

In the densely populated parts of Asia agricultural growth has been mainly the result of technical progress and intensification. However, because labor intensity in agricultural production has already been high, employment elasticities in direct agricultural production have not been high enough to absorb even the annual additions to the labor force. In parts of India, employment elasticities with respect to value of production of 0.6 have been estimated in irrigated rice (Singh, 1979). In Indonesia, however, elasticities as low as 0.28 have been estimated in irrigated rice in the 1970s (Wages and Employment in Indonesia - hereafter, Wages - 1983, p. 42; G. Hart, 1978).

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[5] Annual agricultural output per capita for the same period was -1.4%, 0.6, 1.4, 0.0 for Africa, Latin America, Southeast Asia and South Asia respectively (World Development Report 1982, 1982, p. 41).

[6] For the period of 1970-81, the annual population growth rate is 4% for Kenya, 3.4 for Tanzania, 3.5 for Liberia, 3.2 for Zimbabwe, 3.4 for Rwanda, 3.1 for Sudan, 3.0 for Malawi. (World Development Report 1983, 1983).

[7] Indices of per capita agricultural production for the 1970s for Africa show decreases in most countries (USDA, Indices of Agricultural Production in Africa and the Near East, 1970-79, Statistical Bulletin no. 637, June 1980).

In Africa, with the exception of hybrid maize, growth in agricultural production seems to have been mainly a result of extension of the area under cultivation. Estimations of employment elasticities are less easily available for African agriculture. However because of the extensive nature of cultivation (frequently involving land clearing), they may well be higher than those in Asia, perhaps being close to unity. But, rates of urbanization have also been larger in Africa than in Asia[8], also causing substantial labor shortages in that sector. Women have already been playing an important role in African agricultural production (Boserup, 1970). Urban migration involving male members of households has increased women's role in production as evidenced by the much larger number of female-headed households frequently noted in Africa.[9] Of course, these are not necessarily fully generalizable patterns. There are areas of substantial population densities in Africa as for instance in parts of Kenya and Malawi where some of the same pressures for intensification apply as in Asia. Recent evidence on patterns of urban migration also shows greater migration of households in parts of Africa than previously assumed (Sabot, 1983; Kumar, on-going research).

Despite their different structures and performances, experience of Asia and Africa suggest that overall employment in agriculture has not grown significantly in either continent when considered in relation to population growth. Regions within countries have however experienced substantial growth in agricultural employment, especially in Asia. Their experience is significant to concerns about women in agriculture. We will explore this in the later parts of this paper.

Record of labor absorption in the non-agricultural sectors of the developing world has been quite variable, but again generally disappointing in relation to the growth in labor supply. Rates of overall economic growth exceeded 7% only in a dozen countries in the 1970's (WDR 1983, pp. 150-151). However, because of the capital intensive nature of industrialization in many of these countries, employment growth in the formal manufacturing sector has not been rapid enough to absorb the pool of surplus labor contained in the agricultural sectors. In Indonesia, for instance, output in the formal manufacturing sector grew at 12.3% per annum during the 1970's; however, employment in this sector grew only at 4% (Wages, 1983, p.42). The rapid growth of the

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8 Average annual growth rate of urban population ranges between 5 to 8% in many African countries while the rate of the majority of Asian countries is below 5% with the exception of Bangladesh, Afghanistan, Laos (World Development Report 1983, 1983).

9 In Zambia's Luapula province, women head one-third of the households, while in Kenya women head approximately 40% of all rural households (Chambers and Singer, 1980, and "Kenyan Women and Smallholder Agricultural Productivity", mimeo, 1982). In India, in contrast women are estimated to be heading 9.6% of rural households (from a study by P. and L. Visaria as reported in Agarwal, 1983, p. 43). This figure may however reflect some under-reporting. The percentage of female-headed households is 18.1% in Malaysia, 10.4% in Taiwan, and 11.8% in Sri Lanka (Visaria, 1980, p. 59).

service sectors noted in countries such as Indonesia, Thailand, Malaysia, Brazil, Nigeria, and Cameroon (WDR 1983, pp. 152-153) have raised questions as to whether they represent a supply push from the agricultural sectors experiencing relatively low levels of marginal labor productivity, or a demand pull resulting from the income growth in the rest of the economy. Whatever the reasons for the growth of the service sector, the need to understand the forces which influence the overall growth rates of employment is obvious.

4. THE CHANGING STRUCTURE OF AGRICULTURAL AND ECONOMIC PRODUCTION AND WOMEN'S ROLE

Understanding of the microprocesses of economic activity is of course crucial to assessing the prospects for women's likely participation in the overall employment growth during the course of economic transformation. Both the social structures and agricultural production systems in developing countries are highly diverse. They each determine women's changing relationship to the household and the economic activity in a complex manner. In this paper we can do no more than scratch the surface of the gender role in the process of agricultural and economic transformation by examining them in the context of three rather simple stylized production systems, with their associated social structures, namely, (i) the intensively cultivated labor-surplus agricultures of Asia, with a "unimodel" land distribution consisting of small and marginal farms and a substantial class of landless households; (ii) the extensively cultivated land-surplus agricultures of Africa; (iii) dualistic agricultures of Latin America with radically different factor intensities in agricultural production between small and large farms and with a small proportion of marginal cultivators and landless agricultural laboring households.

The paper primarily focuses on the first two, on the assumption that structural issues are far more basic in Latin America even in dealing with the women's employment issues, and there may be relatively few easy policy solutions which do not center on these. The questions we wish to address are: are there any generalizable patterns in the women's relationship to their households and economic activities across these three types of agricultural systems? What do we know and how much do we need to know about the nature of differences within and among each of these types of production systems to understand the existing interactions between women's household and economic activities and to predict their future course?

4.1. Women's Time Allocation in Traditional Societies

Despite the diversity of these three production types, the most persistent common evidence in traditional agricultural sectors is one of the very long (and typically longer than men's) hours devoted by low-income women to work.[10] Household work seems to be almost

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[10] The long hours result from a combination of three types of activity: household work, contribution to directly productive agricultural activities and/or trade.

exclusively the female responsibility. While some of it is directly the result of women's reproductive function, in addition to child care, women's household work typically involves a number of highly time consuming and directly survival-related activities including fetching water, gathering firewood and food preparation. Gender-related division of labor is thus reinforced by tradition and culture.

Women's role in the agricultural production process varies a great deal among traditional societies. This depends on a variety of factors including the nature of social organization, (whether a patrilineal or a matrilineal society, without or with women's rights to property, whether joint family structure, etc.), religious and cultural attitudes towards women, (whether they are segregated by virtue of their class, caste or religion), the nature of the production organization (whether settled cultivation or nomadism, whether irrigated or rainfed agriculture, whether production of food or nonfood crops, whether perennial or annual crops and whether continuous or shifting cultivation), etc. Despite these differences, the low income women's important role in directly productive agricultural functions in traditional societies is well established. This includes weeding, harvesting, threshing, winnowing, etc. The exceptions are the Middle East, North Africa and parts of South Asia where traditions in the Muslim or Muslim influenced communities prevent women's participation in activities outside the household (Epstein and Watts, 1981).

Women's role in trading differs in different communities, West African women being known as traders par excellence (Bauer, 1954; Meillassoux, 1971). Despite their more limited role elsewhere, literature recognizes women's substantial capability in petty trade and in the production of traditional crafts.

4.2. Labor Substitution Between Income-Earning Activities, Household Work and Leisure

Economists have traditionally treated all work other than indirectly income generating activities as "leisure". The discussion in the preceding paragraphs however illustrates the need to distinguish between "pure" leisure and other household work including childcare which has intergenerational investment implications. Asian literature suggests the low-income women's income elasticity of pure leisure is perhaps significantly higher than men's. This seems to be both due to longer hours of household and income generating work at low levels of income, and social norms, leading to desire for pure leisure. In Asia there is significant evidence suggesting increased substitution of hired labor on farms for household female labor with increased household income (Hayami, 1978; Agarwal, 1983; G. Sen, 1983; and Epstein and Watts, 1981). Preference for improved child care must however also play a part in domestic vs. income earning activities. Due to a combination of these factors with increased income, adjustment in low income women's time allocation seems to come mainly at the cost of directly income-earning activities outside the household (Acharya and Bennett, 1982). The time allocated to household responsibilities including to child care typically tends to be less resilient to income change, although the extent of arduous labor declines with the use of labor saving devices and/or hired labor in household work (Epstein and Watts, 1981). Conflicts between

women's income earning and household responsibilities, especially child care, appear to be considerable in traditional Asian households with important implications for short and long run outcomes with regard to the derivation of women's own utility, household utility and the development of their families and families' long term capabilities and preferences, as they affect socioeconomic development. These tradeoffs are inadequately explored in the feminist literature, which has tended to build on the normative judgments of the utility of women's direct income earnings. The demographic and human capital related literature on the other hand stresses the relationship of the quality of childcare to the size and quality of population and by implication to women's derived welfare (T. Schultz, 1981; also Becker, 1981). To explore these tradeoffs, it is, however, first necessary to examine the determinants of women's access to productive assets, income and preferences as they affect their changing bargaining power, choice and welfare for themselves and their families.

4.3. Women's Role in Asset Ownership, Agricultural Production, Income Earning and Expenditures

Social norms and prevailing practices vary greatly among traditional communities as regards women's ability to mobilize factors of production to earn income. Nevertheless some generalizations are possible. There are also mutually offsetting dynamic effects of modernization on women's ownership of and access to resources, and their preferences. Because these are not well researched, generalizability on these issues is greatly hampered, nor are the effects of these various changes known in quantitative terms even where such evidence exists. In Asia traditionally women have had limited access to land ownership or to other household assets which have been passed on from husbands to sons.[11] The prevailing practice with regard to women's contribution to agricultural production or income in Asia has been either in kind through contribution of their labor to the cultivation of their own household plot(s), or in cash through hiring out their labor to other farms. Low-income wives in Asia and Africa are observed to contribute significantly to family's cash income and thereby to the provision of food, clothing and other consumption needs of the family. Micro studies from a diverse set of traditional societies suggest that sources of income matter in patterns of household consumption as preferences in types of expenditure as well as control of income may vary significantly between male and female members of the household according to source. Women's income is more likely to be allocated to expenditures related to children's food, health and educational needs and into savings, than would be observed in the case of increased household income (Kumar, 1977). In contrast, in the feminist literature both from Asia and Africa, male household members are frequently observed as being more inclined to indulge in unproductive consumption (alcoholism, betting, etc.), and/or certain types of farm investment i.e., cattle ownership in Africa. Much stronger empirical evidence is needed through household surveys to examine how significant these differential preferences are in

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[11] Even in matrilineal societies land is frequently controlled by the mother's brother and passed on to sister's son. Males thus actually control the land.

rural households, to what extent they are influenced by men's (perhaps more) permanent and women's (mostly?) transitory income as distinct from being the result of gender differences, how they relate to economic and social status, access to education of men and women, etc., and how these preferences are exercised by male and female household members. For instance, to what extent and how do women exercise control over the income they earn directly as distinct from the household income needs to be ascertained statistically. There is a frequent message in the anthropological literature both in Asia and Africa that income earning activities outside the household allow women to exercise greater control of income in favor of expenditures they prefer, because of their ability to hide some or all of this income, as well as their increasing bargaining position within the household in comparison to that derived from the contributions they make to household work or domestic agricultural production (Acharya and Bennett, 1982; Bay, 1982). On the other hand, does the substitution of hired for own labor at increased incomes in Asia, referred to earlier, imply poor recognition on the part of women of their ability to exercise greater direct control on income and expenditures through their outside work? It may also suggest their greater ability to exercise control over family income. Social norms which favor the male being the provider of the family in many (but by no means all) parts of Asia may also explain women's withdrawal from the labor market. It is not clear which of these factors prevail, their relative importance and how they influence women's and household welfare at a given point in time and over time.

The question of increased time spent by women of child-bearing age at home is especially important to explore as it is known to improve the quality of child care and food preparation and the reverse is also reported.[12] These benefits may significantly outweigh the low levels of opportunity cost of women's outside work. Similarly, ability to bear (especially) male children is known to compensate for cash income in women's power and status in the household in many Asian communities (Epstein and Watts, 1981). Increased outside employment is on the other hand also known to reduce women's fertility by increasing marriage age and by providing greater economic security and income (Cain, 1984). Adequate evidence does not exist at this stage to indicate the relative importance of gender and socioeconomic class in these decisions. Demographic literature however suggests a substantial importance of the gender role by pointing out that women's freedom to control fertility may have substantial 'liberating' effects on their other activities and preferences (Birdsall, 1976). Women's increased access to education may improve both the quality of child care as well as reducing desire for number of children.

Perhaps because of these various conflicting and compensatory effects on their welfare through their own and their household's positions, women's advocacy literature tends to be schizophrenic as to the effects of modernization on women's lives. Some laments women's increased

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[12] Some evidence shows that domestic work, such as food and cooking are negatively linked with agricultural production and women's outside work (Kumar, 1977, 1979 and on-going work at IFPRI).

employment as a sign of their further exploitation, while others cheer it as leading to their improved status and power (Epstein and Watts, 1981, explore this issue). There is not yet serious analysis of these various tradeoffs in the short and the long run as they affect personal and household welfare in traditional societies. Such analysis is especially important to our understanding of social behavior and its consequences, recognizing that norms and customs may introduce greater rigidity in women's household roles in traditional societies in developing countries than is assumed by their upper income counterparts in developed and developing countries who observe their behavior. The extent of substitutability between women's outside and domestic work, and male and female responsibility, need more value-free empirical analysis in a dynamic context across various social structures.

If anthropological literature is any guide (Epstein and Watts, 1981; Boserup, 1970) norms and practices as regards women's role in household and production decision-making not only seem to differ significantly between the Asian and the African "type" households, but also with regard to their family obligations. Prevailing evidence suggests that overlooking women's role in production in formulating and implementing agricultural policies and programs has particularly unfortunate consequences for efficiency and welfare losses in Africa. In contrast to the situation frequently observed in Africa, surplus labor in many Asian agricultures not only means low productivity of women's labor outside the household, but their low bargaining position in the process of agricultural production.

In large parts of Africa women are solely responsible for the production and sale of certain food crops. They are often but not always entitled to the harvest from their production and are responsible for providing food for their children. Frequently African women also have responsibility for feeding husbands. In polygamous societies they may share this responsibility with their co-wives. To meet these obligations African women may frequently cultivate assigned plots of land by mobilizing their own and other (mostly) household resources. The housing pattern associated with such direct responsibility to women for household survival is frequently reflected in the differences in the African and the prevalent Asian concept of a "household". The latter usually implies conjugal units living under a single roof involving an extended family. In many polygamous African societies, on the other hand, women may frequently inhabit separately with their children within an overall family compound. The compound may be shared with co-wives, their children, the husband and at times with other kins i.e. parents, brothers and their wives, etc. depending on a matrilocal or a patrilocal society. Women may have kitchens, and food storage facilities separate from those of their co-wives. While there are complex and diverse social norms with regard to the disposition of household resources in different African communities, it would appear from the literature that there may be lesser areas of congruence between women's interests and those of their "husbands" as regards agricultural production, consumption, savings, and investment that is typically observed in monogamous households in Asia (Bay 1982). In the latter case, depending on the nature of the extended family, the areas of conflict may be more intergenerational or among conjugal units. Social norms also do not seem to assign Asian women such direct responsibility for <u>household survival</u>, nor as much independent

control of productive resources for its provision, although economic necessity may well dictate this in the case of lower socioeconomic groups. We therefore now explore the implications of this stylized Asian social organization of production in contrast to that typically noted in Africa.

4.4. Women's Access to Factors of Production

Because land is in short supply in Asia , a large part of the rural households is partially or fully dependent on wage labor. Close to 40% of households in rural India own less than 0.49 acre while in Bangladesh, about 30% of all rural households own no arable land and 50% of these own no land at all (Cain, 1983). These landless or near landless households frequently also have little access to other factors of production. In the case of these families, public policy which directly or indirectly adversely affects labor use is highly deleterious to employment and earning of low-income households in which women's contribution of income is an important component of household income. Such policies include both the establishment of minimum wage laws as well as subsidization of capital, both of which encourage substitution of capital for labor. Various forms of labor-displacing mechanization associated with technological change in agriculture are frequently a result of factor price distortions introduced by public policy. These policies may be quite independent of technological change in agriculture. Institutional changes in traditional systems of land access and reward are on the other hand frequently encouraged by increased profitability of cultivation made possible by technological change in agriculture. It is important to note however that, due to growing population pressure, 'land grabbing' is also noticeable in Africa despite the absence of a green revolution (Cohen, 1980). In Indonesia the replacement of the ani ani system[13] by sickles, and the use of contractors in irrigated rice cultivation, reflect such labor-displacing arrangements, both resulting from technological and institutional change (Hart, 1978). They explain the low employment elasticities reported earlier.

There is similar evidence of labor displacement both through mechanization and changes in tenurial arrangements in parts of India. Have such changes had greater adverse effect on low income women than men? And precisely what is its significance for the welfare of women and of their households? These issues need careful distinction between the short and the long run effects, as there may frequently be a conflict between these two time horizons. In the short run to the extent that there is gender oriented division of labor by types of production activities, labor displacement through mechanization or institutional arrangements in certain types of activities is more apt to have a greater or lesser impact on women's employment relative to men's. Evidence for East and South Asian countries is cited in the feminist literature to

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[13] Ani ani, or small finger knife, is used by Indonesian women for harvesting. It is suitable for cutting local rice varieties which mature at different times and have varying stalk length. Ani ani is identified with the traditional harvesting system which requires large number of people (Cain in Dauber and Cain 1981, pp. 127-131; G. Hart, 1978).

suggest that labor displacement in weeding, harvesting or threshing may be hurting low-income women more than men (Beneria, 1982; Agarwal, 1983; G. Sen, 1983). However displacement of labor in land preparation is also known to occur through mechanization adversely affecting male employment (Agarwal, 1983) in South India. There is also evidence that lower paid women take over men's agricultural tasks as male labor market tightens, as Ravinder Kaur observes in the case of Punjab.[14] The net effects on men and women's labor in agriculture are not well established and certainly their significance for women's and family utility and capability in the short and the long run cannot yet be ascertained with confidence for the reasons outlined earlier. Women's literature however argues that even with similar labor displacement, women are the greater losers as a result of their greater difficulty in finding alternative occupations relative to men (G. Sen, 1983). Evidence is cited of women's agricultural activities being taken over by men (i.e. their casual farm labor by permanent hired male labor in South India, and their retailing of milk with large scale wholesaling of milk by men in Uttar Pradesh). However, such evidence is not yet conclusive, as there is also other evidence of women's share increasing in certain occupations, and those occupations thereby being banished to enjoying low status. The problem seems to be more related to women's lesser occupational mobility in the long run than men's, a question to which we now turn.

There is a frequent tendency to view not just direct labor displacement, but even smaller percentage <u>increase</u> in labor share vis-a-vis that going to land and capital following technological change in agriculture as an indicator of the deleterious effects of technological change (Frankel, 1971; Griffin, 1979). Thus the emphasis is on relative income disparities between owners of labor rather than on the improvement in the laboring households' <u>absolute</u> incomes. On the other hand, in the medium to long run the increased incomes of rural households made possible by technological change in the agricultural sector are known to lead to significant multiplier effects on employment as a result of the effective demand for goods and services generated by such income increases (Mellor and Lele, 1973; Lele and Mellor, 1981). Much evidence is accumulating from South and East Asia to suggest that the growth of non-agricultural rural employment through such multipliers may be considerable in areas which have enjoyed high rates of growth of agricultural production. Feminists have argued that women's share in this increase in employment may be insignificant. However, most such agriculturally led growth is in the manufacturing and service activities which in early stages of industrialization (such as food processing, textiles, shoe factories etc.) involve relatively low levels of capitalization, low skills and dispersed location of production. All these features of industrialization would seem to be conducive to increasing demand for women's labor.

Indeed, there is abundant evidence to indicate that women's labor force participation shifts from the low-skill rural to higher-skill, higher-pay urban and semi-urban positions in the course of structural transformation. However, the occupational mobility is significantly more moderate in the women's case than men's, who move into more skill- and

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[14] Communications with the author.

management-intensive positions commanding higher wage rates. For instance, in the Korean case substantial increases in female labor force participation in the course of rapid industrialization have continued to reduce the differential between male and female shares in employment since the 1960s.[15] Indeed women's participation in the manufacturing sector has increased more rapidly than men's albeit from a smaller base.[16] This trend is also evident in the service sector. However, women are disproportionately concentrated in the more labor intensive textile and chemical manufacturing sector (Korea Statistical Yearbook, 1983, p.92), and in all industries they generally occupy low paying jobs of "production workers, transportation equipment operators and laborers", followed by "sales workers". (Annual Report on the Economically Active Population Survey 1980, p. 108-111).

In Japan, women play an even more significant role in non-agricultural employment than in Korea with higher growth rates of female employment noted in the 1960-80 period than that experienced by males.[17] Female workers in Japan are also more evenly represented in the industrial sector than in Korea.[18] However once again they are heavily concentrated in the relatively low paying positions (Japan Statistical Yearbook, 1982, p. 61). Average female earnings within the same industries were uniformly less than half the male earnings in 1965, and by 1980, this differential had increased in several industries (Japan Statistical Yearbook, 1982, p. 428-429). Becker reports similar situations for other OECD countries. The fact that women have provided a relatively more flexible industrial labor force free of unionization in low level occupations in many advanced countries is generally well recognized. What is less well documented is the extent to which their wages are significantly lower in relation to men's for similar work and productivity, and the factors which influence their access to family and societal resources, which in turn influences their human capital.

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15 The non-agricultural share of females in total employment was 13% in 1967, 15% in 1970 and 22% in 1980 with a growth rate of 112% for the 1970-80 period vs. 74% for male non-agricultural employment in the same period. (Calculated from National Bureau of Statistics, Economic Planning Board, Republic of Korea, Annual Report on the Economically Active Population Survey, 1980, 1981.)

16 For the 1970-80 period, the growth rate was 176% for female manufacturing employment and 110% for males. (Annual Report on the Economically Active Population Survey, 1980, op. cit.)

17 The rate for female workers in non-agricultural sectors was 45% (1960-70) and 20% (1970-80) while that for male workers was 35% and 16% respectively. (Japan Statistical Yearbook, 1960, 1970, 1982)

18 In 1980, the shares of female and male employment in manufacturing to total employment were 15% and 10% respectively in Japan and 9% and 13% respectively in Korea. (Japanese Statistical Yearbook, op. cit., and Annual Report on the Economically Active Population Survey, 1980, op. cit.)

A more dualistic pattern of economic modernization should of course be expected to provide even fewer opportunities for women to participate in the formal labor force than noted in Japan and Korea, both due to the likely geographical concentration away from rural households as well as by the sharper segmentation of labor markets in the service and manufacturing sectors by skills, in which women may be less able to make the transition than men. The contrasting experiences of women's labor force participation in Korea and Brazil are striking in this regard. While Korean per capita GNP is less than Brazil's (US$250 vs. in 1970) (World Bank Atlas, 1972), Brazil's female participation was significantly lower than Korea's in 1970 (Brazil Country Demographic Profiles, 1981, p. 19) and had not increased much by 1980 (Tabulacoes Avancadas Do Censo Demograficom Resultados Preliminares, 1980, p. 47), (Annual Report on the Economically Active Population Survey 1980). Even more noteworthy is the pattern of female employment; in Brazil in 1970, 75% of non-agricultural women workers were reported to be in the service sector, and only 13% in manufacturing (Brazil Country Demographic Profiles, 1988, p. 19). In 1980, the percentages were 76 for non-agricultural female workers in the service sector and 16 in the manufacturing sector respectively. This is less than one quarter of total manufacturing employees (Tabulacoes Avancadas Do Censo Demografico, Resultados Preliminares, 1980).

We pointed out earlier the dualistic nature of many African countries which similarly discourage women's migration to the urban sector. This is particularly noticeable in Southern Africa i.e. Zimbabwe, Lesotho, Botswana, Swaziland, Zambia, etc. Evidence also suggests that while growth of the formal public sector employment has been rapid in many organized African countries, women may be paid lesser salaries for similar work in the organized public sector in contrast with the private sector where labor markets seem to show less gender discrimination (Sabot, 1983). If this evidence has any general validity in Africa, thismay be a reason additional to public sector inefficiencies for cautiousness in getting governments involved in upholding women's rights. At this early stage of development however, the more critical questions with regard to women's participation in the African case relates to the women's ability to mobilize factors of production in agriculture and their access to other technology including extension services, agricultural credit, inputs and marketing facilities for output etc.

Despite African women's rights to the income from their own production described earlier, their actual control of this income may not be as great as appears on the surface. It is also noteworthy that perhaps with a few exceptions, their rights to land are far more subsidiary to those of their husbands and sons who are assigned de facto rights to ownership under the traditional communal land structure. These are passed on from generation to generation among male members. The separation of the responsibility to produce and provide food for the family from that to "own" land is worth noting.

As land becomes scarce and land titles become an important means to secure a guaranteed access to land, increased land titles should be expected to be vested in the male members of the household. Feminist literature expresses considerable concern about the increased proletarianization of women, i.e., women in effect renting land from the

male members or becoming laborers on male farms. This of course assumes perhaps correctly that social norms would not change or change rapidly as regards the responsibility for food cultivation and family provision by women, and that changes in legal and social systems would not equalize land access by genders in the course of modernization. This may be the case in many societies where public policy may not actively encourage equal opportunity even if law may provide women's equal access. While there are hints in the literature that inequality between men and women may be growing due to unequal access to land there is little concrete empirical evidence on this issue (Pala, 1976). The policy implication of this discussion is of course obvious, namely through the legal system to provide equal access to land titles between male and female members of households as land market begins to tighten, to ensure its active implementation and to increase education about the likely adverse effects of unequal access on women. While these policies may help change social norms, they themselves may be influenced by the norms.

Once again, in any empirical work such as that recommended by Pala, the importance of socioeconomic class relative to gender in access to land must however be explored. In Kenya for instance, there is abundant casual evidence to suggest that women of higher income families with close access to political power have been able to mobilize a significant amount of good land.

4.5. Access to Labor

As in the case of land a great deal of labor mobilization in farm households in Africa gets done through non-market mechanisms. Therefore, understanding of the traditional means of labor mobilization is critical of assessing women's ability to effectively participate in production. Depending on the crop involved, it is the woman's (or the man's) responsibility to mobilize the necessary labor for the production of their crops from which they control the income. Thus women may frequently mobilize men's labor or animal draft power for land preparation and sowing of food crops. Men similarly mobilize women's labor for cashcropping. When the cropping cycles of the two overlap, it is by no means certain that the interests of the men and women coincide. Christine Jones in an excellent analysis of the rice production system in SEMRY project in Cameroon documents the implications of the conflicts of interests between the production of rice by men with the women's production of sorghum (Jones, 1983). Because of the small share of rice crop offered to them by men in comparison with their opportunity cost of labor women have been reluctant to work on men's rice plots leading to problems in labor supply, rice production response and the distribution of benefits among the male and female labor force from rice cultivation.

Planners of the SEMRY project allowed women access to rice plots. Nevertheless women responded minimally to growing rice as men control rice income even when the crop is produced by women, unlike in the case of sorghum. The inadequate supply response in SEMRY was attributed to low levels of motivation of rural households and lack of consumer goods on which to spend money. The underlying reasons of social organization affecting labor supply had been mentioned in the project's limited success, but obviously relatively little could be done through direct public action to change the situation, beyond giving women access to land

and rice technology until local customs change. The implication of these social rigidities for short and medium run supply response do not receive much attention in traditional economic analysis.

There are many other examples of poor crop response to donor supported projects in Africa because of inadequate understanding of farm level constraints, including gender roles in traditional agricultural production (G. Sen, 1983; Agarawal, 1983). Spencer and Nyanteng's provide many such instances related to rice cultivation in West Africa and point out the ways in which appropriate project interventions could maintain or increase women's access to factors of production during the course of agricultural development (Spencer and Nyanteng, 1983).

Abundant empirical evidence also exists both in Africa and Asia to suggest that women's access to agricultural services including agricultural extension, production credit, and inputs from the formal official agencies is considerably more constrained than men's, all leading to efficiency losses in production. In addition to improved rules and regulations ensuring women's access to services may necessitate the employment of female extension and credit agents, and organization of special training programs for women farmers, as well as women's more active participation in the organizations which control these resources (Hayami, 1978).[19] Also, to the extent that land is needed as a collateral to obtain credit and/or access of women producers to inputs, their lack of land ownership must adversely affect their access to these services.

4.6. Male-Female Labor Substitution, and Realization of Individual and Family Welfare

The effect on women's welfare through their own, as distinct from their households' economic activity, is inadequately researched. The feminist literature points out the constraints placed on women in mobilizing male labor or animal draft when faced with urban migration of male household members (see Buvinic, 1976). On the other hand, migration studies suggest significant advantage of male migration to households (Van der Wiel, 1977). This includes increased cash income, increased access to subsidized agricultural inputs, consumer goods, and educational facilities for the children. These are all too often in short supply in producing areas. Net effect of male rural-urban migration on women's welfare may thus not necessarily be as negative as is frequently implied by feminists. Also situations in which males migrate need to be compared with situations in which households migrate. Sabot's study of urban migration in Kenya and Tanzania points to greater incidence of male migration in Kenya than in Tanzania where households tend to migrate (Sabot, 1983). Sabot attributes this to greater land scarcity in Kenya implying a choice by Kenyan household members to retain land access, as well as to better access of households to secondary educational facilities in rural Kenya than in rural Tanzania. The inadequacy of

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[19] In my paper, "Cooperatives and the Poor" (Lele, 1981), I have pointed out how the disenfranchized groups do not participate effectively when power is decentralized.

consumer goods and the disincentive effects of Ujamaa policies should also not be underrated as push factors in rural Tanzania (Lele, 1984).

Literature also does not reflect other recent changes possibly in favor of women in African agriculture. For instance, do rising food prices and low and officially controlled prices of export crops improve women's income vis-a-vis men?

Gender roles may also not be as rigid in a dynamic context, nor the individual and family interests as exclusive as implied in the feminist literature. There is evidence, albeit preliminary, to suggest that women may be beginning to cultivate and sell cash crops and men have similarly taken to the production of food crops perhaps because of the latter's increasing profitability. Does this suggest greater interchangeability of gender roles over time, leading to equalizing of access to opportunities, or simply additional evidence of female exploitation by males "capturing" the better economic opportunities as some literature would suggest? (See Guyer, 1980).

4.7. Labor/Capital Substitution

The problem of women's work stretching into long hours typically leads to pleas about the need for labor saving devices which would ease women's work. The problem is particularly great in Africa where frequently low densities of populations associated with low and uncertain rainfall mean long walking distances for fetching water and susceptibility to water-born diseases. Both these affect time allocation to and income from productive work. Low densities on the other hand also lead to higher cost of providing public services such as water points and health care centers, as well as commercial services such as grain milling or retail stores. Besides, current government practices with regard to social and commercial services suggest that government interventions have frequently made services less effective and accessible to rural households than low population densities would warrant. Governments have a frequent tendency to take over provision of services in the public sector which could be more efficiently provided by the private sector and grassroot local organizations which foster institutional pluralism. In Tanzania, for instance, the discouragement of private trade has led to a virtual disappearance of the privately operated hammer mills and retail shops in rural areas. Their partial replacement by relatively centralized public sector flour mills and cooperatives imposed from the top typically lead to an uncertain supply of consumer goods at high costs (Lele, 1984). Similarly, in Malawi, recently shortage of consumer goods has been reported in the countryside due to the government changed policy towards the private sector.

Services such as village access roads and health care centers operated in the public sector also suffer from inadequate recurrent resources and poor maintenance (Lele, 1981a). Thus while Tanzania's record in provision of basic needs has been significantly better than Malawi's in the 1970's (See WDR 1983), p. 192) these gains have been often overstated. In practice about 50% of the rural wells were disfunctional a year after they were established (Tanzania Agricultural Sector Report - hereafter, Tanzania Report, 1983). A critical assessment of macroeconomic policies frequently stresses the need for greater cost

recovery, more restraint on government expenditures, and general realism in the coverage of basic needs. It also suggests that the resource crunch in the rural sector is the result of a combination of external shocks and indiscriminate, mostly urban, industrial-oriented public expenditures, both of a capital and recurrent nature. These expenditure patterns have left many African governments little flexibility in meeting basic needs of their populations in periods of resource crunch (Lele, 1984).

Scope for improving the quantity and quality of public and commercial services of course also exists in many Asian countries. Here the record of different countries has been quite different. Thus while Sri Lanka and Indonesia have impressive social indicators, India's record both in primary education and health has been poorer. The number enrolled in primary school as a percent of age group is 95 and 100% in 1960 and 1980 respectively for Sri Lanka, 71 and 98 respectively for Indonesia, while the corresponding numbers for India are 61 and 76 for the same years. The 1980 adult literacy rate is 85% for Sri Lanka, 62% for Indonesia and 36% for India. Indian life expectancy at birth in 1981 is 52 years, compared with 69 for Sri Lanka and 54 for Indonesia. The rate of infant mortality is also higher in India - 121 per 1,000 in 1981 - than in Sri Lanka with 43 and Indonesia with 105. (WDR 1983, p.192-196.) Even where the physical supply of public services (education, village water supply, and health facilities), consumer goods (kerosene) and commercial services (flour mills, etc) exists, however, the lack of effective demand is a greater constraint to increased access by low-income households, due to their inadequate household incomes.

The feasibility of introducing labor-saving devices in low income women's housework - a plea frequently noted in the feminist literature - seems questionable (Epstein and Watts, 1981). Until unskilled labor markets begin to tighten and substitution of capital for labor becomes profitable at market prices, introduction of labor-saving devices is likely to cause greater hardship on low income women where they do such work for a wage. For instance the replacement of hand pounding by hammer mills in South and East Asia has lead to considerable displacement of the lowest income women's employment who traditionally hand-pounded paddy (Timmer, 1975). Increasing their income earning ability would thus seem to be a prerequisite for their being able to enjoy labor saving devices at home, and yet the need for their own and household survival may leave little time for outside activities. It is this vicious circle of poverty which seems to be the crux of the women's problem in many developing countries.

5. CONCLUSION

In this paper, we have illustrated that labor markets ensure women's substantial and frequently growing participation in the course of economic development. Nevertheless many distortions in factor and product markets circumscribe women's participation by limiting the growth of overall employment. These distortionary effects of public interventions in markets are frequently overlooked by those concerned with women's participation. On the contrary, they frequently tend to emphasize the need for direct public intervention to improve women's position.

Women have also been the increasing beneficiaries of many types of social and family expenditures. Nevertheless, there are substantial areas in which non-market factors adversely affect women's ability to mobilize domestic and societal resources, technology and information, thereby adversely affecting their ability to participate in productive processes and affecting social productivity. These various factors have been generally overlooked in the neoclassical approach to female labor markets. To equalize access by gender, a combination of improved public policy, a legal framework and an effective institutional capacity have to be combined with educational programs. These will increase social consciousness about the extensive efficiency and welfare losses implicit in women's unequal access. To what extent these can occur in the short and medium run without women becoming a significant pressure group is questionable however.

Interests of women of different socioeconomic classes and in countries at different stages of economic development are hardly congruent. There are a number of areas outlined in this paper concerning the relationship of women's income earning activity to household and firm decision-making. These require rigorous economic analysis. Particularly in need of serious scholarship is the role of women in low income households. Evidence in hand is not adequate to indicate whether by alleviating poverty of low income households growth processes will automatically address the problem of low income women. Since governments usually have limited capacity to intervene effectively, far more careful identification of critical entry points for public policy is needed than currently exists, if redressal of women's participation is to be achieved.

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Appendix

List of Acronyms

AVRDC	Asian Vegetable Research & Development Center
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture)
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo (International Maize & Wheat Improvement Center)
CIP	Centro Internacional de la Papa (International Potato Center)
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
FAO	Food and Agriculture Organization of the United Nations
IARC	International Agricultural Research Center
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Centre
IFARD	International Federation for Agricultural Research & Development
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Centre for Africa
ILO	International Labour Organisation
ILRAD	International Laboratory for Research on Animal Diseases
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research

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NARC	National Agricultural Research Center
NARS	National Agricultural Research System
TAC	Technical Advisory Committee of the CGIAR
USAID	United States Agency for International Development
WARDA	West Africa Rice Development Association