

IMPROVED TECHNOLOGY FOR WOMEN IN AFRICA

by

Mary Pat McVay

Submitted to the Department of
Urban Studies and Planning in
Partial Fulfillment of the Requirements
for the Degree of

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at the

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ABSTRACT

This study examined the institutional settings, technology selection process, and dissemination strategies of five agencies that assisted women to adopt and benefit from improved technology. The findings suggest that assisting women to adopt improved technology that benefits them may not be as difficult as the literature implies. These better-performing women's technology programs assisted large numbers of women, in part, because 1) the agencies could use existing networks of women to identify women's needs and reach many women quickly, 2) the agencies consulted potential beneficiaries to identify the constraints women face in their work, and they used those needs to drive technology selection or development, 3) women modified their gender roles when necessary, 4) the agencies matched the technology dissemination strategy with the physical characteristics of the technology, and 5) where possible, they selected technology and designed projects so that poorer women could benefit.

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TABLE OF CONTENTS

	Page
List of Acronyms	5
Introduction.....	6
Section 1: Institutional Design.....	16
Section 2: Technology Development and Selection Process....	24
Section 3: Gender Issues.....	33
Section 4: Dissemination Strategies.....	38
Section 5: Reaching the Poor.....	59
Conclusion.....	66
Appendix I: Cases & Photographs.....	74
Appendix II: List of Agencies Consulted.....	82
References	85

LIST OF ACRONYMS

AHF	Africa Housing Fund (Kenya)
ENDA	Environment and Development Agency (Zimbabwe)
GTZ	German Technical Assistance
NCWD	National Council on Women and Development (Ghana)
NGOs	Non-governmental organizations
CIDA	Canadian International Development Agency
TCC	Technology Consultancy Center (Ghana)
UNIFEM	United Nations Fund for Women
WID	Women in Development (literature)

INTRODUCTION

Many efforts to introduce improved technology to poor women in Africa unfortunately result in broken down, abandoned machinery rather than in widespread benefits to women (UNIFEM 1991, Schoonmaker 1988, Date-Bah 1985). The reasons, ranging from poor technology choice to poorly managed projects, are by now fairly well known. We know much less about cases in which large numbers of women adopted technology and improved their lives as a result. This study identifies common characteristics of five better-performing programs in which 600-30,000 women benefitted from women's ownership and use of improved technology. The findings in the study indicate ways institutions, technologies and projects might be selected and designed to be more effective at helping women benefit from improved technology.

Background

Women's technology programs are on the current agendas of African governments, donors, and non-governmental organizations. Appropriate technology and women's organizations, for example, promote technology for women as an alternative to modern, centralized production systems. According to this view, modern technologies tend to displace women from their traditional productive activities (Schumacker 1973, Carr 1985, Dauber & Cain 1988, Stamp

1989). For example, many traditional women's industries in Africa, such as the processing of oil and beer are threatened or have already been displaced by large scale, centralized production of canned cooking fat and bottled beer. Introducing improved technology to women, then, can be a strategy for helping women retain their traditional economic activities. In addition, the World Bank has financed several women's technology programs. In recognition that structural adjustment programs have hurt the poor, these women's technology programs try to reduce poor women's arduous labor burden and/or increase their income. As an immediate example, the World Bank financed this study through the Ministry of Community Services of the Government of Malawi, which is embarking on its third "technology for women" program in five years.

Most agencies trying to disseminate improved technology to African women provide equipment and training to women's groups or cooperatives. Members of the groups benefit from access to and control of improved technology and, it is hoped, the viability of the technology will cause other women to adopt. In practice, however, many of these programs have had a limited impact. For example, a recently evaluated program in Mali tried to introduce mechanized de-hulling machines to rural women for use in millet processing. Two and a half years into the project, only one in six of the machines was even operating, despite constant

subsidies from the development agency (Schoonmaker 1988). In another program in Kenya, an agency donated manual maize mills to tens of women, who actually preferred to carry their maize to mechanized mills. In another case, an assessment of a well known weaving cooperative in Nairobi revealed that the manager was running the cooperative as a private business -- the workers did not even know they were entitled to a share of the profits. Such cases are fairly common (UNIFEM 1991, D'Onoflores and Pfafflin 1982, Dauber and Cain 1988, Ahmed 1985).

The problems that typically plague women's technology programs fit three general categories:

1. Institutional inefficiency: the programs reach few women, at a high cost, in an untimely manner.
2. Dependency: either because the technology itself is not viable or because of mismanagement, many women's groups have to depend on development agencies for continuous subsidies and repair services. Often, when the development agency pulls out, the projects collapse.
3. Limited adoption: even successful demonstration projects often do not result in widespread technology adoption beyond the project, often because women cannot adopt without assistance.

Since these problems have been frequently analyzed, this study focuses on a few success stories.

Cases & Methodology

I selected the five cases in this study because 1) they benefitted more women, 2) the beneficiaries were not financially dependent on the development agencies, 3) and/or the technology was widely adopted by women as a result of the project. Table 1 summarizes the cases, their locations, the number of women that benefitted, and the time it took for the technology to be successfully adopted.

TABLE 1			
TECHNOLOGY	LOCATION	NUMBER OF BENEFICIARIES	Time
Fuel Efficient Stoves	Kenya, rural	30,000 stoves, individually owned	4 yrs
Housing & Water Tanks	Kenya, rural	900 women in one project, 4 factories	2 yrs
Mechanized maize mill	Zimbabwe, rural trading centers	600-900: 3 mills, owned by 5-10 women each, used by 200-300 women each.	2 yrs
Palm Oil Processing	Ghana, rural trading centers.	2,500: 50 factories, owned by 15-30 women, used by 30 additional women each.	4 yrs
Improved Fish Ovens	Ghana, fishing villages	845-1950: 200-300 women owners in Choker, 15-30 women owners in three other fishing villages, and 645-1650 employees.	2 yrs

In each case, a local agency implemented the program with foreign donor funding, but these agencies did not work alone. Rather, they benefitted from cooperation or prior

work of agencies that organized women at the grass roots level and of technical institutes or companies that developed the technologies. Table 2 lists the donor, the implementing agency, the agency that organized women, and the technology developer in each case.

TABLE 2				
TECH-NOLOGY	DONOR	IMPLEMENTING AGENCY	WOMEN'S ORGANIZER	TECHNOLOGY DEVELOPER
Fuel Ef-ficient Stoves	GTZ, German Govern-ment	Ministry of Energy (with Ministry of Agriculture and others)	Maendeleo ya Wanawake, Ministry of Culture and Social Services	GTZ & Maendeleo ya Wanawake
Water Tanks & Housing	CIDA, Ford Founda-tion	Africa Housing Fund, Shelter Afrique, OAU	Ministry of Culture and Social Services	Intermediate Technology Workshop, UK
Maize Mills	UNIFEM	Environment & Development Agency (ENDA)	Ministry of Community Services	Private Sector
Palm Oil	ILO	Nat'l Council on Women and Development (NCWD)	NCWD	Technology Consultancy Center, USE, Ghana
Fish Ovens	ILO	NCWD	NCWD	Kagan Institute, Ghana

I began this study by interviewing staff in several technology development agencies based in the US¹ in order to identify important issues and successful programs. I then visited 11 reputedly successful programs in Kenya, Nigeria, Ghana, and Zimbabwe, later selecting the five more established programs to analyze here. I visited each country for two to four weeks, and interviewed (1) high level staff in the implementing agencies, (2) field staff that work directly with the women and, (3) in most cases, a few women's groups that the field staff selected. I had some access to evaluation reports, but most of the information contained in this study comes directly from my interviews with agency and field staff. When visiting each country, I also consulted other agencies working on women and technology projects. These interviews were important in confirming some interpretations and bringing others into question. In addition, over the last three years, I have consulted for several community development and appropriate technology organizations in East Africa and have had the opportunity to observe other women's technology projects to which I refer for comparison.

This paper organized the findings around five issues that development agencies and the literature focus on to explain the problems women face in adopting improved technology, and to propose solutions. With many of these

¹ See List of Agencies Consulted.

issues, the current thinking tends to look for broad, categorical reasons for program failure. The cases in this study suggest different ways of thinking about these issues and reveal several simple and pragmatic ways the better-performing agencies were able to help larger numbers of women adopt and benefit from improved technology.

Issues

1) **Institutional Design:** Current thinking on the institutional design of women's technology programs focuses on whether government agencies or non-government organizations, whether women's organizations or mainstream development agencies, can more effectively reach women with improved technology. Surprisingly, however, the agencies in this study represented all four types of institutions. Section 1, then, examines the common ways these different types of agencies were able to reach large numbers of women in a timely manner.

2) **Technology Development & Selection:** One commonly cited explanation for the limited impact of many women's technology programs is that the technology itself is inappropriate, according to this view, because technology is often developed in "isolated" technical institutes. The literature on technology development counsels agencies to avoid this problem by developing technology with input from

potential users. In practice, though, technology developers find this process arduous. In addition, in the cases studied, some designers used both non-interactive design processes. This means that interactive design processes are not necessarily crucial to appropriate technology for women. Section 2 looks into the technology development and selection processes used by the agencies in this study, and identifies other key factors that also contributed to identifying appropriate technology for women.

3) **Gender Issues:** The Women in Development (WID) literature and many development professionals dispute women's ability to change their culturally defined gender roles. A few authors (Ventura-Dias 1985, Stamp 1989) advocate women openly challenging gender roles by taking up men's work, but most current thinking argues that women will not adopt technology associated with men's work. Since most improved technologies in Africa are perceived as something for men, this view presents dim prospects for women adopting improved technology at all. Most of the technologies in this study, however, led to women performing some of these male-specific tasks. How, then, did these women manage to adopt the technology? Section 3 illustrates what types of men's work these technologies required, and how women were able to step out of their gender roles to adopt the technology.

4) **Dissemination Strategies:** Development agencies and the literature on women and technology deliberate extensively on what technology dissemination strategies work well for women.² Dissemination strategies currently used generally fall into the categories of "extension" and "market" approaches (Carr, 1989). In "extension-style" programs, agencies reach women by providing technology directly to selected women's groups, but in many cases women's groups are poorly managed and often rely on development agencies for constant subsidies. In the "market-style" programs, agencies have been more successful at widely disseminating technology because they promote the technology broadly and train private-sector machine manufacturers, who then sell equipment to large numbers of buyers. Though these individuals tend to manage the improved technology better than women's groups, they are usually middle-income men, who have more capital, mobility and access to information than rural women (Carr 1989, McVay and Fisher 1989). Both approaches, then, have so far been limited in their ability to get technology out to large numbers of women.

The better-performing agencies in this study used two different strategies that each included elements of both the "extension" and "market" approach. Section 4.1 examines three cases in which women's groups adopted the technology

² These titles are somewhat misleading. See Section 4.

without remaining dependent on the development agency. Section 4.2 looks at the other two cases in which the technology was widely adopted by individual women. Neither strategy was consistently more successful than the other. Rather, the physical characteristics of the particular technologies determined which dissemination strategies worked better.

5) **Reaching The Poor:** Most of the literature on women and technology maintains that improved technology is inherently detrimental to the poor, mainly because it displaces paid labor (Ahmed 1985, Dauber and Cain 1988, D'Onoflores and Pflafflin 1988). The approach most development agencies take to avoid this process, in the case of women, is to donate equipment to groups of poor women. The cases in this study raise questions about this analysis of the distributional impact of improved technology. Four of the technologies did not displace women's paid labor, and the women in the groups that benefitted from these programs were better-off women, not the poor. Section 5, then, looks at other aspects of these programs that affected the distributional impact of the technologies.

SECTION ONE: THE INSTITUTIONAL DESIGN

One reason for the limited impact of many women's technology programs is that the implementing agencies are ineffective at organizing and working with women or at developing, assessing, and disseminating technology. In trying to explain this ineffectiveness, many planners in this field criticize the type of institution that implemented the program, whether government agencies or NGOs, women's organizations or mainstream technical agencies. The implementing agencies studies here, however, had two other characteristics in common: 1) instead of trying to organize women themselves, they benefitted from existing networks of women; the latter helped the agencies to identify women's need for technology and to target large numbers of women; and 2) they had successfully developed a business orientation and technical capacity. The type of implementing agency was, thus, not a major factor in the success of these programs.

1.1 Governments or NGOs

Government agencies and NGOs have different strengths and weaknesses in their ability to reach women with improved technology. Government agencies can reach larger numbers of people because they are larger, are more permanent, and have more resources. NGOs, in contrast, are significantly smaller, often operate in limited geographic areas, and tend

to reach fewer people. At the same time, many writers see NGOs as more responsive to the needs of particular client groups, (James 1987, Lipsky and Smith 1989) such as women.

TABLE 3		
TECHNOLOGY	IMPLEMENTING AGENCY	DESCRIPTION
Fuel Efficient Stoves	Ministry of Energy, Government of Kenya, with Ministry of Agriculture.	Government Agency
Water Tanks & Housing	Africa Housing Fund, a part of Shelter Afrique, the housing program of the OAU.	Multilateral Government Agency with offices in Nairobi, Kenya.
Maize Mills: Zimbabwe	Environment and Development Agency (ENDA).	International NGO with offices in Harare, Zimbabwe
Palm Oil & Fish Ovens	National Council on Women and Development (NCWD)	Government advisory board on women's affairs.

In these cases, however, both government agencies and NGOs reached significant numbers of women (See Table 3). A government agency in Kenya (the Ministry of Energy) disseminated the fuel efficient stoves. An international NGO with offices in Zimbabwe (Environment and Development Agency, ENDA) disseminated the maize mills. The other two agencies were neither typical government agencies nor NGOs. One is a government advisory board that also organizes and trains women's groups, the National Council on Women and Development (NCWD), which disseminated both the improved fish ovens and the palm-oil processing equipment. The other is a semi-autonomous program within a multilateral

government organization -- the Africa Housing Fund (AHF) of Shelter Afrique, part of the Organization of African Unity. All kinds of agencies, in short, turned out to be able to reach women with improved technology.

1.2 Women's Organizations or Mainstream Agencies

A parallel concern focuses on the limitations of both women's organizations and mainstream development agencies. For mainstream development agencies working with both men and women, such as government ministries and appropriate technology organizations, women are often a low priority, and these agencies therefore do not effectively reach women. For example, the mainstream agencies sometimes take funding that was set aside for women and use it for higher priority projects that target men (Buvinic 1989). Even when mainstream agencies have the will to work with women, they sometimes have limited links to rural women and limited capacity to establish such links. This problem has led donors to fund national women's organizations to implement women's technology programs in Africa. They work exclusively with women and have built up extensive contacts with large numbers of women due to their considerable organizing efforts.

Depending on the particular women's organization, the latter approach also has had limitations (Buvinic 1989,

Overholt 1985, Ventura-Dias 1985, UNIFEM 1991, Stamp 1989). Many women's organizations have a historical "welfare" focus on home economics, health, and family planning issues. They therefore lack the economic orientation to implement programs that increase women's productivity, which is the focus of women's technology programs. Other women's organizations do not represent the "true" interests of women because they are founded primarily for political purposes or are co-opted by political parties. The criticisms of both women's organizations and mainstream agencies bring out the importance of an agency having technical capacity, on the one hand, and the will and capacity to work with women, on the other. They nevertheless leave the impression that neither type of institution is capable of reaching women with improved technology.

In the cases in this study, however, both mainstream agencies and women's organizations implemented the better-performing programs. As with the debate over government agencies and NGOs, whether the agencies in this study were women's organizations or mainstream agencies does not account for their success. One agency, which disseminated both the improved palm-oil equipment and improved fish ovens in Ghana, was a women's organization, the NCWD. The other three, however were mainstream development agencies: the Ministry of Energy and Shelter Afrique in Kenya, and ENDA in Zimbabwe.

1.3 Benefitting from Women's Networks

The implementing agencies in this study, in contrast to the typical cases, had a broad impact, were responsive to women's needs, reached large numbers of women, and implemented economically and technically viable projects. They were able to do these things by 1) relying on existing networks of women to identify widespread needs for technology and to reach large numbers quickly, and 2) by developing a strong technical capacity and development orientation.

In trying to gather information about women's needs and at the same time reach large numbers of women, staff of the programs in this study took advantage of extensive, prior organizing efforts often carried out by other development agencies. Since the late 1970s, in each of the countries in this study, governments have called for rural women to form and register groups of 15 to 30 women in order to gain access to development assistance. As a result, development agencies, different government ministries, and national women's organizations had assisted women to form such groups by providing organization and leadership training. This organizing process occurred prior to and unrelated to the implementation of the women's technology programs. In Kenya, the Ministry of Community Services trained and registered the women's groups that participated in the

Africa Housing Fund Project. Both that Ministry and Maendeleo Ya Wanawake, the national women's organization, helped identify women who participated in the fuel-efficient stove program. In Ghana, the NCWD kept track of and provided training to the women's groups that benefitted from their technology program. In Zimbabwe, the Ministry of Community Services registered and trained the women's groups that benefitted from the maize mill programs. The women's networks were essential because they were the only way the agencies in this study could contact large numbers of rural women. Women in rural areas of Kenya, Ghana and Zimbabwe have limited access to television, radio or newspaper communication, and in many cases agricultural extension agents contact men more than women.

How, precisely, did the women's networks assist the implementing agencies in this study? Initially, the implementing agencies conducted surveys of the women's groups to identify widespread needs for improved technology. The agencies later contacted field staff in the agencies described above to inform large numbers of women of the program's potential benefits. These field staff then assisted women's groups to apply to participate in the improved technology programs. With a large pool of applicants, the implementing agencies selected the most experienced and appropriately located groups to carry out demonstration projects. This process easily linked the

implementing agencies with large numbers of women whose needs the agencies could then identify and respond to.

Unlike many "top down" government agencies, the better performing agencies solicited women's input in designing the program. Unlike many NGOs with limited outreach, these agencies could easily survey and communicate with large numbers of women. In contrast to many mainstream agencies that work more easily with men, these agencies successfully targeted women.

At the same time, critics of many national women's organizations and women's groups organized by development agencies describe them as being "sold out," highly politicized, or otherwise not being truly representative of women's needs (Stamp 1989, Sorensen 1990). This makes the above represented positive finding surprising. Some of the women's networks used by the better performing agencies in this study may indeed have functioned as such patron-client systems that cater primarily to political agendas. Maendeleo ya Wanawake, which is now a wing of the only political party in Kenya, is infamous for these characteristics (Stamp 1989, Sorensen 1990). Their positive contribution to the better-performing programs - that is, providing a point of contact between rural women and the implementing agencies - requires some explanation.

Perhaps the implementing agencies were able to keep many of the political tendencies of the women's

organizations and networks at bay because the agencies had developed a technical staff. ENDA in Zimbabwe, AHF, and the Ministry of Energy in Kenya are all mainstream agencies that had both the technical skills and the development orientation to disseminate technology in a technically and financially viable way. In Ghana, the ILO provided extensive training to existing staff and funds for additional staff to the NCWD to develop its technical and financial capacity. This technical and business orientation balanced the political leanings of the women's networks. For example, if an influential person pressured the implementing agency to supply equipment to a particular women's group, the implementing agency often refused if the proposed site was not suitable. Other particular mechanisms the agencies had for ensuring financially viable projects will be discussed in more detail in Section 4. For now, the main point is that these networks of women served as invaluable communication channels between women and the women's technology programs. And, the determined intervention of technically competent implementing agencies tempered the political tendencies of the women's networks.

SECTION TWO: TECHNOLOGY DEVELOPMENT AND SELECTION PROCESSES

One common critique of improved technology programs, for both men and women, is that technology developed by professionals in "isolated" technical institutes is often not economically viable or is otherwise "inappropriate." Many concerned planners see this problem as worse for women because most engineers are men and because most machines are not designed with women in mind as owners and operators (Carr 1985, Ewusi 1987, Date-Bah 1985). For example, manual mills for home use may seem affordable, given average household income, but may not be affordable for women given that they control a smaller portion of household income.

According to this view, an "interactive" technology development process between designers and potential women users produces technology that better fits women's constraints and their gender roles (Carr 1985, Ewusi 1987, Date-Bah 1985). For example, the successfully disseminated fuel-efficient stoves in Kenya represent only a marginal change in the way women normally cook, and they cost the equivalent of only two days' rural wages. In this case, two female designers lived in rural villages and developed the stoves with rural women, incorporating the way they cook and their strategies for saving wood with components of stoves used in other countries.

Though few technology developers would dispute the usefulness of this interactive approach, in practice, many

find it time-consuming and burdensome. It is difficult for educated, often foreign and male engineers to communicate well with rural African women. In addition, many designers feel that designing technology for one particular context limits its applicability in other situations. As a result, interactive processes are rarely used.

In the cases of this study, how was the technology developed? Only the development of the fuel efficient stove fits the ideal "interactive" design process, which fully engages rural women. (See Table 4) Two cases were mixed. With the improved palm-oil processing equipment and the improved fish ovens, male Ghanaian engineers at local technology development institutes designed the improved technology, on the one hand but, surprisingly, they used an "interactive" approach, on the other. Though they did not live in rural villages for extended periods, they had women in mind as the ultimate users, they observed women at work, designed the technology as an improvement on women's processes, and then field tested it with them. These two cases contradict the stereotype of the "isolated" technical institute that refuses to design technology for women.

Even more surprising, given the importance attributed to the interactive process, are the two final cases in which the technology designers did not even have women in mind as the ultimate users. In the case of the building-materials equipment in Kenya, a British agency (Intermediate

Technology Workshops) designed the machines in the UK. The few field tests took place with elite building engineers at the University of Nairobi in Kenya. With the maize mills in Zimbabwe, a large scale private-sector manufacturer copied the machines from imports, also without thinking about rural women as potential operators. Both of these technologies, have nevertheless benefitted significant numbers of women. These two cases contradict the prevailing wisdom that technology developed without input from women does not benefit women.

<u>TABLE 4</u>		
TECHNOLOGY	SOURCE	PROCESS
Fuel Efficient Stoves	German and Kenyan technical experts in Maendeleo ya Wanawake, a national women's organization.	interactive
Low-cost Water Tanks & Houses	Intermediate Technology Workshops, an NGO in the UK, now profit making Parry Assoc.	not interactive
Mechanized Maize Mill	Large scale private sector manufacturers copied imports.	not interactive
Palm Oil Processing	Technology Consultancy Center, Kumasi, Ghana	partly interactive
Improved Fish Ovens	Kagan Technical Institute	partly interactive

Identifying technology that is "appropriate" for women, then, may be easier than the current thinking suggests. The agencies studied here were able to select appropriate

technology for women, for the most part, without engaging in burdensome, "interactive" research and development themselves. Rather, they 1) consulted potential women beneficiaries in identifying women's need for technology, and 2) where possible, selected existing technology.

1) Identifying Women's Need For Technology

To identify women's need for technology, the agencies in this study first chose a sector, and then consulted women to identify constraints within that sector. In Kenya, the Africa Housing Fund (AHF) focused broadly on the shelter "sector" - housing, water, and sanitation - because providing shelter is their mandate. The AHF staff then consulted women's groups in Eastern Kenya, which identified water as their primary concern in that sector. In response, AHF narrowed the focus of that project to providing household rain catchment, which supplies cleaner water and reduces the time and energy women have to spend collecting water.

The Women and Energy Project in German Technical Assistance (GTZ), the donor for the fuel-efficient stove program in Kenya, has a mandate to assist women in the energy sector. By living in rural villages and surveying women's groups with Maendeleo ya Wanawake staff, GTZ staff examined the energy needs of average rural women and saw that the vast majority of Kenyan women cook on three-stone

fires, burning wood that is becoming increasingly scarce. GTZ therefore chose to assist women with a more efficient stove that would reduce their wood consumption and thereby save women's time and labor.

In Ghana, the NCWD conducted a national survey of women's groups to identify sectors women worked in, and the problems they face. Large numbers of women identified palm-oil processing as their major source of income. Though the oil extraction rates the women obtained using traditional methods were high enough to earn a profit, the women could not process all the palm nuts grown in their area because the traditional methods were so slow. As a result, they were missing an economic opportunity to increase production and, therefore, their income. In addition, in some areas, the (male) palm-nut growers were starting to process oil themselves, using improved equipment. This posed a threat to the traditional women processors, because the improved equipment produces oil more cheaply than the traditional method. The NCWD therefore identified palm-oil processing as a priority sector, and the slow speed of traditional processing methods as a major obstacle to the growth of women's businesses in that sector.

In the NCWD survey, women also identified fish smoking as a major economic activity in coastal areas. Women fish smokers were having trouble taking advantage of the increasing demand for fish that came from rapidly growing

cities and towns and from the increased use of fish as a component in animal feed. Women were working longer hours during the fish-smoking season and neglecting some of their household duties, such as cooking regular meals. The NCWD thus chose to assist women with fish smoking and to address the major problems women were facing - the low capacity of the ovens and the extensive labor required to smoke fish.

Finally, UNIFEM, the donor for the ENDA Maize Mill program in Zimbabwe, chose to launch an international program focusing on the "food cycle" because women are the major food producers in Africa. With ENDA staff, they surveyed Zimbabwean women to identify limitations women faced in food production. Among other difficulties, the women named the hard labor of grinding maize with a mortar and pestle or long walks to the few mechanized mills that existed in the area. UNIFEM and ENDA then decided to assist women with improved maize milling technology.

The approaches illustrated above differ from most technology programs, which typically choose a particular technology and then focus on disseminating it, only to find out later that it was "inappropriate" for women, or did not meet a priority need. They are similar, though, to an effective strategy used by Oxfam in its women's program in India and Bangladesh. In that program, Oxfam assisted large numbers of women by identifying the sectors they are already working in, organizing women and identifying their common

needs (Chen, 1986). Though that program did not focus specifically on improved technology, this type of "sub-sector" approach is also used by at least two agencies that disseminate technology, Technoserve and Appropriate Technology International. By examining the sectors and identifying specific difficulties that large number of women share, this approach avoids the typical problem of disseminating technology that women do not really need.

2) Technology Selection

In four cases - palm-oil processing, fish smoking, housing and water tank building, and maize milling - the agencies selected technology that was already available, rather than developing it from scratch. As a result, the task the agencies faced was easier and narrowed - namely assisting women to obtain equipment and training them to use it. AHF in Kenya found and purchased a full "kit" of equipment to manufacture low-cost building materials for houses and water tanks. The "kit" and training were available from a private dealer in Nairobi. AHF then hired, in their Nairobi office, an expert in that technology who formerly worked with the dealer. He trained other AHF staff in the new technology and AHF quickly became one of the regional experts in that type of low-cost building, again, without having to do any research and development.

In Ghana, the NCWD identified improved palm-oil processing equipment developed by a local technical institute, TCC. The improved equipment increased the amount of palm nuts women could process in a given time. The NCWD purchased palm-oil processing equipment from a manufacturer in central Ghana trained by TCC and they hired experts from TCC to train their staff in machine installation, maintenance and repair. In the case of the fish ovens, the NCWD hired the technology developers from another technical institute, Kagan Institute, to train village manufacturers and NCWD staff on how to make, use and repair the fish ovens. In both of these cases, the task was significantly reduced because the NCWD took advantage of prior research and development carried out by the technical institutes.³

Finally, when ENDA decided to assist women with maize milling, they decided to disseminate mechanized maize mills, in part, because they were available. The mechanized mills were already being manufactured in Harare and were used throughout Zimbabwe. In addition, ENDA staff had expertise in maize mill installation, maintenance and repair. Again, ENDA selecting an existing technology was easier than designing a new one.

³ This study did not allow for an investigation of what enabled these institutes to successfully make the technologies readily available, although this part of the story is obviously important to the overall success of the women's technology programs.

There was one exception: the fuel-efficient stoves. In this case a technology was not available on the market in Kenya. GTZ (the donor) therefore sponsored a three-year research and development project before launching the national dissemination program that this study focuses on. This shows that there is sometimes a trade off between running an efficient program by selecting existing technology and meeting some priority needs that existing technology does not address. In this case, the investment in developing the stove had a high payoff: 30,000 women now use the stove and more women continue to adopt it. The other four cases nevertheless indicate that women's technology programs do not have to develop their own technology in order to benefit many women.

SECTION THREE: GENDER ROLES AND IMPROVED TECHNOLOGY

The third issue surrounding women's technology programs focuses on their ability to adopt particular technologies that go against their culturally-defined gender roles. One "WID" position advocates that women take up men's work, even carpentry and metalwork, because wages are higher and because it is felt that women can best achieve equality with men by playing as important a role as they do in production (Ventura-Dias 1985, Stamp 1989). Some African authors characterize that view as a Western feminist perspective imposed on African women (Ewusi 1987, Date-Bah 1985, Stamp 1989). These and other writers argue that, in practice, women will not adopt technology in male-dominated sectors nor will they adopt technology that requires performing tasks ordinarily considered men's work (Overholt 1985, Tinker 1985, Carr 1985, Ahmed 1985). Many improved technologies -- from growing cash crops to using animal-drawn plows and carts, to operating any mechanized equipment -- are associated with "men's work" in Africa. Sometimes this is due to extension workers having originally introduced them to men, not women (Boserup 1972), and sometimes it is due to long-standing cultural traditions (Ewusi 1987, Date-Bah 1985). Either way, the literature sees the gender roles associated with improved technology as major barriers to women adopting.

In contrast to these views, this research suggests that women's culturally-defined gender roles may be less of a barrier to women adopting technology than has been implied, for two reasons. 1) The technologies reviewed here cannot be easily categorized as "male" or "female," as fitting or challenging existing gender roles. 2) Women adopted the improved technologies even when the technologies clearly involved men's work.

3.1 Defining Gender Roles

The five technologies that women in this study adopted did not require women to enter male-dominated sectors, but in most cases women had to perform some tasks that are ordinarily considered "men's" work. The activities improved by the technologies selected were all in sectors that women are active in: cooking, collecting water, palm-oil processing, fish smoking and maize grinding. In four cases, however, the technology did involve jobs considered to be men's work, specifically: operating mechanized equipment, performing full-time wage labor, keeping accounts, and managing complex businesses.

For example, the improved palm-oil processing equipment, the building-materials equipment and the maize mills were all mechanized. In addition, these machines are much larger scale than women's individual production methods. Operating and managing the equipment required

full-time work at small factories, the keeping of written records of the financial transactions, and a manager to take charge of the enterprise on behalf of the group. In the areas where these projects took place, these sorts of tasks were normally done by men, even though men were not responsible for processing palm oil, milling maize or collecting water. The fuel efficient stove, used by women to cook meals, could not have been considered a "men's" technology, but commercial production of the clay stove liners required men's work. The liners were made in small factories with full-time wage workers and relatively complex management systems. In four cases, then, the improved technologies could not easily be categorized as either fitting or challenging women's culturally defined gender roles. It would be difficult to predict, therefore, whether women would or would not adopt these technologies based solely on how they fit local culture surrounding gender.

3.2 Changing Gender Roles

When women adopted the technologies, even though they required men's work, they transcended the limited of their gender roles. This occurred in four ways.

1) **Training:** One reason women often have trouble performing men's work is that they do not have the technical skills. Though many rural men also have limited technical

expertise, the problem is more acute for women because they have less education, less leadership experience, and less exposure to complex machinery and equipment. The agencies in this study provided technical and managerial training specifically designed for illiterate women. The training sessions usually lasted one to two weeks, and the agencies also provided follow-up advice once the businesses got started.

2) **Simplifying the business structure:** Sometimes the women and/or the agency structured the project to simplify the management of the new technology. Many typical projects require women to operate equipment as a cooperative, but cooperatives are difficult to manage. For example, if women produced palm oil cooperatively, they would have had to keep a large inventory of palm nuts, risking that the nuts would sit for too long and get spoiled. They would have had to identify bottle suppliers, transporters and large enough markets for their oil production. In selling processing services to individual producers, in contrast, the women's groups only had to collect fees and hire a few workers to operate the machines. This "fee for service" arrangement was much simpler.

3) **Facing and challenging stereotypes:** When faced with social barriers to doing men's work -- such as hostility, resentment, and ridicule from people in their community -- some women were willing to openly challenge local gender

stereotypes. For example, of 900 women involved in the AHF project, only 45 women were willing to work in the building-materials factory. They didn't care, they said, if people laughed at them. One factory worker said, "Now we are laughing because we are getting money and we are getting houses."

4) **Hiring men:** When women did not want to perform men's work, they simply hired men to run the machines or keep the account books, which changed both male and female gender roles, because men do not ordinarily work for women. This was most common with the diesel-powered maize mills and palm-nut "digesters." Diesel engines are difficult run, so women hired skilled (male) technicians to run the machines. Since men rarely work for rural women, hiring and supervising male workers was a significant gender change, for both men and women.

This experience contradicts the prevailing view that women will not adopt technology that requires men's work. It does not necessarily support the claim that women should or can easily enter male-dominated sectors. Rather, it confirms assertions in some feminist literature that, gender divisions of labor are culturally defined and in flux within cultures over time. Women often change their gender roles and perform "men's" work when there are overriding rewards or incentives (Stamp 1989).

SECTION FOUR: DISSEMINATION STRATEGIES

This section focuses on a effective dissemination strategies for getting technology to women. Most development agencies use an approach often referred to as the "public sector" or "extension" route, confusing titles because both NGOs and government agencies use the strategy.⁴ Agencies using this approach launch demonstration projects in which they donate equipment and provide training to women's groups. The agencies then hope that other women will adopt the technology used in these demonstration projects. Other agencies use a so-called "private sector" or "market" approach. They work primarily with small machine manufacturing firms, teaching them to make the improved equipment and sell it on the open market. This title is also a misnomer since agencies using the "market" strategy nonetheless engage in research and development, extension work with machine manufacturers, and often advertising campaigns as well. These are, however, the terms the agencies themselves use, and, in practice, the two strategies have very different impacts and problems (Carr 1989).

The "extension" approach targets women, but it often does not achieve sustainable or widespread technology adoption. Many women's groups that receive equipment in

⁴ I will refer to this subsequently as "extension," even though the contrasting "market" approach also involves extension work.

these programs fail manage it sustainably: the groups are mismanaged, they do not maintain the machines, or they suffer losses. The groups then depend on the development agency for subsidies to keep the equipment operating. Such dependent projects hamper agencies from starting more demonstration projects and reaching larger numbers of women. In addition, few women outside the demonstration projects are convinced that the technology would be feasible without the assistance of the agency (Carr 1985, Schoonmaker 1988).

The "market" approach has so far more successfully achieved widespread adoption but is criticized for not reaching women (Carr 1989, McVay and Fisher 1989, Dauber & Cain 1988, Ahmed 1985). Agencies using a "market" approach start by identifying a technology, which they feel addresses a broad need and is financially viable in a country. They then train manufacturers to make the implements. The agencies promote the technology widely, often only becoming aware of who the beneficiary groups will be when they purchase the implements from the manufacturers.

Sometimes the characteristics of the ultimate beneficiary groups surprise the agencies. For example, NGO promoters of fibre-concrete roofing tiles in Kenya set out to assist in the provision of low-cost housing. Though the agency has been pleased that hundreds of people purchased the machines and independently established small businesses, they were surprised to find that most of these investors

were middle income men. In addition, these entrepreneurs established their factories in wealthy neighborhoods and selling to people who would otherwise have bought more expensive clay tiles, not to poor people who would otherwise have bought corrugated iron sheets (McVay and Fisher 1989). In another example, promoters of ox-carts that set out to relieve women of their heavy transport burden in collecting water and fuel, are often surprised to find that middle income, male farmers purchase most carts. In addition, these farmers often use the cart for commercial activities rather than for women's tasks. (Dawson and Smith 1990, Doran 1989, Gaidzanwa 1990).

As in these cases, the "market" approach tends to achieve wider, technology adoption because 1) individuals tend to manage and maintain the equipment better than groups, and 2) individuals continue to purchase the machinery directly from the manufacturers, even after the agency's intervention ends. According to most literature and many professionals in the field, the investors who benefit from this approach tend to be mainly middle-income men. Due to the seeming inability of the "market" approach to reach women, most women's technology programs still use the "extension" approach, in spite of its limited performance in establishing viable group projects and facilitating widespread technology adoption.

This discussion leaves the impression that reaching large numbers of women with improved technology is not possible. But, the better-performing agencies in this study were able to do so. Why? The agencies combined elements of the "extension" and "market" programs in two different ways. 1) In three cases, palm-oil processing, maize milling, and the building of house and water tanks, the agencies explicitly choose to assist women's groups to adopt the technology. And, these groups managed their affairs independently, in contrast to many typical women's groups, without continuous support from the agencies. 2) In two other cases, the fuel-efficient stoves and the improved fish ovens, the technology was widely adopted by individuals beyond the demonstration projects. And, these individuals were women, not men. The rest of this section examines these two strategies in detail to identify how they worked in ways that neither the "extension" nor the "market" approaches, working alone, have.

4.1 Technology Adoption by Women's Groups

In three of the five cases reviewed, the agencies used a dissemination approach that resulted in women's groups owning, operating, and maintaining the improved equipment themselves, after the project ended (the AHF project, the palm-oil processing and the maize milling). Not only do these groups cover the cost of operating the improved

equipment, but many even turn a profit. Factors contributing to this success were 1) the agencies' carrying out feasibility studies before project implementation, 2) the fact that the agencies and the women's groups were subjected to performance pressures, and 3) mechanisms internal to the women's groups.

4.11 Feasibility Studies

First, in contrast to normal practice of providing projects to women in a particular area or to the most politically connected women's groups, the agencies in this study carried out micro-level feasibility studies as a basis for selecting good locations and capable beneficiary groups for their demonstration projects. The viability of a location was based on market surveys to assess the supply of inputs, the available market, the price women will pay for user fees and, as a result, the projected financial viability of the technology at that site. The agencies selected women's groups that have had successful past endeavors, as shown by group savings and case histories of groups' activities. In the NCWD program in Ghana, for example, a staff person spent two weeks at a proposed project site to carry out a market survey, get a history of the group, and gain a sense of the local politics and group leadership. The agencies used these studies and case histories to weed out locations where the technology would

not be financially viable and to exclude inexperienced groups which did not have the organizational or financial capacity to manage the new business. The NCWD rejected around 20% of the applications for assistance, and the UNIFEM program in Zimbabwe only assisted three of ten groups that wanted maize mills. Needless to say, this initial selection process increased the chances of supporting financially viable projects.

This system of selecting the groups and locations may sound like a reasonable way of selecting viable projects, but many agencies resist it for two reasons. 1) Many development agencies do not have a large pool of locations and potential beneficiaries. For example, many community development agencies organize and assist women's groups in a geographically limited area. Often the agencies work with these groups because they represent the poorest women, which makes it difficult to "weed out" undesirable beneficiaries or locations.

2) In many agencies, program benefits are rewarded on the basis of patronage, rather than project viability. Women's groups often connect to development programs through local patrons (chiefs, politicians, leaders in women's organizations, or other wealthy community members) who recommend their favorite groups to the program in return either for political support in the party or women's organization or for positions in the project itself. When

equipment is distributed in this politically motivated way, without regard to its financial viability or to the group's capacity to manage it, the likelihood of project failure is obviously high. Eliminating patronage is probably impossible and may be counter-productive, since local patrons often offer constructive support to the women's groups. The feasibility studies used by the agencies in this study did limit the negative influence of patronage on project location and beneficiary selection.

The ability of the agencies to carry out and successfully use feasibility studies depended, in part, on the development perspective and technical capacity of the implementing agencies, as described in Section 1. The agencies had a business orientation, rather than a welfare perspective, and they had the technical capacity to carry out good assessments. In turn, the agencies' confidence in the groups' abilities and the viability of the location resulted in their subjecting the groups to pressures to perform.

4.12 Performance Pressures

1) **No donations:** A second strategy these programs used to enhance the financial viability of the group projects was to avoid donating equipment and insist that beneficiaries pay for it. Sometimes, despite field tests of improved

technology, many less successful agencies still donate irrelevant equipment to women who surprise agencies by not using it. For example, in Kenya, a development agency donated manual maize mills to women, but the women preferred carrying their maize to the market and paying for mechanized milling services there. The women rarely used the manual mills because they were not a significant improvement over what they had been doing. This is a common occurrence because many development agencies focus on the immediate goal of distributing large numbers of improved machines, and they only evaluate actual use later, if at all.

Because the agencies studies did not donate equipment, they faced the following kind of pressure to provide viable technology. The beneficiaries had to pay, in various forms. As an initial investment, the NCWD, AHF and ENDA require the groups themselves to build the buildings that house the palm oil presses, building-materials equipment and maize mills. In addition, the groups need to have a specific amount in their savings account to cover working capital. Only then do the agencies loan the groups the money to buy the equipment, which is then used as collateral for the loan.⁵ According to program staff, this level of commitment from the women's groups encouraged the women themselves to investigate whether the investment was a priority for them,

⁵ Only one program, the NCWD, subsidized the price of the equipment, but it is only a partial subsidy.

whether the technology was in fact an improvement and, thus, whether the investment was worthwhile. Although far from foolproof, this system put pressure on the development agencies to provide useful technology.

2) **No Continuous Subsidies:** These better-performing agencies also exerted pressure on the projects to perform well by only loaning the groups start-up capital, and not providing ongoing capital. Even in many programs that do not plan on providing continuous assistance to groups, typically, if a group business begins to fail, agencies prop up the project by injecting additional capital, repairing the machine for free, or otherwise rescuing the situation. Many development agencies do this because they want to keep benefits flowing to their beneficiaries, or because the project collapse will spoil the agency's reputation. But the effect is often to subsidize mis-management and/or poor project design.

In contrast, the programs in this study provided capital equipment at the start of the projects, but the only continuing assistance was technical and management advice. If machines broke down, if the business wasn't making money, if women were refusing to pay for services, then the group had to sort the problem out, which they often did with arbitration from the program staff. Knowing that the program staff could not put additional money into the project, even if they wanted to, legitimate leaders were

under pressure to manage the business well. Even corrupt leaders had an incentive to keep the machines operating. If the machines broke down, the agencies would not fix them and the leaders would lose their source of revenue. The effectiveness of these performance pressures depended, in part, on good feasibility studies at the beginning of the project. Otherwise, many projects would simply have failed in the face of these external pressures to perform. But there were also internal mechanisms that enabled these groups to survive in this sink-or-swim environment.

4.13 Internal Mechanisms

Some groups were able to manage the improved technology themselves because they were well run groups in three ways.⁶ The best example was the Africa Housing Fund (AHF) project in Kenya. 1) One precondition for successful collective action is a socially cohesive group with a common, high priority interest (Ostrom 1990, Wade 1986, Attwood & Bavistar 1987). The women in the AHF project were of the same ethnic group living in a fairly homogenous rural community, in terms of class. They shared the common, severe problem of short water supply in their semi-arid region. This common problem brought the women together, and they were not divided by ethnic, class or political differences.

⁶ Because this study did not collect information from large numbers of women's groups, I cannot be sure how many groups fit this description.

2) A second common element of successful group action is a democratic control structure and, sometimes, an outside arbitrator to settle disputes (Ostrom 1990). The AHF project brought together 12 rural women's groups into one association, the Muungano Women's Group, whose members elected a management committee made up of a chairwoman, secretary, and treasurer. The bulk of the decisions about the project were made by eight committees with elected representatives from each of the 12 groups. Some of the committees, such as the income-generating committee and the farming committee, were formed when members wanted assistance with specific issues, like raising money and increasing their agricultural productivity to be able to pay off their loans. This participatory structure in turn depended on AHF staff to settle occasional disputes. Though the AHF staff said they are trying to withdraw from playing this role, many groups go to some kind of external agent, government or community leaders, to settle disputes (Ostrom 1990). The daily operations and decision, though, were made by the Muungano Women's group.

3) Finally, most collective organizations have established clear incentives, rewards, and sanctions (Ostrom 1990). For example, Muungano Women's Group owned four factories that produced building materials and sold them to individual women at cost. The factories required 45 full-time workers and produced year-round. For this type of

full-time work, the project paid a salary to the hired members. Though this may not seem unusual, many women's projects expect women to volunteer their time, often without clear rewards for the women concerned. For example, small women's groups often build collective water sources, such as small earthen dams, which are then used by the entire community. Or, women often spend one or two days a week at a group factory without receiving wages, knowing only that at a later date the profits should appear in the group bank account.

The AHF project also required women to volunteer labor, but the contribution was limited, had immediate rewards, and women were sanctioned if they do not comply. For example, women formed groups of five with their close neighbors who then built each others' houses. The women built houses during the non-farming season, and in a two-year period they were expected to build five, two-room houses with a water tank. The requirement was fixed, limited, convenient, and each woman helped only those women that help her. If one woman refused to help her neighbors, they would not help her to build her house. In this way, women faced serious consequences if they did not provide the necessary labor.

4.2 Wider Adoption by Individual Women

In two other cases in this study, the fuel-efficient stoves and the improved fish ovens, the agencies used a dissemination strategy that resulted in the equipment being permanently available on the open market and being bought directly by individual women. In other words, most of the women who adopted that technology purchased the stoves and ovens without assistance from the development agencies. In Chorker, a major fishing village near Accra, Ghana, the NCWD established fewer than five demonstration projects of improved fish ovens, all of which were adopted. As a result, other fish smokers in the village were impressed with the performance of the improved ovens, and several years later every fish smoker in the village had hired local builders to make them improved ovens. In five districts in Kenya, in a period of four years, over 30,000 women have adopted a fuel-efficient stove, and less than one in 30 of these stoves were built as demonstration projects.

These results were different from the results of both the "extension" programs, which so far have failed to achieve widespread technology adoption, and the "market-style" programs, which so far have resulted in widespread adoption by men, not women. The strategy described here reached women because of the need and technology identification processes described above. This section describes how the development agencies trained manufacturers

and established commercial distribution systems so that women could independently purchase the fish ovens and stoves without relying on the agencies to supply them.

When the NCWD demonstrated the improved fish ovens in Chorker, they trained village artisans who made the traditional fish ovens to make the mud firebox of the improved ovens. In addition, they trained village carpenters to make the fish trays, which stack on top of the firebox to complete the oven. Once the demonstration ovens proved successful, the women bought them at their full price, and from then on other women purchased them directly from the artisans.

In the case of the fuel-efficient stove, the Ministry of Energy in Kenya also trained local manufacturers. In addition, it had to ensure stove distribution. Manufacturers of the fish ovens make the ovens for women in the village wherever the women smoke fish, and both the oven makers and the carpenters live in the same village. With the fuel-efficient stoves, the women purchase a clay liner, which forms the firebox, and then build the body of the stove themselves. Only the clay liners are manufactured by firms. Manufacturing the liners requires fairly extensive training to ensure good quality liners of a standard shape that will not crack. For this reason, the Ministry of Energy only trained one or two producers in each district, who could supply liners for a whole district. The Ministry

then had to figure out a way of distributing the liners, as explained below, to large numbers of women living in remote rural areas.

Working with clay is considered women's work in most parts of Kenya and the Ministry felt that liner production would generate extra benefits for women. The Ministry therefore originally identified and trained women's groups to produce the clay liners cooperatively. Because of the many problems that typically plague women's groups, most of the women's groups did not produce the clay liners well. When a district-level staff member identified a male entrepreneur who was already experimenting with innovative clay products, the Ministry approached him, trained him to make the liners, and he is now the most reliable liner producer in East and Central Kenya. The most reliable producer in Western Kenya, however, is a women's group that received substantial management assistance from another development agency. Though the Ministry did not have the capacity to work closely with women's groups to help them produce the liners better, the Ministry's flexible approach allowed it to work with whoever could get the job done, whether a women's group receiving outside assistance or a male entrepreneur.

This flexible approach also brought forth an effective distribution system. When the Ministry of Energy began disseminating the stove in each district, it held an

awareness raising workshop open to staff from a wide variety of ministries, local governments, and non-governmental development agencies. Staff from these various, and sometimes competing, agencies then came to the Ministry of Energy's training of trainers sessions to learn how to make stoves and set up demonstration projects. These agencies experimented with different ways to distribute the stove, until, eventually, a private sector mechanism emerged that seemed to work best.

For example, in Murang'a District in Central Kenya, volunteers from Maendeleo ya Wanawake were the first people to demonstrate the stoves and distribute the liners, but they lost interest in time because there was little financial reward for the work. The Ministry of Agriculture then became active through its agricultural extension agents, who demonstrated the stoves to women's group and contact farmers. They then distributed liners, using Ministry of Agriculture vehicles, directly to women who wanted to make stoves. Soon, however, the demand for liners was higher than the amount the Ministry's could transport. To fill the gap, several women's groups went into business building stoves for women in the community and became an outlet for the Ministry to deliver larger numbers of liners to one place. Building on this experience, Ministry of Agriculture staff began identifying traders in market centers or villages who were interested in "stocking" the

liners, and selling them at a profit. Finally, the Ministry introduced these groups and traders (distributors) to the manufacturer of the clay liners, a male entrepreneur. Now, the distributors keep track of how many women need liners, they place orders with the manufacturer and he delivers liners to the distributors in a truck he rents himself. The final production and distribution system, then, ultimately requires no ongoing assistance from the Ministry of Energy or any other development agency.

4.3 Dissemination Strategies & Characteristics of the Technology

Neither of the two technology-dissemination strategies used by the better-performing agencies inherently worked better than the other. Rather, the characteristics of the different technologies led to these two different dissemination strategies. These characteristics fall into three categories: affordability, technical complexity, and scale.

1) **Affordability:** The stoves and ovens were affordable to individual women, whereas the other implements in this study were not. As a result, the agencies disseminating the more expensive technologies had to provide financing directly to women, and the agencies disseminating the cheaper technologies did not.

Maendeleo Stove	1 chicken, or 2 days of rural wages
Improved Fish Oven	2 times price of traditional oven
House & Water Tank	3 years of rural wages
Maize Mill	10 years of rural wages

⁷ Due to the high inflation rapidly devaluing currency in Ghana since the technologies were adopted, I could not estimate "wage-prices" for the palm oil equipment or the fish ovens.

"Affordability" is difficult to compare across countries so Table 5 expresses the price of the implements in terms of the prevailing rural wage. The fuel-efficient stove, which represents only two days' labor, is much more affordable than the house and water tank, which costs three years worth of rural wages, and the maize mill which costs ten years of rural wages.

2) **Technical Level:** The skills required to use and maintain the stoves and improved ovens are familiar skills to women who adopt these technologies. Both are used in the same way as traditional stoves and ovens, and the primary maintenance task is smearing mud over cracks as they develop. This is how women repair the traditional fish oven and how women in Kenya repair the mud walls and floors of their houses. Women could easily watch a neighbor using the oven or stove and copy them. These technologies differ from the mechanized technologies in this study, which require women to learn new skills. In order to adopt the more complex technologies, women had to attend training courses that lasted two weeks and were only available from the development agencies.

3) **Scale:** Finally, when disseminating larger scale technologies, the development agencies insisted that women adopt the technology in groups. Table 6 shows the increase in scale that the improved technologies represent over the existing traditional technologies -- represented as the

factor increase in the amount of raw material processed per hour with the switch from the old processing method to the new equipment.

Women could adopt the fish ovens and stoves without increasing their scale of production. In these cases, the motive for adopting was that the improved stove and fish oven saved enough wood to make the investment worthwhile, and both also cooked slightly faster than traditional methods. Women also adopted the fish oven because the fish smoked in the improved oven was of better quality and could fetch a higher price. If a women wanted to increase her scale of production with the fish oven, however, she could do so incrementally. An improved oven with four trays holds the same amount of fish as the traditional oven, but at its full capacity of 20 trays, the improved fish oven increases scale by a factor of 5, more than the improved palm-oil equipment (3.25). The maize mills and palm-oil equipment, in contrast, are not divisible and represent an immediate, large increase over women's individual scale of production, from a factor of 3.25 to 785.

TABLE 6: INCREASED CAPACITY OF IMPROVED TECHNOLOGIES			
	TRADITIONAL TECHNOLOGY	IMPROVED TECHNOLOGY	FACTOR INCREASE IN INPUT/TIME
Fuel Efficient Stoves	—	Same output, uses 30-50% less fuel	0
Fish Ovens:	60 Kgs. Fish/day	60-300 Kgs. Fish/batch (depends on the number of trays)	0-5 Times more fish/hour.
Palm Oil:	50 Kgs. of nuts/hr	163 Kgs. of nuts/hr	3.25 Times more nuts/hour.
Maize Mills	2 Kgs. Maize/hr	115-145, 1100-1570 Kgs. Maize/hr (depends on size & engine horsepower)	57-72, 520-785 Times more maize/hour

These physical differences in the technologies explain the corresponding different disseminations strategies. Though the dissemination strategy used with the ovens and stoves made the technologies permanently available to large numbers of women, this strategy would not have worked with the other technologies in the study that, nevertheless benefitted large numbers of women. The other three technologies required financing, training and larger scale production, which led agencies to help women's groups. These observations illustrate the interdependence of dissemination strategies and technology characteristics.

SECTION FIVE: REACHING THE POOR

A final issue that concerns many development agencies is whether the use of improved technology helps better-off or poor women. Some literature on women and technology development claims that improved technology is generally labor displacing and therefore bad for the poor (Ahmed 1985, Dauber and Cain 1988, D'Onoflores and Pflafflin 1988). For example, when mechanized rice threshers were introduced in Malaysia, the women who used to thresh rice by hand lost their livelihoods because the machines threshed rice faster and cheaper than they could. Male farmers were given credit and training to adopt the threshers, and the women could not afford to buy them on their own (Hart 1990).

The normal strategy that development agencies use to avoid this negative distributional impact is to introduce the technology to groups of poor women, rather than to individual men. For example, if a development agency donated the mechanized rice thresher to the same women that used to thresh rice by hand, then the machines would increase productivity without displacing the women (Dauber and Cain 1988). Donating improved equipment, however, is expensive and forming women's groups is often time consuming. As a result, programs donating improved equipment to women's groups often do not assist large numbers of women. This experience has led some writers to consider disseminating technology to individual women, but

this literature predicts that only middle income women would benefit from individual adoption patterns (Carr 1989, Schoonmaker 1988). Many development agencies therefore continue to see improved technology as inherently detrimental to poor women, and therefore assume that working with women only in groups is the best strategy. This assumption bears questioning.

The cases reviewed and some literature on women's groups in Africa, suggest that women's groups do not necessarily comprise the poorest women, primarily because women have to pay dues in order to join (Sorensen 1990, Stamp 1989). For example, while most women in Kenya are involved in some kind of women's groups, poor women tend to belong to older forms of neighbor-based groups in which members simply assist each other with household tasks during peak harvest seasons, emergencies and celebrations. In contrast, the registered, dues-paying groups that engaged in income-earning projects are usually made up of better-off women in the area, rather than neighbors (Sorensen 1990, Stamp 1989). According to program staff, the women in the groups they worked with did represent a somewhat better-off income group.

The evidence reported here also questions the assumption that improved technology is inherently labor displacing because four of the five improved technologies reviewed did not displace women's paid labor. The fuel-

efficient stove helped reduce the time women spent collecting wood, which was unpaid labor. Similarly, water tanks reduced women's unpaid labor in carrying water, and, in addition, the building-materials factories created employment. Also, the maize mills reduced the time and arduousness of manual grinding, which was also unpaid labor. Finally, the fish ovens reduced the arduousness of fish smoking and the time it took to smoke fish, while at the same time not reducing the number of employees a fish monger needs. These technologies, then, did not threaten poor women's livelihoods. There was one exception: palm oil processing. When owned by individuals, the improved equipment does threaten small scale women producers. As the literature predicts, however, this did not happen when the equipment was owned by groups of oil producers.

What, then, was the distributional impact of the technologies in this study and what forces led to that outcome? Unfortunately, the agencies in this study either did not have or did not make available, income data about their beneficiaries, either before or after the program. It is therefore not possible to make conclusive statements about whether these technologies helped poor or middle income women. We can, nevertheless, make several observations about aspects of the programs that tended to make the technologies benefit different income groups.

The use of feasibility studies to select viable locations and well-organized groups improved the financial viability of the projects, but it also tended to benefit better-off women. A "viable" location in these cases was one where women could afford to pay for maize milling services, or a productive areas where palm nut supply was high enough to merit investment in larger scale oil processing equipment. By selecting these locations, the agencies in this study "weeded-out" poorer women located in lower-income or less productive areas, where women nevertheless spend long hours milling maize and processing palm-oil by hand. In addition, the agencies judged the organizational capability of a group based on its successful past endeavors and the size of its bank account. Selecting such groups meant excluding poorer groups.

Other aspects of these programs, however, tended to benefit poorer women. 1) Though all of the agencies in this study selected the cheapest technology available, in two cases, the agencies were able to select technology that was affordable to individual women. These women were not better-off women. Women who were too poor to join official women's group were nevertheless able to afford the fuel-efficient stove. And, most women in Chorker village who previously owned a fish oven were able to invest in the improved ovens.

2) In the other three cases - palm-oil processing, building housing and water tanks, and maize milling - the agencies and the women made the technology more affordable, in time and money, through a) credit, subsidies and user fees, and b) structuring the projects to fit women's schedules. Though these practices did not ensure that the poor benefitted, they helped a poorer stratum of women to benefit than would have been possible without these mechanisms.

a) With the palm-oil equipment, the building-materials equipment and the maize mills, the women and the agencies came up with financial mechanisms that helped women adopt the technologies. The NCWD only charged women one third the actual price of the palm-oil equipment,⁸ and they loaned the women the other third, using the machinery itself as collateral and giving the women a two-year payback period. To cover the cost of working capital, the women charged a fee for individual users. ENDA also provided five-year loans for the maize mills in Zimbabwe, using the mills as collateral, and the women's groups also charged user fees.

The AHF financed the building-materials equipment and the women's houses. The group repaid the loans for the factories over five years as individual women purchased materials for their houses and water tanks (with loans from

⁸ Note that this partial subsidy is still different from a 100% donation that characterizes more typical programs.

AHF). The individual women repaid their loans on different schedules according to the income they earned. For example, women who received remittances from relatives working in urban areas could choose to pay monthly, while women who survive on farm income could pay seasonally. Since the women did not hold the title to their land, the loans had no collateral. To encourage repayment, then, the women in the AHF project formed small loan groups. Unless current borrowers in the groups were paying regularly, other members of the group could not receive new loans.

b) In addition, in these three programs, the agencies and the women designed projects to fit the use of the technology into women's existing labor patterns as much as possible. For example, the small groups of women that build each others' houses in the AHF project could arrange to do this work whenever they could more easily spare the time. Similarly, individual women could use the palm-oil equipment and the maize mills when it was convenient for them. The structure of these projects contrasts with many rural women's income-generating projects, which often fail because the women are too busy working on their farms to put extra time into new work, particularly if they are expected to volunteer their time.

3) When the projects needed women to work continuously at the building-materials, stove liner, and palm-oil factories, the women's groups paid wages, and poor women

tended to take those jobs. Mature, married women, for the most part, had land to farm and were too busy for full-time wage labor. Most of the women working full-time, then, were young, landless, single mothers who did not face the same labor constraints as women farmers did, and who were some of the poorest women in the community.

4) Finally, two technologies in these projects benefitted a broader range of women because they allowed those outside the group to use their equipment for a fee. Though the palm-oil equipment was owned by selected groups of women, non-members living near the factories could bring their palm nuts to be processed there. Individual women normally process small quantities of palm oil manually, keeping some for the family and selling the rest. Having access to the improved equipment for a fee, then, reduced the time women spent processing their palm oil and allowed them to increase their production. Similarly, each maize mill was owned by only five to ten women, but several hundred women brought their maize to be milled by each mechanized machine. For women who previously used further away mills, the new mills reduced the distance they had to walk; and for women who used to process maize by hand, the new mills reduced grinding time from five hours to five minutes. In both these cases, then, poorer women outside the official women's groups benefitted from access to the improved technology, though they did not own it.

SUMMARY AND CONCLUSIONS

This study examined five better-performing programs that assisted women to adopt and benefit from improved technology. Various features of these cases shed light on five issues that agencies face when designing and implementing women's technology programs: 1) institutional design, 2) technology development and selection, 3) gender issues 4) technology dissemination strategies, and 5) reaching the poor. The findings suggest different ways of thinking about these issues, and illustrate ways these better-performing agencies were able to reach larger numbers of women than most women's technology programs do.

1) Institutional Design

Some literature on women's technology programs attribute success to the type of implementing institution, but this issue remains unresolved. Government agencies have a broad impact, but NGOs have a reputation for being responsive and working well with particular target groups. Mainstream development agencies that work with both men and women do not have a good track record at targeting women, but the alternative - women's organizations - tend to be technically weak and highly political. The better-performing agencies in this study, however, represented all four types of institutions. In contrast to prevailing wisdom, whether the implementing agencies were government

agencies or NGOs, a mainstream development agency or a women's organization, was not a key factor in the ability of the implementing agencies to quickly reach large numbers of women.

All these different types of agencies worked efficiently because they benefitted from existing networks of women's groups. These networks served as invaluable contact points for identifying women's needs and for publicizing the programs. This finding was surprising, given the clientelist and political tendencies that characterize these women's networks. It seemed that these political tendencies were balanced, in these cases, by the strong business orientation and technical capacity of the implementing agencies.

2) Technology Design Process

Practitioners and writers about technology development have reached a virtual consensus that in order for technology to be appropriate for women or men, it must be developed in conjunction with potential users, rather than in "isolated" technical institutes. This study found, however, that such interaction was not always an ingredient of success. Interaction with potential beneficiaries was significant, however, in identifying women's needs and selecting technology. The agencies conducted studies of specific sectors and consulted women to identify their major

activities and constraints. In four cases, the agencies identified an existing technology that met women's needs, rather than developing new technology. This facilitated fast program implementation because the agencies' main task was to assist women to obtain the equipment and provide training. A technology was not available in the case of the fuel-efficient stove, so the agency had to spend three years developing the technology before disseminating the stove. This technology benefitted the most women, but took three years longer than the other programs.

3) Gender Issues

A third issue about women and technology concerns women's willingness to adopt improved technology in relation to their culturally defined gender roles. Some feminist literature suggests that women have the most to gain by entering male-dominated sectors, like carpentry or metalwork. But, most Appropriate Technology and WID literature suggests that women will not adopt technology that requires work usually performed by men. In several cases in this study, however, women stepped outside their gender roles in order to adopt improved technology. Though the technologies addressed women's problems, such as water delivery, the solutions required tasks that are normally considered men's work, like masonry. The agencies sometimes provided technical training and encouraged women to do this

"men's" work. Sometimes, though, women hired men - that is, to operate mechanized equipment, keep financial records, perform full-time wage labor, or manager the enterprise. Both parties, surprisingly, adjusted to the idea of men working for women. This finding suggests that developing technology that precisely fits existing gender divisions of labor may be less important than identifying women's priority needs and providing training and encouragement that enables women to adopt technology.

4) Technology Dissemination Strategies

A final concern of agencies trying to reach women with improved technology is choosing an effective dissemination strategy. Most agencies have used what the literature calls the "extension" route in which the development agency procures and donates equipment and provides training to selected women's groups. This contrasts with the so-called "market" approach in which agencies train manufacturing firms to produce the equipment; the latter then sell the equipment on the private market. Actually, neither of the approaches has so far reached many women. Though the "market" programs are better at achieving widespread technology adoption, they tend to benefit middle income, male entrepreneurs. Though the "extension" programs do work with women, many of the women's groups they assist rely on the agencies for subsidies, have trouble maintaining the

equipment, or are otherwise mismanaged to the point that women eventually abandon the machines.

The agencies in this study did not use one or the other strategy. Rather, they used elements of each in two ways, 1) one that worked with women's groups, and 2) one that worked with individuals and resulted in widespread adoption in the private sector. Neither combination was inherently more successful. Though the approach that worked with individuals led to wider patterns of technology adoption, working with groups was necessary in some cases in order for women to benefit at all due to the physical characteristics of the technology.

4.1 Strategy 1: Working with Women's Groups

Three agencies in the study introduced technology to women's groups but, unlike more typical programs, the groups managed the equipment well without being dependent on the agency. Three components of the programs encouraged this positive outcome:

- 1) The development agencies carried out micro-level feasibility studies to select experienced, well-organized groups and viable locations where there was adequate supply of raw materials and adequate markets for finished products. This contrasts with more typical women's technology programs in which development agencies donate equipment to the neediest or the most politically connected women's groups.

2) The better-performing agencies provided financing and continuous advice, but did not donate equipment and did not provide continuous subsidies to the women's group projects. Many other agencies donate equipment that women do not use, but the fact that women in these programs had to pay for the improved equipment led women to play a more active role in technology selection. In less successful programs, if a business performs poorly, the development agencies often rush in with emergency grants or repair services. The lack of ongoing subsidies in the more successful programs pressured the women's group members to hold their leaders accountable for the performance of the business. The effective use of these performance pressures, in turn, depended on good feasibility studies.

3) Some of the groups were well managed. They a) were a socially cohesive group with a common, high priority interest, b) had a democratic control structure, and c) established clear incentives, rewards, and sanctions.

4.2 Strategy 2: Working with Individuals

With respect to the fuel-efficient stove and the improved fish oven, the technologies were widely adopted by individual women for two reasons. 1) In contrast to the "market" style-programs, these two agencies surveyed women's groups to identify women's needs and to select the technology, and they carried out demonstration projects with

women's groups. 2) To disseminate the technology further, the agencies (a) trained manufacturers and/or, (b) established commercial distribution of the stoves and ovens so that large numbers of women could purchase them without needing to rely on the development agency.

4.3 Dissemination Strategies & Characteristics of the Technology

The two dissemination strategies that worked best in these cases were intricately connected to the physical characteristics of the technology. Three technologies required financing, training of women, and large scale production: this was only possible if women formed groups. The technologies adopted by individual women through market channels were affordable, in turn, without financing; required no training, since women were familiar with the necessary operation and maintenance skills; and did not require a costly and difficult increase in scale of production.

5) Reaching the Poor

Finally, many development agencies are concerned about whether improved technology programs benefit better-off or poor women. Based on the data collected, it was difficult to tell the income stratum of the women benefitting from these projects, but several observations are possible. On the one hand, the use of feasibility studies to select

viable projects inadvertently benefitted better-off women, because they weeded out lower-income areas where women could not afford to pay for services and lower income groups who did not have enough savings to qualify. On the other hand, four things contributed to these projects helping less well-off women: 1) selecting technology that was affordable for individual women, 2) financing and designing the projects to fit women's labor constraints, 3) providing full-time wage labor to landless women, and 4) allowing non-members to use the improved equipment for a fee.

This study examined five better-performing women's technology programs. The findings suggest that assisting women to adopt and benefit from improved technology may not be as difficult as the literature implies. The different types of agencies in this study took advantage of prior work carried out by women's networks and technology development agencies to facilitate program implementation. In addition, they took a flexible approach toward technology development process and dissemination strategy, which contributed to program effectiveness. Finally, the agencies enabled the women themselves to play an active role in technology selection, project management, and even dissemination, which ultimately helped the programs respond to women's needs and spread the benefits beyond the demonstration projects.

APPENDIX I: CASES

IMPROVED HOUSING & WATER CATCHMENT TANKS: KENYA, Africa Housing Fund

Description

Muongano Women's group, a new association of 12 existing rural women's groups in Eastern Kenya, owns and operates four building materials factories. In small groups of five neighbors, members build each others' houses and rain-catchment water tanks with the building materials which they buy at cost from the factories. The small groups guarantee each others' loans from the Africa Housing Fund. 45 of these women also work full time in the factories. Africa Housing Fund also manages 10 other similar projects in East Africa.

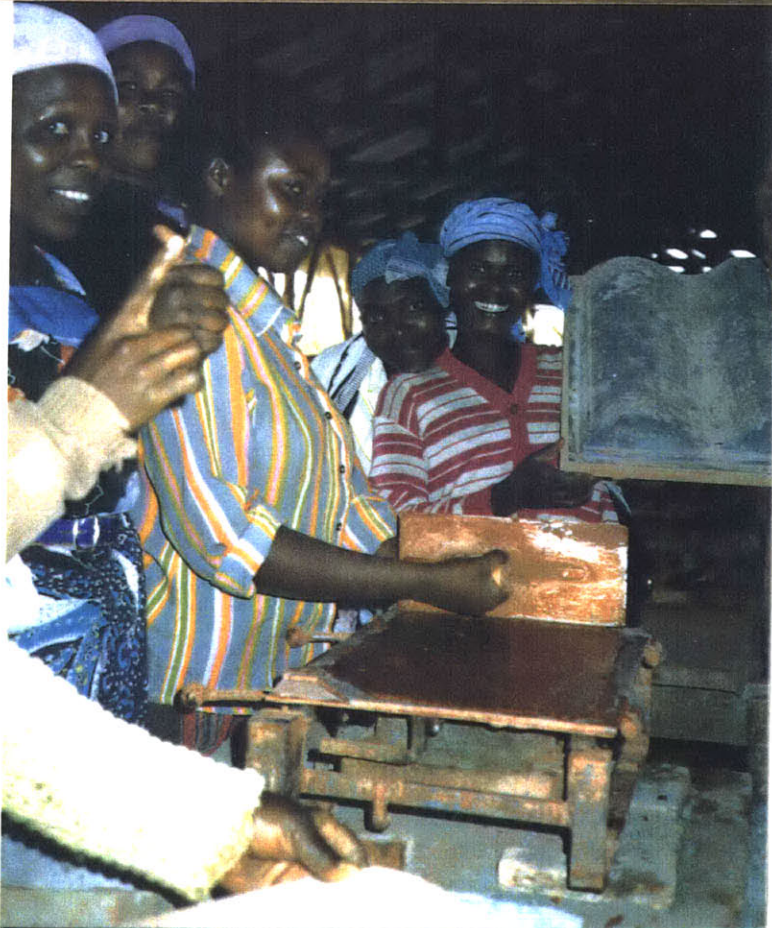
The building materials - fibre-concrete roofing tiles and hollow concrete blocks - are shaped in metal molds and vibrated with a small engine that runs off a car battery. The vibration adds strength so that the tiles and blocks require less cement and cost less than normal cement blocks and tiles.

Previous Technology

Depending on the season, the women previously walked between three and 15 kilometers to use community water sources such as rock catchments and dry river beds. They previously lived in mud houses with thatch or tin roofs.

BENE-FICIARIES	900 members of 12 rural women's groups in a semi-arid region of Kenya.
COST	The house with water tank costs three years worth of rural wages.
BENEFITS	The women now have water at their houses for four to six months out of the year, depending on the rains, and they now live in cement houses with tile roofs. The women that work in the factory have increased income.
TIME TO BREAK EVEN	The building materials equipment breaks even in two years.
FINANCING	Africa Housing Fund gave loans to individual women for their houses, and to the women's group for the building materials equipment.

(See Picture, next page)



FUEL EFFICIENT STOVE: Kenya, Ministry of Energy

Description

A wood saving stove consisting of a factory produced clay liner and a mud and stone body which women make themselves. GTZ funded the research and development of the stove which was carried out within Maendeleo ya Wanawake, the national women's organization. This case focuses on the national dissemination campaign that the Ministry of Energy launched, also with GTZ funding.

Previous Technology: Three stone fire.

BENEFICIARIES	30,000 individual, rural women in five districts of Kenya.
COST	The liner costs the price of a chicken, or two days' worth of rural wages.
BENEFITS⁹	The improved stove uses 30-50 % less wood, so women who adopt the stove save time normally spent collecting wood.
TIME TO BREAK EVEN	In areas where women pay for fuel, they recover the cost of the stove in savings after around one month.
FINANCING	The program only provides financing for the liner production factories.

(See Picture, next page)

⁹ In this and other cases, this study could not assess the exact amount of time women save nor how they use that time.



Fuel-Efficient Stove



Improved Fish Oven

IMPROVED FISH OVEN: GHANA, NCWD

Previous Technology

The ovens are owned by senior women in a family who employ three to five daughters or sisters. The traditional fish oven has a round mud body with a built-in wire tray. During the smoking process, women remove the fish several times, shuffling them around in order to smoke them evenly.

Improved Ovens

The improved oven for smoking fish consists of a rectangular mud firebox with 5-20 removable wire mesh trays stacked above it. It's capacity is five times that of the traditional oven. With this oven the women shuffle the trays of fish. The reduced handling lightens the workload and produces higher quality, higher priced fish.

BENE- FICIARIES	845-1950: 200-300 women owners in Choker, 15-30 women owners in three other fishing villages, and 645-1650 employees.
COST	The improved oven, with 20 trays, costs three times as much as the traditional oven.
BENEFITS	The new oven saves labor and increases income, for both the oven owners and their employees.
FINANCING	In Choker, the NCWD did not provide any financing. In the other villages, they subsidized the oven price by one third.

(See Picture, previous page)

PALM OIL PROCESSING: GHANA, NCWD

Description

Women remove palm nuts from bunches by hand. They boil the nuts in large tanks that sit over slightly enclosed wood fires. Then women pour the boiled nuts into mechanized "digesters" that remove the fiber from the nut. Women then press the red palm oil from this mixture using a manual screw press. Though the equipment is owned by a group, individual women can also use the equipment for a fee.

Previous Technology

Women also remove the nuts by hand and then boil them in smaller pots over three stone fires. They pour the mixture into earth pits dug into the ground and remove the fiber from the nut by stomping with their feet. Then they remove the fibre and palm kernels with baskets and finally remove the palm oil with gourds.

BENE- FICIARIES	3,000: 1500 members of 50 rural women's groups. Each group owns a set of palm oil processing equipment. An additional 30 women use each set of equipment for a fee.
COST	Due to high inflation and the dual currency market, the cost at different times over the four year period is difficult to estimate.
BENEFITS	The time to process oil is reduced by two thirds. Women also save some fuel and get a slightly higher extraction rate from their palm nuts. Women that own the equipment increase their income.
TIME TO BREAK EVEN	2 years.
FINANCING	NCWD provides loans to the women's groups for the equipment and subsidizes the cost of equipment by one third.

(See Picture, next page)



MECHANIZED MAIZE MILLS: ZIMBABWE, ENDA

Description

Diesel powered mechanized maize mills for grinding maize into flour, which women use for cooking the staple food in Zimbabwe.

Previous Technology

Some women grind their maize manually, with a mortar and pestle. Others walk up to 8 kilometers to use other mills.

BENE- FICIARIES	600-900 women living near rural trading centers, who use the mills for a fee, and 20 members of three better-off women's groups that each own one mill in a rural trading center.
COST	The mills cost 10 years' worth of rural wages.
BENEFITS	Mechanized mills reduce grinding time from several hours to several minutes. For women who already used a mill, this one is simply closer so women spend less time and energy walking to the mills. The women who own the mills increased their income.
TIME TO BREAK EVEN	Within five years.
FINANCING	ENDA financed the purchase of the Maize Mill, but the women's groups built the shed and supplied the working capital.

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