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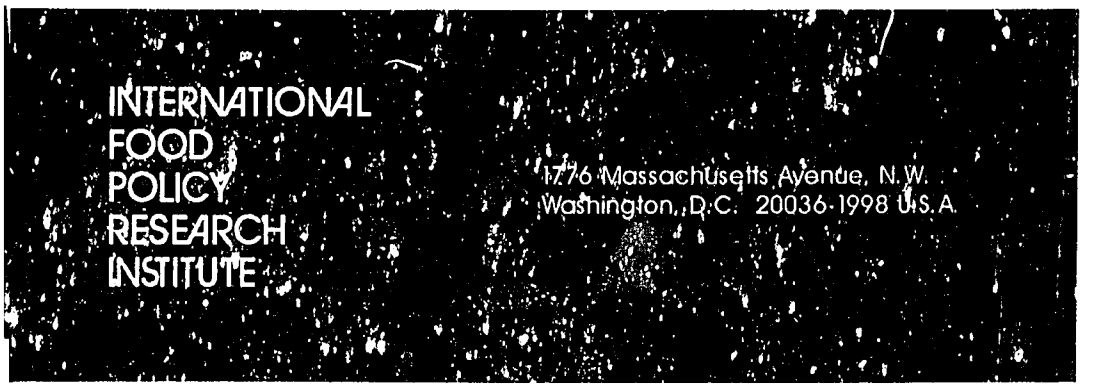

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The Impact of New Crop Technology on the Agricultural Division of Labor in a West African Setting*

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Scope of the Article

The analysis of intrahousehold economics has received increasing attention during the past few years, as planners and policymakers have become increasingly aware that neither poverty nor development interventions affect all individuals in households uniformly. In particular, the dual issues of gender bias and intrahousehold inequalities, and their relationship to technological change in agriculture, have become central concerns.[1]

This article sets out to examine the impact of technological change in a West African environment (The Gambia) where a project introducing new technology in rice production (centralized pump irrigation) was specifically designed to address the issue of differential gender roles in farming. Rice was traditionally a "woman's crop." Today, despite attempts to preserve women's customary role in rice farming, changes in rice-production technology have seen rice become a male-controlled crop. We shall, therefore, consider how households in The Gambia organize their labor resources in agriculture toward production, storage, and crop disposal, as a result of the changing roles of men and women in rice production. The question to be examined is, What has happened to the division of labor in agriculture between women and men in communal and individual farming? An understanding of how technological change affects the distribution of resources at the intrahousehold level is essential both to an evaluation of the distribution of benefits involved and to a better understanding of how responsiveness to incentives might change in such complex West African farming systems.

The results reported in this article derive from a wider research exercise designed to assess how technological change and the increas-

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ing commercialization of agriculture affect (*a*) the income and nutrition of farm households and (*b*) decision-making authority and farming activities at an intrahousehold level. During 1985 and 1986, structured questionnaires were applied by trained local enumerators to 1,414 women and 1,395 men living in 200 households in 10 different villages. At the same time, more in-depth anthropological surveys were carried out in a 10% subsample of these households.[2]

We join P. Hill in stressing the point that because West Africa is so ethnically heterogeneous only very broad generalizations may be made on the basis of individual studies.[3] Nevertheless, the detailed information gained from case studies may lead to a reassessment of broad generalizations that are accepted as conventional wisdom. This is what the present study attempts.

The Area and the New Technology

The study took place in central Gambia, on the south bank of the river in MacCarthy Island Division. This region is an almost ideal West African laboratory case because different ethnic groups are affected by the same programs of technological change. Four different ethnic groups are involved in agricultural production in the study area. Mandinka, Wolof, Fula (also known as Peul or Fulani), and Serahuli (also known as Sarakole). Yet the basic organization of household and farming activities are quite similar for all four groups.

Located on the edge of the Sahel, the agriculture of these groups is adapted to the rigors of a very short growing season (late June until October).[4] Based primarily on hand-and-hoe technology and a bush-fallowing system of land rotation, farmers are obliged to concentrate the bulk of their rain-fed cultivation activities within these few months only. The principal crops involved are groundnuts (the main export crop), millet, sorghum, maize, and rice. Small vegetable gardens are frequently maintained during the long dry season, but until the recent innovation of dry-season rice irrigation, this was the only form of nonrainfed cultivation able to be practiced.

The technological change being considered in this setting is the upgrading of rice-production technologies that was brought about by the introduction of a large-scale pump irrigation project. Implemented in 1983, this project covers over 1,500 hectares and was designed to raise rice yields and output by producing a crop both in the wet and the dry seasons through the centralized control of water pumping and draining around 0.5 ha plots. The project is owned and managed by the state, with plowing services and a package of fertilizer and improved seed being provided on site on a credit basis. However, all other farming activities are carried out by smallholders who are registered as temporary tenants of plots or portions of plots (up to five households to one plot).

An attempt was made in this project to maintain the traditional use rights of female farmers to rice land by giving priority to women during the official registration of plots. In the past, women of this region generally maintained usufruct rights to particular swamp fields; rights that were passed down from mother to daughter or to daughter-in-law.[8] While arrangements varied from one village to the next, access rights to that piece of land generally did not move from one household to the next. In other words, use rights were household-specific rather than individual-specific. Learning from the mistakes of past schemes, the project management endeavored to ensure that plots of swamp land taken over and redeveloped for pump irrigation would be registered in the name of the head woman of each household (usually the most senior active female). All aspects of the land-distribution process were made public at village meetings and through extension agents. The results of this legal attempt to target the benefits of the new technology were mixed, as will be shown later.

Cooperation and Conflict in the Household Production System: The Compound

The Gambian household is referred to as a "compound." In physical terms, the compound is the structure that serves as the arena for family interactions. In this sense, the compound constitutes a collection of dwellings, kitchens, and stores that is clustered around a central courtyard and fenced off from the pathways outside. The number of people in one compound may exceed 100; the national average stands at around 16. These are eclectic collections of people who share various rights, duties, and material possessions, who recognize the overall authority of a single head (usually a male), and who contribute directly or indirectly toward the survival, reproduction, and advancement of the group as a whole (which, it should be noted, does not necessarily imply the mutual advancement of every individual in the group). In large compounds subdivisions of distinct spheres of responsibility and activity become apparent. The decision-making units in both production and consumption are multifaceted, which complicates, therefore, the application of a uniform production economics approach to the study of households. Aggregation at the compound level also covers up the variable effects of technological change on different groups in the household arena.[9]

The two highest principles of life that define and govern family obligations at compound level are expressed in the Mandinka terms *badingya* and *fadingya*. The concept of *badingya* represents harmony, cooperation, and productivity. It is the principle that binds relatives and whole communities together in an idea of shared progress and happiness or, alternatively, in shared decline. *Fadingya*, on the other hand, refers to the negative traits of personal, selfish ambition, compet-

itiveness, even aggressiveness. If allowed to get out of hand, the negative attributes of *fadingya* could lead to the breakdown of structures of mutual support and, theoretically, to the collapse of community spirit. Yet the positive aspects of *fadingya* are also recognized as being driving forces necessary for the advancement of the group as a whole.

Responsibility for the maintenance of a productive balance between *badingya* and *fadingya* lies with the compound head who, with very few exceptions, is a man. There are many different ways in which a head can run his compound. Like the head of a state in miniature, the compound head has to maintain a good grasp of all activities taking place within his domain in order to fulfill his obligations and to provide all the services required by the compound populace. One of his primary obligations is to manage the compound's economic system in such a way that he can ensure that his people do not go hungry at any time. And yet, the organization of farming does not follow the conventional assumption that all labor is pooled under the direction of a single head.

The compound farm is divided into two distinct parts: a communal farm, whose function it is to meet domestic food consumption needs, and private farms, which consist of fields allocated to individuals who will use them for crops under their personal control. The income from such private fields is used both for support of the household and for personal consumption. The communal crops are produced by the combined labor of all compound members—all men and women have a customary obligation to provide labor to the communal fields. Men traditionally work more on the upland communal crops (millet, sorghum, and maize) under the authority of the male head, while women in villages located closer to the river customarily work more on swamp rice (rain-fed and/or tidal flow–irrigated) under the direction of the head woman.

Labor for the private crops, on the other hand, is organized by the individual who is responsible for the field. The individuals can choose to provide as much or as little labor to this crop as they want. However, this becomes a focal point of competition between personal interest and cooperation with the rest of the compound group. Given that private fields have to be cultivated during the same seasonal period as the communal fields, time spent on the communal farm is time spent away from private crop production as well as from other nonfarm income-earning activities or household work. And time spent on the private farm or on other jobs is time away from communal food production or household work.

This issue—known to every compound head in terms of the *badingya* and *fadingya* balance—can be seen in terms of "cooperative conflicts," which, as argued by A. Sen, are a general class of intrahousehold problems, of which the so-called "bargaining problems" form a

special subclass.[7] In the case of the West African compound, continuing Sen's terms, the two problems faced by household members simultaneously involve (1) cooperation (adding to total availabilities) and (2) conflict (dividing the total availabilities among the members of the household).

Cooperative conflicts not only are an issue of women versus men but also involve age groups and groups of different social status within the same compound.[8] Ultimately, such interactions may lead to a very different distribution of the benefits of technological change. As H. Papanek has underlined, "*Gender differences* are among the fault lines along which the effects of [change] are differentially distributed within populations. *Gender relations* are proving to be among the most vulnerable social processes in the face of rapid change" (Papanek's italics).[9] Thus, the sexual division of labor in farming, and its adjustment in the context of technological change, is just one important aspect of "cooperative conflict" within the compound. Although this article focuses on the labor issue, this should be seen in the wider context of the entire social structure because the prosperity of the household depends on the totality of both farm and nonfarm activities.[10] In other words, the singling out of farm labor for analysis in this article in no way diminishes the importance of other female-dominated activities in household production, such as food processing and preparation, fuelwood collection, child care, and so on.

For example, while we do not have comprehensive time allocation data for men, we do have average weekly time allocations for women (table 1). These show that although there are differences in time-use patterns between upland villages (those located far from the river) and lowland villages (lying close to the river), women are spending a minimum of roughly 40% of their available work time during both the wet season and dry season in household chores (including child care) and leisure. The subset of rather fixed time requirements among these chores naturally limits the time that they can devote to farming. They spend an additional 13%–16% of their time in the wet season fetching firewood and water, and going to the market (buying and selling). During the dry season this percentage rises as trading opportunities increase and farming activities decrease. This rise is most marked among the upland women because these are predominantly Wolof and Fula women who are renowned for their business acumen and because the upland villages are much less involved in the rice irrigation project than the lowland villages. The upland women, therefore, seem to choose to allocate more of their nonfarm time to nonhousehold activities rather than to staying in the compound.

The productive role played by women off the farm must not be underestimated, and the primary role of women in household production activities is not questioned. The focus of the following analysis is,

TABLE 1

WOMEN'S WEEKLY TIME ALLOCATION (%)

	LOWLAND VILLAGES		UPLAND VILLAGES	
	Wet Season	Dry Season	Wet Season	Dry Season
Household work (including child care) and leisure	38.6	55.7	47.1	41.4
Farm work	48.5	27.2	37.1	15.7
Other nonhousehold work*	12.9	17.1	15.8	42.9
Total	100.0	100.0	100.0	100.0

SOURCE.—IFPRI/PPMU Survey, 1985–86.

NOTE.—The time-allocation information is based on recall data for time spent during each day over 1 week in each season. The day's time was broken down by fractions, such as half mornings, whole mornings, etc., which in pretesting proved to approximate to actual hourly times spent in this society which does not operate by the clock. Four hundred women were included in this time-allocation survey.

* Including fetching water and firewood, marketing, etc.

however, on their role on the farm fields and how this role has been influenced by the introduction of new production technology in one crop, rice.

New Technology and Division of Labor in Agriculture

In the wet season of 1985, women in the 10 villages studied provided 32% of all labor inputs to agriculture while men provided 68% (table 2). This proportion of female labor in farming may at first sight appear to be small, especially in the light of the widely quoted generalization concerning the role of African women in farm production—namely, that women in Africa provide 60%–80% of all labor to food production.[11] However, an increasing number of detailed microlevel studies have shown during the past 20 years that women's share of work in crop production varies considerably from one part of Africa to the next.[12] For example, I. Tinker shows that women are responsible for 49% of labor inputs to crop production in Burkina Faso.[13] H. T. M. Wagenbuur reports a 46% share of women's labor in farming in southern Ghana.[14] And in the strictly Moslem Hausa communities of northern Nigeria, women provide less than 1% of total farm labor.[15]

Similar variations may be found within a single region. S. Kumar, for example, finds that the share of female labor in household farm labor varies by different types of households in Zambia: in male-headed households, women's share was 45% of crop labor; in female-headed households, it was 83%; and in polygamous households, it was 51%.[16]

TABLE 2

DIVISION OF AGRICULTURAL LABOR IN UPLAND AND LOWLAND VILLAGES IN THE GAMBIA, BY MAIN CROPS (Wet Season 1985; in % of Total Labor)

	Project Rice					
	Pump-irrigated	Improved Rainfed	Traditional Rice	Upland Cereals	Maize	Groundnuts
Upland:						
Men	63	49	13	83	85	61
Women	8	42	78	15	14	34
Hired	29	9	9	2	2	5
Total	100	100	100	100	100	100
Lowland						
Men	39	25	19	94	89	78
Women	39	64	76	2	7	13
Hired	22	12	5	4	4	9
Total	100	100	100	100	100	100

SOURCE.—IFPRI PPMU Survey, 1985/86.

Even within the small area covered by the present study in The Gambia, considerable regional differences show up between crops, and also (as we saw in table 1) between village locations. Where variations by crop are concerned, table 2 indicates that on average the share of women's labor to food crop production is low (8%) for the upland cereals that are the main food staples (millets, sorghum, and maize), and high (77%) in the traditional women's crop—rice (rain-fed varieties cultivated in low-lying swamps). Furthermore, while women's contribution to upland cereal production is an average of only 8%, this ranges from 15% in upland communities (which tend to specialize in upland cereal cropping and livestock herding) to only 2% in the lowland areas (which traditionally place a much greater emphasis on swamp rice cultivation).[1] Also, while women in upland villages are much involved in groundnut production (which is the main cash crop), the involvement of lowland women in groundnut production is still limited. As discussed later, women from lowland villages traditionally generate cash from their traditional rice production that shows a sizeable marketed surplus.

In both village locations, it is the men, not women, who provide the greater share of total farm labor. This holds true also for two control lowland villages (not involved in the rice-irrigation project) that were selected at random in order to broaden the variability of observations and to represent patterns of crop production in the area without the influence of the new rice-farming technologies. Table 3 shows that,

TABLE 3

DIVISION OF LABOR IN AGRICULTURE BY GENDER IN SAMPLE VILLAGES (Wet Season 1985) AND IN HASWELL'S STUDY VILLAGE (1948/49)

VILLAGE TYPE BY LOCATION AND PROJECT PARTICIPATION	PERCENTAGE OF TOTAL FAMILY LABOR TO AGRICULTURE PROVIDED BY		
	Men	Women	Children*
Participation in rice project:			
Upland villages:			
Njoben	70	25	5
Sinchou Abdou	77	22	1
Sare Bala	73	25	2
Kussalang	77	21	2
Lowland villages:			
Sare Samba Sumali	64	33	3
Sukurr	49	37	8
Pacharr	51	42	7
Dasilameh	59	35	6
Not in rice project:			
Lowland villages:			
Teneng Fara	62	27	11
Tuba N'ding	54	38	8
Village studied by M. Haswell (1948/49)†	48	52	...‡

SOURCE.—IFPRI PPMU Survey, 1985/86.

* Youths aged < 15.

† Data are based on household-specific information for 19 households presented on pp. 133–39 of M. Haswell (1953).

‡ Not available.

in both project-participant and in nonparticipant villages, men provide between half and more than two-thirds of all family labor to agriculture.

The question arises if the observed sexual division of labor in farming (in terms of total labor input) is a consequence of the introduction of the new pump-irrigation scheme or of long-standing nature in the region. Unfortunately, there does not exist a reliable baseline data set for this location against which our contemporary data can be compared. Nevertheless, M. Haswell's classic study of a lowland village 150 kilometers to the west of the present survey location does provide some interesting insights into this question. Her study of 19 compounds in 1949 shows that women provided 62% of household labor to family farms that year compared to men's 38%.[18] This female percentage appears much higher than that observed in our much larger sample today. Do these differences reflect a major change in production arrangements over the past 40 years which have reduced women's labor share in agriculture? A closer look into Haswell's original data does not suggest this. There were some specific circumstances at play in the

village of Haswell's study that led to the results shown by her data. She points out that men had recently shifted much of their labor away from growing family crops toward cultivating a village-wide communal groundnut farm, using new mechanization techniques sponsored by the nearby European research station, and working directly as farm laborers on the research station during the farming season. As Haswell puts it, "the incentive to work for Europeans caused a drop between 1947 and 1949 in the work done on farms by the men . . . for many compounds, almost as much time was given to work for Europeans as for native farms."[19] If the number of days given by men to the communal village farm and to the European research station had been spent on the compound farm (as in former years), the relative proportions of labor inputs to household farming would have appeared thus: men 48% and women 52%, which is much closer to what we find in three of the sample villages today (table 3).[20]

Haswell's results, deriving from the study of one lowland village, closely match the results found in several lowland villages in our data set 40 years later (but are at variance with the data from the upland villages). Although these sets of results from lowland villages provide a very small basis for comparison, their similarity implies a considerable stability of division of farm labor by sex in this region over the past 4 decades.

It should be stressed that the presentation of averages for men and women in this section is just a first step in covering highly complex intrahousehold relationships.[21] J. van Driesen Lewis's detailed work on the Bambara in Mali, for instance, demonstrates that there is considerable variation in the specific organization of families in a single village.[22] Wealth, the power of the lineage group, age of the woman, her marital status, number of children, and number of co-wives, all interact and determine what agricultural role a woman plays—whether she had a large or small individual plot, to what extent she works on the family's communal fields and assists other women, or vice versa. Such further disaggregation is taken into account in the next sections.

Individual versus Communal Farming

Figure 1 indicates how men and women in this area divide the overall time that they spend in agriculture among the different options open to them. Out of a total average of 74 days spent by men in agriculture in the rainy season, 43 of these days were spent in communal work versus 31 days in private work. The women, on the other hand, spent 15 days per capita on the communal farm, compared with 24 days spent in private production. In other words, men are contributing 58% of their household farm labor to communal food production, while the figure for women is 38%. Labor pooling and sharing is also substantial on the individual fields (see bottom right of fig. 1). Men spend about one-third

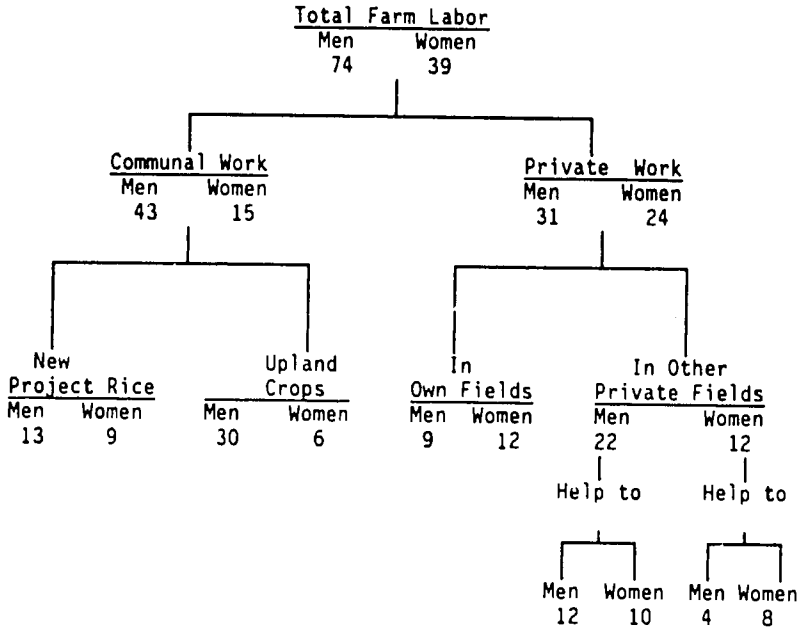

FIG. 1.—Time spent by men and women in each category of household farm labor during the wet season of 1985 (average days per capita).

of the time that they allocate to individual farming helping women in their own fields; women also spend one-third of their individual field work time in other women's fields.

E. Boserup states that in an agriculture dominated by crops destined for export, there develops a male market-crop system parallel to a female food-crop system, with men receiving the cash income and the women cultivating food crops and vegetables as food supply for the household.[23] However, generalizations in this field may be misleading. The evolution of very different divisions of labor between men and women with the introduction of a cash crop has been exemplified by J. I. Guyer, in the case of cocoa in Nigeria and Cameroon, and by J. Dey for The Gambia.[24] This study adds further evidence not only that many African women are active in the trade of agricultural products, processed and/or unprocessed, but also that the cultivation of market crops by women themselves is more usual than is generally acknowledged. This has been documented before among the Wolof, Serer, Bambara, and Hausa in West Africa.[25] Similarly, in this part of The Gambia (inhabited by Mandinka, Wolof, Serahuli, and Fula), women are substantially involved in the production of crops for the market.

Table 4 indicates the percentage contribution of male and female labor inputs into lowland and upland crop production by communal and individual farming. These data show that men are on average con-

TABLE 4

TOTAL LABOR INPUTS TO EACH CROP TYPE, BY MEN AND WOMEN FARMERS (Wet Season 1985) (%)

	Communal Food Production		Private Crops		
	Rice in the New Scheme	Upland Cereals*	Upland Crops†	Traditional Rice	Total Average
Women	39	15	39	99	32
Men	61	85	61	1	68
Total	100	100	100	100	100

SOURCE.—IFPRI PPMU Survey, 1985/86.

NOTE.—105 women and 100 men are included in this randomly drawn subsample.

* Millet, sorghum, and maize.

† Mainly groundnuts, cotton, and some cereals.

tributing almost twice as much labor to communal agriculture (which is primarily food) as are the women. However, women contribute as much labor to individual upland crop production (largely export crops) as they do to communal rice production. In this sample, they are personally in charge of (and receive the income from) 27% of all groundnut fields and for 28% of all cotton production. Interestingly enough, the labor demands (both on a per unit of land and a per unit of output basis) are much lower in these crops grown for sale and export than in traditional swamp rice. It would thus be misleading if policies and programs in this West African environment were to be designed under the assumption that women farmers are just the "communal food producers" while their role in the private production of subsistence and export crops is overlooked. Women farmers may be as adversely affected as men by the policy of export crop taxation in West African agriculture and would thus similarly benefit from more free trade.

Control over Technology and Labor Productivity by Gender

The next question to be answered is, How was this complex pattern of division of farm labor between men and women in communal and individual farming influenced through the introduction of new technology in rice cultivation? Table 5 shows that women's control over rice fields reduces parallel to reductions in yield (technology) levels for the various types of rice production. As yields per unit of land increase from 1.3 to 5.9 tons, the share of women's rice fields in the totals drops from 91% to 10%. This shift should not be seen simply as rice switching from being a woman's crop to a man's crop, but more precisely as a switch from rice being a woman's individual crop to a communal crop under the authority of the male compound head. The higher-yielding

TABLE 5

RICE TECHNOLOGIES AND WOMEN FARMERS IN THE GAMBIA (Wet Season 1985): PROFITABILITY, DIVISION OF LABOR, MARKETED SURPLUS, AND CONTROL OVER FIELDS

	TECHNOLOGIES		
	Project Pump-irrigated	Project Improved Rainfed	Traditional Rice
Fields under women's control (%)	10.0	77.0	91.0
Yields per hectare (wet season, in tons)	5.9	2.5	1.3
Input cost per hectare* (U.S. $)†	294	154	20
Labor input by women (in % of unpaid family)	29.0	60.0	77.0
Marketed surplus in % of production‡	21.6	17.6	36.1
Communal fields (%)	98.9	88.8	16.6

SOURCE.—IFPRI/PPMU Survey, 1985/86.

* Variable input cost (seed, fertilizer, irrigation, hired labor, transportation, mechanized land preparation).

† Converted at parallel exchange rate (US$1 = Dalasi 6).

‡ Includes sales for cash, barter, gifts (excluding loan repayments for labor and inputs).

technologies (per unit of land and labor) have much higher variable input costs per unit of land and labor, and these become the responsibility of men (see table 5). The reduction in women's control over the rice crop by technology levels is also paralleled by a reduction of women's labor input to the respective crop production. Furthermore, the decline in the control over rice by women is paralleled, in some cases, by an increase in their upland cash crop production. Table 6, for instance, indicates the shifting patterns of the individual (*kamangyango*) production by crop for a subsample of 71 women (equally distributed between upland and lowland villages). The table shows that,

TABLE 6

CHANGES IN CULTIVATED AREA AND THE NUMBER OF FEMALE CULTIVATORS OF INDIVIDUAL RICE AND GROUNDNUT FIELDS (*Kamangyangos*) FROM 1981 TO 1986

	1981	1983	1986
Groundnut:			
Area (hectare)	18.90	23.70	26.30
Cultivators	40	50	67
Rice:			
Area (hectare)	8.00	2.90	1.30
Cultivators	31	11	5

SOURCE.—IFPRI/PPMU Survey, 1985/86 (subsample).

for this group of women, a progressive decline in traditional swamp rice production has been mirrored by an increase in access to groundnut *kamangyango* fields.

Women not only end up growing the crops with technologies that result in lower net returns to their labor time but they also exhibit lower average labor productivity levels than men in the same crop and broad technology groupings (table 7).[26] This difference is partly explained by women's reduced access to labor-saving implements, and women's time constraints which generally allow them to cultivate only smaller pieces of land causing diseconomies of scale.[27] This result coincides with the work of Dey, who argues that technological change often increases the work burden of women relative to men, while at the same time reducing their access to the resources required for higher production and productivity.[28]

The internal distribution of labor between men and women in communal and individual farming is substantially affected by the change. The complexities of labor pooling and sharing in the compound are manifold. The final section focuses on the intracompound changes in labor allocation induced by new rice technology.

New Technology and Change in Intrahousehold "Taxation"

Communal agriculture in the extended family entails costs and benefits for the individual in the system. The benefits may be seen in terms of

TABLE 7

AVERAGE LABOR PRODUCTIVITY IN WOMEN'S AND MEN'S FIELDS IN THE GAMBIA (Wet Season 1985)

	Women's Fields (U.S.$ per Day)*	Men's Fields (U.S.$ per Day)	Men's Fields (in % of Women's Fields)
Fully water-controlled (new scheme)	...†	2.32	...
Partly water-controlled (new scheme)	1.30	...†	...
Traditional rice	.90	1.48	164.0
All rice‡	1.01	2.09	206.0
Millet, sorghum	1.33	1.52	114.0
Groundnuts	1.08	1.67	155.0
Cotton	.33	.65	197.0

NOTE.—Average labor productivity is measured in terms of gross margin per person day. Gross margins are the production times sales price minus input costs for all variable inputs (this excludes land and unpaid labor to which the gross margin is related).

* Mean values of sample. Local currency is converted at parallel market exchange rate (US$1 = Dalasi 6.00).

† Less than 25 observations.

‡ Area weighted average (fields under each group's control).

potentially improved levels of (food) security. Communal agriculture supports the individual in the face of an uncertain environment that lacks functioning capital and insurance markets.[29] It also helps the extended family cope with the "covariate risks" that confront most households in a region which is affected by unpredictable periods of drought. For instance, families cope with drought by securing and maintaining a joint household-level stockholding of foodgrains or capital (mostly livestock) under the control of the head of the compound, or by maintaining support relationships during times of need with relatives living far away, or by forming patron-client relationships between rich and poor at the location. The first option is the most common at the study location.

Scale economies in production and long-term planning of the household-level food security stocks lead to the development of extended households with the compound head functioning as the head of a "mini-state." Food security is only one of the many benefits (like marriage arrangements, celebrations, etc.) that the compound head provides. In order to provide these benefit streams to the "citizens" of the compound economy, the system has to generate "tax revenue" from its "citizens." This is largely achieved through physical work in communal fields over which the compound head has command. Contributions in cash or kind from craft workers in the compound and remittances from absent relatives provide further resources to the compound leadership. For different types of individuals in the compound, or for specific subgroups, the imposed "tax burden" at any point in time may differ.

A person's (i) work in communal agriculture (c_i measured in days per season) is the sum of all his or her labor input (L) into the communal (*mariuo*) crops (j) by task (k):

$$c_i = \sum_j \sum_k L_{ijk}. \tag{1}$$

Instead of working c days in communal agriculture, the person could theoretically have spent more time in individual agriculture (*kamangyango*) and produced more personally controlled income from crops of his or her own choice which yield net returns of r_i per working day in that season on his or her fields with

$$r_i = f(R, T, P), \tag{2}$$

where the marginal net returns are determined by resource endowments (R), technology (T), and prices (P), and

$$m_i = r_i \cdot c_i, \tag{3}$$

where m_i is the tax transferred to the extended households community through the labor input in communal agriculture which equals the income forgone in private farming. Similarly, a person not involved in agriculture could have earned more income in nonfarm activities or could have enjoyed more leisure time; both may be priced at his or her marginal wage rate, and this may replace r_i in (3). The tax sum can be expressed as a tax rate (t_i) over total actual income of the person from individual economic activity (n_i) and the income forgone due to communal obligations (m_i):

$$t_i = m_i/(m_i + n_i). \tag{4}$$

We are interested to further explore what determines different levels of intrahousehold tax burden (t_i) for different types of persons inside the compound, especially women; and how these tax burdens changed with the introduction of the new rice technology.

We, therefore, attempt to explain t_i in a multivariate analysis with demographic (D) and socioeconomic characteristics, such as status and lineage of individuals (S) and their specific compound (H) and in this context test the effect of the new rice fields (F) for men's and women's intrahousehold tax burden from communal agriculture:

$$t = f(D, S, H, F). \tag{5}$$

The average results of the computation of t_i by major groups in the compounds and by amount of new rice land obtained in the scheme are presented in table 8, and the results of the multivariate analysis as specified in equation (5) are presented in table 9. The main results of this analysis can be summarized as follows: (*a*) Men carry a higher intracompound agricultural tax than women due to communal agriculture. In those compounds with little access to new rice technology, men's income is taxed 74% but women's is only taxed 51% (table 8). Women make up for the difference by carrying a higher share of nonagricultural communal work (food preparation, fuel wood, child care, etc.). (*b*) Both men and women are taxed less with increased age, but this reduction is higher for women (AGE in table 9). (*c*) Where the proportion of new rice land allocated to communal agriculture increases, the intracompound taxation of both men and women rises from 63% to 77% (table 8). The relative increase in taxation is, however, much larger for women than for men. Holding other factors constant, the acquisition of an average-sized piece of new rice land in the scheme (0.03 ha per adult equivalent person) leads to a 22.5 percentage point rise in women's tax but only 6.9 in the case of men (SIZEPAE in table 9). Clearly, the new high-technology rice, which is largely grown as a communal crop, impinges relatively more on women's private

TABLE 8

NEW RICE TECHNOLOGY AND INTRAHOUSEHOLD TAX BURDEN (Agricultural Tax Rate)

	Households with Limited Access to New Rice Fields*	Households with Greater Access to New Rice Fields*
Men:		
Compound head	.76	.98
Upland food crop head	.52	.74
Other men with own field	.49	.51
Other men without own field	1.00	1.00
All men (average)	.74	.87
Women:		
Head woman	.18	.58
Head cook	.41	.62
Other women with own field	.18	.32
Other women without own field	1.00	1.00
All women (average)	.51	.67
Total average	.63	.77

SOURCE.—IFPRI/PPMU Surveys, The Gambia, 1985/86.

NOTE.—For definition of the agricultural tax rate, see eq. (4) above.

* The average amount of new rice land in the group with little access to the scheme is 0.02 ha per adult equivalent person and 0.06 ha in the group with more access. The computations are made for a subsample of 22 compounds, with 100 women and 105 men as individual observations.

agriculture than on men's. This finding is in line with Boserup's generalization that African women are tending to become more economically dependent on their husbands due to increased control over land by men, and that changes in the food production system deprive women of their role as independent producers.[30] (*d*) In larger compounds, women are taxed significantly more than men (AEA, table 9). In compounds with more children, women end up with a reduced tax but men do not (NOCHILD). A woman's workload in the communal fields is reduced by her children's assistance. Also, a woman's bargaining position to escape into her own private agriculture might be enhanced by her having more children, which increases her standing within the compound. (*e*) Men in the highest lineage status compounds (FOUNDER, MASTER) and in lowest status compounds (EXSLAVE) are taxed more than the largest groups (freeborn) to which the respective dummy variables in the model are compared. The lineage variable does not significantly alter women's tax burden, except the much lower tax on women in ex-slave compounds.

Looking at the effects of technological change in the household from this intrahousehold "taxation" perspective does, of course, focus on the distribution of burdens rather than benefits. Tracing the benefits distribution requires looking into marketed surplus, expenditures, con-

TABLE 9

DETERMINANTS OF DIFFERENCES IN INTRAHOUSEHOLD TAX BURDEN AND ROLE OF NEW RICE TECHNOLOGY: MULTIVARIATE ANALYSIS

	Women		Men	
Variables	Parameters	*t*-Values	Parameters	*t*-Values
AGE	-.211290	-8.58	-.074940	-24.08
AEA	.026450	2.49	-6.038400E-03	-.80
NOCHILD	.026490	2.46	8.258288E-03	1.05
HHEAD	-.079250	.96	...	...
COMPHEAD	...	...	.205960	3.08
UPHEAD	.466820	1.60	.210540	2.45
HEADCOOK	1.396099E-03	.01	...	...
INCWS2	1.530023E-04	.69	1.300830E-04	.78
FOUNDER	.120240	1.37	.155630	2.71
SF	.75000	.36	.027050	.25
MASTER	.142560	1.25	.194760	2.56
EXSLAVE	.389730	3.22	.279660	3.03
CRAFT	.062570	.49	.243190	2.29
UPLAND	7.341275E-03	.08	.085260	1.38
SIZEPAL	7.500500	3.80	2.312810	1.79
(Constant)	1.119270	4.90	.992450	5.46
	F-value = 8.320		*F*-value = 9.320	
	R^2 = .578		R^2 = .571	
	Degrees of freedom = 85		Degrees of freedom = 91	

NOTE.—Variables:

AGE	person's age (in groups 2, ..., 7).
AEA	adult equivalent persons in whole compound.
NOCHILD	number of children in whole compound.
HHEAD	head woman (= 1, else = 0).
UPHEAD	head of upland communal crop production (male).
HEADCOOK	woman heading the cooking unit (= 1, else = 0).
INCWS2	wet-season income of person earned off-farm (Dalasi).
FOUNDER	founder compound (= 1, else = 0).
SF	strange farmer (= 1, else = 0) (seasonal migrant laborers).
MASTER	master compound (= 1, else = 0) (former slave owners).
EXSLAVE	ex-slave compound (= 1, else = 0).
CRAFT	craftworkers compound (= 1, else = 0).
UPLAND	compound in upland village (= 1, else = 0).
SIZEPAL	size of field obtained in the new rice scheme (in fully water-controlled land) per adult equivalent person in compound.
COMPHEAD	compound head (= 1, else = 0).

sumption, and nutritional effects of the changes. This can be done only briefly in the context of this article.

It is interesting that when the women's share of control over rice land and crop is reduced, the marketed surplus of the rice crop declines (table 5). This can be explained by the fact that women's traditional rice was, and still is, both food crop and a market crop. By contrast, the new male-controlled rice fields are mainly used as communal fields

for the common food stock of the compound. Much of the incremental output of rice grown under the new technology adds to consumption. During the wet season of 1985, per capita calorie consumption per day of compounds that were only marginally involved in the rice scheme stood at 2,444, while for individuals in households most involved in the scheme, daily per capita calorie consumption was 2,556.[31] The consumption side of the effects of technological change needs to be evaluated jointly with the production side if the overall distribution of benefits within the system is to be fully understood.

More detailed analysis of the consumption effects of the technological change in rice showed that despite the shift in control over rice under the new crop technology (to men, communal regime), per capita consumption of basic food increased, children's nutritional status improved somewhat, and women's seasonal weight fluctuations reduced.[32]

These changes toward nutritional improvement of household members who are not direct beneficiaries of the new rice technology—and in the case of women, identified as relative losers in terms of control over the income stream from the new technology—still suggest significant participation in the benefits stream. Also, it is observed that women, who formerly had access to their own individual rice fields in the area that is now occupied by the scheme, are sometimes compensated by the compound head for their labor inputs into the present communal rice fields with some of the produce from these fields.[33] Sample average of these payments were 2 kg of paddy per woman's labor day, the value of which is about equal to the average labor productivity of women in their least remunerative individual cash crop fields, cotton.

Clearly, the consumption side and the changes in intracompound transfers that result from the new crop technology need to be evaluated jointly with the production side if the overall distribution of benefits within the system is to be fully understood.

Conclusions

New agricultural technology in rice farming in this West African setting leads to a transformation of the status of the crop, traditionally a women's crop largely grown in individual farms, it has become a communal crop under the authority of the (male) head of the extended household. Consequently, the selection of a so-called woman's crop for promotion, in order to improve the welfare of women, has not automatically benefited women more than men. The transformation of production arrangements has involved more complex changes in the system than a simple switch from rice being a women's crop to becoming a men's crop. The whole intrahousehold division of labor in agriculture between men and women has been affected. The reassignment of rice as a

communal crop, which has reduced the opportunity for women to grow it as a private cash crop, has led some women to expand their individual production of upland export crops, such as groundnuts and cotton. The concept of "women's crops" and "men's crops" is therefore not very useful in this context, where divisions of labor by sex and by crop have been shown to be less rigid than is often proposed.

The changes in the production system have led to an absolute increase in the burden of communal agricultural work for both men and women, although the increase was relatively more for women than for men. Yet even after the change, men's labor input into communal agriculture for the common food stock remains much higher than women's. The role of African women in private agriculture and in export crop production has tended to be underemphasized.

Women's labor productivity in individual farming is consistently less than men's by an average of roughly 70%. The difference is mainly due to women's reduced access to labor-saving implements, to technologies of production which give lower crop yields, and to the limits imposed on women's available farm work time by household chores. Apparently the rigidities in the two sectors (male and female individual agriculture) are strong and not easily overcome by an efficiently functioning technology-exchange system, despite a fair amount of labor sharing by men and women in each other's private fields. An alleviation of these constraints through programs designed to facilitate women's access to labor productivity–increasing implements and inputs (seeds, fertilizer) is called for. Credit to women has to play a major role in this context.

The study found that less of the rice crop is marketed when it falls under male control, as a communal crop, than when it was under female control as an individual crop. Clearly, the consumption side of the effects of technological change needs to be evaluated jointly with the production side if the overall distribution of benefits within the system is to be fully understood.

The increased expansion of communal agriculture inside the compound leads to a reduced ability of individual farmers to maximize their individual welfare. The responsiveness of the whole system to economic incentives is becoming more centralized under the compound head. This concentration of economic power in the hands of the compound head means not only that he has more leverage to imposed taxes on compound members, but also that he has a greater ability to redistribute benefits within the compound. Inefficiencies of intrahousehold resource allocation in the compound "mini-state" similar to those resulting from rent seeking in economies with strong state control over scarce resources (titles) may thus develop in periods of transformation, with technological change in agriculture being rationed out to (male) household heads.

Further evolution of the system may lead to the development of new household structures. Large compounds are beginning to split up into smaller operating units. According to the results of this analysis, this appears to be an advantage for women, who are "taxed" less by communal agriculture in smaller compounds.

There do exist risks, however, if large schemes, such as the irrigated rice project in the study area, should collapse in the future. This scheme was not the first rice irrigation project in the region. Four previous attempts at introducing new rice-production technologies succeeded in raising yields in the region, but each one failed after a few years because of various design faults. Readjustment to former intracompound food security arrangements then took some time and posed problems during the readjustment periods. The adaptability of Gambian farmers (male to female) to such strains has been amply demonstrated during these periods. However, the need for planners to protect farmers against the vagaries of the rise and decline of projects has yet to be fully recognized.

Notes

* We are grateful to the International Fund for Agricultural Development (IFAD), Rome, and to the U.S. Agency for International Development for funding this research.

1. Uma Lele, "Women and Structural Transformation," *Economic Development and Cultural Change* 34, no. 2 (January 1986): 195–220; and Nancy Folbre, "Cleaning House, New Perspectives on Households and Economic Development," *Journal of Development Economics* 22, no. 1 (June 1986): 5–41, and the extensive review of literature in both these articles.

2. The labor data presented here were obtained through detailed interviewing on a field-specific activity-by-activity basis. Each subsample household was visited twice a week during the research period, and interviewing was frequently conducted in the fields. Women farmers were generally interviewed by female enumerators, and all responses were cross-checked at least twice.

3. Polly Hill, *Development Economics on Trial* (Cambridge: Cambridge University Press, 1986), pp. 78–82.

4. J. R. Dunsmore et al., *The Agricultural Development of The Gambia: An Agricultural, Environmental, and Socioeconomic Analysis*, Land Resource Study no. 22 (Tolworth Tower, U.K.: Ministry of Overseas Development, 1976); Government of The Gambia, *Monthly Rainfall Data for The Gambia to 1980*, Technical Report no. 8, Department of Water Resources (Banjul: Book Production and Material Resources Unit, 1982).

5. Jennie Dey, "Women in African Rice Farming Systems," *Women in Rice Farming*, prepared for the International Rice Research Institute (Westmead, Hampshire: Gower, 1985), pp. 419–44; Peter Weil, "Wet Rice, Women, and Adaptation in The Gambia," *Rural Africana* 19 (Winter 1973): 20–30.

6. Jane I. Guyer and Pauline E. Peters, "Conceptualizing the Household: Issues of Theory and Policy in Africa," *Development and Change* 18, no. 2 (April 1987): 197–366.

7. Amartya Sen, "Women, Technology, and Sexual Divisions," *Trade and Development* 6 (1985): 195–223, and *Gender and Cooperative Conflicts*, Working Paper no. 18 (Helsinki: World Institute for Development Economics,

1987); see also C. Jones, "Women's Labor Allocation and Irrigated Rice Production in North Cameroon," in *Rural Development: Growth and Inequity*, ed. B. L. Greenshields and M. A. Bellamy, IAAE Occasional Paper no. 3 (Westmead, Hampshire: Gower, 1983).

8. Marie-Angelique Savanne, "The Effects of Social and Economic Changes on the Role and Status of Women in Sub-Saharan Africa," in *Understanding Africa's Rural Households and Farming Systems*, ed. Joyce L. Moock (Boulder, Colo.: Westview, 1986); James Warner Bjorkman, ed., *The Changing Division of Labor in South Asia* (Riverdale, Md.: Riverdale, 1986).

9. Hanna Papanek, "False Specialization and the Purdah of Scholarship—a Review Article," *Journal of Asian Studies* 44, no. 1 (November 1984): 127–48.

10. Sen, "Technology and Sexual Divisions," p. 198.

11. UN/ECA, *The Changing and Contemporary Role of Women in African Development* (Addis Ababa: UN ECA, 1974); UN/IFEM, "Paying Tribute to the African Woman Farmer," *Development Review*, vol. 10 (January 1986).

12. E. Boserup, *Women's Role in Economic Development* (New York: St. Martin's, 1970), p. 21, reports that women's percentage of work in farm is 9% (Nigeria), 29% (Senegal), 56% (Cameroon), and 64% and 70% (The Gambia, 1950s).

13. I. Tinker, *Energy for Essential Household Activities* (Washington, D.C.: Dames & Moore, 1981), p. 12.

14. H. T. M. Wagenbuur, "Labor and Development: An Analysis of the Time Budget and of the Production and Productivity of Time Farmers in Southern Ghana," Occasional Paper no. 23 (The Hague: Institute of Social Studies, 1972).

15. D. W. Norman, "Economic Rationality of Traditional Hausa Dryland Farmers in the North of Nigeria," in *Tradition and Dynamics in Small-Farm Agriculture*, ed. R. D. Stevens (Ames: Iowa State University Press, 1977).

16. Shubh Kumar, "Women's Agricultural Work in a Subsistence-oriented Economy. Its Role in Production, Food Consumption, and Nutrition" (paper presented at the thirteenth International Congress of Nutrition, Brighton, England, August 1985).

17. It is also noteworthy that a sizeable proportion of all labor to the pump-irrigated rice takes the form of paid hired labor which was rarely used in traditional rice. The hired labor input (deriving from seasonal migrant laborers [strange farmers] and from a wide spread of compounds within the community) is most important in the rice crop grown at the most advanced technology level, which coincides with the least involvement of women's labor. For information on strange farmers, see Kenneth Swindell, "A Report on Migrant Farmers in The Gambia," in *Demographic Aspects of Migration in West Africa*, vol. 1, ed. K. C. Zachariah and J. Conde, World Bank Staff Working Paper no. 414 (Washington, D.C.: World Bank, 1980).

18. Margaret R. Haswell, *Economics of Agriculture in a Savannah Village*, Colonial Research Studies no. 8 (London: Her Majesty's Stationery Office, 1953), pp. 133, 135.

19. Ibid., p. 10.

20. Unfortunately, the description of Haswell's revisit to the same village a decade later does not include detailed labor data; see Margaret Haswell, *The Changing Pattern of Economic Activity in a Gambia Village* (London: Her Majesty's Stationery Office, 1963).

21. Joyce L. Moock, ed., *Understanding Africa's Rural Household and Farming Systems* (Boulder, Colo.: Westview, 1986).

22. John van Dusen Lewis, "Domestic Labour Intensity and the Incorpo-

ration of Malian Peasant Farmers into Localized Descent Groups," *American Ethnologist* 8, no. 2 (1981): 52–73.

23. Boserup, *Women's Role in Economic Development*, p. 77. Also, other related sources are reported in B. Venema, "Male and Female Farming Systems and Agricultural Intensification in West Africa: The Case of the Wolof, Senegal," in *The Household, Women, and Agricultural Development*, ed. C. Presvelou and S. Spijvers-Zwart (Wageningen, 1980), pp. 27–34.

24. J. I. Guyer, "Food, Cocoa, and the Division of Labor by Sex in Two West African Societies," *Comparative Studies in Society and History* 22 (1980): 355–73; J. Dey, "Development Planning in the Gambia: The Gap between Planners' and Farmers' Perceptions, Expectations, and Objectives," *World Development* 10, no. 5 (1982): 377–96.

25. C. Presvelou and S. Spijvers-Zwart, eds., *The Household, Women, and Agricultural Development* (Wageningen, H. Veenman, 1980).

26. This finding is in line with the findings in Zambia by Kumar (n. 16 above), and in Senegal by Venema.

27. Two examples show this: (*a*) women's and men's fields (with the same crop) are on average equally distant from the sample. Yet, women's groundnut fields are on average half as big as men's. Therefore, due to smaller fields women's walking time to the field is more costly per unit of output. (*b*) A multipurpose animal drawn implement for ploughing, seeding, and weeding was used in 24% of women's groundnut fields only, while it was used in 43% of men's fields.

28. J. Dey, "Women in African Rice Farming Systems" (n. 5 above), pp. 419–44.

29. For a theoretical account of the relationships, see Hans P. Binswanger and John McIntire, *Behavioral and Material Determinants of Production Relations in Land Abundant Tropical Agriculture*, Discussion Paper no. 17 (Washington, D.C.: World Bank, June 1984).

30. E. Boserup, "The Position of Women in Economic Production and in the Household with Special Reference to Africa," in Presvelou and Spijvers-Zwart, eds. (n. 25 above), p. 12. It should be pointed out, however, that exceptions to this process are found. Women in several of the lowland villages in the sample receive on average 2 kg of paddy from their compound head in remuneration for each day of labor that they spent on the project rice fields.

31. A more detailed analysis of the consumption effects of the technological change is given in Joachim von Braun, "Effects of Technological Change in Agriculture on Food Consumption and Nutrition: Rice in a West African Setting," *World Development* 16, no. 9 (1988): 1268–83.

32. Ibid.

33. A similar evolvement of intrahousehold transfers is observed by Jones (n. 7 above), in Cameroon.