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THE IMPACT OF TECHNICAL CHANGE ON THE RURAL KENYAN HOUSEHOLD:  
EVIDENCE FROM THE INTEGRATED AGRICULTURAL DEVELOPMENT PROGRAM  
A RESEARCH PROPOSAL AND LITERATURE REVIEW

By

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A B S T R A C T

The research draws together two areas of inquiry: the employment and welfare implications of technical change in agriculture and the economic roles of women in rural Kenya. Anthropological sources indicate that traditionally men, women and children have had responsibility for different crops, tasks and support obligations within the rural Kenyan household. Although the traditional patterns have changed due to the colonial experience and pressures of increasing commercialisation of the rural economy, they still form the basis for current practices and attitudes.

The basic research hypothesis is that the division of labor, rights and obligations by sex and age within the rural household will be an important factor affecting adoption and effective use of new technology as well as the welfare consequences of adoption for each household member and the household as a whole. Concomitantly, it is hypothesized that technical change will have a differential impact on the labor input of each household member as well as on his or her access to productive resources, right to the benefits generated by increased productivity and decision making roles within the household.

The research proposes to examine the hypotheses within the context of evaluation of the constraints and consequences of adoption of the Integrated Agricultural Development Program (IADP) recommended crop packages for a sub-set of 6 IADP areas spanning 3 climatic zones and 4 agro-ecological zones.

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SUMMARY

Employment generation as a means of meeting basic needs in the rural sector is the focus of Kenyan as well as international and bilateral development assistance efforts. Technical change in agriculture, resulting in increased productivity and more intensive use of land, is viewed as the principal vehicle for rural development (Development Plan 1979-83). At the national level, it is a means of increasing national food supplies to meet escalating demand resulting from rapid population growth and rural-urban migration as well as a means of increasing agricultural exports in order to ease the critical balance of payments situation. At the farm household level, it is viewed as a means of increasing agricultural output, marketed produce, income and consequently welfare.

Until recently, the belief that technical change in agriculture, particularly the "green revolution" seed-fertilizer package, was inherently beneficial and desirable was an implicit assumption of research and policy which remained unchallenged. As a result, most of the resulting economic research was oriented to finding out how to encourage farmers to adopt the new technology. There were few examinations of whether or not farmers effectively use the technology after the initial adoption decision nor what the welfare consequences of adoption were (Schutjer and Van der Veen 1977). Now there is a growing body of literature about the Asian experience with high yielding cereal varieties which takes these issues into account (Griffin 1974; Ruttan 1977). It has been shown that regional and inter-household relative inequality of income increased with the successful introduction of high yielding varieties. It is the contention of several writers about women's role in economic development that the intra-household disparity in welfare will also be accentuated (Boserup 1970; Tinker 1976; Palmer 1977).

This research draws together two areas of inquiry: the employment and welfare implications of technical change in agriculture and the economic roles of women in rural Kenya. Anthropological sources indicate that traditionally men, women and children have had responsibility for different crops, tasks, and support obligations within the rural Kenyan household

In the theoretical literature, a broad distinction is made between bio-chemical agricultural technology which is characterized as land saving since it augments the productivity of land and mechanical technology which is said to be labor saving since it augments the productivity of labor. Hayami and Ruttan developed the theory, firmly based in the principles of classical economics, that technical change in agriculture is guided by the factor endowment of the economy as this is reflected in factor prices (Hayami and Ruttan 1971). Therefore, technology usually embodied in new inputs, will be developed to substitute for the relatively scarce factor of production. In a relatively labor scarce, land abundant economy like the United States, animal traction and machine generated power replaced human labor. In a relatively labor abundant, land scarce economy such as Japan, labor and capital inputs (new seed varieties, fertilizer, etc.) substituted for land.

However, this theoretical distinction is too simplistic. As Singh and Day point out, technical change must be examined in the context of the seasonal and task specific nature of resource allocation in agriculture (Day and Singh 1977). It is guided not by the "relative factor proportions in the annual aggregative sense" as Hayami and Ruttan theorize, but by "relative factor scarcity at a given time in the cropping year" and by the availability of complementary inputs such as fertilizer (Day and Singh 1977, pp.13-14).

Furthermore, although technical change involves the simultaneous change of various aspects of the production process, it does not usually involve, except perhaps in the case of introduction of a new crop, the wholesale replacement of an entire set of traditional inputs and activities with a new set of modern inputs and activities. For these reasons, Singh and Day recommend that it be analyzed on a task by task basis: new tasks may be included, old tasks eliminated, the number of times a task is performed may change, the quantity and quality of inputs used may vary, and the sequence of tasks may alter. If the implications of technical change for labor use are analyzed on a task by task basis, one may find results quite different than those obtained when the aggregate annual picture---which reflects tradeoffs between labor saving and land saving changes --is analyzed. One must dissect the process of technical change in order to understand its impact.

TECHNOLOGICAL CHANGE AND EMPLOYMENT<sup>3</sup>

In traditional agriculture, the key production input is family labor; returns to this labor provide an approximate measure of family welfare. Therefore, it is important to consider how technical change affects the demand for labor and, conversely, how labor supply affects adoption. There are very few studies of this kind available for Africa. Spencer and Byerlee note in a recent monograph: "Despite the obvious importance of these labor supply and demand relationships to small farmer development there are relatively few detailed studies of labor utilization in traditional African agriculture and almost none that examine labor use under improved technologies" (Spencer and Byerlee 1976, p.2, emphasis added).

Most of the available literature on this subject evaluates the Asian experience with high yielding cereal varieties. As a result of preoccupation with "absorbing surplus labor" these analyses for the most part neglect the potential constraints to adoption arising from labor supply as well as from the seasonal distribution of labor demand. A recent review of the literature on the economic constraints to adoption of agricultural technology in developing countries found only three studies which related the supply of household labor to adoption of high yielding varieties (Schutjer and Van der Veen 1975). This is surprising in view of well accepted empirical evidence which shows the importance of seasonal labor supply/peak labor demand constraints in African agriculture (Cleave 1974; Helleiner 1975). As Spencer notes and Singh and Day illustrate for the Indian Punjab, the use of labor in peak seasons should be a key consideration in designing a technological package for smallfarmers (Spencer 1976; Singh and Day 1975).

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3. Once it was recognized that contrary to the theoretical predictions of dual sector models (Fei and Ranis 1964) the urban-industrial sector in most developing countries could not absorb their rapidly growing population into productive employment and thus a costless transfer of labor from the rural to urban sector could not be achieved, attention was focussed by the ILO and others on the labor absorptive capacity of the rural sector. Initially, this entailed sector-level analysis (Sen 1975), but eventually it included more detailed farm level investigations.

Evidence from various studies indicates that technical change in agriculture--whether in the form of new crops, new production inputs, or new production techniques and tools--has a significant impact on farm-level labor requirements. These effects can be broken down into several components for purposes of analysis: annual labor demand; seasonal labor demand; and composition and elasticity of labor supply. The existing empirical evidence on bio-chemical<sup>4</sup> technology will be very briefly reviewed within this framework in order to provide a context for generating the research hypotheses.

#### Annual Labor Demand<sup>5</sup>

The consensus of reviewers of the currently available empirical evidence about the impact of adoption of bio-chemical technology on the annual use of farm labor is that: it results in a substantial increase in annual labor use per hectare (Ruttan 1977, p.17; Yudelman 1971; Schutjer and Van der Veen 1977, p.16; Singh and Day 1975; Staub 1973). A survey of case study evidence for India, Pakistan, and the Philippines indicated that the use of high yielding varieties leads to a 20 to 50% increase in the demand for labor, per hectare, at the farm level (Yudelman 1971, p.78). One of the few studies on this subject which was undertaken outside Asia and one of the only to compare labor use under the traditional and new technology found that farmers employing the new technology for maize-beans and potatoes-peas production utilized more labor (man days) per hectare than those using traditional technology (Sepulveda 1979).

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4. Bio-chemical technology means the use of high yielding seed with associated complementary inputs such as fertilizer. Yudelman (1971) found that in all cases examined for India, Pakistan, and the Philippines, the use of high yielding seeds was associated with the use of complementary purchased inputs, though not necessarily at the recommended levels, which were not found in traditional agriculture. Irrigation or water control measures are complementary to bio-chemical technology, but are considered mechanical technology.

5. Although most studies use the terms labor demand and labor use interchangeably, in most cases actual labor use is examined and taken as a proxy for labor demand. However actual labor use reflects adaptation to the labor supply situation: it does not necessarily accurately reflect labor demand (Cleave 1974, p.179).

The increase of labor use per hectare associated with adoption of bio-chemical technology is due to the interaction of several factors: increased yields per unit of land; the direct effects of the change in technology (change in the quantity and quality of production inputs, production techniques, operations performed, crops produced); and the indirect effects of possibilities for more intensive cultivation (multiple cropping). The specific tradeoffs between inputs and operations which increase labor requirements and those which decrease them are complex and region and crop specific. Even mechanization, by enabling timely performance of certain operations, may provide for an increase in labor input per hectare by facilitating intensified land use. The impact of technical change on total labor use is thus the aggregation of its effect on specific agricultural operations.<sup>6</sup>

#### Seasonal Labor Demand

The impact of technical change on seasonal labor use involves its impact on the seasonal pattern (timing) of labor use as well as the change in labor requirements of each farming operation performed during the season. In traditional and modern, non-irrigated agriculture, the key determinant of the seasonal pattern of labor use is the rainfall pattern. This determines planting time and the vegetative cycle of the crop determines subsequent seasonal labor requirements.<sup>7</sup> Irrigation, by evening out the distribution of water availability and by providing a means of controlling the planting time and the growth cycle; tends to even out the distribution of labor use throughout the season.

Since, as Singh and Day note, technical change is for the most part specific to certain tasks and materials used in their performance, one would expect it to change the seasonal labor requirements more substantially than the aggregate annual labor requirement which reflects tradeoffs between labor saving and labor using innovations. This is supported by the evidence from their study of the introduction of high yielding varieties and selective mechanization in the Punjab. They found

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6. It should be noted that annual labor use may vary considerably from year to year depending upon climatic conditions.

7. Cleave finds that in traditional African smallholder agriculture the labor peaks tend to come toward the middle of the wet season. Weeding is the most important seasonal pressure and, if the hand hoe is used, land preparation is the secondary bottleneck (Cleave 1974, p.195)



only a slight increase in the total demand for labor, but a marked and substantial change in the seasonal distribution of labor demand which increased considerably in some periods and declined in others (Singh and Day 1975, p.673). However, other studies found that the seasonal pattern of labor use did not change, but that the amount of labor required for certain tasks changed considerably (Sepulveda 1979; Spencer and Byerlee 1976). This was directly associated with the use of new inputs particularly fertilizer.

It is important to identify seasonal peaks in labor demand since these are a potential source of constraints to adoption. Technical change should aim at modifying and complementing rather than aggravating these seasonal peaks in labor demand so that maximum benefit can be achieved from production. It seems likely that incomplete adoption of inputs and practices is in part a reflection of labor constraints.

#### Composition and Elasticity of Labor Supply

As discussed earlier, analysis of the relationship between labor supply and technical change has been quite limited. One survey of the literature on constraints to adoption found only limited evidence that shortage of labor was an important constraint to adoption and effective use of high yielding variety technology (Schutjer and Van der Veen 1977, p.16). However, this could reflect the nature of the studies undertaken which tend to assume that labor supply is adequate and the fact that labor use rather than actual labor requirements of the new technology were being measured. In one of the three studies which did relate labor supply to adoption, it was found that shortage of family labor was a barrier to adoption (Ibid). In the Punjab, Singh and Day found that selective mechanization was a response to labor supply constraints at certain times of the season (Singh and Day 1975).

The limited empirical evidence seems to indicate that technical change has the greatest impact on hired labor (Sepulveda 1979; Staub 1973; Yudelman 1971).<sup>8</sup> One of the only detailed studies of the differential impact of technical change on different types of labor (family, hired permanent, hired casual) found that the use of inputs associated with

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8. Several studies found an inverse relationship between farm size and use of family labor (Yudelman 1971, p.74).

bio-chemical technology had a greater impact, at least in the short run, on use of hired labor per farm and per hectare (Staub 1973,p.41). Staub's models had little explanatory power regarding the use of family labor. Contrary to his original hypothesis that introduction of the new technology which increased labor demand would result in absorption of underemployed family labor, the results suggested that family labor per farm did not vary freely with variations in input use (Staub 1973,p.60).

It argued in Staub's study (1973) and elsewhere (Sepulveda 1979) that family labor supply is inelastic and is endogenously determined in the short run by the number and work capacity of the household members and alternative employment opportunities.<sup>9</sup> Staub concludes that underemployment of family labor is overestimated. If his study had taken into account time actually spent on off-farm and household activities and the seasonal basis of labor use perhaps the reasons underlying the results would have emerged.

On the whole, there is a lack of empirical evidence on this subject and the existing evidence does not seem conclusive. It does seem that family labor supply could be a definite constraint to adoption and effective use of new technology if other sources of labor, in particular hired, and the means to employ it, cash, are not available when needed.

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9. Cleave (1974) notes that although family labor supply is inelastic, in the short run at least, regarding the number of laborers and possibly the number of days worked, it is elastic regarding the number of hours worked per day.

WOMEN AND TECHNICAL CHANGE IN AGRICULTURE

It is extremely difficult to separate the effects of technical change on the rural household from those stemming from the transition from a subsistence to commercial rural economy.<sup>10</sup> In fact, of course, these two processes are interlinked and technical change is viewed as a means for "modernization" of the economy.<sup>11</sup> The interaction of these two processes and the difficulty of sorting out the effects of each contributes to the apparent contradictions encountered in discussions of the impact of rural development on the role of women in agriculture. There is actually very little theory or empirical data concerning the impact of the introduction of new agricultural technology on the socio-economic relations within the rural household.

Ester Boserup's work (1970) brings together statistical and ethnographic data about women's changing roles to generate hypotheses which have become the guideposts to further, more detailed research on the subject. She presents an evolutionary theory of the dynamics of change from a traditional, extensive agricultural system to a modern, intensive one which links the predominance of men or women in food production to the land use pattern and corresponding techniques of production (type and quality of tools, method of watering and fertilization) and to the type of social relations (land tenure, type of marriage and marriage payment). For example, she explains that polygynous marriage prevails where land is abundant and therefore shifting agriculture, hoe cultivation and allocation of user rights to land are found. Polygyny is prevalent since women are an economic resource ensuring greater access to land (through greater ability to use it), high status, and more leisure.

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10. The Kenyan rural economy is in the midst of transition from a predominantly subsistence to a predominantly commercial, capitalist economy; the degree of commercialization of course varies by region and perhaps more importantly by ecological zones, with those zones suited to the most lucrative cash or export crops—tea and coffee—being more commercialized than those suited, for example, to cotton. If one relies on the percentage of food originating from retained or subsistence production as an indicator of commercialization, then Kenya is mid-way on the subsistence-commercial continuum (Schmidt 1979, p. 20)

11. This is generally taken to mean use of 'modern' technology, specialization of production and production for sale, and increased dependence on the market for production inputs and purchase of other goods and services formerly produced within the household (Z goods).

She thus links her theory of the sources (population density which induces a change in land use) and correlates (technology, land tenure, source and productivity of labor) of technical change in agriculture (Boserup 1965) to changes in the division of labor by sex and social relations within the household (Boserup 1970). The discussion is extended to include the impact of colonialism and commercialization of the economy, including introduction of modern technology, on the relations of production between men and women in the rural household.<sup>12</sup> She concludes, as do various other researchers (Palmer 1977; Tinker 1976; Staudt 1976), that the kind of rural development promoted under colonialism and thereafter has had an adverse impact on women relative to men. These arguments however remain for the most part too general and impressionistic.

The guiding hypothesis of this research is that technical change in agriculture will have a differential impact on men and women. The principal theory in this regard is that technical change increases the productivity gap between men and women (Boserup 1970; Palmer 1977). This is partly due to historical factors which resulted in differential access to agricultural technology according to economic status, race and sex. The colonialists promoted the development of technology for cash crop production. Even hybrid maize was developed for large, European farms growing maize as a cash crop; coincidentally, maize was also grown as a subsistence crop by most small farmers and the technology was transferable to them. The new technologies were generally introduced to men who were considered the "appropriate" farmers and who were in theory at least more involved in cash crop production.

As compared to their wives and woman farm managers, men therefore have had better access to productivity increasing innovations which in any case were more suited to their crops.<sup>13</sup> This was accentuated by the fact

12. For a summary of Boserup's theory and criticism <sup>of</sup> it see Garfield (1977) and Huntington (1975).

13. There is a widespread misconception that women farmers are tradition minded and unreceptive to technical change. (See for example, Ouko 1979.) This resembles arguments about the failure of smallholders to adopt agricultural innovations. Empirical data, however, support the view that farmers are rational resource allocators and that it is factors such as risk and the on-farm profitability of the innovation that are the determinants of adoption behavior (Perrin and Winkelmann 1976). Likewise, the available evidence - although limited - shows that women are responsive to innovation and willing adopters of profitable technologies (Weil 1973; Currens 1976). For Kenya, this is demonstrated by Gerhart (1976) in the case of hybrid maize in Western Kenya; by Staudt (1976) for a six point scale of cash and food crop innovations in Nakamega (p. 220),; and by Hunt (1974a) for various crop innovations and husbandry practices in Mbere, Embu.

that women farmers tend to have less of the prerequisites--such as cash, loan security in the form of land title or salary, and enough land to meet certain program requirements of minimum hectareage--which make adoption feasible. Furthermore, as Staudt (1976) has shown in her Kakamega case study, even when women do have these prerequisites they face discrimination in the provision of agricultural extension services.<sup>14</sup> Even if extension services were oriented to disseminating information and services to women, they would face communication problems since most of the staff is male.

The predicted consequence of these factors is that the productivity gap between men and women in agriculture will increase. Women will remain in the subsistence sector using traditional technologies while men become increasingly involved in commercial production with modern technologies (Palmer 1977, p. 104). Furthermore, the on-farm division of labor by sex is predicted to change so that performance of tasks incorporating new technology will be taken over by men (Murdock and Provost 1973, p. 216). These trends are reinforced by a similar tendency in regard to employment in the rural non-farm sector which affords less opportunities to women (Kenya, Women in Kenya 1978; Stichter 1975).<sup>15</sup>

Although this research will not directly tackle the productivity gap issue, which presents serious methodological problems,<sup>16</sup> various subsidiary hypotheses will be tested. The fundamental hypothesis guiding this research is that the division of labor, rights to income, support obligations, and decision making roles by sex within the rural household will be an important factor affecting:

14. In her thoroughly documented study, Staudt (1976) found, controlling for the level of wealth, that: "the proportion of women farm managers receiving services at higher economic levels is exactly the same as that of jointly managed farms in the lower economic category" (p. 224).

15. Furthermore, it seems that women tend to be involved in less remunerative, small scale activities in the informal sector, whereas participation in larger scale, more lucrative activities particularly in the formal sector tend to be undertaken by men. This is the case in maize and beans marketing where market traders of the informal subsystem are predominantly women (70.8% maize and 87.6% beans) with no previous employment except on the family farm who utilize very small working capital and deal in small quantities of produce (Schmidt 1979, pp. 29-30). On the other hand, larger scale trading which involves much larger volumes, higher capital investment and considerable capital costs is primarily done by men (65% in the case of lorry traders and 21.9% in the case of produce store/MPB agents), (Ibid).

16. To the author's knowledge, there are no studies which successfully test this hypothesis. In some studies, inferences are drawn about productivity (Staudt 1976; Monsted 1977), but it has thus far not been adequately dealt with. Mook (1976) has done a comparison of technical efficiency of farms managed by women as compared to jointly managed farms, but this seems to be the extent of this type of research. Comparing productivity within the household becomes much more difficult since it is extremely difficult to determine the output of individual household members particularly when part of that output is for subsistence consumption and household maintenance.

- (1) the adoption of new agricultural technology,
- (2) the effective use of the technology, and
- (3) the welfare consequences of adoption for each household member as well as the household as a whole.

It is argued that technical change will have a differential impact on the labor input of each household member as well as on his or her access to productive resources, right to the benefits generated by increased productivity, and decision making role within the household (Pala 1976, p. 3). The specific research hypotheses will be delineated within the framework of a brief discussion of the division of labor; intra-household distribution of income, support obligations, and access to productive resources; and household decision making roles.

#### Division of Labor

In the Sub-Saharan African context, the composition of household labor supply by sex and age is a relevant and important variable in predicting and evaluating adoption and effective use of new technology. As discussed earlier, the employment implications of technical change must be examined on a task/<sup>by task</sup>basis. Since tasks are allocated on the basis of sex and age, this means that technical change will have a differential effect on the labor inputs of adult male, adult female and child household members depending upon which tasks (for which crops) become more labor intensive (Spencer 1976, p. 2).<sup>17</sup> Of course the possibility of outside sources of labor, hired or exchange, substituting for a family member's labor must also be considered.

There are few studies which examine the change in labor demand disaggregated by sex which results from the introduction of technical change. One of the few that does substantiates the argument that the introduction of new production inputs and techniques has a differential impact on family labor inputs which is tied to the "sex specific nature of some farm activities" (Spencer 1976). This study found that with the introduction of mechanical technology for swamp rice cultivation in Sierra Leone, the mean hours work per adult male per month decreased slightly while that of an adult woman

17. This is a key assumption of many rural development strategies including the current Kenya Development Plan 1979-83 and the IADP.

increased 50% over those farms using hand cultivation. This is explained by the fact that mechanization reduced the time needed for land preparation, which was done primarily by men, while it increased the amount of land that could be cultivated and thus required more labor for planting and harvesting which was primarily done by women. This is then compared to the introduction of bio-chemical technology for inland swamp rice cultivation which increased the adult male labor contribution 50% due to increased need for land development and left the adult female labor input (per month) about the same (Spencer and Byerlee 1976).<sup>18</sup>

There are indications that there is, in the short run at least, a lack of substitutability among male and female family labor which is dictated by the traditional division of labor (Cleave 1974; Wills 1968). However, it has been observed that due to the pressures of male migration and wage employment, women are increasingly assuming formerly male tasks (Fischer 1956; Hanger and Moris 1973; Pala 1978). It is thus possible that:

Hypothesis 1: The change in labor demand due to adoption of new technology may pose a constraint to adoption due to the composition by sex and age of the family labor supply.

Hypothesis 2: The incomplete adoption of recommended levels of input usage and husbandry practices may reflect labor supply constraints stemming from the division of labor by sex.

Hypothesis 3: If there is a modification of the traditional division of labor due to the introduction of the new technology, women will tend to perform traditionally male tasks rather than vice versa.

Hypothesis 4: There will be a change in the sources of labor with hired labor becoming more important.

Hypothesis 5: Hired labor, particularly casual labor, will follow the same division of labor by sex as family labor. Thus, if technical change increases the labor demand for women's tasks, the labor constraint will be accentuated since adult female family labor is already fully employed and therefore not available for hire.

However:

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18. In the first study, Spencer (1976) specifically tested the hypothesis that the introduction of bio-chemical technology would disproportionately increase the work load of women. He found that male children experienced the greatest percentage increase in their work load; thus, the hypothesis was not supported. However, it remained true that women worked more than men in inland swamp rice production. In fact, in order to assess their total burden, time spent on household tasks should have been examined.

- a. If the unemployment situation for men becomes severe enough and/or the economic incentives (due to seasonal labor shortages which raise the wage rate) become high enough, men will move into women's jobs.
- b. Seasonal in-migration of female labor for hire may meet the constraint or for that matter male labor willing to perform female-typed tasks.<sup>19</sup>

Hypothesis 6: Wage rates for women's tasks will be lower than those for men's tasks. Women will get paid less than men for performing the same task.<sup>20</sup>

The impact of technical change on the overall labor burden and thus physical welfare of women must be examined in the context of all their activities not just on-farm or non-farm "productive" activities since household support tasks take a great percentage of their time and are relatively inflexible in terms of the amount of time required (Hanger and Moris 1973). Furthermore, technical change may increase the burden of these household activities. For example, with the introduction dairy cows, water requirements of the household increase considerably and it is usually the woman's task to fetch water.<sup>21</sup> On the other hand, non-agricultural innovations such as piped water and posho mills may actually save women significant amounts of time which could then be used in other productive activities or simply ease their heavy work burden.<sup>22</sup>

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19. In her study of Embu Wills found that: "Where males are found performing 'female' tasks, it tends to be among casual labourers working for other farmers outside of their immediate home community (and hence less subject to ridicule from their peers" (Hanger and Moris 1973, p. 229).

20. Pala (1978) found this to be the case in Luoland. For example, she found that men who do ploughing are better paid than women who do weeding. However, she does not analyze this adequately. In the case of these two tasks at least, ploughing requires investment in a power source and equipment whereas weeding requires a simple tool such as a panga and human labor.

21. In drier areas of Kenya, fetching water is an extremely time consuming task (Hunt 1974a; Whiting and Krystall 1977 as cited in Monsted 1978, pp. 35-36; Hanger and Moris 1973).

22. In the case of posho mills, there seems to be a trade off between the time saved from manual grinding and the increased time spent walking to the mill and queuing (Wills n.d., RDR 51).



Hypothesis 7: Increased use of inputs and introduction of labor intensive husbandry techniques and crops will disproportionately increase the work burden of women relative to men and children. Possible indirect effects increasing labor time include: increased time spent on the husband's cash crops; increased marketing, transporting, and processing due to HIGHER yields; greater time spent on household requirements like fetching water to meet new needs stemming from the innovation.

The question of the increasing work burden of women must also be seen in the context of pressures stemming from increased commercialization of the rural economy.

Hypothesis 8: Commercialization of the rural economy leads to a greater work burden for women, since:

a. Due to pressures for cash, she is likely to spend greater time on non-farm income generating activities without a corresponding decline in her on-farm work.<sup>23</sup>

b. Male migration and increasing education of children will increase the number of tasks performed by women unless they can afford to hire labor or otherwise compensate for the diminished household labor supply.

c. Household duties which already take up a large portion of women's time may become more time consuming. For example, de-forestation makes it more difficult to gather fuel and finding nearby sources of water is a serious problem in certain areas.

Hypothesis 9: As farm management and agricultural labor become increasingly the province of women, labor constraints due to the division of labor by sex may become of less concern than the overall work burden which is borne almost entirely by women.

23. Cleave (1974, summary Chpt 6) cites evidence indicating that women tend to give up leisure time when they put in more work on the farm, while men tend to trade off time spent on the farm with non-agricultural work so that leisure remains constant.

Intra-Household Distribution of Income, Support Obligations and Access to Productive Resources.

Anthropological evidence indicates that within the rural household men and women have different sources of income based primarily on their differing productive activities (Fischer 1956; Monsted 1975; Pala 1976). The division of labor is thus the basis of certain rights to dispose of produce and to retain cash accruing from the sale of such produce. There is a corresponding division of support obligations within the household with women generally assuming responsibility for provision of food and basic household necessities (Monsted 1975; Staudt 1976; Hanger and Moris 1973).

This has important implications for evaluating the impact on family welfare of adoption of technical innovations. It is generally assumed that increasing output and thus presumably increasing food consumption and/or cash income will automatically benefit the entire household or that it will benefit each household member equally. However, this will depend on which household member has the right to the income and whether or not it is used for the welfare of the household as a whole. Furthermore, one must examine whether or not rights to income and support obligations change with the introduction of the technology in order to see how the burden of household support changes. This issue, therefore, must be examined in terms of the impact of technical change on the distribution of physical product as reflected in nutritional status; the intra-household distribution of rights to cash income; and access to cash generating activities as it relates to support obligations within the household.

It is often presumed that technical change, specifically the innovation of food crop production as part of the crop package in the case of IADP, will improve the nutritional status of household members since it will insure the household food supply and also increase cash available for food purchases. It should be noted, however, that within the household the nutritional welfare of different family members varies on the basis of sex and age. A comparative review of data on nutritional status for various countries found --controlling for level of income, family size and composition -- that "at every age males fare better than females in terms of nutritional inputs" (Rao cited in De Tray 1977, p. 4). Although this issue will not be analyzed in this study, it is hypothesized that adoption of technical change will have a differential impact on the nutritional status of male and female household members with females remaining in a less favorable position.<sup>24</sup>

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24. This must be examined in the context of how the work load of household members changes since an increased work load would of course raise the nutritional requirements of those affected.

Furthermore, it may have an overall negative impact on nutrition in the household (Bukh 1977).

Before the predominance of the cash economy, the existence of separate granaries for the husband and wife was the basis for maintaining separate rights to income which was largely in kind rather than cash (Fischer 1956; Oboler 1977b). Under conditions of the cash economy, it can be generalized that men retain the right to income from cash crops, particularly export crops, and that women have rights to income from sales of subsistence crops (Monsted 1977)<sup>25</sup>. When this subsistence/cash crop distinction is blurred, which is the case for maize in certain areas of Kenya, it results in "increasing family disputes between husband and wife, especially when the crops in the granary are low" (Monsted 1977, p. 283).

Hypothesis 10: Although women have had disposal rights over surplus food crops, with the introduction of output increasing technical change for food crop production, men will claim at least a part of the increased product for sale.

Hypothesis 11: For the most part, cooperative members are men.<sup>26</sup> Since the IADP requires that the cash crop be marketed through a cooperative, men are likely to retain the right to these earnings even when women are the actual producers.

Hypothesis 12: Income derived by the man from cash crop production will not be pooled with the family. In fact, the other family members, in particular the wife, may not know the actual income acquired in this way. Thus, increased cash income does not automatically benefit the entire household. This depends on how the man decides to dispose of it.

As the rural economy becomes increasingly monetized, cash generating activities become crucial to securing basic necessities like food and clothing and to having access to economically important opportunities such as education. This is resulting in a great strain on smallholder households which often do not have an adequate productive base to acquire the needed cash; only the richest 25% of smallholders (KShs. 1000 and above) do not face a serious cash constraint (Smith <sup>1977</sup>/p. 49). The pressures of commercialization of the economy seem to be accentuated in the case of rural women since they have less access to productive resources and opportunities to earn cash.

25. This was the case for the peasant strata. Monsted (1977) finds that in the middle and rich strata, the husband disposes of nearly all farm income and the wife depends on him for essential cash needs in the household.

26. Staudt (1976, p. 272-73) found that the man represents the family as cooperative member. Of the 7% cooperative members who were women, all were widows. If the husband was not present, the wife was unlikely to join.

With the colonial imposition of the concept of private ownership of land in place of allocation of use rights by the kinship group, legal control of land including the right of alienation went for the most part to men (Pala 1978).<sup>27</sup> Lack of ownership of the basic productive resource is one of the bases for lack of access to other productive inputs and services. Furthermore, 90% of the women on rural smallholdings had no other employment apart from agricultural production on their own holding (Kenya. Women in Kenya, p. 9). In contrast, less than 5% of women in smallholder households were engaged in wage, including casual, employment whereas 29% of the men were so engaged (Ibid, pp. 10-11). Women also tend to be less involved in self-employment in non-agricultural rural enterprises.

Hypothesis 13: Male or jointly managed farms have better access to productive inputs (e.g. hired labor, cash inputs like fertilizer) and agricultural services such as extension, credit and training than female managed farms.<sup>28</sup>

Hypothesis 14: Within the household, women have less access than men to purchased inputs and agricultural services for use on their plots and crops.

It has been found in various case studies (Monsted 1977; Hanger and Moris 1973; Pala 1978; Staudt 1976), that despite the fact that men are more closely tied to the cash economy through wage labor and sale of cash crops and have greater access to productive resources, women maintain their traditional support obligations which increasingly require cash purchases (Kershaw 1975). Hanger and Moris (1973) in their study of the Mwea Irrigated Rice Settlement Scheme show the serious problems resulting from the fact that income is not pooled but instead accrues to the man, cash needs are increasing and women retain traditional support obligations yet have less access to cash generating activities.

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27. Pala (1978, p. 9) found that in only 6% of the cases was land registered in a woman's name.

28. Moock/ (1976) found that women farm managers had smaller farms and used less purchased inputs and more labor. Lack of access to cash could explain the lower level of purchased inputs. Data from other countries indicates that women tend to farm less land and land of poorer quality (Bukh 1978, p. 72).

Hypothesis 15: Women will retain their traditional support obligations, for example, provision of the food for themselves and their children, while they may have less means to meet them.

Hypothesis 16: Husbands tend to assume a greater proportion of support obligations as the level of cash expenditures increases.<sup>29</sup>

Hypothesis 17: Within the household, the woman will benefit less than the man from introduction of technical change since he will have better access to the increased income. Thus, intra-household disparity of income and welfare will increase.

Hypothesis 18: The disparity in income between male or jointly managed farms and female managed farms will increase with the introduction of technical change.

#### Household Decision Making Roles

The nature of decision making within the household has important implications for to whom and how new technology is disseminated. This relates to the issue of whether there is unified decision making or whether there is a division of decision making into male and female realms. The key factors affecting the nature of household decision making roles are: the presence or absence of the husband; the stage of the domestic cycle; and socio-economic status (Abbott 1974; Kershaw 1975; Hanger and Wills 1973).<sup>30</sup>

29. The high incidence of male migration and female headed households raises the important question of cash remittances as a form of support contribution by the husband to the household. Staudt (1976) found that of the 40% of households where the husband is absent, 30% received no remittances at all. There is little available information on this subject. It is a crucial though sensitive issue which is key to understanding how the smallholder household functions as an economic entity. What degree of interaction and economic support is maintained and how does this vary with the level of the migrant's income, distance from home and possible establishment of another family in the new area. Is there in fact the phenomenon of "one family, two households"? Without a clearer picture of these economic interactions neither the urban or rural household situation can be clearly understood.

30. Abbott (1974) found in Myeri that whether or not the husband was present, women exercised more decision making authority at later stages in the domestic cycle than when they were younger and still within the extended household. In her comparison of traditional and contemporary decision making roles among the Kikuyu, Kershaw (1975, p. 178) found that for the bottom strata (0-1.99 acres, 57% of sample) women had greater decision making authority than traditionally probably in large part because men were in the cities in low paying jobs which did not permit them to contribute much to the rural household either in remittances or labor. In the middle strata (2-6.99 acres, 29% of sample) it was quite similar to the traditional pattern. However, in the top strata (7 acres and up, 14% of sample) women had lost independence in traditional realms. On the other hand they served as the husband's farm manager which due to increased economic power meant expanded responsibilities.

Anthropological sources (Fischer 1956; Oboler 1977b) indicate that men and women within one farm household may make separate farm management decisions for their respective plots and crops. However, the notion that there is a single decision maker who manages the farm as a single production unit is pervasive; in fact most definitions of the sampling unit for farm management surveys rest on this assumption.

Moock (1973) in his study of maize production in Vihiga has refined this concept to include two levels of farm decision making. He draws a distinction between the farm head (basically the same concept as the household head) and the farm manager who are generally assumed to be the same person in most studies. The farm head makes decisions about what enterprises and investments will be undertaken and what resources will be employed as well as what produce will be sold; he or she thus makes virtually all decisions regarding the use of cash resources. The farm manager makes the technical decisions about how and when to use a given set of resources which the farm head has decided upon; he or she makes decisions about such matters as when to plant and how to allocate family labor. There is a grey area of uncertainty about who makes decisions concerning such matters as whether to grow more or less maize and over sales of small quantities of produce. (See Table on Page 45, Moock for delineation of the decision making model.)

Evidence indicates that women tend to be responsible for day-to-day farm management decisions (Staudt 1976; Pala 1978; Hanger and Moris 1973). Staudt (1976, p. 172) found that for the 60% of her sample where the husband was present, in at most 50% of these households did the husband take an interest or participate in farm management. Therefore, even when the husband is present, decisions regarding husbandry practices, crops grown, time of planting and storage are frequently taken by women. In accord with their almost exclusive performance of household maintenance tasks (food preparation, child care, fetching water and so on), women exercise decision making authority in this area (Hanger and Moris 1973, p. 228). Decisions involving regular or major cash expenditures and land transactions, however, in line with Moock's distinction seem to be more frequently the province of men (Hanger and Moris 1973; Pala 1978).

Hypothesis 19: The traditional division of decision making authority by crop and plot will diminish if the husband works off the farm. The woman will assume responsibility for farm management.

Hypothesis 20: If the husband is present on the farm, even if he is not involved in farm management, he will tend to make the adoption decision. This is because the male household member tends to be the cooperative member and has better access to the complementary services necessary for successful adoption due to his ownership of land and the orientation of agricultural services to men.

Hypothesis 21. Women retain authority in the domestic domain particularly in the area of food provision despite greater dependance on the cash economy.

Hypothesis 22: If the husband is present, decisions regarding home improvements and education for children will be either made by him or jointly with his wife.

Presumably, when the husband is absent, the wife's decision making authority increases (Kershaw 1975). In fact, it seems plausible from a practical point of view that in households where the wife manages the farm and the husband has resided away for an extended period of time, Mook's distinction between the farm manager and the farm head breaks down.<sup>31</sup>

Hypothesis 23: If the husband has been absent for an extended period of time, the distinction between the wife as farm manager and husband as farm head will break down and the wife will assume all decision making authority. She will thus be the one to make the adoption decision.

Hypothesis 24: Woman in the lowest socio-economic groups, in part due to high male out-migration, will have greater decision making authority relative to their husbands than those in higher economic strata.

Hypothesis 25: Women in households later on in the domestic cycle and those who are widowed will have greater decision making authority than those earlier in the domestic cycle and those whose husbands are alive.

Another aspect of decision making which has serious implications for dissemination and effective use of the technology is whether the household member(s) making the adoption decision is the actual implementer of the decision.

Hypothesis 26: If the husband makes the adoption decision and receives the agricultural training which is part of the adoption package while the wife is the actual farm manager and therefore the implementor of the decision, problems may arise in effective use of the technology.

31. Of course this probably depends on factors such as: the length of time he has lived away and the frequency of visits; the distance to his residence; whether or not he has established a new household in his place of residence; and the level of remittances as a percentage of family income. A major decision such as a land transaction would probably still be made with the consent of the son or husband.

In this section, various hypotheses were developed concerning the guiding research question of how the division of labor, income and decision making by sex within the household affect the adoption, effective use and welfare consequences of technical change in the form of the IADP crop package. It is hypothesized that adoption will be affected by potential labor constraints stemming from the division of labor by sex and by the division of decision making authority which affects dissemination of the innovation. Effective use will be affected by labor constraints, by the fact that the person who makes the adoption decision may not be the implementor of it and by other factors exogenous to the household such as availability of inputs. Welfare consequences of adoption within and between households will depend on who has rights to the increased product and income, the division of household support obligations and whether there is differential access to the technology.



RESEARCH METHODOLOGY

IDS/WP 358

The study will rely on and supplement input-output and division of labor data gathered by the Monitoring and Evaluation Unit of the Integrated Agricultural Development Program (IADP) of the Ministry of Agriculture.

The Integrated Agricultural Development Program (IADP)

The IADP aims to increase the productivity and welfare of the small farm sector through introduction of new technology and improvement and coordination of basic services and facilities. It is oriented to farmers "not yet significantly participating in the cash economy" and "aims to recruit participants who have not benefited from previous projects" (Development Plan 1979-83; Kenya, IADP Phase II 1978). Phase I, commencing in 1977, included farms in 4 provinces, 14 districts, and 76 locations. Phase II, commencing 1978/79, will expand the program coverage to all 6 provinces and will cover 29 districts including all the former Special Rural Development Program (SRDP) districts. It is estimated that program coverage will be 90% of the smallholders in each program area.

The IADP is based on a "package" approach to introducing technical change in agriculture. This approach stems from the recognition that the profitability of a new technology, particularly new seed varieties, depends on availability and utilization of a complementary set of inputs, husbandry practices, and supporting services. It is an integrated program in the sense that it aims at introducing in a coordinated fashion the technology, training, infrastructure development and services.

The main component of the IADP is the dissemination of a location specific crop package--composed of a cash crop to secure loan repayment and one or more food crops to insure the family food supply--which minimizes risk and does not exceed on-farm economic and technological constraints.<sup>32</sup> Seasonal production credit through cooperatives is the vehicle for dissemination

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32. Employing a cash crop as security for agricultural credit was tried in the Cooperative Production Credit Scheme (CPCS) pilot project in 1969. It means that the program can be undertaken in areas where land adjudication has not been undertaken or completed since the title deed is not used as loan security.

of the technical package of crops, livestock improvements and complementary material inputs.<sup>33</sup> Improvement in livestock, basic services (marketing, extension, cooperatives) and infrastructure (transportation) are to be introduced simultaneously. Other sub-programs such as the Coffee Rehabilitation Project and the Horticultural Development Project are also subsumed under the IADP.

The IADP Monitoring and Evaluation Unit (MEU)

The IADP developed out of experiences with other rural development programs, in particular the SRDP (1971-77) and the Smallholder Production Services and Credit Project (1976). It reflects the recognition, becoming more and more widespread among planners and scholars, that there are technological and socio-economic constraints to adoption by small farmers of productivity increasing innovations. Arguments about "tradition-minded" farmers and failure to adopt "profitable" technologies have proven unsatisfactory in the face of mounting empirical evidence that farmers in fact know more about their economic interests and the profitability of various technologies than planners and agricultural technicians seem to think (Development Plan 1979-83, p. 229; Perrin and Winkelmann 1976).

The Monitoring and Evaluation Unit of the IADP was established to follow the progress of the project in order to identify these constraints so that on-going modifications of the program can be made. It has an ongoing farm survey which gathers input-output data on a monthly basis. For Phase I,

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<sup>33</sup>The credit is repayable in 18 months through deductions by the cooperative from a members cash crop receipts. There is a borrowing limit based on an average value of past production and the farmer is expected to contribute one-third of the package costs (including family labor contribution) while the credit contributes the remaining two-thirds. For Phase 1, approximately 90% of the credit was in-kind with the largest percentage going to fertilizer and 10% was in cash for hiring labor (Table 1.3, Annex I, Summary of District Work Plans, IADP Work Plans 1977-78). There is also a specified minimum area of the farm (1.2 to 1.6 hectares) which is to be designated for the crop package; this is believed to ensure the profitability of the package and is derived from the Enterprise Budget. Aside from this, the requirement of cooperative membership and the general program objective of reaching those not significantly involved in the cash economy and who have not benefited from other programs, the criteria for choosing program participants seem to be rather vague (Work Plan for 1976-77). It is left to divisional agricultural and cooperative officials to initially select and recommend farmers. District level officials draw up recommendations for the technical package and draw up the Enterprise Budgets which provide estimates of costs and profit of the package.

the survey includes a sample cluster in one location chosen from each of the 14 districts participating in the program.<sup>34</sup> Once the location (Co-operative Society) was chosen for each district, the sample frame consisted of the Co-operative Society list of March 1977 IADP loanees from which a systematic random sample of 40 farmers was selected.<sup>35</sup> Therefore, the farm survey originally included 560 IADP loanees in 14 locations (Co-operative Societies). In April 1979, a randomly selected control group of ten farmers per sample cluster was introduced.<sup>36</sup>

The farm survey information is gathered by resident enumerators through the instrument of a three part questionnaire.<sup>37</sup> Part A is administered once a year to determine the "opening and closing valuation analysis." It gathers information about household size, labor force, acreage and value of acreage under each crop category as well as information about farm assets. Part B is designed to gather detailed farm management input-output data by plot; it is administered once a month to each household. It records inputs (type, quantity, cost) and all labor inputs for each production activity by plot and crop. Each activity is recorded after it is completed in order to avoid double counting. Part C gathers information about input supply, marketing and extension service. It is administered two times a year at the end of the Long Rains and Short Rains. In 1979, a supplementary module entitled Average Wage per Day was introduced which gathers information about the division of labor by sex and age as well as

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34. Criteria for selection of the location within each district were that the Co-operative Society: had at least 50 IADP loan participants for Feb/March 1977 and that it only served members within one location and operated in one agro-economic zone. There is a roughly a one-to-one correspondence between Co-operative Societies and locations and the choice of locations also reflected the desire to get a good distribution among agro-economic zones for the survey as a whole.

35. In the case of 2 locations, not included in this research, the sample frame was the AFC and the sample size was in one case less than 40.

36. The sample locations were divided into five grids and two holdings were randomly chosen from each.

37. A pilot survey was undertaken in March, 1977 to test the questionnaire. The Farm Survey began in June 1977 for the Long Rains, 1977.

the wage rates per day according to on-farm activity and crop.<sup>38</sup>

This farm survey data is analyzed by the MEU to determine adoption rates (e.g. a ratio which compares actual to recommended adoption, for example, actual fertilizer use/recommended use per hectare) and comparisons of actual results to predicted results (e.g. rate of profitability, output, etc.). In this way, problem areas can be identified. In addition, a Proforma Survey is administered quarterly to key institutions such as the cooperatives and AFC to monitor their performance and identify problems.

#### Research Techniques

A sub-set of six of the fourteen MEU Phase I sampling locations was chosen according to the following criteria: representativeness by climatic and agro-economic zone, crop package, ethnic group and availability of previous studies providing information about the division of labor by sex, household time allocation and the role of women in agriculture. (See Table 1.) Since neither the original sample nor the choice of the six locations to be studied here was completely random, the farm households chosen must be considered case studies rather than a representative sample of the smallholder population.

Data gathered by the MEU Farm Survey for four crop seasons spanning two calendar years (1977, 1978) will be supplemented by additional data gathered in follow-up interviews more specifically oriented to testing the hypotheses of this study.

#### Supplementary Data

The MEU Farm Survey was designed in modules so that supplementary components could be easily added. For the purposes of this analysis, the Average Wage Per Day module is of key importance since it facilitates disaggregation by sex and age of the family labor inputs gathered in Part B of the Farm Survey. It is assumed that this breakdown of family labor inputs will remain approximately the same between crop seasons so that this module will elucidate a percentage which can be applied to labor inputs for all crop seasons. In addition, a supplementary module elucidating more detailed information about the composition of family labor supply, the division of labor and approximate time spent on livestock, domestic and non-farm activities will be administered so that a more complete picture of labor constraints is available. This is particularly important in the case of women household

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38. The questionnaire does not make a distinction between hired and family labor. It thus is implicitly assumed that the division of labor by sex and age is the same for both. This will be examined as one of the research hypotheses.

inputs such as fertilizer which increase productivity as well as labor demand (Development Plan 1979-83, pp. 220-21). Since the IADP is the main program for smallholder development, the emphasis of this research on its on-farm employment implications should be of great interest to policymakers because it will provide information about both the probability and actual progress toward meeting plan objectives.

It is important to examine the Plan and IADP assumptions that there will be sufficient labor supply so that this will not act as a constraint to adoption of labor intensive crops and husbandry techniques (see Appendix 1). While it is recognized in the plan that there are seasonal and spatial labor shortages at peak times of labor demand, this is not viewed as a serious problem. Appropriate mechanization, technical changes which increase labor productivity and increased credit to smallholders which includes cash for hiring labor are thought to be sufficient to alleviate possible labor constraints (Development Plan 1979-83, p. 245). However, it may be that in a concern to absorb labor in the rural sector, the issue of labor supply constraints has been dismissed too easily. Particularly since this issue has most likely not been considered in the context of the division of labor by sex.

This latter point relates to the second contribution of the research which is to evaluate the differential welfare effects of the program within the household and between households with female farm managers and those that are male or jointly managed. As recognized in the Plan, higher income may not mean greater welfare of the entire household since it may, for example, be spent on pombe or changaa. This relates to the issue of whether men and women continue to retain rights to separate sources of income and separate obligations for family support.

It is also stated in the Plan that low incomes reflect lack of access to income generating opportunities. It is the contention here, which is supported by empirical evidence, that women in fact have less access to income generating activities than men and that this is accentuated by commercialization of the rural economy and introduction of technical change in agriculture. Since women constitute a high proportion of household heads and are the provisioners of vital family needs, this has important implications for the rural development strategy.

While this study will provide information vital to evaluation of achievement of Kenyan development objectives, it will also contribute empirical data which may form the basis for modification, refinement and possible refutation of the existing theories and hypotheses regarding the impact of technical change in agriculture on the rural household and, more specifically, the impact on women's roles and access to the benefits of technical change. In summary, the limitations of existing studies and approaches to the examination of the impact of technical change on the rural household and its members combined with the overall lack of empirical data on women's roles in rural development indicate the need for research on how farm households effectively use new technology and what the consequences of adoption of the technology are. Just as "trickle down" theories of development do not accurately describe the dynamics of national economic development, analagous "trickle down" theories of development as applied to the impact of technical change on the welfare of the rural household may be equally inappropriate.

APPENDIX 1: LABOR IMPLICATIONS OF THE IADP CROP PACKAGES

Evaluation of the impact of the IADP crop packages on employment is more complicated than analyzing the labor impact of a single innovation. Adoption of the package involves the following depending upon the specific location:

1. introduction of a new crop(s) which involves a change in the crop mix and the corresponding introduction of new production techniques;
2. change from traditional to new seed varieties<sup>1</sup> in the case of maize and use of complementary inputs;
3. change in the method of performing certain tasks, for example the change from hand cultivation to cultivation using oxen or tractor;
4. addition of new tasks such as dust/spray or application of fertilizer.

It is predicted that these changes will interact to result in increase in aggregate labor use and a change in the seasonal distribution as well as the labor burden on different family members by sex and age.

The planners of the IADP have tried to predict its consequences for labor demand. In the IBRD appraisal of Phase 1, it was estimated that the program would not result in increased use of family labor; increased use of hired labor during peak periods (an increase from 96 man-days a year to 270) was thought to be available to meet increased labor demand. It was assumed that provision of 25% of the program credit in cash for hiring labor would overcome the farmer's constraint for hiring labor.

In a more detailed estimation of the labor implications of the crop package the following table was derived.

Table A1: Incremental Hired and Family Labour for Typical Technical Crop Package (Work Days)<sup>2</sup>

	Traditional	New Technology	Net Increment	% Change
Hired	8	33	25	+ 313
Family	71	127	56	+ 79
TOTAL	79	160	81	+ 98

Source: Kenya. Ministry of Agriculture. IADP Loan Application, Phase 11, Annex 16, p.7.

1. The introduction of new seeds does not seem to have much impact on labor demand. It is the complementary inputs like fertilizer and the change in husbandry practices which significantly affects labor demand.

2. It was not stated how these estimates were derived. Given the variety of crop packages and ecological conditions, it seems difficult to generate a reliable 'average' estimate.

Total labor requirements increase almost 100% and on a percentage basis the hired labor contribution increases more than 300%. However, in absolute terms family labor still constitutes most of the increased labor needed. The impact on seasonal peaks in labor demand was not discussed.

A key concern of this research is to evaluate in more detail the actual labor implications of each crop package and to examine whether assumptions about the availability of hired and family labor in fact hold. If not, this could pose constraints to adoption and use of the package.



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