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# Technical Change and Intra-Household Welfare: A Case Study of Irrigated Rice Production in South Sulawesi, Indonesia

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*In this article the effect of an agricultural technical change on intra-household welfare is discussed. Existing theories of the household suggest that the distribution of resources within the household is a function of household members' employment. The differences in male and female employment levels under rainfed and irrigated rice production are investigated in a case study of two villages in South Sulawesi, Indonesia. It is concluded that the pattern of labour allocation in the irrigated area involves higher absolute labour requirements for both men and women, compared to the rainfed area, but that women's agricultural labour relative to men's is lower. Furthermore, women's participation in the cash economy is, relative to men's, lower in the irrigated than in the rainfed area. It is argued that these differences can be seen as a response to the different agricultural production technologies being used. This suggests that the levels of inequality within the household are greater in the irrigated than in the rainfed area.*

## I. INTRODUCTION

The purpose of this article is to examine how a technical change, in this case irrigation, affects patterns of male and female labour allocation and to suggest the implications of this for the intra-household distribution of welfare. This issue is analysed by considering data obtained from a case study of two villages, one based upon an irrigated agricultural system and the other on a rainfed system, in South Sulawesi, Indonesia.

In analysing technical changes in agriculture, such as those associated with the 'Green Revolution' for example, many studies have considered the implications of these changes for households in different rural

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classes.<sup>1</sup> However, as the evidence of inequalities within the households have become better documented, the effect of technical change on the intra-household distribution of resources has also become an important topic for analysis.

The unequal distribution of working time and of access to goods between males and females within the household have been reported by many detailed studies. In a recent survey article, Agarwal concluded that 'there is today a fair amount of literature from different parts of the Third World which points to the unequal sharing of food within the family - with female members getting a much lower share than male members in food quality and quantity'.<sup>2</sup> For example, Agarwal refers to a study by Gulati of daily caloric intake for a region of India which showed that 'when both the man and the woman are employed, the woman's shortfall *vis-à-vis* recommendations is 20 per cent and the man's 11 per cent; when both are unemployed the relative shortfalls are 50 per cent and 26 per cent respectively'.<sup>3</sup>

Based upon a study in the Philippines, Folbre observed that not only did women receive poorer diets,<sup>4</sup> they also 'worked unequivocally longer hours than adult men'<sup>5</sup> leading her to conclude that 'the household's distribution of work responsibilities must be deemed to be quite unequal'.<sup>6</sup>

The recognition of these inequalities has led to important changes in the behaviour of development agencies. For example, the Development Assistance Committee (DAC), which represents the major aid donors, recently stated that:

in designing projects, DAC Members recognise the need to study and assess the impact on both men and women. Such design should wherever possible take into account the intra-household dynamics, as it is well known that access to resources and distribution of income within families vary depending upon context. In many cases, individual family members benefit unevenly. Therefore, project design, particularly in terms of goal-setting, needs to go beyond the family as a unit of analysis to intra-household and intra-family factors.<sup>7</sup>

The approach taken in this article is as follows. In the absence of direct proxy measures of welfare (such as nutrition levels, health, leisure, etc.), intra-household welfare is inferred from data on employment levels. The theoretical justification for this is provided in the next section. Here, the relationship between an individual's employment and the share of household resources that he or she receives is demonstrated with reference to a variety of approaches which have been taken to analyse the determinants of the intra-household distribution of resources. In section III, the ways in which a technical change may affect male and female employment opportunities are outlined. It is argued that whilst a technical change may alter total labour requirements, the ways in which the new labour requirements are met, and the implications which this has for male and female welfare levels, varies considerably due to different socio-economic conditions and

cultural practices. For this reason, the remainder of the article investigates the response of households to changing labour requirements in a specific village level study. In section I V, the setting for a case study of irrigated and rainfed rice production in two villages in the province of South Sulawesi, Indonesia, and the research methodology used are outlined. The results are presented in section V and a conclusion is offered in the final section.

## II. DETERMINANTS OF THE INTRA-HOUSEHOLD DISTRIBUTION OF WELFARE

The unequal distribution of resources within the household is now well established and a variety of approaches to the household identify employment levels as a key determinant of such inequalities. However, the precise set of determinants, the significance of factors other than employment levels and the dynamics of intra-household distribution are still a matter for debate. This section reviews and assesses a number of approaches to the household which identify employment levels in this context.<sup>8</sup> Of course, employment levels are not the only determinants and other factors are noted. The discussion in this section provides the theoretical justification for the subsequent case study in which the relative welfare levels of men and women are inferred from employment data.

The two main approaches to the household reviewed in this section are classified as the 'joint utility' approach and the broader 'bargaining' approach. The former is closely associated with the work of Becker,<sup>9</sup> and the latter approach is used by a heterogeneous group of writers ranging from neo-classical game theorists to feminist writers. These approaches, and the variations within each, utilise a variety of assumptions and reflect different views of the world. This article does not propose to 'test' one theory against another. Rather it outlines a conclusion common to both approaches, namely that employment levels are a major determinants of intra-household welfare levels, and uses this conclusion to inform the case study.

In the joint utility approach, it is assumed that no conflict exists within the household and the household is modelled as maximising an exogenously given joint utility function. Production and consumption decisions are integrated within the household and the household optimises amongst its choice of consumer goods, as well as its supply of labour to the market and to household production. It pools all its income and allocates its resources between household members in order to maximise the collective benefit of the household as a whole. The household is treated as a maximising individual and Becker uses the device of a 'benevolent dictator' to avoid the problem of aggregating individuals preferences. As Becker states, 'an altruistic family can be said to have a family utility function that is voluntarily maximised by all members regardless of the distribution of family income'.<sup>10</sup>

In allocating resources to individual household members, account is taken of each individual's potential contribution to household welfare, as if implicit markets operated within the household. In considering a household resource such as food, which is an input into an individual's human capital, Rosenzweig has argued that:

the *marginal* returns to food allocated to each individual in terms of family welfare and earnings [will] be equal for each individual and equal to the (marginal) cost per unit of food . . . . Food will thus be allocated equally among family members only if exogenous endowments or characteristics [such as ability] are the same for all members. Differences in market returns to human capital, differences in endowment levels, differences in returns to human capital inputs or differences in employment among family members will lead to an unequal intra-family distribution of resources.<sup>11</sup>

This implies that 'parents allocate resources to those uses which produce the highest returns'.<sup>12</sup> Thus, an unequal distribution of resources within the household can be seen as optimal when viewed from the perspective of the household as a whole.<sup>13</sup>

Rosenzweig and Schultz applied this theory to explain the observed differences in child survival rates by sex in India. In those districts where female employment opportunities were highest, they argued that the difference between male and female child survival rates would be lowest. The family would devote more resources to female infants, thereby raising their survival chances, where their potential earnings, and hence contribution to family welfare, were greatest. Empirical tests using household and district level data, led Rosenzweig and Schultz to conclude that 'children who are expected to be more economically productive adults receive a larger share of family resources and have a greater propensity to survive'.<sup>14</sup>

The joint utility approach concludes, therefore, that household members' employment opportunities, wage rates and abilities will all influence the share of household resources which they receive and consequently, the degree of inequality within the household. The importance of employment opportunities in influencing intra-household distribution is supported by the empirical tests of Rosenzweig and Schultz.

The premise upon which the joint utility approach is based – specifically that no conflict exists within the household – has led to its rejection by many researchers who explicitly recognise the possibility of intra-household conflict. In the bargaining approach, both altruism and self-interest, or cooperation and conflict, are assumed to coexist within the household.<sup>15</sup> The difference between the two approaches arises not only from these premises but also from the perceived mechanisms by which household resources are distributed. As noted earlier, in the joint utility approach the device of the 'benevolent dictator' is used to determine intra-household

resource allocation, whereas, in the bargaining approach, household members' shares of resources are determined by their success in bargaining within the household.

The bargaining approach has a number of variants which differ in the complexity and realism of their models of the household. One of the variants is the neo-classical game-theoretic approach to marriage.<sup>16</sup> Here, marriage is viewed as a positive-sum game where the individuals bargain over the distribution of the gains from marriage. The outcome of this 'game' lies somewhere between each individual's 'threat point', which is represented by the respective single-state utility of each individual. Although the determination of these threat points and bargaining power are not very clearly specified in this literature, individual's endowments, non-human wealth, the legal system, and employment opportunities would be important factors. Any changes in these factors influence the threat points and therefore the relative bargaining power, which will result in a reallocation of goods and services within the household. Thus, an increase in women's employment opportunities, for example, would enable women to bargain for a solution to the game which is more favourable to them.

The game-theoretic approach has the merit that it is based upon a more realistic view of the household, although it still suffers from weaknesses such as the indeterminacy of the bargaining rule to be used and the precise specification of the threat points. Feminist writers have also analysed the household using a bargaining framework. Various studies support the result that changes in employment levels affect an individual's ability to bargain for household resources, although they do so with certain qualifications. Summarising the evidence from the countries of sub-Saharan Africa, for example, Safiliou-Rothschild has argued that:

in general, we can conclude that the significant labour contributions of women, their economic responsibility to feed the family through the cultivation of land, through their ability to control earned income represent important power bases for them . . . control of earned income is clearly the key force that tends to break down male dominance and to equalise power relationships between men and women.<sup>17</sup>

The difference between the actual contribution and perceived contribution resulting from labour expended is an important issue which has been emphasised in discussions of the determinants of bargaining power. Numerous recent studies have shown that women themselves may not perceive their labour as value-producing. It is not the actual contribution which provides the individual with 'bargaining power' but the perception of that contribution. One of the implications of this is that it is necessary to

differentiate between types of income when discussing the determinants of bargaining power. In particular, this approach distinguishes between paid and unpaid employment rather than relying simply upon the quantity of labour performed. As summarised by Agarwal, women's share of household resources 'is likely to be related not merely to whether or not they work in productive tasks but whether or not they *earn* (which would make their work *economically* more visible)'.<sup>18</sup> This is supported by a study of household decision-making in Nepal. The results indicate that there is a higher correlation between female decision-making power within the household and the extent to which women participate in the market economy and home production of crafts for sale, than with female input into subsistence production or domestic activities.<sup>19</sup> The importance of cash income is also likely to be greater in determining an individual's share of household resources in contexts where income is only partially pooled.

While women's employment is an important determinant of the share of household resources which women are able to claim, it is also argued that the strength of this relationship varies according to socio-cultural context and class.<sup>20</sup> Furthermore, it is stressed that providing women with greater employment opportunities is, in itself, insufficient to eliminate the differences in welfare levels between men and women. This conclusion stems in part from an analysis of how women's reproductive roles condition their participation in paid employment.<sup>21</sup> A related point is that women are incorporated into the wage labour force based upon gender hierarchies which work to their disadvantage.<sup>22</sup> These structural issues, which are largely ignored by the joint utility approach and some bargaining approaches, lead feminist writers to conclude that increasing women's employment opportunities are a necessary, but not sufficient, condition for eliminating the differences in welfare between men and women.

In summary, both the joint utility and bargaining approaches identify employment as a key determinant of the intra-household distribution of welfare although the mechanisms and intra-household dynamics implicit in these approaches are quite different. In the joint utility approach, households (via the benevolent dictator) allocate more resources to those household members whose employment and income opportunities are greatest as this maximises total household welfare. In the bargaining approach, household members who have higher earnings are in a stronger position to bargain for a greater share of household resources for themselves. In addition, the more complex variants of the bargaining approach suggest that the relationship between employment and bargaining power should not be viewed mechanistically but must take account of other factors influencing the ability of individuals to bargain effectively. Nevertheless, relative employment levels are identified by all approaches as a key determinant of intra-household welfare and it is on this basis that we proceed in the case study.

### III. TECHNICAL CHANGE AND EMPLOYMENT

In this section, the possible effects on male and female employment of an agricultural technical change in a developing country are discussed. In the context of Third World agriculture, the possibility that a technical change may lead to different employment consequences for men and women arises because of the pronounced sexual division of labour. In Africa, this usually takes the form of men and women growing different crops on separate plots of land. However, in Asia it is usually a case of men and women performing different tasks in the production of the same crop. Apart from this general characterisation, the sexual division of labour varies substantially both between and within countries because of numerous cultural and socio-economic factors, such as access to, and conditions in, labour markets.<sup>23</sup> This implies that the effect of a technical change on male and female labour allocation is likely to vary according to the particular context in which it is introduced.

A technical change may lead to a given change in *total* labour requirements, but the way in which this total is divided between men and women, and hence the effect that this has on relative welfare levels, is likely to vary by context. For this reason, assessing the implications of a technical change needs to proceed from a case study. Given the emphasis placed upon cash earnings as a determinant of bargaining power, the need for concrete analysis is further reinforced, due to the uneven penetration of the cash nexus.

Of course, the sexual division of labour may change in response to the labour demands resulting from the technical change. Thus, some tasks performed by women may, as a result of a technical change, be performed by men or vice versa. For example, the introduction of high yielding varieties (HYVs) of rice in Indonesia resulted in a change in harvesting procedures. The HYVs introduced are more susceptible to shattering than traditional varieties and hence are harvested using sickles and threshed in the fields. In contrast, the traditional varieties are harvested using finger knives (*ani-ani*) and transported on the stalk to the household for storage. With the introduction of sickle harvesting, men's participation has increased in this activity.<sup>24</sup> A technical change which is, for example, female labour-augmenting may also lead to the participation of males in some previously exclusively female tasks, if female labour is in short supply.

A technical change may also lead to induced mechanisation which may have a different effect on men and women. In Java, for example, the introduction of the HYV package led to increases in output which made it economical to use mechanical rice mills, thereby displacing the hand pounding performed by women.<sup>25</sup> Other studies from Bangladesh, South India and Sri Lanka also support this point.<sup>26</sup> These effects on the sexual division of labour need to be considered when



analysing the impact of a technical change on relative labour requirements.

Non-human endowments may also be affected by a technical change. For example, Dey has argued that the introduction of irrigated rice production in the Gambia led to the appropriation of common land by men. This led to an increase in the difference between male and female welfare levels, with women becoming increasingly economically dependent upon men.<sup>27</sup> This result was in part due to the irrigation project foreign aid team assuming that all household resources were pooled and that the benefits of increased income accruing to the male head of the household would also benefit all other household members.

Changes in household members' agricultural labour time as a result of a technical change affecting a particular crop will also have implications for their participation in the cultivation of other crops, other economic activities and in the household.<sup>28</sup> These new patterns of labour allocation need to be examined for both men and women to bring out their implications for intra-household levels of welfare.

The changes in household labour allocation strategies may vary by class. In particular, women from landless and small land-owning households may have different labour responses to women from large land-owning households. For example, a study by Illo in the Philippines found that women from large land-owning households were less likely to participate in irrigated rice production although they may supervise other women's work and remain involved in the care of livestock.<sup>29</sup> Thus, the effect of a technical change also needs to be considered by class of household.

The issue addressed in the case study concerns how male and female employment levels differ between irrigated and rainfed rice farming systems. The case study considers, therefore, differences in total labour demands under the two systems and investigates how these particular demands have been met.

For this purpose, the following information is required:

- (i) the quantitative differences in the labour requirements of men and women under rainfed and irrigated conditions;
- (ii) the sexual division of labour in irrigated rice production;
- (iii) the sexual division of labour in rainfed rice production;
- (iv) differences in the degree of mechanisation;
- (v) differences in endowments;
- (vi) differences in male and female labour allocation to the cultivation of non rice crops, other economic activities (particularly cash earning activities), and to the household; and
- (vii) variations by class.

#### IV. IRRIGATED RICE PRODUCTION IN SOUTH SULAWESI, INDONESIA

Indonesia is the world's fifth most populous country with approximately 160 million inhabitants in 1985.<sup>30</sup> While GDP per capita has grown rapidly since 1960, in terms of other development indicators (such as literacy, infant mortality and life expectancy), Indonesia compares unfavourably with other South-east Asian countries.<sup>31</sup> Oil revenues have been an important source of export earnings but Indonesia remains a primarily agricultural economy. In 1985, the agricultural sector accounted for 24 per cent of GDP and 57 per cent of the labour force.<sup>32</sup>

Feeding this population has proved to be a difficult task and at times during the 1970s, Indonesia imported a third of all the rice sold on the world market. Since then, however, Indonesia has come close to achieving self-sufficiency in rice.<sup>33</sup> Increased rice production has been a goal pursued by the Government of Indonesia since the late 1960s through the application of 'Green Revolution' technology. While the Indonesian government's rice intensification strategy initially focused on the island of Java,<sup>34</sup> emphasis is now being placed on increasing agricultural productivity on the Outer Islands, of which Sulawesi is one of the most important.<sup>35</sup>

The island of Sulawesi is comprised of four provinces and one, South Sulawesi, accounts for about 80 per cent of the island's rice production.<sup>36</sup> As part of the government's ongoing rice intensification programme, an irrigation project has been initiated in the district of Bone, South Sulawesi. Irrigation is a complementary input in the 'Green Revolution' package of HYVs, fertilisers and agrochemicals, enabling not only higher yields but also additional land to be brought under cultivation.<sup>37</sup>

Field research was conducted in two villages in the district of Bone in 1986. The economies of both villages are based primarily on a system of wet rice cultivation, although one is rainfed and the other is irrigated. Given the variations in the sexual division of labour due to cultural factors, and the ethnic diversity of Indonesia, selection of the two villages for study was critical. Both villages are populated by the same ethnic group, the Buginese, who are a well-established and tightly-knit group and share the same religion, Islam.<sup>38</sup> Consequently, differences in agricultural labour practices due to variations in social and cultural traditions are likely to be minimized.

For the rainfed system, one village was chosen from 14 villages that have been targeted for irrigation as part of the rice intensification strategy. It is located approximately 90 kilometres from the district capital. In 1985, it had an estimated population of 2,822. One crop of rice per year is always grown, and a second crop is planted by over 50 per cent of households on a part of their land. However, the variability of rainfall means that it is not uncommon for households to lose all of this second crop because of a lack of rainfall. Farmers mainly use nationally improved seeds in this area. In addition, around 30 per cent of farmers also grow secondary food (*palawija*) crops.

An irrigated system, was selected in a village located eight kilometres from the district capital. The village had an estimated population of 1,984 in 1985. All households grew two crops of rice per year on all of their land. All households have adopted high yielding varieties of seed, the most widely used of which is IRRI 42. The use of irrigation and the adoption of these seeds are associated with a greater use of complementary inputs such as fertilizer and pesticides than in the rainfed system. Therefore, input costs per crop are correspondingly higher for households in the irrigated area. Data on net agricultural incomes and labour allocation are presented below in section V.

Data were collected using in-depth interviews with a sample of women from the two villages and this was complemented by informal interviews with other village residents and observation.<sup>39</sup> One hamlet (*dusun*) in each village was selected for detailed study. A household census of each *dusun* was undertaken to ascertain the pattern of land ownership. On the basis of this census, households were categorised according to the following sizes of land holdings: 0–0.5 hectares; 0.51–1.0 hectares; and greater than 1.0 hectares.<sup>40</sup> Given that we are interested in relative employment levels of men and women, only conjugal households in which both partners were currently residing were considered for inclusion in the sample survey. An equal number of households from each of the three land groups in the two villages were randomly selected from this reduced population for the survey. The total sample size was 108 households and all of the respondents were the female partner.

Data were collected from each household in the following areas: female and male labour allocation in agricultural (rice and secondary crops) activities;<sup>41</sup> female and male cash earnings; the value of agricultural inputs and outputs; access to land (owned and sharecropped/rented); the labour allocated to domestic activities. The results of the survey are presented and discussed below.

## V. RESULTS

Given the theoretical framework outlined in section II, data on patterns of male and female labour utilisation in, and income from, the agricultural, cash and domestic sectors are presented for the rainfed and irrigated agricultural systems and differences among classes reported. It should be noted that the case study utilises cross-section data and that particular care must be taken in attributing causal relationships. Data on agricultural and cash incomes are presented first.

Total household income is higher in the irrigated area because of the higher net agricultural income resulting from the greater intensity of rice cultivation permitted under irrigated conditions. Data on net agricultural, cash and total household income are presented by land group size in Table 1.

TABLE 1  
MEAN HOUSEHOLD INCOME BY LAND GROUP

Land Group	RAINFED				IRRIGATED			
	Small (0-0.5 ha)	Medium (0.51- 1.0 ha)	Large (>1 ha)	All	Small (0-0.5 ha)	Medium (0.51- 1.0 ha)	Large (>1 ha)	All
Net Agricultural Income <sup>1</sup> (000s Rupiahs)	114	146	224	161	144	161	615	307
Land <sup>2</sup> (hectares)	0.46	0.91	2.05		0.32	0.69	1.49	
Cash Income <sup>3</sup> (000s Rupiahs)	47	75	166		54	63	146	
Total Household Income (000s Rupiahs)	161	221	400		198	224	761	

*Notes:*

1. Net agricultural income includes the imputed value of rice and other crop production.
2. Land includes land owned by the household and a proportion of the land that it share-crops. The proportion of sharecropped land attributed to the household is taken to be equal to the proportion of the output (this varies between a third and a half) from the land which the household received.
3. Cash income here refers to agricultural labour income (compensated by wages or 'in kind'), non-farm wage labour, non-farm self-employment (for example, trading) and own-account farm production for sale (for example, eggs, chickens) for all household members.

Average net agricultural incomes per household are nearly twice as large in the irrigated area (307,000 rupiahs compared to 161,000 rupiahs). The difference in net agricultural incomes between the two areas is particularly striking for the large land group. The main reason for this seems to be that the large landowners in the rainfed area are unable to utilise all of their land due to water shortages. That is, they own a higher proportion of dry land than households in the other categories. The large landowners in the irrigated area, in contrast, are able to utilise all of their land and hence their output is considerably higher. The difference between the two areas is less pronounced for the small and medium land groups. This latter finding is due in large part to the fact that access to land in each land group is lower in the irrigated area than in the rainfed area. For example, in the medium land group while net agricultural income is only slightly higher in the irrigated area (Rps 161,000 compared to Rps 146,000) the mean amount of land is considerably lower (0.69 hectares compared to 0.91 hectares).

Although it is clear from the above analysis that household incomes are highest in the irrigated area, the main concerns of this article are the intra-household distribution of resources and costs. These, as indicated earlier,

will depend to a considerable extent on the relative participation of males and females in employment. Consequently, this study focusses upon the patterns of male and female labour allocation in the two areas. Labour allocated to three categories of activity are considered, namely, agriculture, cash earning and household.

With respect to the agricultural sector, there is, as expected, a higher labour utilisation in absolute terms in the irrigated area and this is the case for each land group. This is shown below in Table 2.<sup>42</sup> For example, the total labour allocated to the agricultural sector by males and females in the small land group is over twice as large in the irrigated area compared to the rainfed area (1341 hours per year compared to 646 hours). The difference is less striking for the large land group reflecting a greater use of hired labour by the large landowners in the irrigated area. Women in the irrigated area all participate in the agricultural sector for more hours per year than their counterparts in the rainfed area.

Of particular importance to the argument of this article, female participation in the agricultural sector is lower relative to male participation in the irrigated area. Specifically, the percentage of agricultural labour performed by females is 39 per cent in the irrigated area compared to 48 per cent in the rainfed area. This result is consistent with other studies in Indonesia which have shown a declining proportion of female labour in total labour with the intensification of agriculture.<sup>43</sup>

The difference in the participation of women relative to men between the two areas, cannot be explained by other factors, such as lifecycle position and household composition, which influence female labour participation outside of the domestic sphere. With respect to the lifecycle position, for example, women with young children are less likely to participate in activities outside of the domestic sector. Table 3 below provides data on the average age of men and women, the number of children under four years of age, age at marriage and number of members per household for the two areas.

Table 3 shows that households in the rainfed and irrigated areas are similar with respect to all of the indicators, except age of men in the small land group. Thus, any differences in patterns of male and female labour allocation between the two areas are unlikely to be related to differences in household characteristics such as lifecycle position.

The lower participation of women relative to men in the irrigated area may be explained, however, as the particular response by households to the higher total labour requirements necessary under irrigated rice production. A distinct sexual division of labour is observed in the rainfed and irrigated agricultural systems and the differences between them may be attributed to the ways in which households have responded to the higher labour requirements in the irrigated system. Table 4 provides data on the sexual division of labour.

TABLE 2  
MEAN LABOUR ALLOCATED TO AGRICULTURAL SECTOR BY MALES AND FEMALES  
(IN HOURS IN AN ANNUAL BASIS)

	RAINFED				IRRIGATED			
	<u>Small</u>	<u>Medium</u>	<u>Large</u>	<u>ALL</u>	<u>Small</u>	<u>Medium</u>	<u>Large</u>	<u>ALL</u>
Labour Allocated per farming household:								
Female	326	500	548		498	548	754	
Male	320	467	753		843	776	1121	
TOTAL	646	967	1301		1341	1324	1875	
Percentage of Female Labour in Total Male and Female Labour	51	52	42	48	37	41	40	39

TABLE 3  
CHARACTERISTICS OF THE HOUSEHOLDS IN THE RAINFED AND IRRIGATED AREAS

	Rainfed			Irrigated		
	<u>Small</u>	<u>Medium</u>	<u>Large</u>	<u>Small</u>	<u>Medium</u>	<u>Large</u>
Mean Age (years):						
Female	33	37	36	38	39	38
Male	37	42	42	45	46	40
At Marriage (female)	17	17	17	18	19	18
Mean Household members:						
Number	6.4	6.2	6.4	5.9	6.6	6.8
Number less than 4 years old	0.9	0.6	0.4	0.5	0.4	0.3

In both areas, men are primarily responsible for the tasks of land preparation, bund fixing, weeding and fertilising; women perform most of the work associated with harvest and post-harvest activities.<sup>44</sup> However, significant differences between the two areas also exist. In the irrigated area, women's relative labour participation is higher in the weeding, fertilising/application of chemicals, and harvesting tasks, and lower in the

TABLE 4  
THE SEXUAL DIVISION OF LABOUR IN AGRICULTURE: MEAN FEMALE HOURS  
ALLOCATED TO AGRICULTURE AS A PERCENTAGE OF THE SUM OF MEAN FEMALE  
AND MALE HOURS ON AN ANNUAL BASIS

Task	RAINFED				IRRIGATED			
	<u>Small</u>	<u>Medium</u>	<u>Large</u>	<u>ALL</u>	<u>Small</u>	<u>Medium</u>	<u>Large</u>	<u>ALL</u>
Land Preparation	9	7	2	6	1	3	2	2
Planting	47	50	49	49	4	15	5	8
Bund fixing	2	5	0	1	0	0	0	0
Weeding	2	4	3	3	29	25	13	22
Fertilizer/Chemicals	0	9	5	5	33	23	20	25
Harvesting	60	54	62	59	74	81	67	74
Post-Harvest Activities	100	100	100	100	100	100	100	100

planting task, in comparison with rainfed area. Each of these differences can be explained as a response by households to the different labour demands arising from the two production technologies being used.

The main difference is observed in the task of planting which is a particularly labour intensive task and is an almost exclusively male task in the irrigated area. In fact, women in the rainfed area contribute 49 per cent of the labour performed in planting,<sup>45</sup> in contrast to only eight per cent by women in the irrigated sample. This can be explained by the shorter period of time within which planting must be performed under irrigated conditions. That is, in order to maximise the usage of the irrigation water by all households using the same irrigation system, planting must be done quickly and sequentially from the source of water supply. Consequently, labour from one household is rarely sufficient. Households in the irrigated area responded by forming male reciprocal labour groups (*tolong menolong*) (usually four to ten males per group) to carry out this operation. Women are not engaged in this task but are often involved in preparing meals for the male labour groups.<sup>46</sup> This significantly increases total male labour relative to total female labour.

Conversely, female participation in weeding is considerably higher in the irrigated area (22 per cent compared to three per cent). This may be because total labour requirements of weeding under irrigated conditions are higher

and the importance of timeliness is greater. In addition, the lower effectiveness of herbicides under irrigated conditions has led to higher labour usage. Thus, women's increased participation in this task may be a way of meeting the higher total requirements in weeding. The higher total labour requirements in applying fertiliser has also been met by an increased participation in this task by women.

A further difference in the sexual division of labour between the two areas is observed in the harvesting task. Harvesting consists of two tasks, cutting and threshing. Cutting is mainly undertaken by men and threshing by women. The higher yields and output in the irrigated area are associated with a higher ratio of threshing to cutting labour hours and hence a higher participation of women in harvesting overall.

Thus, the differences in the sexual division of labour between the two areas can be interpreted as a response to meeting the higher labour requirements of irrigated rice production. Again, it should be stressed that this represents the way in which the increased labour demands have been met in this particular case study – it may be met in other ways in areas with different socio-economic conditions.

The difference in the relative participation of females in the agricultural sector between the two areas is of substantial importance in light of its implications for the intra-household distribution of welfare. However, before any definite conclusion can be reached, it is necessary to consider non-agricultural employment.

The nature and extent of participation in the cash economy varies by gender and class and also between the two samples. In terms of gender, men tend to be involved in activities such as brick-making, carpentry and

TABLE 5  
CASH SECTOR: PARTICIPATION AND EARNINGS OF MALES AND FEMALES

	RAINFED				IRRIGATED			
	Small	Medium	Large	ALL	Small	Medium	Large	ALL
Percentage of females participating in cash economy	42	35	50	42	13	25	25	21
Percentage of males participating in cash economy	20	15	30	22	25	31	38	31
Female cash earnings as a percentage of total household income	10	14	19	14	8	5	2	5
Female cash earnings as a percentage of male cash earnings	136	91	99	109	48	42	13	34



as labourers. Women on the other hand are more likely to be traders (of rice, chickens, eggs, palm sugar, clothes, cloth) and labourers. In terms of class, female traders from the large land-owning group tend to sell articles of higher value than those traded by small land-owning group – for example, clothing and cloth compared to eggs, palm sugar and corn. It tends to be only women and men from the small and medium land owning classes who work as labourers (women in factories, rock breaking for road construction, harvesting, and men in factories and transporting goods). Teachers, civil servants and owner/operators of rice mills tend to be of either gender and from the large land group.

Comparing the two areas, there is a higher percentage of women in the rainfed sample participating in the cash economy than in the irrigated area as shown in Table 5. In the rainfed area, 42 per cent of the women participated in the cash economy compared to 21 per cent in the irrigated area. Furthermore, in the rainfed area, female cash earnings constitute a higher percentage of total household income than in the irrigated area. Significantly, female cash earnings as a percentage of male cash earnings is substantially lower in the irrigated area. In the rainfed area, women's cash earnings are slightly higher than those of their husbands (109 per cent), whereas in the irrigated area they are approximately one third (34 per cent).

There are two main reasons which account for women's lower participation in the cash economy in the irrigated area. The first concerns a difference in the institutional arrangements for the sale of rice. In the irrigated area, given its greater annual agricultural production per household, government cooperatives (*KUDs*) and rice traders from outside the village buy the majority of surplus rice. In the rainfed area, women play an important role in the purchase of surplus of rice which they then transport for resale in district capitals. This explains in part the lower employment opportunities for women in the irrigated area.

Second, women in the irrigated area may experience a binding labour constraint. In addition to women's substantial labour allocations to the agricultural sector, especially during peak seasons, women also perform the majority of time-consuming household tasks. As an indication, the female partner in the households sampled allocated between 23 and 31 hours per week on six major domestic tasks. See Table 6 below.

It must be noted that these estimates are very conservative as they exclude child care and do not include all household tasks.<sup>47</sup> The figures presented in Table 6 are only illustrative but they do indicate that, given women's higher time in agricultural production, and the time spent in domestic activities, it is likely that their lower participation in cash earning activities in the irrigated area is partly the result of a binding time constraint. That is, women in the irrigated area are fully occupied with agricultural and domestic tasks. The lower agricultural labour requirements for women



## VI. CONCLUSION

In this study, the differences in the labour allocation of male and female partners in rainfed and irrigated rice producing areas have been documented. It has been argued that these reflect the different technical conditions under which agricultural production is conducted.

Irrigation is associated with a higher level of household income. In addition, however, on the basis of our case study, it is clear that in the irrigated area, relative to men, women's labour contributions to agriculture and their cash earnings are lower than in the rainfed area. This may mean that the inequalities in the levels of welfare between men and women within the household are higher in the irrigated area if the theoretical propositions outlined in section II are correct. This finding has implications for other irrigation projects now underway in South Sulawesi. If the introduction of irrigation leads to systematic changes in the patterns of labour utilisation as described in this paper, then it seems likely that irrigation will generally be accompanied by an increase in the levels of inequality within the household between men and women.

It should be stressed that this conclusion rests first, upon the validity of the theoretical perspectives outlined above and specifically, the validity of inferring levels of intra-household welfare from patterns of labour allocation. Second, it depends upon attributing a causal relationship to differences between two villages utilising different farming technologies. Third, this conclusion is only valid for the area in question and cannot be generalised to other cultures where different labour practices and a different sexual division of labour may exist.

If it is accepted that the benefits of increased household income arising from irrigation are unlikely to be shared equally within the household and that existing inequalities will be increased, it is of interest to ask what implications this has for development policy. The most obvious implication is, of course, to provide more and/or higher income earning opportunities for women in irrigated areas so that they can claim a greater share of household resources. However, this may not be such a straightforward and automatic process given the structural rigidities noted previously and the possible existence of binding time constraints. A number of studies have shown that women's increased participation in paid employment does not bring about a reduction in their household activities.<sup>49</sup> The results presented above also indicate that women in the irrigated village allocate as much labour to domestic activity as women in the rainfed village, even though the agricultural labour performed by the former is considerably higher. Thus, greater participation in paid employment may be at the expense of intensifying the 'double day'. Increasing women's employment opportunities in such a way as to enable them to take full advantage of these opportunities is unlikely to occur without other complementary social changes.









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