

RICE, MEAT AND MILK: SYSTEM COMPONENTS IN NORTH EAST INDIA

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1. Introduction

In the recent history of agricultural research equity and efficiency have often been cited as implicit objectives of technology-for-development programmes (Ashby 1981, Boserup 1970). The recognition of economic polarization between households as a result of technological intervention (Farmer 1977) established the need for inter household analysis as a component in agricultural research. More recent research findings have suggested that intra household analysis is equally as important for formulating programmes to meet the above objectives (Acharya 1984, Feldstein 1985).

The degree to which sexual differentiation cuts across social and economic groupings and the way in which these are dynamically related varies according to, often very specific, location (Richards 1985, Sutherland 1986). Because of this it is important to avoid resting on assumptions drawn from experiences elsewhere. Therefore to assist in ascertaining research priorities systematic analysis of both inter and intra household analysis is called for as an integral part of any farming systems research programme (Hill 1986, Rhoades 1985).

This paper focuses on two components of a particular farming system in North Bihar in India. The data are drawn from a research programme where agricultural scientists were examining the possibilities of new rice technologies. Clients were identified as resource poor producers operating under rainfed conditions (see appendix 1). Inter and Intra household information collected is used to show that knowledge of time allocations, decision making and labor use can directly assist efficiency within the confines of this particular research domain. It is also used to demonstrate how, by looking at other elements of the system (eg. livestock and feed), the productivity of more than one system component can be enhanced. Consideration of the relationships between these components illustrates how the underlying principles of an efficient programme with equitable and efficient results can be integral to an agricultural research effort.

Within this framework the following analysis first outlines the social and economic organization of the village in relation to agricultural/livestock production and resources. Secondly it focuses on the intra household differentiation across these groupings. Finally there is a discussion of the agricultural research interests that emerge from this kind of social and economic information.

2.1. The Village.

Belkunda village lies an hours drive to the north of the Ganges and the city of Patna in Bihar, India. Farming is dominated by the chaur conditions found in this area (see appendix 2). Chaur

consist of dished depressions in the soil surface up to 5km across and reaching depths of 3 metres in the centre. During the rainy season (June -October) they are subject to flooding and waterlogging. Water levels recede during the remainder of the year exposing slopes of 5-15 degrees and soils varying from sandy loams at the top to heavy clay at the centre of the depressions. Soils tend to be neutral (Ph 6.8-7.0) with good potash and nitrogen content but low in phosphate and generally zinc deficient. For social and economic survey purposes land was divided into five types i.fully irrigated upland,ii.partially irrigated upland,iii.shallow rainfed,iv.deep rainfed/chaur, and v.banjar or waste land.

Temperatures are highest in April and May, reaching up to 38 degrees centigrade. Rains in 1985 were heavy and late with an average of 372mm per month falling between July and October. As distribution and density of precipitation affects cropping patterns and labor use specific observations within this paper relate to the conditions of 1985/6.

Paddy is the main subsistence crop with different varieties being grown at different points of the chaur. Local varieties dominate, especially in deepwater where no modern cultivars have as yet been found suitable. No irrigated rice is grown, although some bunding is done for nurserys, and no rice is sold. Deepwater yields in 1985, which was recognised by farmers to be a bad year, averaged 1425 kg/ha according to growers. (Government figures quote an average of 792kg/ha between 1973 & 1983.) Other staples include millet, wheat, channa, and mung. Maize growing has decreased in latter years due to a reported increase in insect attack. A variety of vegetables, including potato, and fruits are cultivated - generally in small plots close to the home. Castor and mustard are grown for oil. At present tomato and tobacco are the main cash crops. Animal feed (Janera)is only grown now as a field border or very occasionally as part of a mixed crop.

Only one farmer in the village owns a tractor, which is available for hire to other cultivators. Three families have diesel pumpsets - which are again hired out. Oxen are the main source of draught power being used either by families alone, hired out with a driver for cash or used in reciprocal exchange relationships. Water is readily available in this village with the dry season water table lying at about 5 metres. Cultivators unable to use mechanical pumps use a combination of scooping and channels for irrigation.

2.2.The Village Disaggregated.

There are eighty seven households in the village divided into nine caste groups (4 scheduled,3 backward) and a Muslim community. All data referred to in this paper relate to that drawn from a sample of thirty eight households. Sample selection was based on agricultural labor use or connection with agriculture/livestock. Households not falling into these

categories are ignored for the purposes of this analysis. A total of two hundred and fifty four people were included with a male:female ratio of 1:0.8.

Five income strata were devised based on households' gross annual income. As Table 1 shows there is a positive correlation between income group (1 is high) and size of holding, with the richest 9% of cultivating households holding 74% of the land and the poorest 31% holding 4% of available land. Furthermore, in the lowest income strata, 69% of land cultivated is on a sharecrop basis, and of this 69% is chaur (only good for deepwater, risky paddy). Sharecropping terms mean that 50% of gross product accrues to the landlord. In the low income group 16.6% of owned land is partially irrigated, no farmer owns fully irrigated upland, and only 9.5% of total sharecropped land is of this type. Conversely in income group 1 23% of land owned and cultivated is fully irrigated (used mainly for growing tomato and tobacco as cash crops), 11% is partially irrigated (wheat, maize and vegetables) and 21% is chaur. Of land rented out by the highest income group 53% is chaur, 29% is fully irrigated upland and 18% is shallow water rainfed (used mainly for paddy and tomato in Kharif season and wheat, gram and mung in rabi). Land ownership and access is therefore skewed both in terms of gross amount available and in terms of the land quality as measured by returns and security of that return.

Original stratification of the sample was carried out along the lines of net use of agricultural labor. Four strata were formed - i. households who were net hirers in of agricultural labor, ii. households who were net users of family agricultural labor, iii. households who were net hirers out of agricultural labor, and iv. households who used no agricultural labor for cultivation but who owned land or livestock. This stratification proved to be a relatively good indicator for the resource wealth of households. Disaggregated in this way households displayed similar patterns in ownership and access to livestock as to land.

Table 2 shows the positive correlation between high income group and high incidence of ownership of livestock. In labor use strata 3, (net hirers out of family agricultural labor), it is noticeable that although 90% of households have access to livestock 86% of these animals have been taken in on a share basis. This means that these households will only receive half the gross income derived. As household income falls the incidence of shared animals rises.

Table 3a illustrates the importance of various sources of income to the households in the different strata. Table 3b details this more closely. For example, 62% and 72% of households in low income groups (4 & 5 respectively) were net hirers out of family labor. Of these households 53% of income is derived from agricultural wage work in income group 4 and 59% in income group 5. Alternatively 72% of the income for income group 1 was derived from agricultural/ livestock production, and 19% from non-agricultural wage sources. Although wage labor is an

important source of income for a large number of households the level of wages is such that subsistence levels of consumption are the norm. Agricultural wages will be paid in both cash and kind and are often tied to other factors such as renting of land, availability of loans or security of future work. Imputation of market values therefore becomes inappropriate.

There is generally little surplus to invest in any form of asset. Ownership of capital goods is directly related to households annual income as is the educational level of members indicating that at present there is little chance of poorer families investing in the only readily available resource ie. human capital. It is only richer families producing cash crops that have full control of the generated income. In all other cases cash crops were produced on sharecropped land. Hence although there exists a situation of strong market awareness in this village the mode of production is not purely capitalist.

Although labor is the one commodity that poorer families can sell its market value, as discussed above, is often affected by many factors. Labor was initially identified by cultivators as problematic during peak agricultural times. Investigations were, therefore, carried out on time allocation (using a Random Instant methodology), and hired labor use (monthly recall). Because of the methodology used Time Allocation data is mainly discussed in the section below on intra-household analysis. However, in relation to what occurs between households, it does give a clear picture of when family members are involved in activities external to the domestic unit. Among these number education, agricultural wage labor, exchange labor, social events or other waged activities.

Of particular importance to this research was the amount of time men and women of different economic groups were spending in agricultural wage labor, and at what times of the year. As expected July/August and November/December were periods of maximum intensity for both sexes. The former represents the beginning of the agricultural season when land is prepared and crop growth initiated. The latter is the time of harvesting, processing and storage. Neither male nor female members of income group 1 were involved in agricultural wage labor. There were only two occurrences of income group 2 males working for agricultural wages were observed - and none for females of this group. In lower income groups the pattern was one of increasing use of time for males in agricultural wage labor as the household income fell. Female patterns showed an increase in other forms of wage labor that peaked slightly after the mens. This indicated a hiring of their services for processing and storage work. There was not a smooth increase in the amount of time women spent as wage workers by income strata. This can be explained by the attachment to households as semi-permanent domestic workers by some income group 3 women. The subsequent remuneration improved household income but skewed the pattern of female wage employment.

Farmers who hired in labor in only one month stated that they had hired females as agricultural wage laborers. When including post-harvest work as a task for which people were hired instances were recorded of hiring female laborers. Table 4 shows the pattern of labor hired over the busy six month growing, harvesting and processing period. The discrepancy between the differences recorded for days hired in over time and days hired out can be explained by the movement in of labor from other locations during times of high demand. For these migrant workers the influences upon the price that they will accept for their services are different than for those people resident in the village. Their mobility has meant that they command higher rates than the laborers tied to one location. Hirers of labor report that increasingly work is done by groups of these laborers on a contract basis. They also commented that work was done faster and with less supervision. The laborers stated they felt they were able to earn more money and liked the control that they had over both their own time and the payment they received. There were also cases where males from the village were moving out to work elsewhere at these peak times - suggesting that mobility has to some extent broken the previous bonds and is changing the nature of labor relations.

2.3. The Household Disaggregated

Each household in the sample was disaggregated by sex and age, and details on decision making, time allocation and labor use collected accordingly.

(i) Labor and Time.

The Time Allocation data not only give an indication of the amount of time is spent on various activities at different times of the year, but also of who does what. An underlying assumption of this analysis is that there are four ways in which the sexual division of labor manifests itself. These are that tasks are sex sequential, sex segregated, sex supportive or sex substitutable. With this framework it becomes easier to see the dependency network within household labor relations and to ascertain what constraints or opportunities exist for changing or introducing new practices.

Table 5 outlines seventeen major time use categories and the percentage of time spent in these activities by men and women between the hours of 0500 and 2200 over seven months. This information is then broken down by income strata where markedly different patterns of activity occur. A more detailed breakdown of these major categories into a total of 161 activities has served to both identify specific activities and highlight particular relationships within a major area.

For example we find that, in the aggregate information shown in Table 5, women spend on average 5.7% of their time in the major

category of Livestock and Poultry. The detailed breakdown shows that within this category of time use 4.1% of their time is spent collecting fodder. However disaggregation by income group shows that, over the total time period, strata 1 women spent no time in fodder collection, while women in strata 2 spent 1.2%. Strata 3 women spent 4.4% of their time collecting fodder, 4.1% in strata 4, and 11.3% of their time in this activity in strata 5. With men the pattern is slightly different : 1.1% in strata 1, 4.1% in strata 2, 1.7% in strata 3, 1.9% in strata 4, and 5.0% in strata 5.

It appears then that, for the richest households, animal care is a sexually segregated task. In strata 2, in which women do not collect fodder all the year round, the time women spend is above their overall average during July and August. This is when fodder is in scarce supply and males are spending a lot of time in crop growth and maintenance. This clearly indicates that activities are sex substitutable or sex integrated. July is a the time of high agricultural wage employment. As only 0.5% of the sample involved women who worked as wage laborers it is reasonable to suggest that the data relating to fodder collection in income strata 5 further supports the idea that this activity is sex substitutable. As males assume a heavy agricultural wage work load the females in this strata spend an above average time in fodder collection (7.0% against an average of 4.3%, and 13.1% against an average of 11.3%).

The overall pattern is primarily one of females increasingly being involved in fodder collection as household income falls. Pursuing this further it seems that a similar pattern in the substitution of labor occurs between the sexes, ie.rising as income falls. This is indicative of a conflict between the social ideal of women being kept in purdah and of economic pressure causing deviation from this ideal at times of stress when women will take part in some activities outside of the domestic sphere.

In relation to the production of paddy there is a shift in emphasis - although the general structure of the argument is the same as above. Activities associated with rice production were divided into three categories, i.Field located work (crop growth & maintenance,harvesting,drying,carrying),ii.Household located work (drying grain,threshing,storing), and iii,Processing work (cleaning,parboiling,post boiling drying,other). The following results were obtained relating to percentage of time spent during seven months.

Category i		Category ii		Category iii	
Male	Female	M	F	M	F
9.5	1.3	0.6	1.6	0.2	5.5

Female participation decreases as work location moves away from the home particularly in high income groups. Group 1 females do no field work while group 5 spend 0.6% of their overall time in

the fields. Male field activities increase as income decreases from income group 1 spending 0.4% of their time in them, group 2 1.0%, group 3 1.8%, group 4 1.9% and group 5 4.4%. This table also demonstrates the sex sequential nature of rice production. In this labor relationship the efficient execution of one task is dependent on the efficient execution of the preceding task. It is a chain of dependency that has actors of different sexes sequentially performing different roles.

The disparity observed in time spent by men and women in the execution of the three groups of tasks also leads to the conclusion that if looked at more closely it is likely that there will be some activities performed by one sex only. These are tasks that are sex segregated. In the fields we find no recorded evidence of women engaging in ploughing or irrigation. In processing the same applies for men in husking, par boiling and post boiling drying. The reverse occurs with oil pressing where only men have been observed participating. In other areas this clear delineation is cut across by income group, and a pattern of labor substitution occurs in the poorer groups where females will sow, weed and transplant rice.

In the first part of this analysis labor was used to illustrate the links between fodder collection and rice production. Fodder is collected throughout the year. Peaks and troughs of time taken in this activity occur as shortage of supply and problematic access in July means high time inputs are called for. Shortage in labor during the period of rice harvesting, processing and storage means less time is available for the collection of animal feed. Using the same connection, ie. available labor time, there is evidence that although some duties may not immediately appear as important to the production of rice there is a direct link in terms of work burden. Instances of sex supportive roles are those of cooking, child care, religious/social obligations and other female domestic functions. As an example, in November when rice harvesting begins, through to January women spend more of their time cooking and serving the family than during the rest of the year. This is related to a decrease in the actual amount of time females were observed eating and engaged in personal grooming and hygiene. Leisure time in November was also the lowest recorded. There was also a marked decrease in the amount of religious activity as time spent in domestic duties increased. As demand for supportive services increases in one area it seems that time allocations are manipulated to satisfy this need. This occurs apparently in some cases to the detriment of the person supplying the service.

The situation in the rice production of this village is thus one of an overall concept of sex sequential activities, backed by a social ideal of sex segregation, with evidence to support the proposal that sex supportive roles are important to the system. Cutting across this chain of interdependency are economic forces that influence to differing degrees the amount of task integration and substitution occurring between the sexes.

(ii) Decision Making.

What people physically do is not the only factor that affects the way in which a system functions. Taking a further step into descriptive analysis and considering efficiency within an agricultural research programme it seems important to find out who makes decisions about what is done (and by whom). Three areas of participation in decision making were considered, i.who initiated, ii.who influenced and iii.who executed decisions.

Investigations were carried out in eight areas of household decision making. The results for three of these areas felt to be of immediate importance to the agricultural system are summarized in Table 6. The table is concerned with female participation but this is merely an attempt to redress the balance in a situation where women's influence was previously considered to be minimal. In most cases female participation increases as the household becomes more involved in agricultural wage labor (proxy for resource wealth of household) indicating that the inter household status of women is highest in low income families ie. they have greater control over their lives and greater authority within the family unit.

Within the context of decision making relating to agricultural technology women hardly ever carried out the decisions. However they increasingly initiated and were involved in discussions about agricultural technology as the households became poorer. Investigations into the Disposal of Family Resources examined decision making in expenditure on major items such as agricultural equipment and animals. Again a general inverse trend between female participation in discussion and the resource wealth of the household can be seen. Figures for strata 1 women can be related to the fact that females of rich households often have cash or gifts from parents over which they have some control. Cash and Kind Expenditure looked at more regular outgoings. Influence in this area would affect expenditure on items such as smaller agricultural inputs including seed (type, variety and amount), fertiliser etc. Investigations were not carried out into the relative importance of these latter expenditures to different households. However it is felt that where cash is tightest there would be the greatest competition for use of this resource and that male/female discussions could play an important role in the possible adoption rates of technologies.

These findings illustrate the fact that both men and women are involved in decision making with the ratio of womens to mens participation increasing as household income decreases. Higher percentages for females can be correlated to their direct participation in the activities that are the subject of the particular discussion. In the case of richer households this is only high in tasks carried out in the domestic sphere. As household income decreases women move further into participation

of those activities that have a direct relationship to incoming goods (cash or kind). It is therefore apparent that there is a relationship between women's intra household status and their participation in economic activities outside the domestic sphere. The ramifications of this for an agricultural research programme are clear. If the existing pattern of withdrawal of women to the domestic environment as household financial status grows continues, then increasing yields and overall household income is likely to result in a loss of intra household status for women.

3.1. Implications for Agricultural Research.

The preceding sections have shown that data on labor use, time allocations and decision making can describe the dynamics of relationships within a farming system, both within and between households. It remains now to demonstrate why such information can be useful if there is concern over how the outcome of research relates to issues of equity and efficiency. An underlying assumption is that the second cannot exist without the first.

Equity concerns can be divided into two crude categories corresponding to inter and intra household. The former, as commented on at the very beginning of this paper, is related to the avoidance of economic polarization within a society. The concern of the latter focuses on the issue of status within the household. Efficiency is the concept that links the two. In terms of efficiency within the village it is inefficient, particularly in aggregate welfare terms, to displace smaller cultivators from land. It is also inefficient to utilize capital inputs where labor (which in this case has low alternative market options) is available and substitutable. Within the household the decrease in women's status, as household incomes increase, means they have less control over the welfare of the whole household. Secondary sources have recorded similar cases where female status has declined as they have lost control over economic decisions even though gross income has increased. Therefore it is important to ensure that, if innovations are to increase income, strategies are adopted that at least do not decrease females power within the household unit. A further step in this argument is that if measures are taken to protect or enhance female status then there is the possibility of utilizing presently inaccessible female labor.

3.2. Livestock and Rice.

Different groups within the village have different needs and will be affected by new technologies in different ways. This applies to both economic and sexual variables. Social and economic information can help to identify intended clients and can also point to relationships that may be affected by intervention between groups.

In the agricultural research programme under discussion here the clients had already been identified as resource poor cultivators. The data shows that for many of the households at the lower end of the income scale agricultural wages play a major part in household earnings. Therefore, if technological change is likely to affect the hiring of labor, analysis of richer households - and particularly the dynamics of their resource allocation - is required for agricultural research focusing on the poor. For households involved in cultivating their own crops and in the agricultural wage market there are also ramifications for changing labor patterns. Higher demands would mean juggling time allocations, which in turn could affect the adoption of recommendations. Bearing this in mind it seems that research into new rice varieties and techniques would be less likely to have inopportune effects. There would also be a higher probability of adoption if attention were paid to the staggering of timing of peak activities. Further, long grain varieties need to be concentrated on. This type of grain both commands a higher market price and was preferred for consumption by 87% of sample households.

Time is the major dimension where sexual variables play a part. It has been shown that both men and women are part of the production system. Different roles are occupied according to economic situations. A general observation is that females direct involvement in the agricultural/livestock system is in fodder collection, rice processing and storage. From the information gathered it appears that women are likely to be withdrawn from wider economic participation into the domestic sphere as household earnings grow. Coupled with a concern to maintain, and hopefully improve, womens status it seems that attention should be paid to ways in which they can remain involved in, and build upon, activities that currently give them some economic control. Livestock appears to be a possibility. Even in income group 2 the pattern of sex task substitution was one of females collecting fodder when demand for male agricultural wage labor was high. The return to labor in terms of tending livestock is very low - partly because of the time spent gathering feedstuffs and partly because of the high rate of animal mortality. Little milk is available to many of the households rearing animals as yields are only sufficient to maintain a calf. Again it is only in richer households that milk was found to be readily available with both buffalo and milch cows being kept for that purpose. Concentrates were used as supplementary feed in these cases. Milk has a high market price and could also help to improve the nutritional status of households if more were available. Feed is a definite constraint on production at present. It is suprising then that so little is grown as a field crop, or that no tree or perennial species - apart from occasional banana biomass - are used as a source of fodder. By-products of pulse crops grown are currently used as feed, which would suggest that inter cropping with rice - or wheat in the winter - could be another useful direction for research investigations.

Meat is also a costly commodity with goats as the primary source. Goats, predominantly the concern of lower income women, are usually tethered with little other food supplement apart from household waste. Mortality rates are high, and most of these animals are kept on a share basis from richer households. Milk production for kids is problematic, reflecting the poor physical state of the nannies. Improving feed for these animals could be one way of augmenting and ensuring output and therefore earnings.

Chickens are not of direct interest in discussions of rice/fodder linkages, apart from the fact that they consume broken grain and chaff. With heavier harvests quantities of both of these should increase resulting in an increase in the number of fowl able to be supported. Only low caste or muslim groups can keep poultry. As these tend to fall in the low income strata, an improvement in the quantity of eggs and meat, could be seen as a beneficial side effect.

However there does have to be time to deal with these extra animals and their products. It was noted earlier that juggling of time budgets occurred when activities associated with rice took precedence. Even if attempts to introduce new varieties/ techniques that spread labor demands were successful, larger harvests or more intensive techniques could mean that time became more intensely used during certain parts of the year. Remembering the substitution of female labor that took place when male labor was in demand in the fields it follows that a higher burden will be placed on women. For this reason, and also if emphasis is to be placed on livestock as the means to economic participation of females, it is necessary that fodder, as a key element, be readily available.

4. Conclusions.

The basis of the argument contained in this paper has been that components within the rice production system in the village surveyed are related in such a way that intervention causing a shift or change in one will automatically cause a change in another. Two major components of the rice production system, rice and livestock, have been examined using analysis of intra and inter household information to show that cause and effect relationships differ over sexual and economic groupings. Four types of labor relationships have been developed and used to explain and understand the patterns of time allocation and decision making.

Within this framework time allocation data has demonstrated the nature of labor relationships both within the household and within the local economy. Linked with the time allocation, hired labor use information has given a picture of demands made upon time and labor by particular activities and households during certain parts of the year. Decision making questionnaires revealed patterns of control over resource allocations.

The use of such information has been shown in the way it can trace the relationships between different elements within a production system. Therefore areas for intervention can be highlighted. Information such as has been discussed in this paper can suggest where manipulation of one specific aspect can be used in a positive way develop strategies to increase the productivity of another aspect.

In placing emphasis on disaggregating data over sexual and economic variables it has been shown that research activities can ensure efficiency at the investigative and implementation stages. Both direct beneficiaries and secondary interest groups can be identified. The respective needs and available resources of each can be ascertained. An awareness of the different implications for these groups therefore means that equity issues can also be considered as an integral to an agricultural research programme.