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9. ABSTRACT

A PROJECT: To examine how technical changes in agricultural production in Asia influence the distribution of income in rural households and how altered production techniques affect the demand and supply of farm labor.

DURATION: July 1, 1976-Ongoing

DEVELOPMENTS: The provinces of Laguna and Luzon in the Philippines, a coastal region of Java in Indonesia, and a sample of villages in Andhra Pradesh in India were chosen as typical of a broad spectrum of Asian production techniques. Most subsistence agriculture in the Asian lowlands centers around paddy rice, with other grains and tubers playing a less important role. Research was completed in the Philippines on the impact of improved rice production on income accruing to various factors of production, landlords, tenants and landless laborers. As land-holders' income increased because of the new technology, hired labor was substituted for family labor. The demand for hired labor and its share of output increased. Field work was completed on a study examining family decision-making, particularly as it related to the supply of male and female labor among families with varying resources. Cropping patterns and income distribution in Andhra Pradesh have been altered by tractor mechanization of land preparation, harvesting and transportation. Primary data was collected in six villages on the availability of tractors and how that has altered the supply and demand for labor on farms with a wide range of cropping combinations. Two related projects in Nepal are described. One deals with the role of highway transportation in the process of economic development and the other evaluates the technical transfers and income distribution aspects of multiple cropping. All research progress and results are discussed in detail. Six publication abstracts are included in the appendix.

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ANNUAL RESEARCH REPORT

POOR RURAL HOUSEHOLDS, TECHNICAL CHANGE AND INCOME DISTRIBUTION IN LDC'S

Contract No. AID/ta-C-1327

Daniel G. Sisler, Director

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A. ANNUAL REPORT SUMMARY SHEET

POOR RURAL HOUSEHOLDS, TECHNICAL CHANGE AND INCOME DISTRIBUTION IN LDC'S

Contract No. AID/ta-C-1327

Project Title and Contract Number

Daniel G. Sisler Cornell University

Principal Investigator and Contractor

Department of Agricultural Economics, Cornell University, Ithaca, N.Y. 14853

Contractor's Address

July 1, 1976 -	July 1, 1976 - July 1, 1977
Contract Period From-To	Reporting Period From-To
Total Expenditures and Obligations Through Previous Contract Year	0
Total Expenditures and Obligations for Current Contract Year	$100,140.00

NARRATIVE SUMMARY OF ACCOMPLISHMENTS AND UTILIZATION

Cornell University's principle obligation in fulfilling the objectives of this contract is to examine how technical changes in agricultural production in Asia influence the distribution of income in rural households and how altered production techniques affect the demand and supply of farm labor. Although not uniform, Asian agriculture in general may be characterized as having high man/land ratios and intensive use of agricultural resources. Most subsistence agriculture in the Asian lowlands centers around paddy rice, with other grains and tubers playing a less important role. With the knowledge that a project of this magnitude could not examine changes in agricultural production in a myriad of Asian settings, it was decided to select three countries which typified farming in a large number of nations. The provinces of Laguna and Luzon in the Philippines, a coastal region of Java in Indonesia, and a sample of villages in Andhra Pradesh in India were chosen as typical of a broad spectrum of Asian production techniques.

In the Philippines, the research has been completed although several additional papers will still be forthcoming. Excellent time series data on the impact of high yielding rice varieties, the use of fertilizer, irrigation, and the modernization of threshing was available. The period from 1970 to 1975 was examined to see how these improvements in rice production influenced the proportion of increased yields and income accruing to various factors of production, landlords, tenants, and landless laborers. As land-holders'

incomes increased because of the new technology, hired labor was substituted for family labor. The demand for hired labor increased as did its share of rising output.

The general thrust of the Indonesian research was to examine family decision making, particularly as it relates to the supply of male and female labor among families with varying resource endowments. The field work has been completed, as has a large proportion of the analysis, and a draft manuscript is presently being written.

Tractor mechanization of land preparation, harvesting, and transportation has altered cropping patterns and income distribution in Andhra Pradesh, India. Primary data was collected in six Indian villages to see how the availability of tractors has altered the supply and demand for labor on farms with a wide range of cropping combinations. Analysis of this data has just begun.

While not funded under this project, two investigations currently underway in Nepal are of a parallel nature. One deals with the role of highway transportation in the process of economic development. The second looks at the technical transfers and income distribution aspects of multiple cropping. Descriptions of these projects are included in this report in the hopes that they may add to the information collected under this contract.

The purpose of this summary is to provide US/AID personnel and researchers at Michigan State University and Purdue with an interim report on the progress of the Asian research. It is hoped that it will serve to acquaint co-researchers with an overview of the Cornell analysis so that a more closely coordinated research effort by the collaborating universities will be possible.

ANNUAL RESEARCH REPORT

Poor Rural Households, Technical Change and Income Distribution in LDC's

Contract No. AID/ta-C-1327

Daniel G. Sisler, Director

B. Project Objectives:

The contract has eight specific objectives.

1. To compare and contrast production systems, use of time, participation in labor markets, and family income under different ecological and institutional environments and at different stages of development in selected African, Asian and Latin American countries.

2. To analyze sources of income and differences in income of poor rural households, including landowners, tenants and landless workers.

3. To analyze the rural labor market with respect to demand/supply behavior, efficiency of the labor market, and migration.

4. To analyze the barriers to the increased participation of landless workers in the development process.

5. To analyze the constraints to the adoption of new production technology.

6. To develop and test models to measure the impact of technical change on output, income and employment of poor rural households.

7. To develop and test policy models for analysis of aggregate impacts of trade, taxation, and domestic agricultural policies.

8. To identify policy and institutional changes to increase the participation of the rural poor in, and their benefits from, the development process. Cornell's effort will be concentrated on the first six of these objectives. Comparative data on farming systems, the participation of family members in

the labor supply, and technical change in agriculture are available for specific areas of the Philipoines, Indonesia, and India. This data bank provides a valuable benchmark for comparing various aspects of Asian agriculture. Within the Asian context, income sources for rural households vary considerably among the sample nations. In the Philippines, the production and sale of rice constitutes nearly ninety percent of family income, while in India less than a quarter of arable land is devoted to rice production and income is from a wide variety of sources. Female labor working off the farm in Indonesia provided subsistence earnings for landless households thereby allowing male labor to engage in more lucrative but less certain activities.

New technology has apparently created a stronger demand for landless labor in the Philippines than in either Indonesia or India. In the latter case, tractor mechanization has altered cropping patterns. However, the demand for labor, both family and hired, has remained approximately stable after purchase or rental of a tractor.

Children appear to be a major constraint to the availability of female labor for off-farm work in Indonesia. This, in turn, has an important and measurable effect on male activities in the off-farm labor market. The task of child rearing does not appear to have an equivalent constraint on the availability of female labor and the utilization of male labor in either the Philippines or India. It would appear that this is the result of different social stratifications in India and higher average income levels in the Philippines which make it less imperative that women work.

No major constraints to the adoption of new technology have been identified in the Philippines except the shortage of capital in the poorest

households. In contrast, female labor appears to be a constraint to the adoption of shorter season rice varieties in Indonesia. Double or triple cropping of rice is only possible if time required for land fitting, transplanting, and harvesting is compressed. This is extremely difficult where the activities occur simultaneously or very closely and social structure is such that women provide a considerable part of the labor.

Technological change has been very rapid in rice production in the Philippines, hence research there concentrated on the relationship between technology and the demand for labor. In contrast, the pressure of the supply of labor is acute in India and Indonesia, and therefore in these countries the research focus will be on the supply side. Two general hypotheses will be tested using data from each of the three Asian nations. They are that the factors of production will receive their marginal product and that the relative share of labor and other inputs will change according to the quantities of different inputs applied on the farm. The research on the supply side of labor examines the ways agricultural households allocate labor among three activities, i.e. agricultural production, activities within the home (e.g. child care and cottage industries) and off-farm employment. The supply of labor for agricultural production is importantly tied to the availability of farm assets, notably land, draft animals, and implements. Work in India specifically deals with tractor ownership and its effect on the supply of labor.

C. <u>Accomplishments to date:</u>

Progress on the Central Research Effort

I. The Philippines

Dr. Chandra Ranade has been the principal investigator relative to the

analysis of technical change in Filipino rice production. Dr. Ranade has completed his Ph.D. dissertation and three publications based on the data collected in the Philippines. These papers authored or co-authored by Dr. Ranade are presented in Appendix A of this report. Perhaps the most meaningful way of presenting the results of Dr. Ranade's Ph.D. dissertation is through his thesis abstract which is presented below.

Cereals production has taken a quantum jump in Asia after the introduction of modern varieties in the mid 1960's. This technology coupled with mechanization has directly benefited agricultural production in terms of growth and efficiency. The thesis analyzes distribution of these benefits among direct participants in rice production in two regions in the Philippines where technological change has been very rapid.

The approach is to compare distribution of output between traditional and new technologies from two perspectives; observed distribution and distribution estimated from production functions. The former perspective involves a partitioning of observed shares according to claimants called socio-economic classes, such as landlords, tenants and hired labor, and according to factors of production. The latter perspective involves estimation of production elasticities which also has two elements; first, comparison of factor shares and production elasticities, and second, measurement of input-substitution. In doing so, the thesis establishes Hicks coefficient as the criterion of changes in production elasticities and explores use of generalized CES and VES production functions.

The data are taken from two series of farm surveys carried out by the International Rice Research Institute for the same rice growing farmers before and after technological change. It contains information on inputs

and output and institutional arrangements through which costs and returns of production are shared among the participants.

Analysis on observed income distribution shows that as new technologies increased production, all socio-economic classes gained in absolute shares. However, the relative share of landlords declined while that of tenants, chemical inputs, tractors and hired labor increased. It appears that as tenants' absolute as well as relative income increased because of land reforms and new technologies they substituted hired labor for part of family labor, and therefore employment as well as wages paid to hired labor increased and laborers benefited. The relative share of total labor, however, declined because total farm employment did not increase as much as increase in output. Tractorization prevented this increase but if this innovation was discounted, the relative share of total labor increased.

Production function analysis shows that changes in production elasticities and relative shares are similar. For any individual technology, chemicals and inputs in land preparation are paid their marginal product. Although the production elasticity and relative share of land and labor for remaining operations differ substantially, the difference is less in modern technology than in traditional. It appears that the wage rate of laborers for harvesting operations was more than their marginal product in traditional technology.

Estimates of the direct and partial elasticities of substitution, and Hicks coefficients offer several exploratory implications on demand for inputs which were never tapped in previous research. Production elasticities of chemicals and labor are more sensitive to changes in chemical-labor ratio in new than traditional technologies; implying that the former is more flexible in terms of distributive bias. Within new technologies, chemicals and labor

are highly substitutable implying that the chemicals' price has a strong effect on demand for labor and so does the wage rate on demand for chemicals. However, compared with traditional, new technologies are more land-saving than labor-saving.

Various policy options for redistribution of income without revolutionary redistribution of assets are available due to the flexibility of the distributive bias of new technologies. Effective use of these options, however, requires a knowledge about changes in labor supply due to technological change. Still, from labor demand side the thesis shows that a limited redistribution of land towards tenants and some reorganization of landless labor for ownership of mechanical inputs are feasible conditions for redistributing benefits of new technologies towards rural poor, at least for the next decade.

II. Indonesia

Miss Gillian Hart has been the principal investigator relative to the work in Indonesia. An outline of what she has accomplished is presented below.

1. Overview

The work in Indonesia has emphasized that household labor allocation decisions vary according to the household's control over production assets. The Indonesian phase of the project focuses on conceptualizing the way households allocate their labor among different activities. Preliminary analysis definitely shows that there are significant differences in labor allocation behavior among three classes defined as follows: 1. The wealthiest class which consists of those households which own and operate at least 0.5 hectares of wet rice fields; 2. Those which control wet rice fields between 0.5 and 0.15 hectares in size; and 3. Those who control less than 0.15 hectares.

2. Data processing

a. Household data:

At the time of writing this report, processing of the main set of household data has just been completed. The data on labor allocation, income and consumption have been transformed and incorporated into an SPSS file consisting of about 400 variables per household per month. Data for each of the 12 months are set up in a subfile comprised of the following groups of variables:

(i) Basic data: household size and composition, agricultural and nonagricultural assets

(ii) Income and consumption

(iii) Labor allocation: These data have been transformed to the household level, and broken down according to age-sex group (females and males aged 10-15 and 16+), and activity (own production consisting of rice, fish pond, tobacco and dryland crops, home garden and livestock; wage labor; trading; fishing; gathering). For each age-sex group and activity there is data on number of participants, hours spent working and travelling and for off-farm activities, returns to labor including and excluding travelling time.

b. Farm management data:

One of the major additions will be farm management data generated in a survey conducted at the end of the wet and dry rice growing periods. This data included costs of production and physical input information in rice production. Currently, analysis based on production functions has been completed. Elasticities and marginal product coefficients have been estimated with good results.

c. Child care data

This is the only set of data which has not been processed. It consists of detailed time budgets of households with children under the age of three. The data covers different types of child care activities, which household members performed them, food intake, clinical examinations, and anthropometric measures. The original questionnaires are available and the plan is to analyze them during the latter months of 1977. Some descriptive tables on child care will be included in Miss Hart's dissertation. The major analysis of this data will be presented in a subsequent research paper which will incorporate previous work on the relationship between women's labor force participation and the health and nutritional status of young children.

3. Outline of Miss Hart's Ph.D. dissertation

LABOR ALLOCATION STRATEGIES IN RURAL JAVANESE HOUSEHOLDS

Part A.

Chapter I: Rationale, scope and objectives

(a) Policy issues to which a micro level understanding of household labor allocation is relevant (macro growth and micro welfare).

(b) Brief review of theoretical debate and empirical evidence which focus on the need for detailed micro studies.

(c) Objectives - outline of thesis.

Chapter II: Basic assumptions in the analysis of labor allocation in a densely populated rural environment

The basic arguments to be developed in this chapter are:

(a) That in any analysis of labor allocation, the household and not the individual constitutes the relevant unit;

(b) That labor allocation behavior can only be understood within the

specific context of the environment or system within which the household operates, and that analysis of the system logically precedes analysis of decision making behavior in individual households;

(c) That in an environment such as rural Java, the distribution of production assets is fundamental to the understanding of labor allocation. At the system level, the distribution of production assets and the mode of production determine the system of exchange relationships, and the modus operandi of labor markets; at the micro level, the individual household's control over the means of production is likely to determine not only what household members are willing to do, but which income earning opportunities are potentially available to them.

The argument will be developed in three stages.

1. Basic Assumptions

This will primarily involve elaborating on points (a) and (b) above.

2. Models of Household Labor Allocation

An outline of (a) the anthropological approach, and (b) neoclassical household production models, demonstrating their evolution from the extension of labor-leisure analysis. This section will also focus on some similarities between the two approaches.

3. The Relevance of Household Models to the Analysis of Labor Allocation in Rural Java

This section will argue that both models involve explicit and/or implicit assumptions about the nature of the system in which the household operates, and that these assumptions are not relevant to rural Java. Emphasis will then be placed on the importance of asset distribution, and the arguments outlined in (c) above will be developed.

Part B.

Chapter III: The Evolution of Land and Labor Relationships in Rural Java

Proceeding from the arguments developed in Chapter II that analysis of the system logically precedes the analysis of household behavior, this chapter will trace briefly the evolution of land and labor relationships in rural Java. Taking as a starting point the Geertzian arguments that Java constitutes the prototype of involution and shared poverty, this chapter will illustrate the basic similarity between this and the concept of disguised unemployment. Evidence will then be put forward on trends in land and labor relationships in rural Java which suggests strongly that in many villages there is a clearly definable class structure based on control over the means of production, and that this is likely to have important implications for access to income earning activities.

Chapter IV: Environmental and Structural Features of the Study Village

This chapter is basically a description of the study village with particular emphasis on asset distribution, the structure of income earning activities and the "representativeness" of the village. Criteria are developed for stratifying the 92 sample households into three asset classes, which will be compared in terms of assets, demographic composition and educational levels. The basis for delineating the three classes is outlined above.

Chapter V: Inter-Class Differences in Labor Allocation Patterns

Preliminary analysis based on average characteristics of each household class have been completed. It should be emphasized that this work has little statistical sophistication and much with-in class variation has been masked. Five topics are covered by this analysis. A part of the findings are reported

in "The Survival Strategy of Labor Allocation With Illustrations from a Javanese Coastal Village." This paper is included in Appendix A of this report.

The following topics will be covered in this chapter.

1. Some Recent Evidence on Labor Allocation in Java.
2. General Patterns of Labor Allocation According to Class Status
   (a) Income earning activities
   (b) Housework
   (c) Child care
   (d) School attendance
3. The Labor Allocation of Different Sex, Age and Class Groups
   (a) Children 6-9
   (b) Females and males 10-15 and 16+
4. Seasonal Variations in Different Types of Income Earning activities
   (a) Rice labor
   (b) Female wage labor markets
   (c) Male wage labor markets
   (d) Some comparisons between male and female labor markets
   (e) The relationship between wage labor and fishing/gathering activities
5. Inter-Class Differences in Intra-Household Allocational Strategies

This section will integrate the various strands of evidence presented in the above four topics and argue that there appear to be important inter-class differences in the manner in which the three asset classes adjust to seasonal changes in wage rates, job opportunities and ecological conditions, many of which revolve around the labor force behavior of women and children relative to that of adult men. The evidence suggests that there is a

significantly higher degree of interdependence among the activities of households which have some degree of control over the means of production. More specifically, landless households are far more inclined to decide upon the activities of individual members on the basis of opportunities available to the household as a whole. Hence they are more likely to be allocated towards an integrated set of activities which might involve relatively low returns for certain members, but which are optimal from the viewpoint of the household as a whole in terms of both the level and - very importantly - the stability of income.

Chapter VI: The Interaction of Labor Allocation, Income and Consumption

This chapter will describe inter-class and inter-seasonal differences in income and consumption patterns and relate these to labor allocation behavior.

Part C.

Chapter VII: The Determinants of Time Allocation among Different Types of Income Earning Activities, Housework and Leisure: A Theoretical Analysis

The purpose of this chapter is to construct a conceptual framework to serve as the basis for a multivariate empirical analysis of the impact of assets, household size and composition and wages, prices and job availability on household labor allocation, and their relative importance. Citing evidence presented in Part B, Chapter VII reviews briefly some of the complexities involved in the analysis of labor allocation in an environment such as rural Java, and points out how some of the common assumptions made by the standard neoclassical models require adaptation in the context of this study. An attempt is then made to develop a simple constrained maximization model which is then adapted to take account of various types of discontinuities suggested by the descriptive analysis.

Chapter VIII: Results of the Empirical Analysis

Part D.

Chapter IX: The Potential Impact of Alternative Policy Measures on Domestic Economic Organization and Welfare

Chapter X: Conclusions

As of July 20, Chapters I, II, V and VI are in draft form. The remaining chapters should be completed by the end of calendar 1977.

4. Preliminary results

Initial findings indicate that assets are the only policy parameter which operates directly on both the supply and demand sides of the household labor market. From the demand side, it tends to shift the opportunity curve upwards, whereas from the viewpoint of supply, access to the means of production provides the household with the minimum of security necessary to break its complete dependence on fluctuations in labor and foodgrain markets.

Policy implications of the research need to be pragmatic and acceptable within the political context of the nation being studied. In the Indonesian context, major asset redistribution is not considered a feasible policy instrument. In the absence of such measures, attention must be focused on massive increases in high productivity income earning activities, combined with minimizing fluctuations in wages and prices.

In the context of the present analysis, however, it seems relevant to argue that increases in agricultural productivity, while obviously very important, are unlikely to provide significant opportunities for the landless groups in much of rural Java. The data suggests strongly that households holding between 0.15 and 0.5 hectares of paddy land respond strongly to the

availability of high income earning opportunities within the village; thus any attempt to increase the opportunity structure of the landless group by making jobs available must take account of the possibility of a fairly high labor supply elasticity in small landowning households. Preliminary analysis indicates that the type of relationships which exist between rich and poor households is not only determined by the ecological and technological factors, but also by complex socio-political influences which must be recognized by analyses of labor allocation behavior.

III. India

Mr. Gorantla Doraswamy has completed the field work in India and is currently analyzing the data that he has collected. The following material discusses his preliminary findings.

1. Field Work

To study the effect of tractorization on demand for labor and the supply of family labor, data has been collected from 99 farmers in Chittoor District, Andhra Pradesh, India. The data was collected during 1976. The sample of farmers was selected from four different clusters of villages. Two of the clusters, deemed the central area, are about 20 kilometers apart. Two other clusters are situated at a distance of 80 and 100 kilometers from the central clusters, in opposite directions. Thus the sample covers a wide area of the district. The size of holding varies from 0.67 to 56.20 acres. The most important crops of the district are paddy, sugar cane, groundnuts, ragi, and perennial crops such as mangoes, coconut, tamarind, and limes. Twenty-eight farmers owned tractors. In addition, four tractors were owned jointly between two families each. Two tractor owners shared their tractors with other farmers who were not in the sample. The sharing of tractors occurred in only

one village cluster. It is interesting to note that the villages in this cluster are in close proximity to one of the major market towns of the district.

2. Work Presently Completed

The principal researcher, Mr. Doraswamy, returned to Cornell during the last week of February, 1977. Since his return, data related to the sample farmers has been categorized and put into a form suitable for further analysis. The four categories of data established so far are:

a. Labor. The initial record for each family consisted of employment of casual and permanent laborers, and the allocation of the time of family members to each crop. It was impossible to obtain the labor costs for many activities since they were accomplished by permanent employees who were paid an annual wage rather than by enterprise or activity. To rectify this situation, annual wages paid to permanent employees was allocated to enterprises and activities in proportion to the amount of total annual hours worked.

b. Assets. These consist of land, traditional implements, pump sets, tractors, mechanical cane crushers, livestock, houses, cattle sheds, storage sheds, pump sheds, and financial assets. Information on debts was also collected.

c. Sources of income. Items in this category are the hiring out of human labor, the hiring out of animal labor, the hiring out of tractors, selling irrigation water, selling animal products, money lending, and self-employment and/or the provision of services.

d. Family size. Information on total number of family members and number of members remaining in the village has been collected and tabulated.

3. Some Preliminary Results

A summarization of the data collected appears in seven tables at the end of this section of the report. The preliminary results presented below will draw on this tabular material.

The average size of holdings in the case of tractor owners is 19.8 acres and in the case of non-tractor owners is 7.8 acres. The average farm size for the sample as a whole is 11.2 acres. An increase in farm size appears to be associated with an increase in the proportion of farmers owning tractors. As farm size increases, the percent of the area that is under irrigation and also the percent of arable land that is not cultivated increases. The proportion of area under irrigation is about 69 percent for both tractor and non-tractor owners.

The cropping pattern is observed to be different among tractor owners and others. Tractor farms allocated 12.5 percent of their area to traditional paddy and non-tractor owners allocated 10.5 percent. The percent of area under high yielding varieties of rice is 22.6 percent and 20.6 percent in the case of tractor owners and non-tractor owners respectively. The percent of area under other food grains is lower among tractor farms. The percent of area under sugarcane, groundnuts and vegetables is distinctly different between tractor and non-tractor owners. The percent of area under perennial crops is about the same for both groups of farmers (6%). As farm size increases there is a strong tendency among both tractor and non-tractor owners to allocate more land for perennial crops. But the tendency seems to be stronger among non-tractor farms. On farms where tractors are owned, farm size is about two and a half times larger than farms not having tractors, so mechanization must be reducing land under perennial crops.

Twenty-seven percent of non-tractor owners and 71 percent of tractor owners did not own draught animals. Out of the 3 farmers operating below 2 acres of land, 2 farmers did not own draught animals, but all 3 owned milch animals. There seems to be a tendency for smaller farmers not to invest in draught animals. In spite of the fact that 71 percent of tractor owners did not invest in draught animals, total investment in livestock per farm is higher among tractor owners (Rs. 3,711 as against Rs. 2,780).

Land value forms a significant proportion of total assets on both tractor and non-tractor farms. In the case of tractor farms, land constitutes 80 percent of assets while for non-tractor farms it is 78 percent. Housing is the second major important asset, consisting of 11 percent of total assets for all farms taken together. For tractor owners, housing is 8 percent of assets, while for non-tractor owners it is 13 percent. For farms that own tractors, their value accounts for 9 percent of total assets.

Farmers owning tractors and having farms of from 4 to 12 acres earn the largest rupee value from tractor rental of any farm size class. Apparently, larger farms have more on-farm work for their tractors and less time available in which to rent them out. The bulk of the farmers sampled are of high caste. Among these families, there is little hiring out of labor. In actuality, only one family hired out its labor to any significant degree and this was not for agricultural tasks.

Table 1. Selected Characteristics of Farms in Eight Size Categories

Operational size (acres)	Number of farms			Operated area (acres)			Net area sown as % of operated area			Gross cropped area as % of operated area			Cultivable waste + fallows as % of operated area			Own irrigated land as % of operated area			Own irrigated land as % of own land			Operated area irrigated as % of total operated area		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0 - 2	3	-	3	1.00	-	1.00	100	-	100	189	-	189	0-	-	-	100	-	100	100	-	100	100	-	100
2 - 4	15	-	15	3.29	-	3.29	94	-	94	142	-	142	6	-	6	84	-	84	87	-	87	88	-	88
4 - 8	30	4	34	5.96	6.73	6.05	97	93	97	127	99	123	3	7	3	77	70	76	71	67	71	73	66	72
8 - 12	11	6	17	9.54	9.72	9.61	97	93	96	133	123	129	3	7	4	58	88	68	61	75	67	59	71	63
12 - 20	10	6	16	15.24	15.95	15.50	94	100	96	123	158	136	6	0	4	74	69	72	75	76	75	75	79	76
20 - 28	2	7	9	22.19	24.40	23.91	95	95	95	97	115	111	5	5	5	49	82	75	49	82	75	49	82	75
28 - 36	1	2	3	29.41	31.05	30.50	61	100	87	64	128	108	39	0	13	52	71	65	52	71	65	52	72	65
36 +	-	3	3	-	47.21	47.21	-	80	80	-	91	91	-	20	20	-	46	46	-	46	46	-	46	46
All	71	28	99	7.83	19.83	11.23	94	92	93	123	118	120	6	8	7	70	70	70	69	69	69	69	69	69

Note: Figures under column No. 1 refer to non-tractor owners.
Figures under column No. 2 refer to tractor owners.
Figures under column No. 3 refer to all farms.

Table 2. Actual Acreage Per Farm Under Selected Crops

Operational size (acres)	Traditional paddy			HYV - paddy			Other foodgrains			Sugar cane			Groundnut			Vegetables			Plantains + betels			Green fodder			Seed bajra + jowar		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0 - 2	0.22	-	0.22	0.33	-	0.33	0.56	-	0.56	0	-	0	0.73	-	0.78	0	-	0	0	-	0	0	-	0	0	-	0
2 - 4	0.43	-	0.43	1.13	-	1.13	0.33	-	0.33	0.97	-	0.97	0.91	-	0.91	0.59	-	0.59	0.01	-	0.01	0	-	0	0.29	-	0.29
4 - 8	0.80	0.41	0.75	1.63	1.01	1.55	0.70	0.26	0.65	1.11	2.51	1.28	2.53	1.54	2.41	0.62	0.42	0.59	0	0	0	0.03	0	0.03	0.07	0	0.06
8 - 12	1.20	2.48	1.65	2.63	2.25	2.50	1.38	0.26	0.99	1.58	1.03	1.39	3.93	4.75	4.21	0.89	0.04	0.59	0	0	0	0.30	0	0.19	0.39	0.83	0.54
12 - 20	2.52	1.68	2.21	4.45	8.25	5.88	1.02	2.51	1.58	3.46	0.76	2.45	5.57	9.84	7.17	0.08	0.33	0.17	0.06	0.04	0.05	0	0	0	0.92	1.33	1.08
20 - 28	1.16	5.03	4.17	0.45	5.31	4.62	0.41	0.70	0.64	9.07	2.43	3.91	0	11.41	8.88	0.25	0.19	0.20	0	0	0	0	0	0	0	2.43	1.89
28 - 36	1.00	0.85	0.90	1.50	11.00	7.83	0	0	0	4.00	6.50	5.67	2.50	8.80	6.70	1.00	0.15	0.43	0	0	0	0	0	0	0	6.50	4.33
36+	-	6.10	6.10	-	5.93	5.93	-	1.00	1.00	-	5.67	5.67	-	16.73	16.73	-	0.05	0.05	-	0	0	-	0	0	-	0	0
All	1.01	2.92	1.55	1.99	5.27	2.91	0.75	0.91	0.80	1.70	2.42	1.90	2.68	8.62	4.36	0.55	0.20	0.45	0.01	0.01	0.01	0.06	0	0.04	0.28	1.54	0.64

Operational size (acres)	Mangoes + coconut + tamarind + limes		
	1	2	3
0 - 2	0	-	0
2 - 4	0	-	0
4 - 8	0.10	0.48	0.14
8 - 12	0.32	0.28	0.30
12 - 20	0.65	0.40	0.56
20 - 28	10.25	0	2.28
28 - 36	8.91	6.00	6.97
36+	-	7.50	7.50
All	0.59	1.45	0.84

Note: Figures under column No. 1 refer to non-tractor owners.
Figures under column No. 2 refer to tractor owners.
Figures under column No. 3 refer to all farms

Table 3. Percent of Total Cropped Area Devoted to Selected Crops

Operational size (acres)	Traditional paddy			HYV - paddy			Other foodgrains			Sugar cane			Groundnut			Vegetables		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0 - 2	11.82	-	11.82	17.64	-	17.64	29.45	-	29.45	0	-	0	41.09	-	41.09	0	-	0
2 - 4	9.27	-	9.27	24.22	-	24.22	7.09	-	7.09	20.80	-	20.80	19.52	-	19.52	12.61	-	12.61
4 - 8	10.51	6.21	10.04	21.46	15.17	20.78	9.29	3.95	8.72	14.59	37.86	17.10	33.32	23.22	32.23	8.16	6.32	7.96
8 - 12	9.47	20.79	13.32	20.82	18.88	20.16	10.93	2.17	7.95	12.48	8.68	11.19	31.01	39.83	34.00	7.03	0.31	4.74
12 - 20	13.45	6.70	10.44	23.77	32.80	27.80	5.47	10.00	7.49	18.45	3.01	11.57	29.71	39.14	33.92	0.43	1.31	0.82
20 - 28	5.39	17.96	15.69	2.08	20.77	17.39	1.92	2.50	2.40	42.00	8.67	14.69	0	40.77	33.40	1.16	0.66	0.75
28 - 36	5.29	2.12	2.74	7.93	27.64	23.86	0	0	0	21.15	16.33	17.26	13.22	22.11	20.40	5.29	0.38	1.32
36 +	-	14.19	14.19	-	13.80	13.80	-	2.33	2.33	-	13.18	13.18	-	38.93	38.93	-	0.11	0.11
All	10.52	12.52	11.50	20.61	22.57	21.57	7.80	3.92	5.90	17.65	10.38	14.10	27.86	36.94	32.29	5.67	0.86	3.32

Operational size (acres)	Plantain + betel			Green fodder			Seed bajra + jowar			Mangoes + coconut + tamarind + limes			Credit for crops per cropped acre (Rs.)			Total credit per cropped acre (Rs.)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0 - 2	0	-	0	0	-	0	0	-	0	0	-	0	67	-	67	1000	-	1000
2 - 4	0.19	-	0.19	0	-	0	6.30	-	6.30	0	-	0	128	-	128	221	-	221
4 - 8	0	0	0	0.45	0	0.41	0.91	0	0.81	1.26	7.26	1.91	82	40	77	319	441	335
8 - 12	0	0	0	2.34	0	1.54	3.06	6.99	4.39	2.52	2.35	2.46	43	17	34	146	119	134
12 - 20	0.32	0.15	0.25	0	0	0	4.94	5.30	5.10	3.47	1.59	2.63	26	125	65	54	495	224
20 - 28	0	0	0	0	0	0	0	8.67	7.11	47.44	0	8.57	34	109	93	34	150	126
28 - 36	0	0	0	0	0	0	0	16.33	13.20	47.12	15.08	21.23	-	0	0	17	0	5
36 +	-	0	0	-	0	0	-	0	0	-	17.45	17.45	-	120	120	-	42	42
All	0.11	0.04	0.07	0.62	0	0.32	2.91	6.58	4.70	6.17	6.20	6.18	55	90	72	170	174	172

Note: Figures below column No. 1 refer to non-tractor owners. Figures below column No. 2 refer to tractor owners. Figures below column No. 3 refer to all farms.

Table 4. Number and Percent of Farms not Owning Draught Animals

Operational size (acres)	Non-tractor owners		Tractor owners		All farms	
	No.	%	No.	%	No.	%
0 - 2	2	67	-	-	2	67
2 - 4	5	33	-	-	5	33
4 - 8	10	34	4	100	14	42
8 - 12	0	0	6	100	6	35
12 - 20	2	20	4	67	6	38
20 - 28	0	0	3	43	3	33
28 - 36	0	0	1	50	1	33
36 +	-	-	2	77	2	66
All farms	19	29	20	71	39	40

Table 5. Value of Selected Assets

Operational size (acres)	Traditional implements			Irrigation & equipment			Tractor			Sugar cane crusher			Livestock			Dwelling house			Land			Total assets		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	(Value in Rs.)															(value in 000's Rs.)								
0 - 2	235	-	235	1167	-	1167	-			0	-	0	1273	-	1273	8	-	8	12	-	12	25	-	25
2 - 4	595	-	595	2647	-	2647	-			100	-	100	2517	-	2517	18	-	18	63	-	63	94	-	94
4 - 8	714	193	651	3974	3275	3889	30,000			483	1550	612	2003	2473	2517	18	9	17	113	145	117	137	183	142
8 - 12	1612	531	1231	3641	5533	4309	33,333			582	0	376	3025	2383	2060	25	29	26	145	193	161	186	278	218
12 - 20	1233	665	1021	6631	7620	7002	30,500			1720	583	1294	3985	4105	2799	31	29	30	230	285	232	309	304	307
20 - 28	1185	992	1035	5500	5743	5689	32,143			1500	543	756	6680	3891	4030	58	33	38	292	369	352	375	444	429
28 - 36	886	1206	1099	9900	9000	9300	42,500			2000	0	667	4100	7350	4511	6	40	29	323	524	457	345	662	559
36 +	-	711	711	-	5500	5500	31,667			-	1667	1667	-	4388	6667	-	27	27	-	436	436	-	501	501
All farms	897	694	839	4024	5954	4570	32,786			621	661	632	2780	3711	4388	21	28	23	128	288	173	164	363	221

Table 6. Value of Selected Assets as a Percent of Total Assets

Operational size (acres)	Land			Traditional implements			Irrigation equipment			Tractors			Sugar cane crusher			Livestock			Dwelling house		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0 - 2	46	-	46	0.9	-	0.9	4.6	-	4.6		-		0	-	0	5.0	0	5.0	31	-	31
2 - 4	67	-	67	0.6	-	0.6	2.8	-	2.8		-		0.1	-	0.1	2.7	0	2.7	20	-	20
4 - 8	83	79	82	0.5	0.1	0.5	2.9	1.8	2.7		16		0.4	0.9	0.4	1.5	1.4	1.4	13	5	12
8 - 12	78	69	74	0.9	0.2	0.6	2.0	2.0	2.0		12		0.3	0	0.2	1.6	0.9	1.3	13	10	12
12 - 20	75	77	76	0.4	0.2	0.3	2.2	2.5	2.3		10		0.6	0.2	0.4	1.3	1.4	1.3	10	9	10
20 - 28	78	83	82	0.3	0.2	0.2	1.5	1.3	1.3		7		0.4	0.1	0.2	1.8	0.9	1.1	15	7	9
28 - 36	93	79	82	0.3	0.2	0.2	2.9	1.4	1.7		6		0.0	0	0.1	1.2	1.1	1.1	2	6	5
36 +	-	87	87	-	0.1	0.1	-	1.1	1.1		6		-	0.3	0.3	-	0.9	0.9	-	5	5
All Farms	78	80	79	0.6	0.2	0.4	2.5	1.6	2.1		9		0.4	0.2	0.3	1.6	1.0	1.4	13	8	11

Note: Figures under column No. 1 refer to non-tractor owners. Figures under column No. 2 refer to tractor owners. Figures under column No. 3 refer to all farms.

Table 7. Income in Rupees from Sources Other than the Sale of Crops, Per Farm

Operational size (acres)	Hiring-out labor			Hiring-out animals			Selling water			Hiring-out tractors			Sales of live-stock products			Earned interest			Self-employ-ment + service			Total		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0 - 2	0	0	0	364	0	364	0	-	0	0	-	0	962	-	962	120	-	120	1000	-	1000	2447	-	2447
2 - 4	48.96	0	48.96	28	0	28	0	-	0	0	-	0	2047	-	2047	-	-	0	2773	-	2773	4897	-	4897
4 - 8	0.52	0	0.45	10	0	9	650	0	571	0	3821	463	1579	1358	1552	7	0	6	83	0	73	1904	3,840	2139
8 - 12	0	0	0	40	0	26	0	0	0	0	3015	1064	2726	2369	2600	227	809	458	955	0	618	4475	6,192	5081
12 - 20	0	0	0	0	0	0	45	0	28	0	536	201	2158	2476	2277	192	60	143	4200	0	2625	6595	3,072	5274
20 - 28	0	0	0	0	0	0	0	0	0	0	1898	1476	3275	1423	1835	0	0	0	1000	0	222	4275	3,321	3533
28 - 36	0	0	0	0	0	0	0	0	0	0	2260	1507	2127	5311	4250	0	2438	1625	0	0	0	2127	10,009	7381
36 +	0	0	0	0	0	0	-	0	0	0	2880	2880	-	1484	1484	-	0	0	-	0	0	-	4,364	4364
All farms	10.56	0	7.57	32	0	23	272	0	195	0	2251	637	1967	2126	2012	76	360	157	1430		1025	3688	4,546	3931

Note: Figures under column No. 1 refer to non-tractor owners.
Figures under column No. 2 refer to tractor owners.
Figures under column No. 3 refer to all farms.

IV. Related Research Conducted in Nepal

The original thrust of Cornell's contribution to the contract was centered in the three Asian countries of the Philippines, Indonesia, and India discussed above. While not funded by this AID contract, two research projects of a parallel nature are presently being conducted in Nepal. Since the results of this research may have a direct bearing on the delivery of new technology and the income distribution effect of that technology, conclusions of the Nepalese research may be incorporated in the findings of this contract. The Nepalese research proceeds along two lines. The first deals with the role of highway transportation in the process of economic development. The second concerns technical transfers and income distribution aspects of multiple cropping, intercropping, and relay cropping. It is felt that a description of these two projects will be useful to US/AID personnel as well as to researchers connected with the contract at Michigan State University and Purdue.

The two reports are:

"Transportation and th Structure of Regional Development in Nepal," by Gary Ender, Principal Researcher and Daniel Sisler, Research Leader.

"The Role of Intercropping in the Farming Systems of Four Communities in Kabre District, Nepal, with Particular Emphasis on How Technological Change may Influence Intercropping, Multiple Cropping and Relay Cropping" by Douglas Pachico, Principal Researcher and Daniel Sisler, Project Leader.

Progress Report, November 1, 1976 to June 15, 1977

Transportation and the Structure of Regional Development in Nepal

Gary Ender, Principal Researcher

and

Daniel Sisler, Research Leader

I. Introduction:

This report is a synthesis of the monthly reports submitted by Mr. Gary Ender from Nepal. The time covered by the report is from November 1, 1976 through June 15, 1977. Mr. Ender is the principal field investigator for this project, and is responsible for collecting twelve months of primary data relative to highway use, road maintenance, and road traffic patterns in Nepal. This data will be supplemented by published information concerning vehicle registration, governmental expenditures on highway construction and maintenance, tariffs on imported vehicles, replacement parts, tires and fuel, accident records, and the rupee value of tolls and licenses collected by the Nepalese Ministry of Works and Transport.

II. Brief Overview:

Over the past fifteen years several major hard surfaced highways have been constructed in Nepal. Few nations have expended as high a proportion of total government revenues in the transportation sector. In addition the International Bank for Reconstruction and Development and other lending institutions have provided loans and a considerable amount of capital to fund highway construction. These roads have been constructed by a variety of techniques ranging from very labor intensive methods employed on highways built by the Peoples Republic of China, to capital intensive techniques with heavy power equipment employed by construction companies from industrial nations.

The current development plan for Nepal is based on the principle that major emphasis will be placed on a relatively small number of development centers, and improvements in agricultural production and the standard of

living among the rural residents will fan out from these growth axes. An additional facet of the plan is to improve hills/plain integration so that gains from comparative advantage and exchange can take place. The role of transportation is pivotal to the growth strategy yet little is known about highway utilization and maintenance in Nepal.

The research reported here has three broad objectives:

1. To identify highway utilization from the standpoint of commodity and passenger movement. These movements will be examined to discern seasonality and the point-to-point destinations of goods and people.

2. To examine policies and practices which hamper the efficient use of existing roads in Nepal. Poor highway maintenance, lack of feeder roads, high license and toll fees and excessive tariffs on parts, fuel and tires will be investigated.

3. To provide recommendations for policy changes which will allow for the more efficient use of highways to meet governmental objectives for developing rural Nepal.

III. Progress report:

Activities to date fall into three distinct time frames -- November 1, 1976 to January 12, 1977, January 13, 1977 to April 3, 1977 and April 4, 1977 to June 15, 1977. The report will be cast in the framework of these three periods of time.

A) November 1, 1976 to January 12, 1977.

Mr. Ender arrived in Nepal on November 3, 1976. He was only able to obtain a two-week tourist visa in the United States and entered Nepal carrying that visa and a letter of affiliation with CEDA. Even though he

is fluent in Nepalese, Hindi, and several dialects as well as the customs of the country, approximately one week was spent in "settling in," obtaining housing, clearing sea freight through customs, etc. Then began a two and one-half month period of frustration over the acquisition of a research visa and official affiliation with the Ministry of Works and Transport and Tribhuvan University.

After a long period of negotiations, and gaining affiliations with Tribhuvan University and the Ministry of Works and Transport, a permanent visa was obtained on January 12, 1977. During the time from November 3 to January 12, it was impossible to begin any phase of the field work, for Mr. Ender had to have his visa renewed every two weeks, and there was considerable uncertainty concerning whether or not he would be granted a more permanent visa. Over this period Mr. Ender was able to gather some valuable secondary data, and lay a sound basis for his field work.

Six sets of secondary data were collected.

1. Monthly traffic data for the three year period 1973-75 on aggregate traffic movements between each of the 31 highway collection stations.

2. Governmental expenditures on highway construction and maintenance over the most recent three years, and data related to public expenditures in other areas -- education, research, etc.

3. Revenues realized from tolls collected at the check stations, and other revenues realized from related sources such as licenses, fees, and tariff receipts.

4. Official statistics on movements of major commodities to include gasoline, diesel fuel, salt, sugar, rice and cloth.

5. Data on vehicle registration by class and weight.

6. Reports on highway accidents from the most recent three years.

Preliminary analysis on traffic flow data was prepared on graphs to identify low and average traffic patterns for passengers and freight at the major collection posts.

B) January 13, 1977 to April 3, 1977.

To assist in the time consuming process of obtaining secondary and primary data as well as the later traffic survey, an enumerator was hired. He has the equivalent of a B.S. degree in agriculture, and has proven to be intelligent, well motivated, and extremely accurate. He is bilingual, and to date has been particularly helpful in working with middle and lower level officials of His Majesty's Government of Nepal.

As a preliminary method of developing good work habits and accuracy in record keeping, the enumerator completed the collection of the secondary data mentioned in the previous section. This allowed Mr. Ender to concentrate his efforts on preparation for the actual field survey of traffic flows, road conditions, commodity passenger movements, and vehicle and tire conditions. Two field questionnaires were prepared to gether this data. These questionnaires were field tested at the Benepa check post. This allowed the enumerator and Mr. Ender to study first hand how the check stations worked, and to modify the questionnaire accordingly. After pretesting, the questionnaire was altered in several ways, with the most useful assistance of the officer at Benepa. The four week trial run at the Benepa station also helped Mr. Ender to evaluate a traffic sampling procedure, and learn of the variability of traffic during a 24 hour period. This was particularly important if the sample was not to be biased as a result of sampling during ordinary working hours. It was decided that 24 hours a day sampling was necessary.

A map which located the 31 checkpoints and recorded the flows of trucks, buses and other vehicles between them was prepared. From this map and traffic flow charts it was decided that sampling at 8 of the 31 check stations would provide a representative sample. Each of these eight sites was visited to obtain the cooperation of the officer in charge, and gain local rapport. The eight sites selected were Tarahara (Dharan), Duhbi (Biratnagar), Kanchanpur (Rajbiraj), Lalgadh (Janakpur), Jitpur (Biragnj), Naubise (Kathmandu), Manigram (Bhairahawa), and Pokhara.

C) April 4, 1977 to June 15, 1977.

A "round robin" sampling procedure was established whereby the eight toll posts are systematically sampled. A post is sampled for a week, 24 hours a day, and then Mr. Ender and the enumerator move to the next post. Some slack time is lost in moving, assembling data, and recovering from the long hours. Between April 4 and June 15 each of the sites was sampled for a full seven day period. It is anticipated that three additional week long visits will be made to each of the posts to take into account seasonal variations in traffic flows and road conditions.

The staff of the check points were very cooperative, with one exception, and in some instances assisted with data recording during the late evening and early morning hours. Data was collected on origin, destination and type of vehicle. In the case of trucks, jeeps and other freight carriers the cargo was recorded in sixteen classifications. Buses and other passenger carrying vehicles were classified by number of seats and occupancy. Discussions with the drivers were helpful in obtaining information as to main points of passenger and cargo pickup, although precise information of this sort is impossible to obtain due to the practice of picking

up passengers and cargo at virtually any point along the road rather than merely in major towns.

It should be noted that Mr. Ender's wife is helping in coding and recording the mass of information and establishing it in a manner for easy retrieval. This assistance has been invaluable.

IV. Some Preliminary Observations:

A) The secondary data appears to be useful, although there are some obvious discrepancies and difficulties of interpretation. This is particularly true in the case of accident reports, and official records concerning movements of goods. The field survey work suggests that the official reports are seriously distorted. It is not clear how these official records as to commodity and passenger movements were determined. The distortions caused some concern as to whether or not the eight chosen sites were truly representative, but since no systematic bias appeared it is presumed that data from them will provide a good analytical basis for examining traffic flows nationally.

B) Vehicular movements around a particular check point must be interpreted with considerable care. For example, a very high vehicular movement in and out of Tarahara was noted, however, a large percentage of this movement was local -- not even going to the nearest check point. To have merely recorded vehicles and their contents without asking points of origin and destination would have greatly distorted the data.

C) Corruption will definitely be a problem in reporting records. Some local vehicles are merely waved through check points, some underpay, and in some cases bribes are paid in lieu of official tolls. It appears

that a comparison of official records in weeks not sampled with what should have been the assessments and fees paid during weeks when checks were underway will allow the researcher to adjust official figures.

D) The highway toll rates doubled during 1976, and officials state that the number of vehicle miles were down greatly last year. The reported rate of toll recovery is up slightly. Conversations with owners of trucks and buses indicate that they view the higher tolls as a major increase in their cost of business, and that it could be contributory to the smaller operators selling out.

E) A system of route permits appears to introduce considerable inflexibility in vehicular use. This would appear to cause inefficient back hauls, and substantial cargo rehandling.

The Role of Intercropping in the Farming Systems of Four Communities in Kabre District, Nepal With Particular Emphasis on How Technological Change May Influence Intercropping, Multiple Cropping and Relay Cropping

Douglas Pachico, Principal Researcher

and

Daniel Sisler, Project Leader

I. Introduction:

This paper is a brief report on the methodologies and some of the preliminary findings of an ongoing study of the role of intercropping in four communities in Kabre Palanchowk. Intercropping is the focus of this study because it is a technology which is apparently particularly appropriate to the conditions of small farmers. Intercropping has been shown elsewhere to lead to higher output per unit area, greater returns to variable inputs, and greater absorption of labor with less severe seasonal peaks for labor, than comparable monoculture systems. Intercropping may also reduce risk and damage from disease and pests.

As yet, however, little is known about intercropping as practised by farmers in the hills of Nepal today. One important goal of this study is to describe the common intercropping practises in one area of the hills; to identify the relationships between intercropping and the other components of the farming system; and to learn, from the farmers' point of view, what the advantages and disadvantages of alternative cropping combinations are.

This preliminary report is based on some easily processed data that has been gathered in the initial stages of an ongoing research effort. The findings herein are presented in order to stimulate comments and suggestions for the improvement of this research. While some hypotheses about intercropping will be stated, it must be emphasized that these do not represent final or polished versions. This paper will proceed by first discussing the study area. Second, the research design will be described. Third, based on the results of a large sample "general farm survey," some comments on the prevailing cropping and intercropping practises will be

made. Fourth, based on data collected from a subsample of farmers, some aspects of maize based systems will be considered. Fifth, some directions for further research will be noted.

II. Study Area:

Four villages representing different physical environments, different socio-economic contexts, and consequently, differing cropping systems were chosen for study.

Sangha, on the Arniko highway near the important bazaar of Banepa, is well served by social infrastructure. Off-farm employment opportunities are greater here than in the other communities, and agricultural wages are also highest. Sales of milk to the Dairy Development Corporation are also important. Sangha is located in a valley at about 4700 feet and has a much greater proportion of lowland (khet) than upland (pakho). Farms, however, are quite small and all farming operations, including tillage, are done without draft animals. Patlekhat and Dapcha are two fairly typical hill villages two and three hours walk, respectively, from the district headquarters, Dhulikhel. In both communities wages are low, purchased inputs uncommon, and the land is mostly upland. Particularly in Dapcha, many farms are not self-sufficient and farmers seek work outside the village during the winter. The fourth community, Panchkal, is intersected by the Arniko highway and is in a subtropical valley at approximately 3,300 feet. It is possible to grow three crops annually here.

III. Research Methodology:

After extensive visits to areas in the district to choose the four villages for study, a series of loosely structured interviews were held with farmers from each of the communities in order to establish some familiarity with the main features of the cropping system. A general farm management survey was then designed, pretested, and administered by a team of locally hired ennumerators. Three hundred and forty farmers were questioned about their land holdings, crop varieties and yields, livestock, fertilizer use, sale and hire of labor, food purchases, intercropping, credit, education and literacy of family members, tools, sales of farm produce, and income from off-farm employment.

The farmers in the initial sample were all rated on their willingness to communicate and subsequently two follow-up interviews, one for maize, one for wheat, were conducted with a subsample of the most cooperative farmers. The followup interviews gathered detailed information on labor inputs, varietal differences, and intercropping practises. The methodological approach of these interviews is that of the use of key informants, not of statistical sampling.

IV. General Cropping Patterns:

Table I presents aggregated varietal data on major cereal crops by community. The totals for each community may exceed the number of respondents from each community because some farmers grow more than one variety of a particular crop. These data show a rather complex pattern of varietal use. In Sangha, for example, new rice varieties are heavily predominant, local wheat varieties completely absent, but local maize varieties are

Table I. Number of Farmers by Community Reported Using Local and New Varieties of Paddy, Wheat, and Maize

Crop	Sangha	Patlekhet	Dapcha	Panchkal
RICE				
New	111	36	19	6
Local	13	79	62	93
WHEAT-UPLAND				
New	0	17	11	0
Local	0	33	54	8
WHEAT-LOWLAND				
New	75	41	32	70
Local	0	13	13	10
MAIZE				
New	10	33	25	56
Local	54	75	74	33

preferred by the majority of farmers. Dapcha and Patlekhet, the two hill villages, display fairly similar characteristics. There is some use of new paddy and maize varieties but local varieties are more common. New wheats predominate on lowland, but indigenous varieties prevail on the upland. In the subtropical community, Panchkal, there is the least use of new paddy varieties but the highest incidence of new maize varieties.

These data do suggest a few points. First, while some new varieties are in use in all communities, there are substantial differences in the pattern of innovation among communities. This is not unlikely the result of the various new varieties being more or less suited to the different physical and socio-economic conditions in the four communities. Moreover, scarcity of information about new varieties does not seem to be an

important constraint on their use since in all communities there is some innovation. Innovation occurs in different crops, not different communities, presumably because of differences in the suitability of the new varieties in different environments.

Second, new varieties of paddy have been most successful in Sangha. It is hypothesized that they may have made less headway in the two hill communities, Patlekhet and Dapcha, because of farmers' inability to finance purchases of fertilizer necessary to benefit from the new varieties' higher yield potential. In Panchkal, it is hypothesized that new varieties have not been widely adopted because the length of their growing season interferes with the cropping sequences. It must be emphasized that these are impressionistic hypotheses which must be tested by a more detailed follow-up on rice production.

Third, the new wheat varieties are successful in lowland conditions in all communities. These wheats are not, however, well adapted to upland conditions. Since upland wheat is clearly more common in the two poorer hill villages, Patlekhet and Dapcha, it seems that a research strategy aimed at improving the lot of the less advantaged farmers might consider attempting to upgrade upland wheat.

Fourth, while new maize varieties are prevelant in the subtropical community, Panchkal, they are much less common in the two hill communities. Given the importance of maize in hill agriculture, there may be high payoffs in improving maize, particularly for the poorest farmers for whom maize forms a greater proportion of their diet. Thus, it seems that improvements in maize based systems might have a greater impact on the welfare of poor hill farmers than any other agronomic advance.

Fifth, of the new paddy varieties the most widespread is Pokhali Marsino, a variety introduced from western Nepal without having been recommended by the research system or promoted by extension. It is clear from this that there may be further gains to be made through the inter-regional transference of indigenous varieties. Perhaps this process can be left to those farmers who have already proven so expert at this task but a more intensive study of locally available genetic material could possibly help accelerate the spread of superior indigenous varieties that have already been well adapted to hill conditions. Such an effort could, for example, be a part of an upland wheat improvement program.

Table II presents data on some of the most common intercropping combinations in the four communities. These data show the importance of maize-based systems in any consideration of intercropping. By far the most common intercrops are soybeans interplanted with maize and millet relay cropped with maize. These maize-based intercrops are also important in terms of their contribution to the farm household. Millet is an important food grain for many of the poorer farmers and soybeans are a common snack in all communities and a cash crop in Dapcha. Mustard and radishes, on the other hand, are intercropped primarily to provide a supply of winter vegetables. This may be important nutritionally and as a source of variety in diet, but the farmers themselves do not view these as major crops.

Comparing the communities, note that millet is most important in Sangha but least important in Panchkal. Soybeans intercropped with maize are common in all communities. The potato/mustard intercrop is rare in the two hill communities because potatoes are not much cultivated there. The wheat/mustard, barley/mustard, and wheat/radish intercrops are more

Table II. Number and Percent of Farmers Using Major Intercrop Combinations by Community

Intercrop	Sangha		Patlekhet		Dapcha		Panchkal	
	No.	%	No.	%	No.	%	No.	%
Maize/soybean	60	77	85	85	76	95	66	80
Maize/millet	62	79	53	53	54	68	5	6
Wheat/mustard	11	14	14	14	23	29	9	11
Potatoes/mustard	13	17	1	1	1	1	9	11
Barley/mustard	1	1	1	1	13	16	0	0
Wheat/radish	0	0	14	14	10	13	1	1
Total farmers	78	100	100	100	80	100	82	100

common in the two hill communities. The wheat/mustard combination requires more labor than wheat monocropped, and the wheat yields are believed by farmers to suffer from intercropping due to shading and damage during the mustard harvest which occurs about a month before the wheat is ripe. In lowland irrigated fields where high yields of wheat can be attained, intercropping is uncommon. Wheat intercropped with either mustard or radish is typically planted in thin stands on upland fields.

V. Some Notes on Maize Systems:

One important aim of the maize follow-up interviews was to obtain, from the farmers' point of view, an understanding of the major distinguishing characteristics of some of the major maize varieties in use. Appreciation of the perceived advantages of the varieties in use may be of assistance to agricultural scientists trying to develop new varieties acceptable to farmers. Sangha, Patlekhet and Dapcha all have a fairly

similar pattern of maize varietal use. In these three communities a minority of farmers grow newly introduced maize, usually Kumaltar. More common are two local varieties "seto chepto" and "pahelo chepto."

Among farmers who grow Kumaltar there is a recognition of its high yield potential. Concomitant with this is the belief that Kumaltar requires highly fertile soil and the application of chemical fertilizers. The need for high fertility conditions seems to be the most important constraint limiting the use of Kumaltar. Many farmers, especially in Dapcha, complain that they cannot afford to purchase fertilizer. Lodging, date of maturity, and insect problems are not commonly mentioned as problems with Kumaltar, though a small number of farmers make each of the above complaints. A few farmers also noted that since Kumaltar is larger than some local varieties, it can have a detrimental effect on the yields of intercropped soybeans or millet, through shading.

The local variety, seto chepto, is said by farmers to yield well but not quite as well as Kumaltar. While chemical fertilizers are not usually applied to seto chepto, it is normally grown on the relatively more fertile upland soils with the other local, pahelo chepto, being grown on lighter, drier, less fertile soils. Pahelo chepto matures earlier than either Kumaltar or seto chepto, but is more adapted to poor soils and also is good for popping. (Popped or dry fried corn is an important food component of the Nepalese middle hills.)

Farmers in these three communities, then, seem to be making choices among maize varieties along these lines. Where soils are relatively fertile and chemical fertilizers available, Kumaltar may be grown. If farmers cannot afford or obtain fertilizer, then seto chepto will be grown

on the better soils. Pahelo chepto is grown on the poorer soils and is also preferred for its popping.

In Panchkal the pattern is different. Kumaltar is again the most common new variety, but here it is also the most common variety. Since Kumaltar out-yields the local varieties, local varieties are almost never grown on upland fields. The most common local maize variety in Panchkal is "Satiye," a very short season variety that is grown in lowland conditions as part of a three crop annual rotation. The main criterion in varietal use in Panchkal, then, is whether the maize is grown as a main crop on upland soils or as a part of a crop rotation in lowland conditions.

Table III shows the frequency of use of intercropping combinations with maize. Some combinations (e.g. maize/millet in Patlekhet) occur more frequently here than they did in the general survey sample (see Table II). Since the follow-up interviews were conducted in greater depth with a population selected for its cooperativeness, it seems possible that there may have been under reporting of minor crops in the general farm survey. A follow-up is presently being conducted that will resurvey the large sample on this question.

As is clear from Table III, maize is typically grown in combination with a number of other crops, primarily legumes. Almost all farmers in all communities cultivate cowpeas and in all communities except for Panchkal, beans (Phaseolus vulgaris?). These are typically broadcast on the field immediately before maize planting and are picked for green vegetables as they ripen. Cucumbers and squash are also interplanted by practically all farmers in all communities. They are generally planted a day or so after maize planting, 2-3 seeds per hill scattered amongst the maize. Farmers

Table III. Percent Frequency of Intercrops with Maize; Subsample Data

Crop	Sangha	Patlekhet	Dapcha	Panchkal
		(Percent)		
Soybeans	100	100	100	83
Millet	100	88	83	17
Beans (Simi)	78	100	92	17
Cowpeas (Bodi)	78	100	75	100
Squash (Farsi)	89	100	92	100
Cucumber (Kakro)	89	100	75	100
Horsegram (Gahut)	44	-	17	25
Black gram (Mas)	0	0	17	8
Mashyang	0	0	25	83

have only the vaguest notion of the yields of these minor vegetables. The cultivation of these crops requires little effort and is usually relegated to the women.

Horse gram and black gram are common in all communities while "mashyang" is prevalent only in Panchkal. The intercropping pattern in Panchkal is quite different from the other communities primarily because of the higher temperatures there.

The most important intercrops with maize are soybeans and millet. The other intercrops discussed above are usually grown for vegetables or dal. Typically, there are just a few plants scattered in amongst the maize. Millet, though, is an important food grain. It is uncommon only in Panchkal where due to the heat, according to the farmers, there is not enough

residual moisture in upland soils to permit another crop to follow maize. Millet is planted first in seedbeds, then transplanted into the maize, in the hills of Nepal. The millet, which is transplanted about late July or early August, is harvested, usually by women, by cutting off the heads from each individual plant. Millet cultivation, then, both in transplanting and harvest is a laborious process. Many farmers who grow no or little millet mention that the high labor requirement dissuades them from growing millet. This suggests that the maize/millet combination should be more common in families with a high man/land ratio. Millet, moreover, is not a preferred food among the more prosperous farmers, so its cultivation may also be correlated with low per capita family incomes.

While soybeans and millet are not mutually exclusive alternative intercrops, millet tends more to be grown on lighter soils. In Paklekhet, for example, where the soils retain sufficient moisture for a wheat crop to follow maize, soybeans rather than millet are intercropped with maize. In drier soils where a wheat crop cannot follow maize, millet is relay cropped with the maize. In some cases both soy and millet are intercropped in the same maize field, either at reduced plant populations, or with one concentrated at the field's edge, the other towards the center. Thus, farmers deciding to grow either millet or soy in with maize, consider several factors: the availability of labor; their need for additional grain even if not of the most preferred for eating; the water holding capacity of the soil.

Both economic factors and the physical resource base act to determine the type of intercropping that is possible or optimal. Nevertheless, even given the limitations of environment and economics, farmers have an extremely wide range of choice about intercropping combinations.

Table IV. Intercropping Systems with Maize, Panchkal

Loc. soy	New soy	Plow soy	Hill soy	Broad soy	Blk gram	Mshyng	Horse gram	Beans	Millet
1	0	0	1	0	0	1	1	0	0
1	1	0	1	1	1	1	1	0	0
0	1	0	1	0	0	1	0	0	0
0	1	0	0	1	0	1	0	0	0
0	1	0	1	0	0	1	1	1	0
0	1	1	0	0	0	1	0	0	0
0	1	0	0	1	0	0	0	1	0
0	1	0	1	0	0	0	0	0	0
0	1	0	1	0	0	1	0	0	1
0	0	0	0	0	0	1	0	0	1
0	0	0	0	0	0	1	0	0	0
1	1	0	0	1	0	0	0	0	0

1 = farmer uses; 0 = farmer does not use; loc. soy = local soy variety; new soy = new soy variety; plow soy = soy planted in furrow-like maize; hill soy = soy planted by hand, 2-3 seeds/hill; broad soy = soy broadcast; blk gram = black gram; mshyng = mashyang; each line represents the practises used by one farmer.

Table IV illustrates the complexity of intercropping systems with maize in one community, Panchkal. Each line in the table presents the practises used by a farmer. A quick inspection shows that no two are identical.

Farmers face a number of decisions in planning their intercropping with maize. First, since most farmers intercrop soybeans, a soybean variety, local or the new "Chinese" variety, must be chosen. Then, soybeans may be planted three ways. The most common is to plant the seeds 2-3 per hill by hand a day or so after maize planting. Broadcasting of the soy

prior to maize planting is also common. One farmer plants his soybeans in a furrow behind an ox plow team, the same method as is used for planting maize in Panchkal. Finally, the farmers choose from a variety of other crops that may also go into the maize intercropping system.

Farmers' actual decisions in the face of this array of choices leads to quite a remarkable diversity. Some of this diversity may be explicable in economic terms. For example, soy may be broadcast to conserve labor. Soil and water conditions probably permit a couple of farmers to grow millet relay cropped with maize. Some differences in the growing of the minor intercrops may be related to personal tastes and preferences. Nonetheless, these systems are so complex as to make all the differences in farmer practises difficult to explain.

Clearly, among farmers there is not a consensus as to what systems are superior. There may be too much diversity in these systems to permit either farmers or research scientists to identify "best practises." Each farmer must use his own artful judgement as to which practise suits him best. While scientific research on intercropping systems may improve them, it does not seem likely that complete systems to fully supplant farmer practises can be developed unless the scientifically developed systems are rather less complicated than the systems currently in use. Improvements in the components of the farmer systems should be easier and have higher initial returns than efforts to devise new systems.

VI. Directions for Further Research:

This research has so far proceeded on the premise that the essential first step to a cropping system research program is a baseline study of

current farm practises. To complete this phase of the study, further follow-ups on such topics as rice production, minor crops (potatoes, barley, buckwheat), and livestock may be undertaken. In addition, more detailed use will be made of key informants to explore more deeply the reasons, from the farmers' perspective, behind the various intercropping systems.

Statistical analysis shall also be conducted to explore the relationship between farm characteristics and cropping systems. Techniques, varieties and crops may all be related to farm characteristics such as scale, cash income, man/land ratios, stock of educated labor, or quality of social infrastructure.

Another fruitful area of research may be in the economies of farm size. One of the principle objectives of cropping systems research is to improve the welfare of the least well-off farmers in the hills. An initial impression suggests, however, that some farms currently fall so short of providing even the barest subsistence for the farm family that, while cropping systems research may be able to make some improvements in the welfare of these families, given their resource base and growing population, it may not be possible to make some of the small farms viable economic units even if cropping systems research leads to some fairly dramatic increases in system yields. Careful study may show that even the most optimistic projection of the potential gains of cropping systems improvements may be unable to stabilize the degenerating condition of the small farms. To the degree that this is found to be so, other policies such as off-farm employment or changes in land tenure may have to be considered.

A final use of economic analysis in cropping systems research may be to help determine key areas of research. Since cropping systems probably

vary with farm resource endowments, and since there is tremendous geographical variation in prevailing systems, it may be important to attempt to identify research priorities on the basis of target groups (e.g. very small farms) or the size of the population that could utilize a particular system. Research resources are limited and must be allocated among alternative uses. Systematic planning about research objectives may suggest certain areas for cropping systems research. Of course, the biological potential of systems for improvement must also be considered. For example,

if small farmers are a vital target group, it may be possible to show that they could benefit more from improvement in millet, upland wheat, or maize then from improvements in lowland paddy. Naturally, as agronomists and breeders develop new components or new cropping systems, economic analysis may provide a vital link between the farmers and the research scientists. It remains important to try to identify what types of systems farmers may benefit from and also as new systems emerge, to obtain farmer evaluation of them. This last task remains outside the present scope of this study.

D. Dissemination and Utilization of Research Results:

The major effort in disseminating research results is the distribution of the Occasional Papers. Appendices I and II include all the papers published this year. A mailing list of approximately 600 names is used for distributing the Papers. The list has developed mainly from written requests and consists of a large number of libraries and institutions in addition to research scholars. Over half of the names on the list are from countries other than the United States and are truly representative of a worldwide audience with the major emphasis on the developing countries of Asia and Africa. In addition, a large number of requests are received each year for individual papers. Appendix III gives a brief sample of this correspondence.

E. Work Plan for the Coming Year:

During the coming year, it is expected that two Ph.D. dissertations and at least four papers concerning the Asian data will be completed. Two papers by Dr. Ranade based on his Philippine research are presently in draft form and should be finished shortly. Miss Hart expects to complete her Ph.D. dissertation by the end of 1977 and will then begin work on a major paper incorporating the primary data on child care which she collected in Indonesia with previously collected information on the participation of women in the labor force. She plans to work on several other papers on trends in land and labor relationships and on the relationships between family labor and the demand for hired labor, but it is unlikely that these will be completed before the end of the next contract year. Mr. Doraswamy is also expected to complete his Ph.D. dissertation during calendar 1977. A paper will be drawn from the thesis which

emphasizes how the technology of tractor mechanization influences the demand for and supply of farm labor.

Analysis of the data collected in Nepal will be nearly completed by the end of June 1978 and a decision will be made at that time as to the relevancy of this material to the objectives of the contract, and whether the Nepalese data will be included in the contract findings.

The forthcoming contract year should see the beginning of coordination between Cornell, Michigan State, and Purdue for the purpose of writing a book to make more public the results of the research conducted under this grant. Cornell's contribution to this publication will be an explanation of the Asian data with particular reference to the first four objectives of the contract.

F. Involvement of Minority Personnel and Women:

1. The sub-project in Indonesia entitled, "The Interaction between Economic and Welfare Factors in Labor Supply Decisions," has been under the supervision of Ms. Gillian P. Hart.*

2. The sub-project in the Philippines entitled, "Distribution of Benefits from New Agricultural Technologies: A Study at Farm Level," has been under the supervision of Mr. Chandrashekhar G. Ranade.*

3. The sub-project in India entitled, "Mechanisation and Its Effect on Demand and Supply of Labor," has been under the supervision of Mr. Gorantla Doraswamy.*

4. Mrs. Alice Wells has aided in the administration of the project as well as assisting in editing and manuscript preparation.

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*Not U. S. nationals.

5. Mrs. Judith Kramer assisted in editing, computer work, and manuscript preparation.

6. During the last half of this project year, Mrs. Martha Czerwinski served as a computer programmer.

7. Miss Terri Tully has worked as a statistical clerk during the academic year, which includes nine months of the project year.

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NOTICE OF RESEARCH PROJECT

Supporting Agency:	Agency's Numbers:
Agency for International Development	Contract No. AID/ta-C-1327 (a continuation of Contract No. AID/ta-c-1131.)

Title of Project:

Poor Rural Households, Technical Change and Income Distribution in LDC's

Principal Investigator, Associates, School or Division	Department
Daniel G. Sisler	of Agricultural Economics

Recipient Institution:	Periods for this NRP:
Cornell University Ithaca, New York 14853	Start Date: July 1, 1976 End Date: June 30, 1977 Annual Funding: $121,384.00

Summary of Project:

The central objective of the research is to appraise how the adoption of agricultural technology influences income distribution and the demand and supply of agricultural labor. Various facets of this research were conducted in the Philippines, Indonesia and India. Several practical conclusions have been reached based on analysis of the data collected in the Philippines. As technological change increased production, landlords, tenants, and landless laborers all gained in absolute terms. Interestingly, as new technology is adopted the share of gains accruing to landlords declined while that of tenants and hired labor increased. The analysis also provided useful information concerning how the adoption of technology affected the demand for purchased inputs, notably fertilizer and agricultural chemicals.

The work in Indonesia concentrates on the identification of forces which influence the supply of agricultural labor. Factors such as age and sex composition of households greatly influence decisions concerning agricultural production practices and the adoption of technological improvements.

The research in India concentrates on how tractor mechanization affects the demand for agricultural labor and decisions concerning enterprise combinations. This project will synthesize the demand and supply facets of how a specific agricultural innovation affects the allocation of family and hired agricultural labor.

Appendix I.
D.1. Dissemination and Utilization of Research Results:

BIBLIOGRAPHIC LIST AND ABSTRACTS

Contract period -- July 1, 1976 to July 1, 1977

a. Goldman, Heather Warrack and Chandrashekhar Ranade, "Food Consumption Behavior by Income Class in Rural and Urban Philippines," Occasional Paper No. 90, Department of Agricultural Economics, Cornell University-USAID Poor Rural Households, Technical Change and Income Distribution in LDC's Project, November 1976.

b. Ranade, C. G., "Hicks Coefficient to Depict Direction of Movements in Relative Factor Shares in Agricultural Production," Southern Economic Journal, Vol. 43, No. 4, April 1977. Pp. 1588-1593.

c. _____. "Changes in Relative Factor Shares in United States Agricultural and Manufacturing Sectors," Occasional Paper No. 94, Department of Agricultural Economics, Cornell University-USAID Poor Rural Households, Technical Change and Income Distribution in LDC's Project, May 1977.

d. Hart, Gillian, "Patterns of Household Labor Allocation in a Javanese Village," paper presented at the A/D/C-RTN Workshop in Household Studies, Singapore, August 3-7, 1976.

e. Mehra, Shakuntla, "Some Aspects of Labour Use in Indian Agriculture," Occasional Paper No. 88, Technological Change in Agriculture Project, Department of Agricultural Economics, Cornell University, June 1976.

f. Narain, Dharm, "Growth of Productivity in Indian Agriculture," Occasional Paper No. 93, Technological Change in Agriculture Project, Department of Agricultural Economics, Cornell University, June 1976.

Copies of the above papers are available on request from 349 Warren Hall, Cornell University, Ithaca, New York 14853.

Two additional papers stemming from the contract are in draft form. Both are authored by Dr. C. G. Ranade. Their titles and approximate number of pages are as follows:

"Distribution of Benefits from New Rice Technology in the Philippines," (22 pp.).

"Distributive Bias of New Rice Technologies in the Philippines," (40 pp.).

D.1.a.

Heather Warrack Goldman
and
Chandrashekhar G. Ranade
November 1976

ABSTRACT

"Food Consumption Behavior by Income Class in Rural and Urban Philippines"

The paper examines effects of changes in income on consumption of cereals in relation to seafood, meat and milk by using expenditure elasticity and marginal propensity to expend as criteria. Comparison is then made with the results of other studies and implications are drawn about projections of demand for the important staple, rice, in view of lessening income disparity.

D.1.b.

C. G. Ranade
April 1977

ABSTRACT

"Hicks Coefficient to Depict Direction of Movements in Relative Factor Shares in Agricultural Production"

The paper explores most appropriate criterion of changes in relative factor shares. It shows that the concept of elasticity of substitution, Hicks coefficient, defined by Hicks in 1932 is such criterion for two as well as many input production functions. It demonstrates how relative factor shares in agricultural production would vary according to changes in input quantities; depending upon the magnitude of Hicks coefficients. It then compares Hicks coefficient with the partial and direct elasticities of substitution for CES production functions. (Southern Economic Journal)

D.1.c.

C. G. Ranade
May 1977

ABSTRACT

"Changes in Relative Factor Shares in United States Agricultural and Manufacturing Sectors"

This paper examines how relative factor shares would change as different factor proportions are varied for both the U.S. agricultural and manufacturing sectors using the Hicks coefficient as a criterion. This approach provides a means for analyzing changes in distribution of output among some key participants in U.S. production such as laborers and owners of land and capital as the quantities of two key inputs, energy and fertilizer, are varied with respect to the quantities of other inputs.

D.1.d.

Gillian Hart
August 1976

ABSTRACT

"Patterns of Household Labor Allocation in a Javanese Village"

The analysis of household labor allocation relates directly to two sets of policy issues: (1) a macro level focus on the growth potential inherent in the large scale mobilization of rural labor, and (2) identifying an integrated set of policy measures to increase directly the welfare of poor households. This paper examines some preliminary tabulations of labor allocation data collected from a sample of 87 households in a Javanese village during a peak and a slack month of rice production in the wet season 1975-76. Its purpose is to identify the general patterns which seem to be emerging from the data in terms of the major policy questions which they raise

The sample households are stratified into three classes on the basis of control over land; large landowners, small landowners and landless. The data reveal a strong inverse relationship between asset status and the amount of time spent in income earning activities, particularly among women and children. Conversely, time spent in housework is directly related to asset status. There are also major inter-class differences in the allocation of time among different types of income earning activities, and in the mode of adjustment to seasonal changes in wages and job availability. The evidence suggests that the degree of interdependence among the activities of household members is inversely related to asset status, and that landless households are more inclined to allocate towards an integrated set of activities providing a stable and secure income stream, even though this might be lower on average than a more highly fluctuating one.

As far as aggregate labor supply is concerned, it would appear that the elasticity of labor supply to off-farm activities of the small landowning-operating group -- which comprises approximately 35 percent of the population in the study village -- is quite high. Taking into consideration that a further 40 percent of the population is landless, and that a fairly large proportion of time is being allocated to low productivity self-employment activities that serve to supplement income, the orders of magnitude of increase in aggregate labor demand in all sectors required to tighten labor markets and hence increase wage rates to any significant degree are likely to be massive.

From the viewpoint of welfare questions, the landless class is clearly in a precarious welfare position. This is reflected in quantitative and qualitative differences in housework, child care patterns, low school attendance rates and extremely long hours in arduous income earning activities yielding low returns to labor. While social services programs (health care, nutrition intervention and so forth) might contribute somewhat to welfare, their overall impact is likely to be limited.

D.l.e.

Shakuntla Mehra
June 1976

ABSTRACT

"Some Aspects of Labour Use in Indian Agriculture"

This paper examines the cropping pattern, nature of technology and farm size as this bears upon employment in Indian agriculture. The analysis is based upon a substantial and diverse body of data which not only allows for generalization about these key relationships but also provides the basis for describing the variability and the caveats to generalization. From this analysis a set of conclusions is drawn with respect to irrigation investment, new technology, cropping intensity and their interactions with farm size that are important in policy determination.

D.1.f.

Dharm Narain
June 1976

ABSTRACT

"Growth of Productivity in Indian Agriculture"

This paper analyzes the broad question of the sources of agricultural production increase in India. Not only does the paper teach a great deal about the sources of growth but it also leads up to important conclusions about the policies relevant to accelerated growth in agricultural production.

Appendix II.

July 1977

[D.4] Feedback

A brief sample follows of the extensive correspondence with respect ot this research.

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