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CONTRIBUTION OF CROPPING SYSTEMS PROGRAM RESEARCH AND EXTENSION TO THE RURAL POOR: A CASE STUDY OF RATNANAGAR CROPPING SYSTEMS SITE

Jagadish Timsina
Murari Suvedi

HMG-USAID-GTZ-IDRC-WINROCK PROJECT

STRENGTHENING INSTITUTIONAL CAPACITY IN THE

FOOD AND AGRICULTURAL SECTOR IN NEPAL

FOREWORD

This Rural Poverty Research Paper Series is funded through the project, "Strengthening Institutional Capacity in the Food and Agricultural Sector in Nepal," a cooperative effort by the Ministry of Agriculture (MOA) of His Majesty's Government of Nepal and the Winrock International Institute for Agricultural Development. This project has been made possible by substantial financial support from the U.S. Agency for International Development (USAID), the German Agency for Technical Cooperation (GTZ), the Canadian International Development Research Centre (IDRC), and the Ford Foundation.

One of the most important activities of this project is funding for problem-oriented research by young professional staff of agricultural agencies of the MOA and related institutions, as well as for concerned individuals in the private sector. This research is carried out with the active professional assistance of the Winrock staff.

The purpose of this Rural Poverty Research Paper Series is to make the results of the research activities related to rural poverty available to a larger audience, and to acquaint younger staff and students with advanced methods of research and statistical analysis. It is also hoped that publication of the Series will stimulate discussion among policymakers and thereby assist in the formulation of policies which are suitable to the development of Nepal's agriculture.

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Michael B. Wallace
Series Editor

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CONTRIBUTION OF CROPPING SYSTEMS PROGRAM RESEARCH AND EXTENSION TO THE RURAL POOR: A CASE STUDY OF RATNANAGAR CROPPING SYSTEMS SITE

Jagadish Timsina*
Murari Suvedi

INTRODUCTION

Multiple cropping--the growing of more than one crop on a piece of land in a year--has been practiced in developing countries and offered opportunities for subsistence farmers to increase farm productivity (Andrews and Kassam, 1976; Harwood and Price, 1976; Hildebrand, 1976; Harwood, 1973; Beets, 1982; Brady, 1982; Pendleton, 1982; Gomez and Gomez, 1983). A cropping system has been defined as the cropping patterns used on a farm and their interactions with farm resources. Carangal (1977) mentioned that cropping systems are dependent on physical and socioeconomic environments and are highly environment-specific.

Farming system, a broader term than cropping system, has been defined by the Michigan State University (MSU) farming systems research group as a unit consisting of a human group and the resources it manages in its environment, involving direct production of plant and/or animal products, and possibly other products, as well as consumption of those products. From this perspective, a farming system is a result of interaction among several interdependent components (Axinn, 1981).

Cropping systems research can be defined as a systematic approach to the study of a farm's crop production enterprises by utilizing the available physical resources (such as rainfall and solar radiation or soil types). It takes into account the relationship among the various crop production activities, between the crop production enterprise and other production or consumption activities on the farm, or both, and between other environmental factors (physical, institutional, social and economic) and the farm's crop production enterprise (Zandstra, 1977).

Increasingly, empirical evidence shows that the needs of small farmers often have not been adequately addressed in development programs in the Third World over the past 20 years (Khan, 1979; Poleman and Freebairn, 1973). Many development projects have been introduced without a sufficient understanding of the environment in which small farmers operate. Public investment in agricultural research has not always been spent with the needs of small farmers in mind, who should be the major beneficiaries of the results of such research.

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Anderson (1979) gave an excellent analysis of the factors influencing misallocation of research resources in many LDC°s. Allocation of funds for research have often been based on:

-Expressed needs of more influential farmers who often hold non-agricultural jobs in the society;

-Research that will appeal to professional "peer groups" of the researchers; and

-Types of technology that have been developed in high income countries.

As a result, the link between the small farmers and the research organizations has tended to be weak (Stavis, 1979). The cropping systems research (CSR) approach starts with the farmers and provides a link between the farmer and the research institution and funding agency, thus counterbalancing the more conventional "top-down" experiment station research approach. The cropping systems approach has the potential of providing the small farmers with an avenue for communicating their needs, both to research workers and to funding agencies.

Two types of farming systems research programs have emerged in recent years: "upstream" and "downstream." The former involves several years of research, both on and off station, and is particularly the concern of the International Agricultural Research Center (IARCs). The latter is designed to rapidly identify and subsequently test possible innovations which can be easily integrated into existing farming systems, focuses on close interaction with farmers through on-farm trials and draws selectively upon results from commodity, discipline oriented research or "upstream" programs (Gilbert et al., 1980). Similarly, cropping systems research programs are also "upstream" and "downstream."

The primary aim of the CSR approach is to increase the productivity of the cropping system in the context of the entire range of private and societal goals, given the constraints and potential of the existing farming systems. Productivity can be improved through the development of relevant technology and complementary policies which increase the welfare of farming families in ways that are useful and acceptable to them and society as a whole.

The common cropping systems in Nepalese subsistence farms are centuries old, consisting of sequential, mixed, or relay cropping. Subsistence farmers follow these patterns knowingly or unknowingly. The results of traditional agronomic research were less beneficial for small scale farmers because of less effective extension methods and farmers' unwillingness to accept new technology on small-scale farms. (Sah and Flinn, 1981; Wildebrand, 1984).

In Nepal, no research on improving farmers' cropping (or farming) systems had been reported in the literature before the last decade. Hence, there was an urgent need for research on the farmers' fields and suitable research methodology had to be developed and followed.

In 1977, the Integrated Cereals Project (ICP), with its Cropping Systems Program (CSP) in collaboration with the cropping system program of the Agronomy Division of the Department of Agriculture, started research on cropping systems in farmers' fields. On-farm research was initially started in Sukchaina and Bahuwari (Parsa district) and Pumdi Bhumdi (Kaski district) cropping system sites. Three other sites--Chauri Jahari (Rukum district), Lele (Lalitpur) and Khandbari (Sankhuwasabha)--were added in the winter of 1977/78 and Ratnanagar (Chitwan district) was added in the winter of 1980/81. The general characteristics of the cropping systems sites are given in Table 1.

Table 1. Cropping Systems Sites

		Pumdi Bhumdi	Parsa (Irrigated)	Parsa (Rainfed)	Chauri Jahari	Lele	Khandbari	Ratnanagar
Elevation		750-1270	150	150	700	1300-1500	460-1100	350
Rainfall (mm)		4000	1500	1500	1100	1800	1200	1800
Rainfall Distribution	Month wet	6	4	4	3	4	2	4
	Month dry	5	8	8	8	6	6	8
Major soil		Inceptisol	Inceptisol	Inceptisol	Alfisol	Inceptisol	Inceptisol & Ultisol	Inceptisol
Major land types		1.lowland rainfed	1.lowland irrigated	1.lowland rainfed	1.upland rainfed	1.upland rainfed	1.upland rainfed	1.upland rainfed
		2.upland rainfed			2.upland rainfed (summer) irrigated (winter)	2.lowland rainfed	2.lowland rainfed	2.lowland rainfed
					3.lowland irrigated	3.lowland irrigated	3.lowland irrigated	3.lowland irrigated
Farm size (ha/farm)		0.9	0.8	0.8	0.9	0.6	1.1	0.7

* Months wet = months receiving more than 200 mm rainfall; months dry = months receiving less than 100 mm rainfall.

The cropping systems program of Nepal aimed at increasing total production and improving farmers' welfare by increasing the land use intensity (multiple cropping) and increasing the yield of individual crops in the pattern by making better use of the available resources (CSS, 1979). The International Rice Research Institute's (IRRI) cropping systems research methodology was followed (Zandstra, 1977; Carangal, 1977). It also aimed at developing technologies by non-traditional research systems with the integration of research and extension working with farmers in their field (ICP, 1985).

Different ICP cropping systems reports indicate that the program is following logical steps of technology transfer: development of technology in farmers' fields for specific agroclimatic and socio-economic conditions, verification of the technology and finally, extension of the technology on a wide scale. The successful launching of the pre-production verification trials in different parts of the country for different patterns especially for low to mid hill rice-wheat and maize-wheat cropping patterns (Lipinski and Rizal, 1984) and the production program for 17,000 ha. of wheat in 1983/84 (Bolo and Malla, 1984; Sarkar and Chitrakar, 1984) demonstrated that higher yields can indeed be achieved and the farmers are ready to change and accept new farming practices to increase their yield (Bolo, 1984).

An impact study on the rainfed area of Sukchaina indicated the rapid adoption of crop production technologies is a result of cropping systems activities (Singh and Sayre, 1985). Although the cropping systems approach has been successful in increasing cropping intensity and total yields of many farmers, none of the studies have shown the impact or contribution on small and marginal farmers--the rural poor.

This study intended to assess the influence of CSP research and extension activities on the small and marginal farmers in communities of Ratnanagar at cropping systems site which are representative of the inner Tarai of Nepal. The specific objectives for this study were:

- To identify the present cropping systems of small and marginal farmers residing close to the cropping systems research site;
- To explore the extent to which small and marginal farmers residing close to the cropping systems research site have adopted cropping systems technology recommended by the CSP of the ICP;
- To assess differences in total crop yields per unit area between participant farmers and small and marginal farmers; and
- To suggest and recommend to the CSP policies and priorities for the benefit of small and marginal farmers.

Importance of the Study

This study shows the impact of cropping systems program's research and extension on the small and marginal farmers. It also provides information on the existing cropping systems of these farmers. Finally, it suggests and recommends priorities for the benefit of these farmers to policy-makers and development workers.

Definition of Terms

Small and marginal farmers are those farmers have less than 15 katthas (0.5 ha) and whose income is generated mainly from this land.

Participant farmers are those farmers who had participated in cropping systems program of ICP at Ratnanagar cropping systems site. These farmers are called "farmer cooperators" in ICP publications.

Nonparticipant farmers refer to those farmers who had not participated in the cropping systems program of ICP at Ratnanagar cropping system site as "farmer cooperators." In this study nonparticipant farmers include only small and marginal farmers.

Multiple cropping index refers to the sum of the areas planted to different crops harvested during the year divided by the total cultivated area times 100.

Land utilization index refers to the number of days during the year which crops occupy the land, divided by 365 and multiplied by 100.

Cropping system refers to the cropping patterns followed in a farm and their interactions with each other. Cropping systems are environment-specific and depend on physical and socioeconomic factors.

Lowland fields refer to those fields that are flooded for rice growing during at least part of the year and usually have bunds to trap and retain water. If fields have artificial irrigation facilities, they are called irrigated lowlands; if they are dependent on natural rainfall, they are called rainfed lowlands.

Upland fields are those fields that are not submerged during any portion of the cropping season.

STUDY SITE AND RESEARCH METHODS

Characteristics of Ratnanagar Cropping System Site

Ratnanagar Village Panchayat is located on the Bharatpur-Hetauda road about 11 kilometers southeast of Bharatpur. Total population in the panchayat as of December 1984 was 10,265 of which 5579 were males and 4686 were females. The total number of houses and livestock sheds are 1510 and 1018 respectively. Total cultivated area is estimated to be 1516 ha of which 694 ha (45.8 percent) is lowland and 822 ha (54.2 percent) is upland. About 2 percnt of total area is occupied by houses, offices, schools and markets. The altitude of the panchayat is 305 meters above sea level.

The bazaar or market named "Tandi" contains a branch of Nepal Bank Limited, a chemist store, a health centre, a malaria office, a few agriculture offices, a primary and a secondary school and a campus for higher education. Many tea shops, small stores and resturants are in the bazaar. Water from streams, wells and taps is available close to the village.

Adjacent to Ratnanagar Panchayat and located on the north side of Bharatpur-Hetauda road is Panchakanya Village Panchayat. The total population as of December, 1984 in this panchayat was 7640 of which 4041 were males and 3589 were females. The total number of houses and livestock sheds are 1314 and 873 respectively. About 90 percent of the total area is upland and only 10 percent is lowland.

The annual rainfall pattern of Ratananagar is unimodal. On the average, there are eight consecutive dry months with less than 100 mm of rainfall, and four consecutive wet months with more than 200 mm of rainfall. The rainfall begins towards the first week of May, and it usually peaks in July and declines rapidly after September. There is little or no rain from October to April. The panchayat has a maximum temperature of about 37 C in May and June, and a minimum temperature of about 9.5 C in January.

The soil of Chitwan valley is alluvial plains and terraces developed by the three main rivers--the Narayani in the north, the Lothar in northeast and the Rapti in the south and southeast. Geologically, they consist of moderately coarse to medium textured deposits underlined by fine sand and compacted gravel at depths varying between 1.2m and 1.8m. Eastern tributary terraces are the main land group and hydromorphic soils are the most dominant soil in Ratnanagar Panchayat (Mathema et al., 1979). The texture of soil varies from fine sandy loam to silty loam. The major land types are rainfed upland, rainfed lowland and irrigated lowland. Major crops grown in the area are lowland rice, upland rice, maize and mustard and the minor crops are wheat, peanut, soybean, cowpea, lentil, lathyrus, and potato.

The main reason for selecting Ratnanagar cropping systems site with Ratnanagar and Panchakanya villages for this study was the researchers' accessibility to these villages and their acquaintance with the area.

Selection of Households

Selection of nonparticipant farmers. A list of household heads belonging to small and marginal farmer category in Ratnanagar Village Panchayat was prepared with the help of local panchayat officials by using the latest census taken by the Panchayat. Similarly, small and marginal farmers of some adjoining wards of Panchakanya Village Panchayat (wards 6, 7, and 9) were also identified and listed. The list was discussed with the CSP site coordinator and the participant farmers were excluded from the list. Then forty farmers were selected randomly who served as nonparticipant farmer respondents in this study.

Selection of participant farmers. A list of all the participant farmers in the cropping systems program from the Ratnanagar and Panchakanya Village Panchayats was prepared with the help of CSP site coordinator. The site coordinator was requested to identify the participant farmers who belong to small farmer category. Fifteen farmers were thus identified and interviewed to find out the difference in total crop yields between CSP participant farmers and nonparticipant farmers.

In the cropping systems research and extension program, the participant farmers are selected on the basis of land type and farmers' willingness for extending interests and cooperation to research. When-

ever possible, small farmers are selected. The selection is made either with the personal contacts or through meetings with farmers where the objectives of research are clearly explained. About 100 farmers from Ratnanagar and Panchakanya Panchayats have participated in the program of which about 20 percent are small farmers with less than 0.5 ha land and about 15 percent have less than 0.2 ha land (personal communication with site coordinator). Since only 20 percent of the participant farmers had land less than 0.5 ha (15 katthas), 40 percent of the participant farmers in this study respesented small farmers with land between 15 to 25 katthas.

As the cropping system program's research and extension was started in Ratnanagar about five and a half years ago and in Panchakanya just from the spring of last year, about 80 percent of the respondents in this study were selected from Ratnanagar Village Panchayat and the rest from the adjoining wards of Panchakanya Village Panchayat (wards 6, 7, and 9). This was done with an assumption that the contribution of CSP in adoption of improved cropping systems practices by small and marginal farmers could be more in the adjoining areas than the far areas.

Data Collection Procedure

Data for this study were collected by using a pretested interview schedule. Each interview was conducted in the home or the farm of the respondent after a rapport building sessior of at least 10-15 minutes.

The records and documents of the cropping systems program were also reviewed as needed to supplement the survey information. Further, participant observation techniques also helped in understanding the problems related to farmers and their farming systems.

Methods of Data Analysis

The data were analysed quantitatively as well as qualitatively. Descriptive statistical tools such as means, percentages, ranges and frequency counts were used to present the data. Graphs, frequency polygons and histograms were also prepared in some cases.

Most of the data described the changes in the cropping systems technology as historical technology (adopted five years ago) and new technology (adopted at present) for participant and nonparticipant farmers. As the major land types in which the cropping systems program's research and extension were concentrated were irrigated lowlands, rainfed lowlands and rainfed uplands, changes in cropping systems technology were shown for these land types for both participant and nonparticipant farmers.

Multiple cropping index (MCI) and land utilization index (LUI) for all the land types were computed by using the following formulas and expressed as percentages:

MCI = (Total Crop Area/Total Cultivated Area) X 100

LUI = (Number of days crops occupied the land/365) X 100

The gross income obtained from the crops was computed according to the prevailing market price in Narayanghat as of the first week of September, 1985. Market price of farm produce is given in Appendix 1.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

The discussion on this section is based on Table 2. Most of the respondents in this study were migrants from the hills. The majority (60 percent) of them were found residing in the village for more than 15 years. Tharu and Darai were the indigenous residents of the village.

The age of the respondents ranged from 23 to 78 years, with an average of 42 years. The majority of the respondents were below 45 years of age. The mean age of nonparticipant and participant farmers was 42 and 44 years, respectively.

Respondents belonged to different caste and ethnic groups. Brahmin, Chhetry, Tharu, and Darai were the major ethnic groups in the area. Damai, Tamang, Puri, Gurung, and Newar were also found in the area.

The household size of the respondents ranged from 2 to 14 with an average of 5.9. It should be noted that almost half (42.5 percent) of the family members were children below 14 years of age. The household size of participant farmers was relatively larger (mean = 7.0) as compared to nonparticipants (mean = 5.5). Tharu and Darai families were mostly of the extended type.

Almost half (47.5 percent) of the nonparticipant farmer respondents in this study indicated that they could read and write. The literacy rate was even higher (73 percent) for participant farmers. It should be noted that only a few (14.5 percent) respondents in this study indicated no literate family members in their households.

The size of land holding of nonparticipant farmers ranged from 2.5 to 15 katthas (30 katthas = 1 hectare) with an average of 9.6 katthas. In case of participant farmers, the range was 5 to 25 katthas and the average size was 14.3 katthas. Lowland irrigated, lowland rainfed and upland rainfed were three major categories of land found in the area. The majority of the respondent's farms included more than one category of land and farmers were practicing different cropping patterns accordingly.

Table 2. Socioeconomic Characteristics of Respondents

Characteristics		Percent Responding NonParticipants (n=40)	Participants (n=15)	Total
Age of household head	30 years or less	37.5	13.3	23.6
	31-45 years	37.5	40.0	38.2
	46-60 years	37.5	33.3	29.1
	61 or more	7.5	13.3	9.1
Length of stay in the village	5 years or less	2.5	13.3	5.5
	6-15 years	32.5	40.0	34.6
	16-25 years	42.5	26.7	38.2
	26 or more	22.5	20.0	21.8
Ethnic group	Brahmin	42.5	40.0	41.8
	Chhetry	12.5	--	9.1
	Tharu/Darai	32.5	26.7	30.9
	Others	12.5	33.3	18.2
Family size	1-6 persons	66.5	60.0	65.5
	7 and more	32.5	40.0	34.5
Literacy (Hhold head)	Literate	47.5	73.0	54.5
	Illiterate	52.5	27.0	45.5
Farm size	1-7 katthas	27.5	20.0	25.5
	7.1-15 katthas	72.5	40.0	63.5
	15.1-25 katthas	--	40.0	11.0

CROP PRODUCTION PRACTICES ON IRRIGATED LOWLANDS

Use of Improved Crop Varieties. Rice and maize were the major summer crops grown by nonparticipant farmers before the start of the cropping systems program, but these farmers are now growing only rice. Before the program, only 50 percent of the farmers grew improved varieties of rice but at present, all of the farmers grow improved varieties (Table 3). Respondents reported that Masuli was the predominant rice variety because of its high straw yield, fine grain quality, and medium time to maturity. Mustard, wheat, and lentil were the major winter crops; farmers were using local varieties of these crops five years ago, but now they are growing improved varieties of wheat. However, other winter crops were still local varieties. Spring maize was grown by very few farmers five years ago, but the number of farmers growing spring maize has increased by over 500 percent and about 70 percent reported growing improved varieties of maize.

For participant farmers, rice was the major summer crop five years ago as well as at present. Use of improved varieties of rice has increased from 40 to 80 percent. Major winter crops grown were mustard, wheat, and lentil, and the percentage of farmers using mustard as winter crop has increased in the last five years. Use of spring maize has doubled, but the use of improved varieties has not increased (Table 4).

Table 3. Crop Practices, Nonparticipants, Irrigated Lowlands

Season Crops		5 yrs ago farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control		Now farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control
Summer										
Rice	(n=15)	8	2	11	3	(n=22)	22	9	21	6
Maize	(n=7)	2	0	7	1					
Winter										
Mustard	(n=8)	0	0	0	0	(n=11)	0	5	0	0
Wheat	(n=2)	0	0	0	0	(n=3)	2	0	0	0
Lentil	(n=2)	0	0	0	0	(n=1)	0	1	0	0
Spring										
Maize	(n=3)	1	0	3	2	(n=16)	11	0	15	1
Rice	(n=1)	1	0	1	0	(n=1)	1	0	1	0

Table 4. Crop Practices, Participants, Irrigated Lowlands

Season Crops		5 yrs ago farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control		Now farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control
Summer										
Rice	(n=5)	2	2	4	1	(n=5)	4	3	4	1
Winter										
Mustard	(n=1)	0	0	0	0	(n=3)	0	2	0	1
Wheat	(n=1)	1	1	0	0	(n=1)	1	0	0	0
Lentil	(n=2)	0	0	0	0	(n=1)	0	0	0	0
Spring										
Maize	(n=2)	1	1	0	0	(n=4)	1	2	0	1

Chemical Fertilizer. Use of chemical fertilizer on summer rice by nonparticipant farmers increased from 13 to 41 percent during the past five years, while it was 40 to 60 percent for the participant farmers. For mustard, there was dramatic change in the use of chemical fertilizer by both the nonparticipant and participant farmers. Five years ago, none of the farmers were using chemical fertilizer for mustard, but today, 50 percent of the nonparticipant and 66 percent of participant farmers were using chemical fertilizer. However, for spring maize, no change was observed in the use of chemical fertilizer (Tables 3 and 4).

Plant Protection. No remarkable changes were observed in weed, insect, or disease control practices by respondents during the past five years. For summer rice, nonparticipant farmers doing handweeding increased from 73 to 95 percent and the use of chemicals for insects and diseases control increased from 20 to 27 percent (Tables 3 and 4).

Crop Production Practices on Rainfed Lowlands

Improved Varieties. Rice and maize were the major summer crops for both participant and nonparticipant farmers. The use of improved varieties of rice was increased from 40 to 66 percent for nonparticipant farmers, whereas for the participant farmers there was a dramatic change from 40 to 100 percent during the last five years. The percentage of both groups of farmers growing mustard as winter crop did not change.

Improved wheat as a winter crop was not popular among the farmers. The number of nonparticipant farmers growing spring maize increased by 66 percent and the use of its improved variety increased by 60 percent. Similarly, the number of participant farmers growing spring maize increased by 150 percent (Tables 5 and 6).

Chemical Fertilizer. There was dramatic change in the use of chemical fertilizer on rice. Five years ago, 20 percent of the non-participant farmers were using chemical fertilizer on rice, while at present, 66 percent of these farmers are using chemical fertilizer. For participant farmers, use of chemical fertilizer increased from 20 to 100 percent. For winter crops, the use of fertilizer on mustard increased from 0 to 100 percent for both groups of farmers. For spring maize, all farmers were reluctant to use chemical fertilizer (Tables 5 and 6).

Table 5. Crop Practices, Nonparticipants, Rainfed Lowlands

Season Crops		5 yrs ago farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control		Now farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control
Summer										
Rice	(n=5)	3	1	4	0	(n=6)	4	4	5	0
Maize	(n=2)	2	0	2	1	(n=1)	1	0	1	0
Winter										
Mustard	(n=7)	0	4	0	0	(n=7)	0	5	0	0
Lentil	(n=1)	0	1	0	0					
Spring										
Maize	(n=3)	0	0	2	0	(n=5)	3	0	5	2

Table 6. Crop Practices, Participants, Rainfed Lowlands

Season Crops		5 yrs ago farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control		Now farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control
Summer										
Rice	(n=5)	2	1	4	1	(n=5)	5	5	5	3
Maize	(n=3)	2	1	3	3					
Winter										
Mustard	(n=3)	0	3	0	0	(n=4)	0	4	0	0
Wheat	(n=2)	2	2	0	1	(n=1)	1	1	0	0
Spring										
Maize	(n=2)	2	1	2	1	(n=5)	5	1	5	3

Plant Protection Measures. Hand weedings and chemicals for insect and disease control were used only for summer rice and spring maize. There was no change in the use of hand weeding for rice by non-participant farmers but there was an increase in its use by participant farmers during the past five years. Also, chemicals for disease and insect control were used by only participant farmers. There was an increase in its use on rice from 20 to 60 percent during the past five years. For spring maize use of hand weeding increased from 66 to 100 percent by non-participant farmers and their use of chemicals for insect and disease control increased from 0 to 40 percent (Table 5 and 6).

Crop Production Practices on Rainfed Uplands

Improved Varieties. Maize and mustard were the major summer and winter crops, respectively, of both groups of farmers during the past five years. About 33 percent of the non-participant and 57 percent of the participant farmers were growing improved varieties of maize five years ago, which has increased to 78 and 86 percent, respectively. Both groups of farmers reported using local varieties of mustard for the last five years (Tables 7 and 8).

Chemical Fertilizer. The use of chemical fertilizer in maize has not changed remarkably but its use in mustard increased from 43 to 57 percent in the case of the non-participant farmers. For the participant farmers, the use of chemical fertilizer in maize had not changed but its use in mustard increased from 25 to 75 percent (Table 7 and 8).

Plant Protection Measures. The use of weed, insect, and disease control practices on summer and winter crops has not changed in the last five years for either group of farmers (Tables 7 and 8).

Table 7. Crop Practices, Nonparticipants, Rainfed Uplands

Season Crops		5 yrs ago farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control		Now farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control
Summer										
Rice	(n=4)	3	0	4	0	(n=4)	1	0	4	1
Maize	(n=27)	6		23	2	(n=23)	18	2	23	3
Winter										
Mustard	(n=28)	9	12	0	0	(n=28)	0	16	0	0

Other winter crops such as lentil and wheat, and summer crops such as cowpea were also grown by the farmers.

Table 8. Crop Practices, Participants, Rainfed Uplands

Season Crops		5 yrs ago farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control		Now farmers reporting imp. var.	chem. fert.	hand weed	chem.pest control
Summer										
Rice	(n=1)	0	1	1	0	(n=1)	1	1	1	1
Maize	(n=7)	4	7	7	1	(n=7)	6	7	7	1
Winter										
Mustard	(n=8)	3	2	0	0	(n=8)	0	6	0	0

Other winter crops such as lentil and wheat, and summer crops such as cowpea were also grown by the farmers.

Cropping Patterns on Irrigated Lowlands

Farmers, as expected, were practicing different cropping patterns in the area. Cropping patterns followed by the participant and the nonparticipant farmers before the start of the cropping systems program and at present are given in Table 9.

About two-fifths (41 percent for nonparticipant and 40 percent for participant) of the farmers are now adopting a rice-mustard-maize pattern. Other major patterns followed by nonparticipant farmers were rice-lentil-fallow and rice-wheat-maize.

Table 10 shows recommended cropping patterns by the cropping systems program for irrigated lowlands and the number of participant and nonparticipant farmers adopting those patterns. Of seven patterns recommended, rice-wheat-maize and rice-mustard-maize were adopted by the participant farmers and three patterns, rice-wheat-maize, rice-mustard-maize, and rice-fallow-maize were followed by nonparticipant farmers.

The majority of both groups of farmers were adopting the rice-mustard-maize pattern. The rice-fallow-maize and rice-wheat-maize patterns were also common among nonparticipant farmers and the latter was common among participant farmers. It should be noted that mungbean, despite having great potentiality in providing protein for the farmers as well as in improving the soil fertility, rice-wheat-mungbean and rice-fallow-mungbean patterns were not used by any of the respondents. This could be due to the fact that the true subsistence farmers primarily need cereal food for their survival rather than protein, or these farmers do not have much knowledge about mungbean.

Table 9. Cropping Patterns, Irrigated Lowlands

Cropping patterns	Number reporting: Non-participant farmers (n=22)		participant farmers (n=5)	
	5 years ago	Now	5 years ago	Now
Rice-Fallow-Fallow	4	2	1	-
Rice-Mustard-Maize	2	9	-	2
Maize-Mustard-Fallow	6	-	-	-
Rice-Fallow-Maize	3	4	-	-
Rice-Wheat-Fallow	1	2	-	-
Rice-Lentil-Fallow	1	-	1	1
Rice-Lentil-Maize	1	-	1	-
Rice-Wheat-Maize	1	2	1	1
Others *	3	3	1	1

* Others included Rice-Fallow-Rice, Maize+Cowpea-Mustard, Rice-Mustard, Upland rice+Maize-Mustard, Rice-Mustard-Maize+Sesbania, Rice+Lentil-Wheat and Rice-Mustard-Maize+Cowpea.

Table 10. Respondents Adopting Recommended Cropping Patterns

Recommended Cropping patterns	Farmers reporting Nonparticipant	Participant
Irrigated lowlands	(n=22)	(n=5)
Rice-Wheat-Maize	3	2
Rice-Wheat-Sesbania sp.	1	0
Rice-Wheat-Mungbean	0	0
Rice-Fallow-Mungbean	0	0
Rice-Mustard-Maize	9	3
Rice-Fallow-Maize	4	0
Rice-Fallow-Fallow	2	0
Rainfed lowlands	(n=8)	(n=6)
Rice-Wheat-Fallow	0	1
Rice-Fallow-Sesbenia sp.	0	0
Rice-Chickpea-Fallow	0	0
Rice-Mustard-Fallow	1	0
Rice+Lentil-Fallow	0	1
Rainfed uplands	(n=27)	(n=8)
Maize-Maize+Wheat	0	0
Maize-Mustard-Fallow	16	1
Maize+Soybean-Fallow	0	0

(Source: Terminal report of the ICP, 1985)

The rice-wheat-maize pattern gave the highest total pattern yields of 7.4 and 7.8 MT/ha. for gross incomes of Rs.24,760 and Rs.25,910 respectively for participant and nonparticipant farmers. The rice-mustard-maize pattern gave total pattern yields of 6.0 and 4.1 MT/ha. for gross incomes of Rs.27,550 and Rs.1,608 respectively for participant and nonparticipant farmers. It should be noted, however, that nonparticipant farmers reported higher yields for rice-wheat-maize pattern than the participant farmers. This may be attributed to the smaller farm size of the nonparticipant farmers which tends to be more productive.

The higher percentage of adoption of rice-mustard-maize cropping pattern by the small and marginal farmers could be attributed to the fact that the cropping systems program had given more emphasis to this pattern for the irrigated lowlands in the area. However, since rice-wheat-maize gave the highest total pattern yield, farmers in the area could also be encouraged to follow this pattern by including some soil amendment crops so as to maintain the soil fertility and the yield.

Frequently mentioned problems by both participants and nonparticipants in the irrigated lowlands were diseases and insects in crops, and periodic unavailability of improved seeds, fertilizers and pesticides.

Table 11. Total Pattern Yields and Gross Income, Irrigated Lowlands

Major cropping patterns	Average crop yield (MT/ha) Summer	Winter	Spring	Total	Gross income (Rs/ha)
Nonparticipant farmers					
Rice-Fallow (n=2)	3.9	-	-	3.9	14820
Rice-Mustard-Maize*(n=9)	3.5	0.6	1.0	4.1	21608
Rice-Fallow-Maize* (n=4)	3.3	-	1.6	4.7	17180
Rice-Wheat-Fallow (n=2)	4.7	0.5	-	5.2	22060
Rice-Wheat-Maize* (n=3)	3.9	2.2	1.7	7.8	25910
Participant farmers					
Rice-Mustard-Maize*(n=2)	4.2	0.7	1.1	6.0	27550
Rice-Lentil (n=1)	4.0	0.5	-	4.5	18410
Rice-Wheat-Maize* (n=1)	3.9	2.1	1.4	7.4	24760

* Cropping patterns recommended by the CSP.

CROPPING PATTERNS ON RAINFED LOWLANDS

Farmers in the irrigated lowlands were following different cropping patterns. Cropping patterns followed five years ago and at present are presented in Table 12. Fifty percent of the nonparticipant and 66 percent of the participant farmers are now adopting the rice-mustard-maize pattern. Other major patterns followed were rice-mustard-maize and Cowpea by the nonparticipant farmers (25 percent) and rice-mustard-fallow by the participant farmers (16 percent).

Out of the five patterns recommended for the rainfed lowlands by the cropping systems program, few participant farmers adopted the rice-wheat-fallow and rice-lentil-fallow patterns and fewer nonparticipant farmers adopted the rice-mustard-fallow pattern. The rice-fallow-Sesbania sp. and rice-chickpea-fallow patterns were adopted by none of the farmers (Table 10).

Since Sesbania sp. as a green manure crop has great potential to increase rice yield (Shrestha, 1985), more research and extension is required on the rice-fallow-Sesbania sp. pattern. The reason for its nonadoption could be due to the fact that an early maturing rice variety is required to adopt this pattern. Adoption of this pattern with the combined use of an early maturing rice variety like Bindeshwari and a high yielding chickpea variety, Go-332, increased the economic status of Sukchaina farmers (Singh and Sayre, 1985). Hence, the seeds of Bindeshwari and Go-332 should be supplied to the small and marginal farmers of Ratnanagar and an extensive extension is required.

The rice-mustard-maize pattern gave the highest total pattern yield of 6.4 and 5.4 Mt/ha. for a gross income of Rs.26,750 and Rs.22,205 respectively for the participant and the nonparticipant farmers.

Table 12. Cropping Patterns on Rainfed Lowlands

Cropping patterns	Farmers reporting Non-participant farmers (n=22) 5 years ago	Now	participant farmers (n=5) 5 years ago	Now
Rice-Mustard-Maize	1	4	-	4
Rice-Mustard-Fallow	1	1	-	1
Maize-Mustard-Fallow	2	1	2	-
Rice-Wheat-Maize	-	-	2	1
Rice-Fallow	2	-	1	-
Rice-Mustard-Maize +Cowpea	-	2	-	-
Others *	2	-	1	1

* Others included Rice-Mustard+Lentil-Maize, Upland Rice-Maize-Mustard and Maize+Cowpea-Mustard+Lentil.

Table 13. Total Pattern Yields and Gross Income, Rainfed Uplands

Major cropping patterns	Average crop yield (MT/ha) Summer	Winter	Spring	Total	Gross income (Rs/ha)
Non participant farmers					
Rice-Mustard-Maize (n=4)	3.3	0.6	1.5	5.4	22205
Rice-Mustard-Fallow (n=1)	3.4	0.6	-	4.0	17960
Maize-Mustard-Fallow(n=1)	2.2	1.1	-	3.3	15620
Rice-Mustard-Maize +Cowpea(n=2)	2.6	0.8	0.5	3.9	18050
Participant farmers					
Rice-Mustard-Maize (n=4)	3.6	0.9	1.9	6.4	26750
Rice-Mustard-Fallow (n=1)	3.8	0.8	-	4.6	21160

Although the cropping systems program has not recommended the rice-mustard-maize pattern for rainfed lowlands, most of the nonparticipant and participant farmers were adopting this pattern and obtaining the highest total pattern yield and gross income. This could be attributed to the small farm size of these farmers who want to grow several crops in the same land to survive. The inverse relationship between the multiple cropping index and farm size was also evident in the case of non-participant farmers who followed the rice-mustard-maize and cowpea pattern. Hence, the rice-mustard-maize pattern and possibly cowpea or other legumes should be encouraged for rainfed lowland farmers of Ratnanagar.

As for irrigated lowlands, the frequently mentioned problems by both groups of farmers in rainfed lowlands were insects and diseases, and lack of improved seeds, fertilizers, irrigation, and pesticides.

Cropping Patterns on Rainfed Uplands

Several types of cropping patterns were followed by the farmers in rainfed uplands and are presented in Table 14. Of all the patterns

followed, maize-mustard was the major pattern followed by 60 percent of the nonparticipant farmers. Other patterns followed by these farmers were maize+cowpea-mustard (15 percent), upland rice-mustard (7.5 percent), and upland rice-mustard-maize (7.5 percent). In the case of the participant farmers, maize+cowpea-mustard (25 percent) and maize+cowpea-mustard+lentil (25 percent) were the main cropping patterns. Upland rice-mustard-maize pattern was also followed by 12.5 percent of the participant farmers.

Of the three patterns recommended for rainfed uplands, the maize-mustard pattern was adopted by 12.5 percent of the participant and 60 percent of the nonparticipant farmers. Cropping patterns involving maize, mustard and cowpea were adopted by 50 percent of the participant farmers but only 15 percent of the nonparticipant farmers (Table 10) Other recommended patterns, maize-maize+wheat and maize+soybean-fallow were not followed by either group of farmers.

Table 14. Cropping Patterns on Rainfed Uplands

Cropping patterns	Farmers reporting Non-participant farmers (n=27)		participant farmers (n=8)	
	5 years ago	Now	5 years ago	Now
Upland rice-Mustard	2	2	1	-
Maize-Mustard	17	16	4	1
Maize-Mustard+Lentil	3	1	-	1
Maize+Cowpea-Mustard	3	4	1	2
Upland rice+Maize-Mustard	2	-	-	-
Maize+Cowpea-Mustard+Lentil	-	-	-	2
Upland rice-Mustard-Maize	-	2	-	1
Others*	-	2	2	1

* Including Maize-Wheat, Upland rice+Maize-Maize+Wheat and Maize-Maize.

The upland rice-mustard-maize pattern gave the highest total pattern yield of 6.5 and 5.4 MT/ha. respectively for gross incomes of Rs.26,770 and Rs.22,770 for participant and nonparticipant farmers. Other patterns that gave higher yield for participant farmers were maize+cowpea-mustard+lentil (4.1 MT/ha.) and for nonparticipant farmers was maize+cowpea-mustard (2.9 MT/ha.). The maize-mustard and maize+cowpea-mustard patterns gave slightly higher total yields to nonparticipant farmers (2.8 and 2.9 MT/ha.) than to participant farmers (2.7 and 2.6 MT/ha.) providing more gross income to the former group than the latter group (Table 15). It could be attributed to less attention of CSP for research on rainfed uplands or the participant farmers did not properly follow the CSP recommendations.

Although the maize-mustard pattern is followed by most nonparticipant farmers, these farmers may be encouraged to grow cowpea as an intercrop with maize, and lentil as an intercrop with mustard so as to increase the total yield of the pattern as well as to improve the soil fertility. This has happened in the case of the participant farmers.

The upland rice-mustard-maize pattern should be tested for a few years in small and marginal farmers' fields and its potentiality should be measured as it may be difficult to grow long duration crops all the year round especially in spring under rainfed uplands.

Frequently mentioned problems in these lands were diseases and insects in crops and unavailability of improved seeds and fertilizers.

Table 15. Total Pattern Yields and Gross Income, Rainfed Uplands

Major cropping patterns	Average crop yield (MT/ha) Summer	Winter	Spring	Total	Gross income (Rs/ha)
Non participant farmers					
Upland rice-Mustard (n=2)	2.4	0.5	-	2.9	13320
Maize-Mustard (n=16)	1.9	0.9	-	2.8	13154
Maize-Mustard+Lentil(n=1)	1.8	0.9	-	2.7	12780
Maize+Cowpea-Mustard(n=4)	2.0	0.9	-	2.9	14032
Upland rice-Mustard -Maize (n=2)	2.4	0.9	2.1	5.4	22770
Participant farmers					
Maize-Mustard (n=1)	2.1	0.6	-	2.7	11130
Maize-Mustard+Lentil(n=1)	2.1	0.7	-	2.8	11970
Maize+Cowpea-Mustard +Lentil (n=2)	2.8	1.3	-	4.1	19040
Maize+Cowpea-Mustard(n=2)	1.9	0.7	-	2.6	11810
Upland rice-Mustard -Maize (n=1)	3.3	0.9	2.3	6.5	26770

Land Use

Changes in land utilization indices and multiple cropping indices clearly show the extensive changes in land use that occurred 1979 onwards in all the land types for both the participant and nonparticipant farmers (see Appendix 2).

The greatest change in land use occurred in rainfed lowlands for both groups of farmers. It could be attributed to increase in cropping intensity by growing two to three crops a year. There was no change in land use in rainfed uplands mainly because of the difficulties of growing three crops a year in such lands. The increase in cropping intensity in irrigated lowlands during the past five years could be attributed to irrigation facilities available to these lands thus allowing for the growing of an additional crop during the spring season.

The increase in the multiple cropping index for the rainfed lowlands was higher for nonparticipant farmers than for participant farmers but in other land types, it was higher for participant farmers than that the nonparticipants. The reason for the higher index for nonparticipant farmers on rainfed lowlands could be attributed to smaller farm size (Gomez and Gomez, 1983) as well as to individual characteristics of the farmers in the involvement on farming activities.

Much of the increase in cropping intensity has resulted from adoption of spring maize in both irrigated lowlands and rainfed lowlands. In addition, some farmers reported growing early maturing rice varieties like Bindeswari, Malika, and CH-45 that can be harvested early and allow timely land preparation for winter wheat, lentil, and mustard.

Livestock Raised

Cows, buffalo, sheep, goats, and chickens were the major types of livestock raised by the respondents (Table 16). The buffalo, goats and chickens were raised by some farmers on a share basis and none of the respondents were raising improved breeds of livestock. The participant farmers tended to raise more livestock than the nonparticipants, and the size of livestock holding tended to be directly related to farm size. Unavailability of feed, especially green forage and fodder was the most frequently mentioned problem in raising livestock.

Table 16. Livestock Raised by Respondents

	Percent responding		
Livestock	Nonparticipant (n=40)	Participant (n=15)	Total (n=55)
Cows	65.0	80.0	69.1
Buffalo	55.0	66.7	58.2
Sheep and goats	35.0	53.3	40.0
Poultry	52.5	60.0	54.5

Farmer's Response to Cropping Systems Program

About three-fourths (77.5 percent) of the nonparticipant respondents were aware of the presence of the cropping systems program in Ratnanagar and about two-thirds (72.5 percent) indicated knowledge about the functions of the program.

Most of the nonparticipants (67.5 percent) indicated no contact with technicians working with the cropping systems program. Of those who indicated contact, most of the contacts were initiated by the farmers and the purposes of contacting technician were mainly to solve disease and insects problems in their crops as well as to show their willingness to participate in the program. Technician-initiated contacts mainly aimed at asking for land for the cropping systems research program.

Of those who reported participation in the cropping system program, one-third were participating by growing crops on the recommendation of technicians in a limited area (2-3 katthas) of their farm. The provision of inputs, such as seed, fertilizer, pesticides, and supervision of crops by the technicians for the research plots (2-3 katthas) under the program was appreciated by the majority of the participant respondents.

An overwhelming majority (87 percent) of the participant farmers and about one-third (35 percent) of the nonparticipant farmers indicated the program was useful (Table 17). It should be noted however, the majority (60 percent) of the nonparticipants did not give their opinion about the usefulness of the program.

Table 17. Usefulness of Cropping Systems Program

Usefulness	Percent reporting	
	Nonparticipants	Participants
Very useful	15	47
Useful	20	40
No opinion	60	6.5
Not useful	5	6.5

CONCLUSIONS

The following conclusions are limited to the small and marginal farmers and may be less valid for big farmers.

1. Rice, mustard, and maize were the major summer, winter, and spring crops respectively in irrigated and rainfed lowlands. Maize and mustard were the major summer and winter crops in rainfed uplands.

2. Rice-mustard-maize was the major cropping pattern of both the nonparticipant and participant farmers in the irrigated lowlands. In the rainfed uplands, maize-mustard was the main cropping pattern followed by nonparticipant farmers but maize+cowpea-mustard+lentil wa the major cropping pattern followed by participant farmers.

3. Among the cropping patterns recommended by the cropping systems program for different land types, the rice-mustard-maize and rice-wheat-maize patterns were adopted by both groups of in the irrigated lowlands. In the rainfed lowlands, participant farmers were adopting the rice-wheat-fallow and rice+lentil-fallow patterns, while nonparticipant farmers were adopting rice-mustard-fallow. In the rainfed uplands, nonparticipant farmers were adopting maize-mustard-fallow very extensively and the participant farmers were adopting maize+cowpea-mustard+lentil instead of the maize-mustard pattern.

4. The total pattern yield and gross income were highest for the rice-wheat-maize and rice-mustard-maize cropping patterns for nonparticipant and participant farmers respectively in irrigated lowlands. In the rainfed lowlands, the total pattern yield and gross income were highest for rice-mustard-maize for both groups of farmers. In the rainfed uplands, the upland rice-mustard-maize pattern had the highest total pattern yield and gross income for both groups of farmers.

5. In the irrigated lowlands, total crop yields per unit area per unit time for the rice-wheat-maize pattern was slightly higher for nonparticipant farmers, but in the case of the rice-mustard-maize pattern, it was higher for participant farmers. In the rainfed lowlands, the total crop yields for the rice-mustard-maize pattern was higher for the participant farmers. In the rainfed uplands the total crop yields for the upland rice-mustard-maize pattern was higher for the participant farmers than for the nonparticipant farmers. Because of higher crop yield per unit area per unit time for participant farmers, the total gross income was also higher for participant farmers in all land types.

6. Multiple cropping and land utilization indices increased drama-

tically over the past five years in irrigated and rainfed lowlands for both nonparticipant and participant farmers. However, in rainfed uplands, there was no increase in land use indices for either group.

7. Size of livestock holding tended to be related to farm size. Participant farmers were raising more livestock than nonparticipant farmers. Further, crop yield per unit area of a small farm tended to be directly related to the number of farm animals raised on the farm.

8. More participant than nonparticipant farmers expressed the usefulness of the cropping systems program.

Considering the adoption of some improved crop varieties and the use of fertilizer, the small and marginal farmers in the area have benefitted to some extent from the cropping systems program. However, the extent of benefit received by the participant farmers was higher compared to the nonparticipants and thus, there is a need to expand the benefits of the program among small and marginal farmers in the area.

RECOMMENDATIONS AND POLICY IMPLICATIONS

Recommendations

1. Since no increase in land use indices were obtained for past five years in rainfed uplands, it is very necessary that the research activities focus on these lands so as to help the small and marginal farmers. This is because 54 percent of the land of Ratnanagar and 90 percent of the land of Panchakanya are rainfed upland, and small and marginal farmers usually have such lands.

2. Although mustard is the major winter crop in all land types, farmers were not growing its improved varieties and hence the yields were usually low. Either the farmers should be provided with the improved varieties of mustard or they should be shown better agronomic practices for the local variety so as to increase the yield of mustard.

3. Since finger millet and sesamum are important crops of small and marginal farmers, and these crops can be grown with minimum inputs, future research should include these crops in the testing of alternative cropping patterns.

4. Although cereals are more important than other crops for small and marginal farmers, grain legumes also deserve attention because of their many uses (improving soil fertility, decreasing malnutrition problems, providing fodder for ruminants). Hence cropping patterns involving cereals and legumes should be given high priority in research. Early maturing and disease and insect resistant grain legumes like cowpea, mungbean and soybean should be included in testing alternative cropping patterns. An extensive extension campaign is needed to demonstrate the potential and uses of grain legumes for small and marginal farmers.

Policy Implications

1. Since livestock played an important role in increasing the crop yield per unit area, this component should be added to the research, and the research should be carried with a holistic approach in a farming systems perspective rather than simply in a cropping systems perspective. As suggested by Chambers and Ghildyal (1984), the farmer first-and-last model approach should be followed rather than the normal transfer of technology model approach.

2. Since farmers' fields are complex and are affected by several physical or climatic factors each year, the recommendations should be made only after testing of at least three years in such fields. Recommendations should be appropriate for each land type.

3. Although the research is carried out on the limited land of the participant farmers, the objective of the research should be to strengthen the technology for other farmers. Hence, suitable and economical extension approaches should be developed efficiently disseminate the appropriate technology.

4. It is very important that more small and marginal farmers be included in research as the "farmer cooperator" to provide more benefits to such farmers. Hence, at the time of the selection of the farmer cooperator for testing the cropping patterns, small and marginal farmers with different land types should be asked and encouraged to participate in the program. Since these farmers have usually smaller risk-bearing capacity during testing phase because of their small farm size, some sort of incentives or remunerations should be provided in case the crop fails due to unusual or unfavorable weather.

APPENDICES

Appendix Table 1. Market prices in Narayanghat, September 1, 1985.

Commodity	Price (Rs/100 kg)
Paddy	380
Maize	290
Wheat	240
Mustard	840
Lentil	490

Appendix Table 2. Multiple Cropping Index (MCI) and Land Utilization Index (LUI) Before Cropping System Program (1979) and Now (1985)

	Nonparticipant farmers				Participant farmers			
	MCI		LUI		MCI		LUI	
	1979	1985	1979	1985	1979	1985	1979	1985
Land types								
Irrigated lowlands	186	226	60	76	200	259	71	84
Rainfed lowlands	219	278	55	82	192	251	63	84
Rainfed uplands	200	200	54	56	196	200	54	59
Average	202	235	56	71	196	237	63	76

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