UNIVERSITI PUTRA MALAYSIA

THE ECONOMICS OF RICE FARMING IN DHANUSHA DISTRICT, NEPAL: PRODUCTION AND TECHNOLOGY ADOPTION

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By
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ABSTRACT

This study is concerned with the input-output relationship in rice cultivation and examination of difference in response of modern and traditional varieties of rice with respect to the application of fertiliser. An attempt has also been made to evaluate the costs and returns of cultivating rice crop. Finally, influence of various techno-socio-economic variables that might be associated with the adoption of a modern variety rice and use of fertiliser in the rice crop has been examined.

Survey data obtained by interviewing 147 farmers of selected eight Village Panchayats of Dhanusha district were used for the analytical purpose. Production function analysis was used to ascertain input-output relationship in rice cultivation. Difference in response between modern and traditional variety rice with respect to fertiliser use was also examined within production function analysis framework. Costs and returns were computed to evaluate the net returns. Maximum likelihood logit analysis was employed to determine decision regarding the adoption of modern variety rice and use of fertiliser in rice crop.

Irrigation, application of compost and nitrogen appeared likely to increase the yield of rice crop. Although the response of modern variety rice to nitrogen fertiliser seemed better than that of traditional variety, the evidence was fragmentary. Net

returns were found to be higher for modern variety rice than for traditional variety.

Schooling, family size, paddy acreage, proportion of land area irrigated, extension visits and fertiliser use were the important variables that influenced farmers' decision to adopt a modern variety rice, while variables such as age, family size, non-farm income, paddy acreage, proportion of land irrigated, radio listening, extension visits and modern variety use were important in deciding whether to use fertiliser. Interestingly, however, schooling had negative relation in both the decisions regarding adoption of a modern variety or use of fertiliser.

Other things equal, co-operative members who were exposed to extension activities were more likely to adopt a modern variety rice or use fertiliser than non co-operative members who sere not exposed to any of the extension activities.

Comprehensive government programmes to ensure the availability of fertilisers, effective administration of credit, strengthening of extension services and providing other infrastructure would be vital for adoption of a modern variety rice and use of fertiliser. This in turn could lead to increase in farm productivity.

TABLE OF CONTENTS

		Page
ACKNOWLEDGEMENTS		ii
ABSTRACT		iv
LIST OF TABLES		viii
LIST OF FIGURES		ix
I	INTRODUCTION	1
	Nepal's Agriculture Sector	2
	Problem of Low Agricultural Productivity	3
	Efforts and Achievements	5
	Problem	9
	Objectives	9
	Importance	11
	Plan of The Thesis	11
II	LITERATURE REVIEW	13
	Theoretical Framework	13
	Labour Saving Innovations	13
	Land Saving Innovations	14
	Neutral and Non-Neutral Shift of Production Function	16
	Empirical Studies	18
	Production Function and Inputs Use	18
	Adoption of Modern Techniques	25
III	METHOD OF ANALYSIS	34
	Production Function	34
	Comparison of Intercept and Slope	37
	Specification and Measurement of Variables	39
	Costsand Returns	42
	Adoption of Modern Techniques	42
	Logit Analysis	45
	Probability and Elasticity of Probability	46
	Specification and Measurement of Variables	48

		Page
IV	SALIENT CHARACTERISTICS OF THE SAMPLE	54
	The Survey Area	54
	Sampling	55
	Sample Characteristics	60
	Family Characteristics	60
	Farm Characteristics	61
	Rice Varieties and Input Use	64
	Mechanisation and Irrigation	69
	Credit Use	72
	Co-operatives and Extension	72
	Limitations of the Data	75
V	RESULTS	79
	Production Function Analysis	79
	Costs and Returns	83
	Logit Analysis	86
	Reasons for Adopting or Not Adopting a Modern Variety and Using or Not Using Fertiliser	96
	Discussion of Results	101
VI	SUMMARY AND CONCLUSIONS	106
	Problem	106
	Objectives	106
	Data and Analytical Tools	107
	Results	108
	Recommendations	110
	Areas of Further Research	112
BIBLIOGRAPHY		113

LIST OF TABLES

Table		Page
I	Food Balance Sheet	8
II	Cereal Production and Requirements of Dhanusha District (1979-80)	56
III	General Description of Dhanusha District	57
IV	Distribution of Family Members According to Age Category	62
V	Pattern of Labour Use in Rice Cultivation	70
VI	Modern Variety Rice and Fertiliser Adopter by Tenure and Credit Use	74
VII	Modern Variety Rice and Fertiliser Adopter by Different Extension Activities and Membership of Co-operative Society	76
VIII	Summary of Sample Characteristics	78
IX	Least Squares Estimates of Production Function of Rice Farmers in Survey area of Dhanusha District (1981)	80
X	Computed Costs and Returns of Rice Farming Per Hectare in the Survey Area	85
XI	Logit Analysis of Adoption of Modern Variety	87
XII	Logit Analysis of Fertiliser Use	88
XIII	Predicted Probability Regarding Adoption of Modern Techniques	94
XIV	Reasons for Not Cultivating Modern Varieties of Rice	98
XV	Reasons for Not Applying Fertilisers	99
XVI	Reasons Which Motivated Farmers to Cultivate Modern Varieties and Use Fertilisers	100

LIST OF FIGURES

Figure		Page
1	Estimated Average Yield	4
2	Shift in Production Function	17
3	Linear Approximation to a Probability Function	44
4	Map of Dhanusha District	58
5	Classification of Holdings and Farmers in Sample	65
6	Differences in Production Functions Between Traditional and Modern Variety	84

CHAPTER I

INTRODUCTION

There can be no doubt about the importance of agricultural development in countries such as Nepal which have dominant agriculture sectors. Agricultural development involves improvement in productivity of resources employed by farmers (Crosson, 1970, p.1). The rate of increase of agricultural productivity depends upon the rate at which improved inputs are incorporated into production processes at the farm level.

In traditional agriculture, production is increased mainly through slowly increased application of traditional forms of land, labour and capital. In such a case, although expansion of production does occur, the fact that it occurs through an essentially symmetrical expansion of all inputs or through increased input of already abundant low productivity resources results in either no increase or a decline in productivity of resources (Mellor, 1974, p.224).

The modernisation of agriculture is essential not only for this reason of transforming traditional agriculture but also to sustain increasing population and expectations regarding rising standards of living. This process of agricultural modernisation involves increased use of fertiliser, fertiliser-responsive crop varieties and irrigation, coupled with appropriate incentives (Mudahar, 1980, p.1).

This study is concerned with the use of fertiliser and adoption of fertiliser-responsive modern varieties of rice. The study also hopes to examine the financial costs and benefits associated with the traditional and modern varieties of rice; and the responsiveness of these modern varieties to fertiliser input.

Nepal's Agricultural Sector

In Nepal, some 94 per cent of the total labour force are employed in agriculture, a sector that accounts for 62 per cent of the GNP and contributes 80 per cent to the total export earnings (HMG Nepal, 1981, p.8). However, most of the farming is traditional in nature, and monsoon still plays a vital role in determining total output in any particular year. With most of the acreage under food crops, non-food crops (such as tobacco, oils and jute, which provide raw materials for industries) cover a very small acreage of the total cultivated area of the country.

Out of a total land area of 141,177 km^2, only 16.0 per cent constitutes arable land, with very little scope of expansion because of topographical and climatic difficulties. The situation is aggravated by the fact that the average farm size is only 1.2 ha. Of the total number of farmers, 88 per cent are classified as small, and the number of landless is increasing year after year (Comte, 1978).

Rice constitutes a major portion of the diet of the majority of the population. It is also the most important export crop accounting for approximately 30 per cent of the total value of

the country's (1967-71) exports. In terms of area, rice constituted 56 per cent (1,264,000 ha.) of the total cultivated land in 1977-78. Maize covered 444,000 ha. (20%) and wheat 366,000 ha. (16%) of the total cultivated area in the same year.

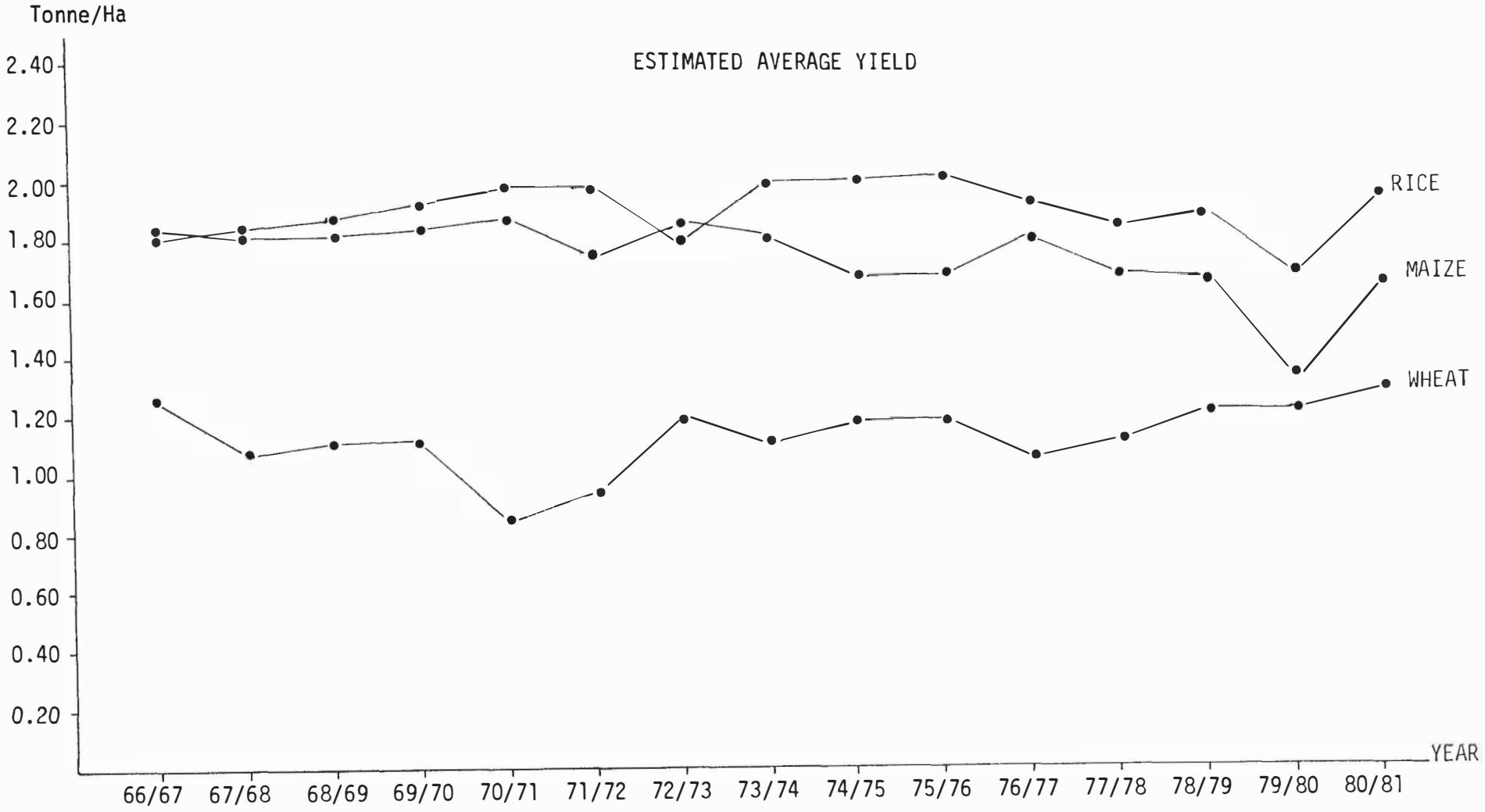
Problem of Low Agricultural Productivity

Agricultural productivity is low and has remained stagnant for quite some time. Yields per hectare of various crops are estimated to be 1.5 to 4.5 times more for developed countries than that of Nepal (Pant and Jain, 1969, p.22). In the period between 1966-67 and 1980-81, the national average yield of rice varied between 1.64 and 2.07 tonnes per hectare, while in the case of maize and wheat, yields varied between 1.87 and 1.28 tonne/ha. and 1.26 and 0.85 tonne/ha, respectively. This is illustrated in Figure 1 which shows the yearly average yield per hectare for the three major cereal crops for the period between 1966-67 and 1980-81. The average yield of rice was 1.93 tonne/ha. in 1980-81 against 1.82 tonne/ha. in 1966-67. Maize and wheat yield in 1980-81 was 1.62 tonne/ha. and 1.26 tonne/ha. against 1.83 tonne/ha. and 1.26 tonne/ha. respectively in 1966-67.

A linear trend function fitted to the estimated average yield data for the period between 1966-67 and 1980-81 showed a declining trend in average yield/ha. in the case of rice and maize crops. Wheat, however, showed a weak positive trend. Results of the estimated trend functions are as follows:[1]

---

[1]Figures in parentheses are standard errors of estimated coefficients.



SOURCE: *1) 1966-67 to 1977-78 Ministry of Food and Agriculture, Food and Agricultural Marketing Services Department, H.M.G. Nepal; in Agricultural Marketing Information Special IssuesVol. IX No.1 Jan.79.*

2) 1978-79 to 1980-81 Ministry of Finance, H.M.G. Nepal; in 'Economic Survey', Fiscal Year (1980-81).

Figure 1. Estimated Average Yield

Paddy:

$$Yp = 1.902 - .0025\ xp \quad (.0064) \qquad R^2 = .011$$

Maize

$$Ym = 1.917 - .0244\ xm \quad (.0064) \qquad R^2 = 0.524$$

Wheat

$$Yw = 1.068 + .0074\ xw \quad (.0069) \qquad R^2 = .083$$

The low level of productivity and stagnation have been attributed to lack of adequate irrigation facilities and lack of knowledge on the part of the cultivators of improved techniques of cultivation. Other factors responsible are the out-dated farming techniques and lack of adequate agricultural credit and marketing facilities (Pant and Jain, 1969).

HMG Nepal has recognised adverse weather condition, decline in productivity of soil, inadequacy of agricultural implements and lack of co-ordination among the development agencies involved as some of the main reasons for the poor performance of agricultural sector (Economic Survey, 1981).

Efforts and Achievements

In recent years, the role of agriculture in economic development has received increasing attention in Nepal, reflecting a growing awareness among the elite that the problem of under-development cannot be solved without first solving the problem of agricultural stagnation. Efforts have been made to modernise agriculture by employing science-based technologies and by providing

marketing, credit and extension services to disseminate new knowledge to farmers, and by making inputs and resources more available to the farming population.

In Nepal, priorities have been given to the agricultural sector in all previous five 5-year plans, and the present Sixth (1981-86) Plan also envisages 30.4 per cent of the total spending for agriculture, irrigation and forestry, which is the highest allocation given to any sector in the economy. The food production target in the Sixth Plan is 4.4 million tonnes a year by 1985 (Singh, 1980). The plan targets reflect the need to overcome problems associated with population growth which had apparently negated achievement of the Fifth Plan. In the Fifth Plan population grew at the rate of 2.3 per cent annually while GNP rose only 2.2 per cent annually.

Efforts by the government include opening of additional agricultural extension offices and establishment of organisations such as the Agricultural Inputs Corporation, the Food Corporation and the Agricultural Development Bank. These institutions which have their networks at district, and in some places at village level, provide the farmers with necessary technical guidance, as well as meet input, marketing and credit requirements. At village level, co-operatives have been organised to this end.

Consequently there has been an encouraging trend in the adoption of modern variety wheat, with 85 per cent of the total cultivated area under it, although in the case of rice it is only

18 per cent. However, it may be noted that the rate of adoption has been rising at 35 per cent per year for rice (FAO, 1977, p.2-13). Similarly, application of chemical fertilizer is on the rise. Compared to the national average application of 2.7 kg/ha. in 1970, the rate observed in 1975 was 6.1 kg/ha. In the case of irrigation, the percentage of net cropped area under irrigation has gone up from 5.9 to 9.1 per cent during the period 1970-75.

While it is debatable whether mechanisation directly contributes towards increasing crop yield, it has been estimated that there is one tractor for every 1000 ha. and one pumpset for every 400 ha. of the cultivated area in the country (Pudasaini, 1980). These figures compare favourably to those available in the early sixties.

But overall, despite these efforts, for the period 1961-74, it has been reported that Nepal's production of major food grains increased at the rate of only 1.35 per cent annually, while population grew at the rate of more than 2.00 per cent annually during the same period (Chapagain, 1980). Food balance sheet figures (Table I) also shows the declining surplus food production between 1974-75 and 1980-81. The crop year 1979-80 actually saw a deficit in food production due to poor weather conditions.

As indicated earlier, the overall production as well as productivity of major crops has been far from satisfactory inspite of improvements in prerequisites for improving productivity. It is

TABLE I. FOOD BALANCE SHEET (IN TONNES)

Year	Consumable Production	Requirements	Balance
1974 - 75	2,410,406	1,871,236	+539,170
1975 - 76	2,470,866	1,912,669	+558,197
1976 - 77	2,352,641	2,020,591	+351,690
1977 - 78	2,246,900	1,935,474	+311,426
1978 - 79	2,302,320	1,990,610	+311,710
1979 - 80	2,000,142	2,034,147	- 34,005
1980 - 81[a]	2,409,347	2,006,511	+348,796

SOURCE: "Nepal Adhirajyako Khadhyanna Basalat" (Fiscal Year. 1979-80), Ministry of Food and Agriculture, Food and Agricultural Marketing Services Department, H.M.G. Nepal.

[a]Figures for 1980-81 obtained from daily newspaper Gorakhapatra, December 22, 1981.

also recognised that a rapid and massive development in agriculture could only be achieved by "breaking through the traditional state of the arts and introducing modern technology in a package consisting of new inputs, agricultural education, special skills and techniques and competent guidance in farm planning" (Reddy, 1965, p.816).

The Problem

Modern crop varieties have been introduced and farmers have been encouraged to apply complementary inputs such as chemical fertiliser to remedy the problem of low agricultural productivity. However, the performance of modern varieties has been erratic and unpredictable in different agro-climatic regions as we shall see from previous studies reviewed in a later section of this study. Therefore the question that arises is whether the modern varieties in the study area are also more responsive to modern inputs such as fertiliser as is usually claimed. A second important question is whether the cultivation of modern varieties is financially beneficial, i.e., whether the net returns are higher from modern variety than traditional variety. A final question that could be raised has to do with the factors that may be associated with the adoption of these modern varieties and use of fertiliser in the study area.

Objectives

This study will attempt to examine the financial benefits of modern variety rice cultivation and to understand the influence

of techno-socio-economic variables in the adoption of modern techniques in rice farming. This crop was chosen because of its importance in the diet and also because of the substantial acreage involved. Specifically the objectives of the present study will be to:

(1) Examine the responsiveness of rice crop to various inputs in general and to compare between modern variety and traditional variety response to fertilisers in particular.

(2) Determine the financial costs and returns associated with traditional and modern variety rice cultivation and ascertain the patterns of input use by farmers growing the traditional and modern varieties of rice.

(3) Identify the effect of different variables which might be associated with adoption of new and improved practices, specifically modern variety rice and chemical fertilisers.

Based upon the above objectives, the following hypotheses will be tested:

(1) Modern rice varieties are more responsive to modern inputs, particularly fertilisers.

(2) Modern variety rice cultivation gives higher net returns compared to traditional variety. At the

same time various input requirements are higher for the cultivation of modern variety rice than for traditional varieties.

(3) variables such as availability of irrigation, mass communications and credit, and education level of farm operator are positively associated with adoption of modern variety rice and use of fertiliser.

Importance

Knowledge of costs and benefits associated with cultivation of rice crop under field conditions would be of interest to the farmers, particularly those growing modern varieties and to the authorities involved in the dissemination of the new seed fertiliser technology. The same would be true regarding the study of responsiveness of rice crop to the various inputs.

Information on the techno-socio-economic determinants in the diffusion of modern techniques, viz., seed and fertiliser, is of interest to the students involved in a study of diffusion of modern farming technology, government officials, policy makers and project implementers.

Plan of the Thesis

Subsequent sections of this study are organised in the following manner. Chapter II contains a review of the literature,

CHAPTER II

LITERATURE REVIEW

Theoretical Framework

Technology is a stock concept indicating the body of knowledge that can be applied in productive processes, while technological change implies changes in this stock (Yotopoulos and Nugent, 1976, p.145). For such technology to be diffused it must also be technically and economically feasible, in which case such techniques are adopted by innovator-entrepreneur to be eventually followed by other imitators in the same field of industry. This study is concerned with the diffusion of such technology which has made impact on the current processes of production.

Modern technologies in agriculture in general can be divided into two types of innovations, namely, labour-saving and land-saving.

Labour-Saving Innovations

An example of this type of innovation is mechanical technology. This type of technology is, in general, designed to facilitate the substitution of power and machinery for labour and typically this involves the substitution of land for labour, because higher output per worker through mechanisation usually require a larger land area cultivated per worker (Hayami and Ruttan, 1971). This type of innovation is significant when land

resource base is good. Specifically it can help bring in unutilised land into cultivation, which earlier could not be utilised simply because of insufficient labour input. Nevertheless, labour-saving technology is quite welcome in the agricultural sector, when it can release vital labour input which is badly needed in other development efforts. However, in the case of Nepal, which is characterised by small land holdings and limited scope of expanding the land frontier, such technology may not be very useful from a social viewpoint. In fact, in economies where the price of labour is low and where the price of material goods (i.e., machinery) is high, there is little economic incentive for mechanisation of field operations (Hayami and Ruttan, 1971, p.47). In this context, the observation of Binswanger (1978, p.73) is notable when he says that tractors are not responsible for the substantial increase in cropping intensity, yield, timeliness and gross returns on farms in India, Pakistan and Nepal. Benefit cost studies also show that the use of tractors do not yield much benefit.

Land-Saving Innovations

This type of innovation is exemplified by biological and chemical technology such as modern crop varieties and chemical fertilisers. Irrigation, though neither biological nor chemical in nature, also is a land-saving innovation. These forms of technology in agriculture are more fundamental than mechanisation. Advances in biological and chemical technology typically pose