

Increasing Farm Incomes and Efficiency of Resource Use under Peasant Farming Conditions in Sri Lanka

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Abstract : It is held that greater growth prospects in agriculture are to be found in new techniques, inputs and market opportunities. In view of this proposition it is considered useful to explore the production possibility frontiers available to peasant farmers by introducing biological and structural innovations into the traditional farming system, given the present resource endowment situation prevailing on these farms. The resource endowments examined in this study relate to a group of settlement farms in Sri Lanka. The technique employed for this analysis is Linear Programming which is well suited to examine production possibilities under constrained conditions. The technical matrix is based on information from the Maha Illuppallama Agricultural Station. The results clearly indicate that the transformation of traditional agriculture by the introduction of biological innovations and structural reorganisation, while compatible with resource endowments on settlement farms, could lead to substantial improvements in farm incomes and efficiency of resource use. It is also evident that the consumption requirements of peasant producers do not seem to be in serious conflict with the objective of maximising farm incomes. The need to undertake studies in depth to identify and remove the constraints which preclude the maximisation of available opportunities is evident.

1. Introduction

The static concept of allocative efficiency concentrates on diagnosing and correcting the disequilibrium in the utilisation of the existing factors of production given the 'state of the arts'. Schultz¹² argues that, greater growth prospects are to be found in the new techniques, new inputs and new market opportunities, since, significant disequilibria in allocative efficiency do not exist under peasant farm conditions. In view of this proposition, it is considered useful to undertake an analysis of the dynamic variant of allocative efficiency or the structural transformation of the 'traditional' production function of peasant farmers in Sri Lanka, based on introducing non-conventional inputs and new techniques.* The changes in technology

*In the broadest sense, a technology may be defined as the employed or operative knowledge of the means of production of particular goods or services. A change in technology or an innovation, is effected by an addition to (and sometimes a concomitant subtraction from) the set of inputs employed in production. Changes in techniques on the other hand are distinguished from changes in technology on the basis of their not involving the employment of new resources.

(innovations) which are specifically examined in the analysis are biological improvements i.e. the package of inputs involving seeds, fertilisers and irrigation which have touched off a transformation in crop production. The main object of this paper is to explore the choice boundaries or production possibility frontiers available to peasant farmers, particularly on settlement schemes in Sri Lanka, by introducing biological and structural innovations into the traditional farming system. It is felt that agricultural development in Sri Lanka has hitherto been too narrowly conceived in terms of single enterprise and single factor projects, which have very often been planned on an *ad hoc* basis to overcome national exigencies. The failure of most of these programmes could be attributed to this approach which has overlooked the fundamental fact that farmers are faced with the problem of optimising the limited resources on farms. If we are interested in bringing about change and development, there is no gainsaying that an integrated approach to farm planning is imperative. Therefore, in this study, the impact of modern farm innovations is examined within the framework of the resource endowment situation prevailing on peasant farms.

The technique employed in this analysis is Linear Programming (L.P.) which is well suited for a normative analysis of this nature, providing valuable insights into the production possibilities and constraints involved in transforming the traditional farming system.

2. The Data

The technical matrix is based on information obtained from the Dry Zone Agricultural Station at Maha Illupallama, which has been modified downwards on the basis of field observations,² to take account of the resource endowment situations and management capacities under peasant farm conditions (Tables 10 & 11). Information relating to resource constraints are based on a field study at the Minipe Colonisation Scheme in Sri Lanka. Farm records covering all aspects of the farm business were maintained on the basis of weekly visits to farmers throughout the period September 1971 to October 1972. A sample of forty farmers was selected. The farmers in the sample were selected on a purposive basis with the object of achieving representativity of the resource endowment situations of the farms, levels of sophistication in farming, farming systems and levels of mechanisation. A small sample was considered desirable for several reasons *viz.* accuracy of data which necessitated the measurement of some inputs and outputs, the assurance of cooperation by farmers to participate in the study for a full year and the availability of limited funds to undertake an intensive examination of a large sample.

It is commonplace in farm management investigations to make generalisations based on the 'average farm'. This is considered too restrictive in making valid recommendations for farms showing a variation in resource endowments. While investigating economic planning in peasant agriculture, Clayton⁵ postulated that peasant

holdings could be appropriately defined and selected on the basis of their land-labour ratios. He commended the use of such a ratio as the basis for selecting representative farms for closer study, since land and labour constitute the most important factors of production in peasant agriculture. The selection of farms on the basis of resource endowments has also been advocated by Barnard³ in using LP, as a short-cut to whole farm planning on individual farms. In this study a similar approach is adopted in classifying the farmers into seven groups based on their land-labour ratios, as land and labour constitute the most important factors under peasant farming conditions in Sri Lanka (Table 1).

TABLE 1. Classification of settlement farms.

Farm group	Average acreage	Average no. of adult equivalents	Land : Labour ratio
A	5.25	4.08	1.1 —1.5
B	7.20	4.10	1.51—2.0
C	6.78	2.93	2.01—2.5
D	6.51	2.33	2.51—3.0
E	7.0	2.30	3.01—3.5
F	3.33	3.75	0.5 —1.0
G	3.37	1.5	3.01—3.5

3. The Model

3.1. Objective function

In this study it is assumed that peasant farmers maximise production valued at the prevailing market prices. Since the main purpose of this analysis is to explore the production possibilities available, this objective cannot be considered too objectionable. However, to take into account goals of production such as family security, constraints have been introduced into the model. Having assumed this objective, there is the problem of its formulation in terms of yield and price components. Prices and yields are subject to wide fluctuations. However, the problem of price variation is minimised to a large extent by the operation of a guaranteed price scheme for most of the farm enterprises considered in this study. The prices used are the guaranteed prices for the 'protected' commodities and the average prices received by farmers during the cropping year 1971/72, for the other enterprises. The yields employed in the computation of the net revenues are the average yields under experimental conditions which have been modified on the basis of field observations.

3.2. Constraints

The lands cultivated under peasant farming conditions are of two types ; lowland and highland. The former are irrigable lands with an assured supply of water, which have been developed for paddy cultivation and the latter are rainfed. In the model,

the land constraint is defined in terms of the operational size of a holding. Besides the distinction of land into lowland and highland, the availability of land during the two cropping seasons has also been taken into account in the LP model, since the production possibilities for the two seasons differ.

The labour restrictions used in the model were computed from the field survey. Both family and hired labour are considered in the model. In computing the family labour availability it was felt that the potential labour force available for farming should be considered, since, the actual labour employed was low under the prevailing farming systems despite the fact that there were no alternative non-farm opportunities available.² The potential family labour force was computed on the basis of a 293 working day year.* The total labour potential for each farm group was considered as the product of total work-days for the respective month and the adult equivalents available for farming. From this potential, the actual labour hours available for farming was computed by deducting the actual number of hours devoted to domestic work for the respective months (Table 2).

TABLE 2. Potential monthly labour available for farming in man-days.

Month	FARM GROUPS							Average of all farms
	A	B	C	D	E	F	G	
September ...	84.31	84.81	55.56	40.56	34.82	79.35	26.03	57.92
October ...	92.33	90.85	60.43	44.83	38.85	84.53	25.09	62.41
November ...	90.14	90.64	61.39	46.39	40.64	81.34	30.20	62.96
December ...	96.43	94.95	64.53	48.93	42.95	88.70	23.11	65.66
January ...	90.33	90.85	60.43	44.83	38.85	81.61	37.24	63.45
February ...	78.14	78.60	51.69	37.89	32.60	71.74	22.87	53.36
March ...	88.75	89.27	58.85	43.25	43.25	81.37	14.99	59.96
April ...	63.57	63.97	40.57	28.57	28.57	59.99	37.35	46.08
May ...	76.15	76.61	49.70	35.90	30.61	71.85	18.60	22.42
June ...	72.07	72.51	46.77	33.57	28.51	68.10	24.60	49.45
July ...	88.39	88.91	58.49	42.89	36.91	83.10	23.10	60.25
August ...	84.39	84.81	58.49	40.56	40.56	79.35	23.10	58.75
TOTAL ...	1005.00	1006.78	666.90	488.17	437.17	931.03	306.28	662.67

*The number of work days are based on observations made during a field study at the Minipe Colonisation Scheme during the cropping year 1971/72.

It was observed that, in general, no work was done on Poya days which was considered a day of rest. The other non-work days were largely determined by religious and national festivities. In the former category were holidays taken for Vesak and Poson, while in the latter category were holidays taken for Sinhalese New Year festivities. On this basis, a total of 72 non-work days was observed.

In setting up labour restrictions, the seasonal distribution of labour available for farming into time periods is an important consideration. Monthly time periods have been used by Clayton⁴ and Odero-Ogwell¹¹ in their studies of peasant agriculture, while, labour periods based on seasonal peak requirements have been used by Desai⁶ and Heyer.⁸ In this study, monthly time periods are adopted and labour availability and input coefficients computed accordingly. A monthly time period is not considered unduly restrictive in the present study, as the farmers generally agree to abide by a cultivation calendar based on calendar months at the commencement of each cultivation season in the case of the settlement schemes.

It is assumed that hired labour can supplement the family labour supply at the current wage rates, but, is constrained by the availability of working capital. The hired labour specifications available specified in the model are the actual levels of these resources employed by the farmers during the cropping year 1971/72 (Table 3).

TABLE 3. Monthly hired labour utilised for farming in man-days

Month	FARM GROUPS						
	A	B	C	D	E	F	G
September	0.71	2.01	7.39	0.90	3.04	3.75	2.23
October	35.01	59.36	64.43	53.13	69.94	45.73	39.24
November	2.98	8.55	9.37	10.41	14.40	8.25	0.06
December	16.55	33.64	46.16	10.08	43.22	11.88	33.68
January	15.55	23.20	30.28	28.52	21.78	46.95	29.33
February	9.99	5.24	6.77	3.87	1.41	23.95	6.58
March		0.60	4.07	4.83	8.86	9.50	7.27
April	39.37	37.40	68.43	30.32	52.79	39.02	24.58
May	13.97	42.94	31.08	30.67	19.10	45.91	28.52
June	22.60	28.62	29.88	39.08	43.75	24.80	9.75
July	11.21	32.21	24.43	9.04	29.21	13.24	20.0
August	2.11	1.11	2.97	1.06	3.38	4.74	0.89
TOTAL	173.05	274.88	319.26	221.91	315.88	277.52	202.13

The need for working capital to employ modern farm inputs has become increasingly important, particularly in relation to paddy production.¹ On the other hand, it is assumed that fixed capital is not restrictive. This is a reasonable assumption, since there is no apparent shortage of simple farm implements such as mammoties (hoes), sickles and so on. Moreover, if there is adequate working capital, the fixed capital limitations such as the lack of draught power whether by the use of tractors or buffaloes, could be overcome by hiring the necessary services. Also in times of extreme shortage, government tractors are commissioned to help and the lack of draught power does not impose serious limitations on farming at the present time.

The capital availability for production is assumed to be the actual production expenditure incurred by the farmers during the cropping year (Table 4). This level

TABLE 4. Data for some constraints in the models.

Constraints	FARM GROUPS						
	A	B	C	D	E	F	G
1. Production capital (Rs.)	2236.27	3789.85	3340.55	2678.23	3471.17	2700.14	1964.20
2. Irrigation water (ac. ft.)	15.0	28.20	24.0	24.78	24.0	12.0	12.0
3. (a) Minimum paddy acreage	3.0	3.0	3.0	3.0	3.0	3.0	2.0
(b) Paddy requirement (bu.)	74.95	78.19	82.06	71.45	69.39	76.70	54.96
4. Level of living (Rs.)	1973.30	2530.63	2520.85	2730.10	2936.85	1881.88	1401.40

is considered more useful than the amount borrowed by the farmer. Farmers generally borrow for the cultivation of paddy only, which is the main farm enterprise. Although institutional credit is available for the production of other crops, farmers rarely avail themselves of the facilities. Also, using the amount borrowed as a measure of capital availability would complicate the consideration of production expenditure from savings. It is therefore felt that an aggregate of all cash and kind expenditure incurred on farming as a measure of the availability of capital for farming is a better measure.

Irrigation water is an important constraint determining the success of farming in the Dry Zone, which receives an effective rainfall only during five months of the year. The feasibility of cultivating in the *Yala* season generally depends on the water stored in the tanks during the North-East monsoon (*Maha* season). Irrigation water is introduced as a constraint in the LP model, to investigate the possibilities of utilising this scarce resource more efficiently. The available water supply is assumed to be 10 acre feet per acre of paddy land per annum, which is the amount supplied to paddy cultivators under major irrigation schemes in the island.¹³ The irrigation requirements for the crops have been based on the research findings reported by the Maha Illupallama Research Station.

Consumption requirements enter the production models as a 'minimum bundle of goods' required per settler family during a cropping year. This requirement not only includes a minimum production of food crops required for domestic consump-

tion, but also includes the non-food requirements of farm families. This broader notion of subsistence has a more important bearing on economic behaviour than the mere production of family food requirements under semi-commercialised farming conditions. Nutritional requirements *per se* have not been critical according to other studies.¹⁰ It is therefore considered more important to take account of the "minimum standard of living." In a given time period it is felt that a farm family has certain standards of food, shelter, clothing etc. with which it provides itself. This is postulated to be a "minimum standard of living" and is an amalgam of physiological, socio-economic and cultural elements. In order to compute this variable, special records were maintained during the study. It was observed that only rice and vegetables were produced for domestic use in the main, while other requirements of food and non-food items were purchased. The need for money income is clear and is included as a minimum constraint besides the acreage of paddy.

No technological restraints in terms of rotational husbandry practices are incorporated in the model as they are inoperative in the farming system at the present time. Peasant farmers in Sri Lanka have practiced a system of continuous cropping of paddy under conditions of impounded water since time immemorial, while on the highlands cultivation has not been systematised. In fact, cultivation on non-irrigated lands has been traditionally by *Chena* (slash and burn system), where the rotation of land rather than crops is practiced. Moreover, due to the lack of a systematic livestock industry, a pastoral fallow is not customary.

3.3. Alternative activities

The farm 'activities' considered fall into two major groups : paddy and highland crops. Records of all farm enterprises, both pure and mixed stands, were maintained in respect of each farm for both seasons. In the case of paddy, many processes were identified on the basis of the age of the crop, i. e. long-aged (4 to 4 ½ months) or short-aged (3 to 3 ½ months) ; method of planting, i. e. whether broadcast sown or transplanted ; and the degree of mechanisation, i. e. whether the lands were ploughed and threshed by buffaloes and tractors. In the case of highland crops, both annual and perennial crops were considered. The activities examined in the models are those which were observed on the settlement farms and also some others which are ecologically suitable. The technical parameters with respect to these are derived from the Maha-Illupallama Experimental Station and modified on the basis of the field observations.

3.4. Assumptions of the model

Besides the usual assumptions of the LP model, the following specific assumptions are made in the analysis :

- i. The analysis is not conducted on an individual farm basis but in respect of the 'average' farm for each of the seven groups of farmers.

- ii. The farmers use improved levels of technology. In order that some operational significance be had, average input-output coefficients are used for all farm groups (Tables 10 & 11).
- iii. Farmers operate within the average resource limitations of each farm group. The monthly family labour used is the potential labour force (Table 2) while hired labour at the level actually observed is used (Table 3). The land resources available are the average for each group as reported in Table 1, and the production expenditure is the actual level incurred by each group (Table 4).
- iv. The capital input coefficients are the requirements of production capital for the purchase of seeds, fertilisers, agrochemicals and tillage.
- v. A single production period is assumed and single value expectations of prices and production functions.
- vi. The production alternatives are those which are currently used by the settlement farmers and also some others which are ecologically suitable.
- vii. Any mechanisation employed is assumed to be hired at prevailing market rates.

The general LP model could be represented as follows :

$$(\text{Max.}) \quad Z = \sum_{j=1}^n c_j x_j \quad (1)$$

$$\text{subject to : } b_i \geq \sum_{j=1}^n a_{ij} x_j \quad (i = 1, 2, \dots, m) \quad (2)$$

$$\text{and } x_j \geq 0 \quad (j = 1, 2, \dots, n) \quad (3)$$

Where x_j is a series of activities and c_j the respective net revenues which maximises Z the objective function, b represents the resource level of the i th resource, and imposes the restriction that the amount of the resource used up by operating the j th activity at a level x_j does not exceed the amount of the resource level b available, while a_j is the technical requirement for the production of a unit of that activity. Equation (3) imposes the requirement of a non-negative activity level.

4. Analysis and Results

The general model discussed above was employed to explore production possibilities under rainfed and irrigated conditions. In order to examine the importance of the behavioural aspects of farmers, restrictions on production capital and consumption are incorporated into the model. In Model 1, both annual and perennial types of

TABLE: 10

BASIC

M A H A C R O P S

UNITS	M A H A C R O P S																													
	B	HAYS	HAYS	HAYS	HAYS	HAYS	HAYS	HAYS	HAYS	HAYS	TV	TV	UP-	MAIZE	DR/	MAN-	KOR-	MUR-	TEA-	CO-	GRAM	GROP	GROP	VEG.	VEG.	LIME	MAN-	SOR-	Q	
	BTM	BTM	TBM	TBM	BTM	BTM	BTM	BTM	BTM	BTM	BTM	BTM	LAND	MAIZE	CHL-	OC	KKAN	UNDA	ACCO	PEA	MIX A	MIX B	MIX A	MIX B	MIX E	MIX E	GO	GO	GRUM	C

NET REVENUE	850.00	720.00	833.00	693.00	1210.00	930.00	1133.00	819.00	345.00	233.00	310.00	333.05	1369.00	273.00	167.00	393.73	1190.00	232.00	260.00	299.00	822.00	260.00	190.00	300.00	350.00	125.00	13							
MIN. PADDY AC.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0				
MARCH LOWLAND																																		
MARCH HIGHLAND																																		
YALA LOWLAND																																		
YALA HIGHLAND																																		
OCT. LAB. DAYS	0.32	0.32	0.32	0.32	0.34	0.34	0.32	0.33	0.30	0.32	0.32	0.33	0.30	0.32	2.15	17.0	18.0	14.0	2.5	11.5	0.47	20.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0		
NOV. LAB. DAYS	12.86	12.82	8.53	8.03	13.07	13.96	8.55	8.69	10.16	8.42	1.0	0.50	20.0	1.0	2.5	0.47	12.65	10.0	2.0	1.0	7.0	0.25	14.0	0.5	3.38	2.0	0.25							
DEC. LAB. DAYS	20.13	11.10	14.85	11.10	18.60	5.33	18.60	6.28	6.57	5.64	1.5	0.25	25.0	0.25	5.50		11.13	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
JAN. LAB. DAYS	18.93	5.99	11.24	6.00	7.47	6.70	7.47	4.50	1.95	2.96	12.0	15.0	25.0	0.25	5.50		17.73	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
FEB. LAB. DAYS	23.93	21.15	24.20	21.20	5.0	6.2	5.3	5.55	2.06	2.86				12.5			18.35	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
MARCH LAB. DAYS	2.58	2.32	2.59	2.59	24.89	21.26	25.20	20.80	18.25	18.12				5.0			0.35	25.19	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
APR. LAB. DAYS					2.59	2.59	2.60	2.59	1.59	1.55							1.20																	
MAY LAB. DAYS																	1.10																	
JUN. LAB. DAYS																	1.11																	
JUL. LAB. DAYS																																		
AUG. LAB. DAYS																																		
SEP. LAB. DAYS																																		
OCT. LAB. DAYS																																		
NOV. LAB. DAYS																																		
DEC. LAB. DAYS																																		
JAN. LAB. DAYS																																		
FEB. LAB. DAYS																																		
MARCH LAB. DAYS																																		
APR. LAB. DAYS																																		
MAY LAB. DAYS																																		
JUN. LAB. DAYS																																		
JUL. LAB. DAYS																																		
AUG. LAB. DAYS																																		
SEP. LAB. DAYS																																		
CAPITAL AC.	205.00	195.00	230.00	225.00	215.00	210.00	245.00	240.00	162.00	192.00	155.00	131.00	475.00	95.00	25.00	10.00	350.00	90.00	70.00	35.00	235.00	80.00	120.00	120.00	120.00	100.00	162.50	47						
MIN. PADDY AC.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		

Note: This model milk was used for all seven crops, with only the 8 column varied according to the resource endowment situation in each month.

BLEAU 1

Y A L L A C R O P S

A C R E

HYVS HYVS HYVS HYVS HYVS HYVS HYVS HYVS HYVS HYVS HYVS
 DRY BRY ITY TBY BRY BRY ITY TBY BRY BRY ITY TBY BRY BRY
 DRY GRAM COW- SNAKE VEG. GEN. GREEN
 CHU- CHU- CHU- CHU- CHU- CHU- CHU- CHU- CHU- CHU-
 LIES LIES LIES LIES LIES LIES LIES LIES LIES LIES LIES

720.00 838.00 698.00 1230.00 980.00 1183.00 819.00 345.00 285.00 821.00 260.00 232.00 211.00 260.00 156.60 722.57

1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

23393 21.15 2420 21.2 5.0 6.2 5.3 5.5 2.06 2.06
 2.58 2.59 2.59 2.59 24.89 21.26 25.2 20.8 18.25 18.12
 2.59 2.59 2.6 2.59 1.59 1.55

0.32 0.32 0.32 0.32 0.34 0.34 0.32 0.33 0.30 0.32 11.28 7.0 15.0 18.0 15.0 10.0 18.20
 12.52 8.53 8.03 13.07 13.96 8.55 8.69 10.16 8.42 12.62 10.0 14.0 1.5 18.0
 20.15 11.10 14.85 11.10 18.6 5.55 18.60 6.28 6.57 5.64 20.5 3.0 1.0 15.0
 6.00 6.00 11.24 6.0 7.47 6.70 7.47 4.5 1.96 2.96 21.09 15.0 1.5 5.0

195.00 230.00 225.00 215.00 210.00 245.00 240.00 162.00 192.00 475.00 70.00 90.00 150.00 80.00 65.00 475.00

H I R E D L A B O U R I N M A N - D A Y S

M A N D A Y

OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP

-4.50 -4.50 -4.50 -4.50 -4.50 -4.50 -4.50 -4.50 -4.50 -4.50 -4.50

-1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0

1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

4.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50 4.50

TABLE: 11
BASIC

MAHA CROPS

IRRIGATED CROPS

RAINFED CROPS

UNITS

ACRE

ACRE

ACRE

NET REVENUE:

PER ACRE 720.00 698.00 1230.00 980.00 1193.00 819.00 345.00 285.00

310.00 323.05 1369.00 275.00 167.00 393.73 119.00 232.10 260.00 299.00 822.00 260.00 190.00 300.00 330.09 125.50 1326.00

720.00 698.00 1230.00 980.00

MAHA HIGHLAND > 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

1.0 1.0 1.0 1.0

YALA HIGHLAND >

1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

1.0 1.0 1.0 1.0

OCT. LAB. DAYS > 0.32 0.32 0.34 0.34 0.32 0.33 0.30 0.32

17.0 17.0 18.0 14.0 15.0 15.0 0.47 20.0 17.0 17.0 17.0 2.5 15.0 15.0 15.0 15.0 2.50 1.0 1.0

21.15 21.20 5.0 6.5 2.59 2.59 24.89 21.26 25.20 20.80 18.25 18.12

NOV. LAB. DAYS > 8.03 13.97 13.96 8.55 8.69 10.16 8.42

2.15 2.75 14.0 2.5 11.50 0.47 20.0 17.0 17.0 2.5 14.0 1.5 13.34 1.0 3.0 3.0 14.0

8.03 13.07 13.96 8.55 8.69 10.16 8.42

DEC. LAB. DAYS > 11.10 11.10 18.6 5.25 18.60 6.28 6.57 5.64

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11.10 11.10 18.60 5.5 2.96

JAN. LAB. DAYS > 6.0 6.0 7.47 6.70 7.47 4.50 1.86 2.96

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6.0 6.0 7.47 6.70 7.47 4.50 1.86 2.96

FEB. LAB. DAYS > 21.15 21.20 5.0 6.20 5.30 5.50 2.06 2.06

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MAR. LAB. DAYS > 2.59 2.59 24.89 21.26 25.20 20.80 18.25 18.12

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APR. LAB. DAYS > 2.59 2.59 24.89 21.26 25.20 20.80 18.25 18.12

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JUN. LAB. DAYS >

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JUL. LAB. DAYS >

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AUG. LAB. DAYS >

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NOV. LAB. DAYS >

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DEC. LAB. DAYS >

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JAN. LAB. DAYS >

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FEB. LAB. DAYS >

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MAR. LAB. DAYS >

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APR. LAB. DAYS >

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SEP. LAB. DAYS >

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2.59 2.59 24.89 21.26 25.20 20.80 18.25 18.12

IRR. WATER AC.Ft. >

155.00 131.00 475.00 95.00 25.00 10.00 350.00 90.00 70.00 35.00 285.00 80.00 120.00 120.00 100.00 162.50 475.00

4.0 4.0 5.0 5.0

CAPITAL RS. > 195.00 225.00 215.00 210.00 245.00 240.00 162.00 192.00

195.00 225.00 215.00 210.00 245.00 240.00 162.00 192.00

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MIN. RAINY AC. < 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

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NET REVENUE:

310.00 323.05 1369.00 275.00 167.00 393.73 119.00 232.10 260.00 299.00 822.00 260.00 190.00 300.00 330.09 125.50 1326.00

720.00 698.00 1230.00 980.00

MAHA HIGHLAND > 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

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YALA HIGHLAND >

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OCT. LAB. DAYS > 0.32 0.32 0.34 0.34 0.32 0.33 0.30 0.32

17.0 17.0 18.0 14.0 15.0 15.0 0.47 20.0 17.0 17.0 17.0 2.5 15.0 15.0 15.0 15.0 2.50 1.0 1.0

21.15 21.20 5.0 6.5 2.59 2.59 24.89 21.26 25.20 20.80 18.25 18.12

NOV. LAB. DAYS > 8.03 13.97 13.96 8.55 8.69 10.16 8.42

2.15 2.75 14.0 2.5 11.50 0.47 20.0 17.0 17.0 2.5 14.0 1.5 13.34 1.0 3.0 3.0 14.0

8.03 13.07 13.96 8.55 8.69 10.16 8.42

DEC. LAB. DAYS > 11.10 11.10 18.6 5.25 18.60 6.28 6.57 5.64

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JAN. LAB. DAYS > 6.0 6.0 7.47 6.70 7.47 4.50 1.86 2.96

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6.0 6.0 7.47 6.70 7.47 4.50 1.86 2.96

FEB. LAB. DAYS > 21.15 21.20 5.0 6.20 5.30 5.50 2.06 2.06

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MAR. LAB. DAYS > 2.59 2.59 24.89 21.26 25.20 20.80 18.25 18.12

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APR. LAB. DAYS >

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MAY LAB. DAYS >

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JUN. LAB. DAYS >

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JUL. LAB. DAYS >

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AUG. LAB. DAYS >

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SEP. LAB. DAYS >

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IRR. WATER AC.Ft. >

155.00 131.00 475.00 95.00 25.00 10.00 350.00 90.00 70.00 35.00 285.00 80.00 120.00 120.00 100.00 162.50 475.00

4.0 4.0 5.0 5.0

CAPITAL RS. > 195.00 225.00 215.00 210.00 245.00 240.00 162.00 192.00

195.00 225.00 215.00 210.00 245.00 240.00 162.00 192.00

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MIN. RAINY AC. < 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

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NET REVENUE:

310.00 323.05 1369.00 275.00 167.00 393.73 119.00 232.10 260.00 299.00 822.00 260.00 190.00 300.00 330.09 125.50 1326.00

720.00 698.00 1230.00 980.00

MAHA HIGHLAND > 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0

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YALA HIGHLAND >

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OCT. LAB. DAYS > 0.32 0.32 0.34 0.34 0.32 0.33 0.30 0.32

17.0 17.0 18.0 14.0 15.0 15.0 0.47 20.0 17.0 17.0 17.0 2.5 15.0 15.0 15.0 15.0 2.50 1.0 1.0

21.15 21.20 5.0 6.5 2.59 2.59 24.89 21.26 25.20 20.80 18.25 18.12

NOV. LAB. DAYS > 8.03 13.97 13.96 8.55 8.69 10.16 8.42

2.15 2.75 14.0 2.5 11.50 0.47 20.0 17.0 17.0 2.5 14.0 1.5 13.34 1.0 3.0 3.0 14.0

8.03 13.07 13.96 8.55 8.69 10.16 8.42

DEC. LAB. DAYS > 11.10 11.10 18.6 5.25 18.60 6.28 6.57 5.64

1.0 0.50 20.0 1.0 2.50 0.47 12.66 10.0 2.0 1.0 13.5 1.0 5.24 1.0 3.0 1.0 18.0

11.10 11.10 18.60 5.5 2.96

TABLE 5. Optimal farm plans with improved technology and unrestricted capital.

MODEL 1

	FARM GROUPS						
	A	B	C	D	E	F	G
1. NET REVENUES (in Rs.)	11,329.82	13,615.77	10,983.48	8598.16	8757.17	7768.88	5175.27
2. LOWLAND UTILISED (ac.)							
Maha Season	2.50	4.70	4.00	3.72	4.00	2.0	2.0
Yala Season	2.50	4.70	4.00	4.14	4.00	2.0	2.0
TOTAL	5.00	9.40	8.0	7.86	8.00	4.0	4.0
Intensity of Use (%)	100.0	100.0	100.0	95.15	100.0	100.0	100.0
3. HIGHLAND UTILISED (ac.)							
Maha Season	2.75	2.50	2.78	2.38	3.0	1.33	1.37
Yala Season	2.75	2.50	1.63	2.38	3.0	1.33	1.37
TOTAL	5.50	5.0	4.41	4.76	6.0	2.66	2.74
Intensity of Use (%)	100.0	100.0	79.31	100.0	100.0	100.0	100.0
4. FAMILY LABOUR USED (m.d.)	799.48	839.59	580.87	432.35	385.60	493.01	265.58
Intensity of Use (%)	79.55	83.39	87.13	88.56	88.21	52.95	86.71
5. FAMILY LABOUR UNUSED (m.d.)	205.52	167.19	79.73	55.82	51.51	438.02	40.70
6. HIRED LABOUR USED (m.d.)	60.01	114.79	175.43	136.34	156.87	14.18	113.81
Intensity of Use (%)	34.67	41.76	53.93	61.43	49.66	5.10	56.31
7. HIRED LABOUR UNUSED (m.d.)	138.38	160.09	149.83	85.57	159.01	263.34	88.32
8. ACTIVITIES IN OPTIMAL PLANS							
HYVL Rice (BTM)	2.50		3.0			2.0	
HYVS Rice (TTM)		1.21					0.40
HYVL Rice (BTM)		2.43		1.42	2.28		1.23
HYVL Rice (BBM)		1.06	1.0	0.05	1.04		0.37
HYVS Rice (TTM)				1.53			
HYVL Rice (TTM)				0.72			
HYVS RICE (BBM)					0.68		
HYVS Rice (TBY)	0.32	2.29	2.13	0.70	1.88		0.30
HYVL Rice (BTY)	1.81	1.52	0.22		0.04	2.0	
HYVL Rice (BBY)	0.37	0.88	1.64		2.0		0.13
HYVS Rice (BBY)				1.21	0.09		1.57
HYVS Rice (TBY)				0.54			
HYVL Rice (BBY)				1.69			
Dried Chillies—Maha	1.41					1.33	
Green Chillies—Maha	1.34	2.50	1.63	0.90	0.27		1.20
Murunga			1.15	1.48	2.73		0.17
Dried Chillies—Yala	2.22	0.83	0.70			1.33	
Vegetable Mixture A—Yala	0.53	1.67	0.93	0.90	0.27		1.20
7. CAPITAL REQUIRED (Rs.)	3751.14	4293.55	3592.28	2508.98	2602.81	2187.31	2016.44

Note: The letters HYV and TV signify high yielding varieties and traditional varieties respectively. The next letter indicates the age, S and L for short-aged and long-aged respectively, followed by B and T which indicate buffalo and tractor ploughing respectively and the penultimate letters B and T refer to broadcast sowing and transplanting. The suffix M and Y indicate Maha and Yala seasons.

Vegetable mixture A comprises cowpea, cucumber and pumpkin.

crops are included and differentiated on the basis of the two cultivation seasons. As stated earlier, the choice of alternative crop activities has been dictated by the actual adoption of the plant types on the settlement farms and their ecological suitability. Selective mechanisation* of some of the paddy activities is assumed. Irrigation facilities are assumed only for the paddy activities, reflecting the current situation. Model 1 was first run with no restriction on capital so as to evaluate the production possibilities, given the resource endowments on the farms. The results indicate a substantial improvement in farm incomes and utilisation of resources as compared with the actual situation prevailing on the settlement farms (Tables 5 & 9). In contrast to the actual situation prevailing on the farms, total land use intensity increases by 26.48 %, total labour use by 159.85 man days, while production expenditure increases by only Rs. 75.23 (2%). The average farm income increases from Rs. 2957.66 to Rs. 9461.22, an improvement of Rs. 6503.56. These results clearly indicate that the adoption of biological innovations *ceteris paribus*, could bring about phenomenal changes in the prevailing farming system. It is also evident that the objective of maximisation of farm incomes does not conflict with a more intensive utilisation of land and labour resources.

In order to incorporate the behavioural aspects of the farmers, the consumption constraint in the form of a minimum paddy acreage constraint and also a restriction on the production capital were imposed on Model 1 and is referred to as Model 2 in the analysis. The results of this model were not significantly different from those of Model 1 and clearly indicate that the provision of consumption rice does not conflict with the object of maximising farm incomes and also that the level of production capital required is not very different from what is being actually utilised. The results of Model 2 are reported in Tables 6 and 9. On average a slight decrease in land use, labour use, production expenditure and consequently farm incomes are observed in contrast to Model 1. However, in contrast to the observed farm situation a substantial overall improvement in farm resource use and incomes is evident (Table 9).

In Models 1 and 2, the only irrigated crop considered was paddy, the other crops being treated as rainfed activities. In recent times, the Department of Agriculture has been encouraging farmers, particularly in areas with water shortages for paddy production in the *Yala* season, to grow other food crops which require less irrigation but are financially more remunerative than paddy.⁹ Some success has been recorded in the Elahera Special Project, where field crop production on paddy lands has enabled considerable diversification without imposing greater demands on irrigation water which is in short supply during this season. In Model 3, the possibility of cultivating crops under irrigated conditions, in the *Yala* season is examined. The irrigation water

* Preparatory tillage and threshing operations of paddy by tractor are implied as usually observed on peasant farms.

TABLE 6. Optimal farm plans with improved technology and restricted capital.

MODEL 2

	FARM GROUPS						
	A	B	C	D	E	F	G
1. NET REVENUES (Rs.)	9725.65	13,406.16	10,761.63	8572.72	8557.17	7768.88	5152.49
2. LOWLAND UTILISED (ac.)							
Maha Season	2.50	4.70	4.00	3.68	4.00	2.0	2.0
Yala Season	2.50	4.70	2.07	4.13	4.00	2.0	2.0
TOTAL	5.0	9.40	6.07	7.81	8.00	4.0	4.0
Intensity of Use (%)	100.0	100.0	75.87	94.55	100.0	100.0	100.0
3. HIGHLAND UTILISED (ac.)							
Maha Season	2.75	2.50	2.78	2.38	3.0	1.33	1.37
Yala Season	2.75	2.50	2.78	2.38	3.0	1.33	1.37
TOTAL	5.50	5.00	5.56	4.76	6.0	2.66	2.74
Intensity of Use (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
4. FAMILY LABOUR USED (m.d.)	614.43	787.36	557.18	430.93	385.60	493.01	265.58
Intensity of Use (%)	61.13	78.20	83.58	88.27	88.21	52.95	86.71
5. FAMILY LABOUR UNUSED (m.d.)	390.57	219.42	109.42	57.24	51.51	438.02	40.70
6. HIRED LABOUR USED (m.d.)	2.52	102.46	156.06	130.15	156.87	14.18	113.81
Intensity of Use (%)	1.45	37.27	47.98	58.64	49.66	5.10	56.31
7. HIRED LABOUR UNUSED (m.d.)	170.53	172.42	169.20	91.76	159.01	263.34	88.32
8. ACTIVITIES IN OPTIMAL PLANS (ac.)							
HYVL Rice (BTM)	2.50	3.31	3.55	2.17	2.28	2.0	1.31
HYVS Rice (T ₁ M)		0.57		0.73			0.42
HYVL Rice (BBM)		0.82	0.45	0.75	1.04		0.27
HYVS Rice (T ₂ M)							
HYVL Rice (T ₁ M)				0.03			
HYVS Rice (BBM)					0.68		
HYVL Rice (BT ₁ Y)	2.50	2.45	0.65		0.04	2.0	
HYVS Rice (BT ₁ Y)		0.83					
HYVS Rice (T ₁ Y)		1.42	1.93	0.91	1.88		0.37
HYVL Rice (B ₁ Y)			1.42	1.83	2.0		0.18
HYVS Rice (B ₁ Y)				1.01	0.09		1.45
HYVS Rice (T ₂ Y)				0.38			
Murunga	0.68	0.31	1.55	1.68	2.73		0.24
Tobacco	0.05						
Green Chillies—Maha	1.04	2.19	1.23	0.70	0.27		1.13
Dried Chillies—Maha	0.98					1.33	
Vegetable Mixture A—Yala	2.07	2.19	0.72	0.70	0.27		1.13
Dried Chillies—Yala			0.51			1.33	
9. CAPITAL SURPLUS (Rs.)	0	0	0	0	868.36	512.82	0
M.V.P. of Capital	1.69	0.63	0.46	0.19	0	0	0.54

available per farm group is based on the assumption that 6.0 acre feet of water is available per acre for paddy cultivation in the *Yala* season.⁷ The other resource availabilities assumed are similar to the earlier models. The production possibilities examined in the *Maha* season are irrigated paddy and rainfed highland crops, similar to those in Models 1 and 2. In the *Maha* season other crops cannot be grown successfully on paddy land due to water-logging as a result of the high rainfall during this season. The *Yala* crop activities include irrigated paddy, rainfed highland crops and irrigated highland crops (Table 11).

In Model 3, the structural organisation of the farming system is examined with no restriction on the capital constraint to explore the production possibilities under the new organisation. The results indicate a dramatic change in farm incomes, with an approximately four-fold increase in income being obtained on average (Tables 7 & 9), and also a more intensive use of available farm resources, compared to the observed situation. The intensity of land use increased by 7.87%, while total employment increased by 181.96 man-days (36.9%) over the levels actually employed. The production capital requirement increased by Rs. 559.10 (19%). In contrast to Models 1 and 2, the labour use has improved but the level of land use has declined. This is due to the limitation of family labour, which is required for intensive irrigated food crop production in the *Yala* season. The results indicate that during the *Maha* season, paddy is the most profitable crop vis-a-vis rainfed food crops. However, in the *Yala* season irrigated food crops are more profitable and enter the optimal plans. Another salient feature is the saving of irrigation water indicated. It is important to note that with a lower level of water use (64.9% of the actual), a higher financial return is achievable. In the context of the high capital investment required to provide irrigation, this finding clearly begs the question; can the wasteful use of this precious commodity be perpetrated in view of the real possibilities that exist for maximising returns.

The behavioural aspects of peasant producers were also examined by incorporating the consumption and capital constraints in Model 3. In comparison to the actual farm situation, the trend observed in Model 3 is again witnessed (Table 8). It is also clear that the capital restriction has led to the choice of less capital intensive farm enterprises. Land use improved slightly but there is a decline in labour use of 70 man-days (Tables 8 & 9). The level of income is approximately three-fold of that observed in the actual farm situation. The minimum paddy acreage constraint could be attributed as the main reason for the decline in farm income, as it has restricted the choice of irrigated food crops that could be grown in the *Yala* season. Another feature of the farm plans is the increase in irrigation water used, which has been necessitated by the introduction of paddy into the farming system. This brings into focus the importance of the choice of crops in ensuring maximum economic efficiency from investment in irrigation projects.

TABLE 7. Optimal farm plans with improved irrigated highland crops and unrestricted capital.

MODEL 3

	FARM GROUPS						
	A	B	C	D	E	F	G
1. NET REVENUES (Rs.)	13,868.59	16,324.54	13,917.55	10,054.35	11,181.19	10,658.29	5,964.50
2. LOWLAND UTILISED (ac.)							
Maha Season	2.50	3.30	1.32	1.45	1.31	2.0	0.93
Yala Season	2.50	4.70	4.0	4.13	4.0	2.0	2.00
TOTAL	5.0	8.00	5.32	5.58	5.31	4.0	2.93
Intensity of Use (%)	100.0	85.10	66.50	67.55	66.37	100.0	73.25
3. HIGHLAND UTILISED (ac.)							
Maha Season	2.75	2.50	2.78	2.38	3.0	1.33	1.37
Yala Season	0.60	1.63	0.65	2.38	3.0	1.33	0
TOTAL	3.35	4.13	3.43	4.76	6.0	2.66	1.37
Intensity of Use (%)	60.90	82.60	61.69	100.0	100.0	100.0	50.0
4. FAMILY LABOUR USED (m.d.)	746.59	852.96	593.06	461.03	419.39	541.61	266.04
Intensity of Use (%)	74.28	84.72	88.96	94.44	95.94	58.17	86.86
5. FAMILY LABOUR UNUSED (m.d.)	258.41	153.82	73.54	27.14	17.72	389.42	40.24
6. HIRED LABOUR USED (m.d.)	85.81	124.12	154.95	123.80	182.74	63.38	107.54
Intensity of Use (%)	49.58	45.15	47.64	55.78	57.85	22.83	53.20
7. HIRED LABOUR UNUSED (m.d.)	87.24	150.76	170.31	98.11	133.14	214.14	94.59
8. IRRIGATION WATER USED (ac. ft.)	10.00	21.40	14.0	15.51	15.04	8.00	7.38
Intensity of Use (%)	66.66	76.42	58.33	62.66	62.66	66.66	61.50
9. ACTIVITIES IN OPTIMAL PLANS (in Ac.)							
HYvs Rice (BBM)	2.5	2.53	1.32	1.45	1.31	2.0	0.93
HYVL Rice (BTM)		0.77					
HYVL Rice (BTY)		2.54	1.26				0.14
HYvs Rice (TBY)				1.63	0.72		
HYVL Rice (BBY)				0.45			
HYVL Rice (TTY)				0.66	1.26		
HYvs Rice (BBY)							0.87
Dried Chillies—Maha	2.75	2.50	0.07			1.33	1.37
Green Chillies—Maha Murunga			2.71	1.84	1.45		
Dried Chillies—Yala	0.49			0.54	1.55		
Dried Chillies—Yala (Irrigated)	2.50	2.16	0.78	0.12	0.70	2.0	0.54
Tomatoes (Irrigated)—Yala			1.95	1.27	1.33		0.46
Vegetable Mixture A—Yala	0.11	1.63	0.65	1.84	1.45	0.03	
10. CAPITAL REQUIRED (Rs.)	3921.44	3818.90	4317.97	3376.74	3642.59	3126.86	2135.10

TABLE 8: Optimal farm plans with improved irrigated highland crops and restricted capital.

MODEL 4

	FARM GROUPS						
	A	B	C	D	E	F	G
1. NET REVENUES (Rs.)	10,956.27	15,572.11	13,008.75	9,661.81	11,106.37	9,498.70	5,885.77
2. LOWLAND UTILISED (ac.)							
Maha Season	2.50	3.34	2.88	1.78	1.52	2.0	0.97
Yala Season	2.50	4.70	4.0	3.72	4.00	2.0	2.00
TOTAL	5.00	8.04	6.88	5.50	5.52	4.0	2.97
Intensity of Use (%)	100.0	85.53	86.00	66.58	69.00	100.0	74.25
3. HIGHLAND UTILISED (ac.)							
Maha Season	2.75	2.50	2.78	2.38	3.0	1.33	1.37
Yala Season	2.30	0.59	1.69	2.03	3.0	1.33	0.21
TOTAL	5.05	3.09	4.47	4.41	6.0	2.66	1.58
Intensity of Use (%)	91.81	61.80	80.39	92.64	100.0	100.0	57.66
4. FAMILY LABOUR USED (m.d.)	498.30	823.50	576.19	459.27	419.52	581.56	265.08
Intensity of Use (%)	49.58	81.79	86.43	94.07	95.97	62.46	86.54
5. FAMILY LABOUR UNUSED (m.d.)	506.70	183.28	90.41	28.90	17.52	349.47	41.20
6. HIRED LABOUR USED (m.d.)	40.23	67.51	123.07	70.63	172.21	39.02	92.64
Intensity of Use (%)	23.24	24.55	37.83	31.82	54.51	14.06	45.83
7. HIRED LABOUR UNUSED (m.d.)	132.82	207.37	202.19	151.28	143.67	238.50	109.49
8. IRRIGATION WATER USED (ac. ft.)	10.50	21.36	16.55	14.69	15.24	9.00	7.58
Intensity of Use (%)	70.00	76.28	68.95	59.35	63.50	75.00	63.16
9. ACTIVITIES IN OPTIMAL PLANS (ac.)							
HYVS Rice (BBM)	1.34	2.54	1.68	1.78	1.52	0.46	0.92
HYVL Rice (BTM)	1.16	0.79	1.20			1.54	0.05
HYVL Rice (BTY)	0.50	2.56	2.0			1.00	0.26
HYVS Rice (TBY)				0.76	0.56		
HYVL Rice (BBY)				0.25			
HYVL Rice (TTY)				1.31	1.43		
HYVS Rice (BBY)							0.77
Dried Chillies—Maha	0.45	1.91	1.09	1.09	0.57	1.33	1.16
Murunga	2.30	0.59	1.69	1.29	1.84		0.21
Dried Chillies—Yala (Irrigated)	2.0	2.14	1.13	0.35	0.70	1.00	0.56
Tomatoes (Irrigated)—Yala			0.87	1.04	1.31		0.41
Dried Chillies—Yala						1.33	
Vegetable Mixture A—Yala				0.73	1.16		
Green Chillies—Maha					0.59		
10. CAPITAL SURPLUS (Rs.)	0	0	0	0	0	25.16	0
MVP of Capital	2.15	1.38	1.26	0.98	0.44	0	0.50

TABLE 9. Summary of the impact of innovations on the farming system.

MODEL	Intensity of Land Use*		Intensity of Labour Use**				Total labour	Production Expenditure (Rs.)	Net Revenue (Rs.)	
	Lowland (a.c) %	Highland (a.c) %	Total land use	Family man days	Labour %	Hired man days				Labour %
1	6.61	4.44	97.04	542.35	80.93	110.25	43.26	652.60	2993.21	9461.22
2	6.32	4.60	100.0	504.87	77.01	96.58	36.63	601.45	2684.17	9163.53
3	5.16	3.67	79.31	554.38	83.44	120.33	47.43	674.71	3477.08	11,709.86
4	5.41	3.89	83.47	517.63	79.55	86.47	33.12	604.10	2879.32	10,812.82
ACTUAL†	6.31	1.96	46.99	223.24	33.57	269.51	100.0	492.75	2917.98	2957.68

*Intensity of land use is the ratio of the land used to the land available expressed as a percentage.

**Intensity of labour use is the ratio of the respective category of labour used to the amount available expressed as a percentage.

†Actual refers to the situation prevailing at the time of the investigation.

5. Conclusions

It is evident from the foregoing LP analysis that a transformation of traditional agriculture by the introduction of biological innovations, whilst compatible with the resource endowments on the peasant farms examined, could lead to substantial improvements in farm incomes and efficiency of resource use. A more than three-fold increase in farm incomes with a concomitant increase in land and labour use intensity of 26.5% and 32.2% respectively were observed. On examining the production possibilities through the structural organisation of the farming system, i.e. growing irrigated food crops on paddy land during the *Yala* season, a four-fold increase in farm income was observed. This structural reorganisation also enabled a better utilisation of land (7.87%) and labour use (36.9%). Another noteworthy feature was the lower intensity of irrigation required (64.9%) under this farming system vis-a-vis the traditional system. This result indicates the wasteful use of water, an expensive input and the real possibilities that exist for maximising economic returns.*

These results clearly demonstrate that the objectives of maximising farm incomes and a better utilisation of resources, particularly the scope for employment generation are not at variance. In other words, the adoption of land augmenting innovations such as those considered in this analysis, increase the total requirements of other resources. It was also found that the consumption requirements of peasant producers are not in serious conflict with the objective of maximising farm incomes. This could largely be attributed to the success of the seed-fertiliser technology in relation to paddy vis-a-vis other crops. Finally, the empirical evidence indicates that peasant producers even in the relatively well endowed settlement schemes are operating well below the production possibility curve achievable, given the present levels of technology. The main thrust of this paper is the need for policy makers to identify and endeavour to remove the constraints which preclude peasant producers from maximising available opportunities, both in terms of efficient resource use and increasing farm incomes.

*The cost of providing irrigation facilities under the Old Colonisation Schemes has been estimated at Rs. 2,500 per acre, while under the Mahaveli River Project the cost is estimated at Rs. 3,000 per acre (2).

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