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OPTIMUM CROPPING PATTERN FOR MAHAWELI SYSTEM C

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1.0 Introduction

The Mahaweli Development programme, the country's biggest investment in recent times has increased agricultural production, and hydroelectric power generation. The original programme (UNDP/FAO, 1968), envisaged irrigating 253,895 ha over 30 years. The six year accelerated programme included only the major projects, mainly in the Mahaweli plain stretching from Mahiyangana to Trincomalee: Systems A, B, C and D. There are five major dams supplying water to 120,800 ha of new land and 36,300 ha of existing paddy land. The Mahaweli System C spans the intermediate and dry zone boundaries. The main river from Minipe to Kalinga forms the left boundary of this system. The Minipe right bank channel and Ulhitiya reservoir form the right boundary. The Mahaweli waters irrigate 24,000 ha in this system through the Minipe right bank channel and the Ulhitiya reservoir. The zone one of system C was already developed under Mapa, Dambarawa and Sorabora settlement schemes. Settlement in zone two is complete, development work and settlement having started in 1980. Settlement in zone three is still continuing and zone four, five and six have yet to be settled. The farm size in System C was determined by the land allotment policy of the Mahaweli development programme: 1.01 ha of lowland and 0.20 ha highland to new settlers. In System C lowland is predominantly rice whereas highland has other food crops such as cowpea, chilli, maize, vegetables. Where water is scarce farmers also grow subsidiary crops in the lowland (Ministry of Lands and Mahaweli Development, 1979).

The farming system of System C is composed of the farm house-hold, crops, livestock, as well as institutional, infrastructural and social environments. The farm production is 25-75% below the maximum achieved by researchers on- farm and at research stations (Nimalagoda, 1984; Weerawardena, 1985). The average paddy yield in System C was 4.1 tons/ha (Economic Review, 1985). In spite of technical advances, institutional facilities such as credit, marketing and extension services of the Mahaweli Authority, Paddy Marketing Board the majority of the farmers do not maximize their farm incomes. The average income in System C was Rs. 27,365/farm as compared with Rs.44,171/farm in System B (Keerthipala, 1986). There was considerable inequality of income and most farmers produce at subsistence level with marginal profits.

The main objective of this study was to compare the profitability of the different cropping patterns practised by the farmers and to determine the optimum cropping plan for the lowland and highland farms in System C.

1.1 Data Collection

The Bathalayaya and Hembarawa blocks in System C were selected for the study. The sampling frame consisted of farmers having only crops and crops as well as livestock. A simple random sampling procedure was used to select 35 farmers from each block with 5% having both crop and livestock enterprises for a total of 70 farmers. The necessary links with the sampled farmers were made through the unit managers and their field assistants. The field data collection was done for two cultivation seasons Maha 1985/86 and Yala 1986 using single personal interviews with a pretested, structured questionnaire.

1.2 Analytical Procedure

A linear Programming model (Gass 1975 Hazell and Norton, 1985) was used in determining the optimum cropping pattern for the lowland and highland in System C.

Let Xj = the level of j th farm activity j = 1, 2 ..... n,
where n denotes the number of possible activities;
Cj = the forecasted gross margin of a unit of the j th activity in Rs./acre;
Aij = the quantity of i th resource required to produce one unit of the j th activity. Let m denote the number of resources; then = 1, 2 ..... m;
Bj = the amount of i th resource available
Z = total gross margin from j th farm activities

The maximization model for the Linear Programming could be represented as follows.

$$\text{Maximize } Z = Cj\,Xj \qquad \text{(i)}$$

subject to

$$Aij\,Xj <= Bj \quad \text{all } i = 1 \ldots m \qquad \text{(ii)}$$

and

$$Xj >= O \quad \text{all } j = 1 \ldots n \qquad \text{(iii)}$$

The analysis was done by using the LINDO (Schrage, 1986) software package for personal computers.

1.2.1 Definition of variables

i) **Lowland**

The farm activities included paddy, vegetable, cowpea and chillies. The row variables were land (acres); fertilizers (kg/acre); chemicals (Rs./acre); labour (man days/acre); animal power (animal days/acre); and credit (Rs./acre).

ii) **Highland**

The farm activities included paddy, vegetables, maize, cowpea, chillies and Kurakkan (Red Millet) cultivation. The row variables included land (acres); fertilizer (kg/acre); chemicals (Rs./acre); labour (man days/acre); animal power (animal days/acre) and credit (Rs./acre).

The irrigation was the main criteria in selection of the lowland and highland cropping patterns. The lowland included only irrigated cropping and highland cropping was mainly rainfed.

1.3 Results and Discussion

The first part of this section will discuss the profitability of the cropping patterns in lowland and highland as practised by the farmers in System C during Maha and Yala seasons. The results of the Linear Programming model will be presented later.

1.3.1 Lowland Cropping Pattern and Profitability

Table 1 shows the important lowland cropping patterns in System C for Maha and Yala. These include -

i) (P-P) paddy cultivation as a pure stand in both Maha and Yala,
ii) (P-P,S) paddy in the entire lowland area during Maha whilst in Yala a fraction was allocated to subsidiary food crops,
iii) (P,S-P,S) paddy cultivation and subsidiary food crops proportionately in both season
iv) Pr(P-P) paddy in both seasons along with the perennial crops on parts of the lowland,
v) Pr(P-P,S) paddy cultivation in Maha and Yala subsidiary food crops also grown together with paddy while part was under perennial crops in both seasons,
vi) (P,S-P,F) paddy and subsidiary food crops cultivation in Maha and during Yala only paddy was grown with a part left fallow,
vii) (P-F) paddy only in Maha and in Yala the land was left fallow.

Nearly 53% farmers in System C cultivated paddy in Maha and Yala (P-P) with an average extent of 1.34 ha. Paddy in Maha and paddy, subsidiary food crops in Yala (P-P,S) was grown by 16% of the farmers. A combination of paddy and subsidiary food crops for both Maha and Yala (P,S-P,S) was grown by 12% of the farmers on an average extent of 1.29 ha. The other combinations included perennial crops, paddy and subsidiary food crops. The lowlands were cultivated with subsidiary food crops and permanent crops in pure and mixed stands, but irrigated food crops such as chillies, vegetables, cowpea, green gram, groundnut and sesame were mainly confined to Yala. Less than 11% farmers in System C cultivated perennials such as coconut, banana, jak, orange and lime where the lowlands were unirrigable. Nearly 8% of the Yala farmers allowed their land to remain fallow in Yala season.

The highest net income of Rs. 19,012/ha was from P,S - P,S pattern grown by 12% of the farmers. In contrast, the double cropped rice adopted by 53% of farmers reported of an income of Rs.10,880/ha. When part of the land in Yala was grown to subsidiary food crops (P-P,S grown by 16% farmers) the net income changed slightly. In the P,S-P, S pattern, cowpea, chillies and vegetables were included in both Maha and Yala as subsidiary food crops. Chillies cultivated by 80% of the farmers in this pattern yielded the highest net income of Rs. 13,489 and Rs. 18,058 for Maha and Yala respectively. The net incomes received from paddy in this cropping pattern was much higher in both seasons than in the P-P pattern (Table 2). The farmers cultivating subsidiary food crops in the lowland were better managers in terms of fertilizer, chemicals and other input use and hence received greater paddy yields.

Table 1: Lowland Cropping Pattern in Mahaweli System C

Cropping pattern	% famers reporting	Average extent (ha)	Net income earned/ha
P-P	53.0	1.34	10,880
P-P,S	16.0	1.22	11,071
P,S-P,S	12.0	1.29	19,012
Pr (P-P)	5.3	1.01	7,226
Pr (P-P,S)	5.3	1.62	12,075
P,S-P,F	4.0	1.01	7,868
P-F	4.0	1.01	5,141

P - Paddy; Pr - Perennial crops; S - Subsidiary food crops;
F - Fallow
- ; separates crops by season
, ; denotes monocrops
( ); Perennial crops and annual crops on separate parts of land

Table 2 : Lowland Cropping Pattern Net Incomes in Mahaweli System C

Cropping pattern	% farmers reporting	Production Kg/ha	Price Rs./kg	Gross income	Total cost	Net income
Maha						
P-P						
Paddy	100	3481	3.00	10478	5123	5356
P-P,S						
paddy	100	3055	3.00	9196	5692	3504
P,S-P,S						
Paddy	100	5055	3.00	15216	5629	9587
Cowpea	60	539	9.00	5068	285	4783
Chillies	80	444	33.00	14764	1275	13489
Vegetables	80	1438	-	7230	757	6473
Yala						
P-P						
Paddy	100	3380	3.00	10071	4567	5504
P-P,S						
Paddy	100	3166	3.00	9436	4726	4710
Cowpea	17	988	8.00	7901	2146	5655
Greengram	17	988	12.00	11852	7729	4123
Chillies	100	871	36.00	31358	7826	23532
Onion	33	802	14.00	10833	2321	8512
Vegetables	33	19210	-	5158	1047	4138
P,S-P,S						
Paddy	100	4937	3.00	14711	5246	9465
Cowpea	60	626	8.00	5004	285	4719
Chillies	80	537	36.00	19333	1275	18058
Vegetables	80	1641	-	7621	757	6864

1.3.2 Highland Cropping Pattern and Profitability

The most important cropping pattern identified in the highlands of Mahaweli systems were :

i) Pr x S - Pr subsidiary food crop cultivation under perennial crops on the entire farm area in Maha and in Yala only perennial crops remained,

ii) Pr,S - Pr, F subsidiary crops and perennials grown separately during Maha,with fallow land during Yala where the subsidiary food crops were cultivated,

iii) Pr x S,S - Pr, F subsidiary crops grown both separatly as well as together under perennials during Maha, land used for the former becomes fallow during Yala,

iv) Pr-Pr perennial crop cultivation on the highland,

v) Pr x S,P - Pr, F subsidiary crops under perennials with paddy grown separately during Maha, leaving land fallow in Yala except where there were perennial crops,

vi) Pr x S - Pr x S subsidiary food crops under perennials in both seasons,

vii) Pr, S - Pr, S, F subsidiary crops grown separate from perennials in both seasons, part of the land was left fallow in Yala.

Nearly 83% of farmers have some subsidiary food crops on their highlands (Table 3). The diversity of cropping patterns in the highlands was mainly due to the locational specificity of farms and farmers multiple objectives such as increase in farm income and household consumption requirement. Highland rainfed paddy was grown on 28% of the total farm extent in Maha. The highland crops were grown as pure or mixed stands, including intercrops of subsidiary food crops under perennials. Further, of the land left fallow due to absence of irrigation water in Yala nearly 1.3% of the highland farms in System C were not cultivated due to damage by wild animals. These lands were used for grazing of cattle and buffaloes in addition to the land reserved by Mahaweli Authority for this purpose.

The highest net income of Rs.30,427/ha was from Pr x S-Pr x S grown by 6.7% of farmers. The Pr x S - Pr cropping pattern as adopted by 21.3% of the farmers yielded a net income of Rs. 12,129/ha. Maize, cowpea, chillies, yams, vegetables and banana were mostly cultivated in the highlands during Maha season. The Yala cultivation was mainly limited to crops such as chillies, vegetables and sesame. Within Pr x S - Pr x S pattern, chillies and banana were cultivated by all farmers during Maha. Only 75% farmers adopting this pattern cultivated chillies and vegetables in Yala. The net income from chillies was Rs. 15,355/ha in Maha as compared to Rs.60,555/ha in Yala. Vegetables contributed Rs.32,882, 20,692/ha in Maha and Yala respectively (Table 4).

Table 3 : Highland Cropping Pattern in Mahaweli System C

Cropping patterns	% farmers reporting	Average extent (ha)	Net income (Rs./ha)
Pr x S - Pr	21.3	0.46	12,129
Pr,S - Pr,F	13.3	0.46	7,501
Pr x S,S - Pr,F	12.0	0.47	11,558
Pr - Pr	12.0	0.76	9,575
Pr x S,P - Pr, F	10.7	0.63	4,551
Pr x S - Pr x S	6.7	0.47	30,427
Pr,S - Pr,S,F	5.3	0.81	8,549
Pr x S,S,P - Pr,P,F	4.0	0.81	13,183
Pr,S,P - Pr,F	4.0	0.61	8,901
Pr, P-Pr,F	4.0	0.81	3,642
P,S - F	2.7	0.81	9,326
Pr x S,S,P-Pr,S,F	2.7	0.40	4,717
F	1.3	0.61	-

Pr = Perennial crops; P = Paddy; S = Subsidiary food crops;
F = Fallow;
\- = separates crops by season
, = denotes monocrops
x = denotes mixed cropping

1.4 Optimum Cropping Pattern for System C

Four linear programming models were fitted, separately for lowland and highland for each season. The objective function was to maximize the gross returns with activities paddy, vegetables, cowpea, chillies, maize, kurakkan (red millet) and sesame cultivation. The resources available were land, fertilizer, chemicals, labour, animal power and agricultural credit. Irrigation was the basis on which the lowland and highland was classified. The priority of the farmers was to fulfil their subsistence requirement by cultivating paddy, which was traditional and did not involve much risk in marketing due to a presence of a guaranteed price. Consequently all the farmers cultivated paddy in both seasons in the lowland.

Table 4 : Net Income from Highland Cropping Pattern in Mahaweli System C

Cropping pattern	% farmers reporting	Production kg/ha	Price Rs./kg	Gross income	Total cost	Net income
Maha						
Pr x S - Pr						
Maize	44	1697	4.00	5921	237	5684
Cowpea	81	676	10.00	6359	766	5593
Chillies	56	653	33.00	21697	1542	20155
Yam	81	3678		9790	-	9790
Banana	69	89 bunches	39.00	3471	-	3471
Pr x S - Pr x S						
Maize	67	3519	3.00	12280	-	12280
Cowpea	67	482	10.00	4526	-	4526
Chillies	100	605	33.00	20096	4741	15355
Yam	100	4172		11105		11105
Vegetables	67	6094		36170	3288	32882
Banana	100	284 bunches	39.00	11076		11076
Yala						
Pr x S - Pr x S						
Chillies	67	1790	36.00	64444	3889	60555
Vegetables	67	4840		23025	2333	20692
Sesame	33	148	5.00	674		674

1.4.1 Lowland Maha

The resources used in the constraint equations included 1.37 ha of paddy which were fully used in the model, 357 kg of fertilizers, chemical cost of Rs.667, labor use of 157 man-days, animal power of 41.7 animal-days and agricultural credit of Rs.3,175. The optimum cropping pattern of the model consisted of 0.75 ha of lowland paddy and 0.62 ha of lowland chillies. The gross return earned from this crop combination with the constrained resources would be Rs.17,004. The gross return would decrease by Rs.7,534 if 1 ha of vegetables was introduced into the optimum cropping pattern. Similarly introduction of 1 ha of cowpea into the optimum cropping pattern would reduce the gross return by Rs.10,093. Since land was the only limiting factor, the gross returns would increase by Rs. 14,764 with 1 ha of more land under cultivation (Table 5).

Table 5 : Optimum Cropping Pattern for Mahaweli System C, Lowland Maha Season

Objective Function Value (Gross returns)		17004.72
Variable	Value	Reduced cost
Paddy	0.7500	0.000
Vegetables	0.0000	7534.000
Cowpea	0.0000	10093.000
Chillies	0.6200	0.000
Row	Slack or Surplus	Dual Prices
Land	0.0000	14764.440
Fertilizer	149.4669	0.000
Chemicals	309.7082	0.000
Labour	69.19799	0.000
Animal power	17.7100	0.000
Agricultural credit	1038.3130	0.000
Number of Iterations	2	

Ranges in which the basis is unchanged

Objective Co-efficient Ranges

Variables	Current coefficient	Allowable increase	Allowable decrease
Paddy	10467.6900	4296.7500	infinity
Vegetables	7230.4200	7534.0210	infinity
Cowpea	4670.9900	10093.4500	infinity
Chillies	14764.4400	infinity	4296.7500

Right hand Side Ranges

Row	Current RHS	Allowable increase	Allowable decrease
Land	1.3700	0.615245	0.6200
Fertilizer	506.2790	infinity	149.4669
Chemicals	977.0700	infinity	309.7082
Labour	226.5600	infinity	69.1979
Animal power	59.4000	infinity	17.7100
Agricultural credit	4233.2500	infinity	1058.3130

1.4.2 Lowland Yala

In Yala the land resources of 1.37 ha was fully used thus becoming the only limiting factor as in the Maha cropping pattern. However, the model used fertilizer (402 kg), chemical cost (Rs. 1,270), labour use (203 man days), animal power use (40.7 animal days) and agricultural credit (Rs. 1,355). The optimum cropping pattern for Yala consisted of 0.75 ha of paddy and 0.62 ha of chillies and a gross return of Rs.23,300 could be expected from such a cropping pattern in the lowland. The introduction of 1 ha of vegetables would reduce the gross income by Rs.18,572. Similarly, the addition of 1 ha of cowpea would reduce the estimated gross income by Rs.19,696. The addition of 1 ha of cultivated land would increase the gross income by Rs. 25,425 (Table 6).

1.4.3 Highland Maha

In the highland Maha the land extent of 0.61 na was fully used thus making it the limiting resource in the linear programming model. The used resources in the model included fertilizers (246 kg), chemicals (Rs. 679), labour (78 man days) and animal power (13.1 animal days). The optimum crop plan included 0.31 ha of vegetables and 0.30 ha of chillies with an expected gross return of Rs.11,560. Since land was the only limiting factor, the gross returns increased by Rs. 18,620 by an addition of 1 ha of cultivated land. Cultivating 1 ha of paddy, maize, cowpea and kurakkan would decrease the gross income by Rs. 11,933, 12,162, 13,449 and 13,741 respectively (Table 7).

1.4 4 Highland Yala

In highland Yala 0.61 ha of land was fully used making it the only limiting resource among others. The other used resources in the model included 182 kg of fertilizer, Rs. 554 of chemicals, 59 man days of labour and 14.1 animal days of animal power. The optimum crop plan consisted of 0.313 ha of vegetables and 0.30 ha of chillies with an expected gross return of Rs. 26,540. Addition of 1 ha of cultivated land would increase the gross returns by Rs. 23,024. Cultivating 1 ha of either paddy, cowpea or sesame would decrease the gross income by more than Rs. 12,688 (Table 8).

The results of the optimum cropping pattern was subjected to a MOTAD model to measure the publication of price risk on the model parameters (Hazell, 1986). The results indicated that the chosen cropping pattern permits a considerable flexibility of the cropping plan with price risk while retaining feasibility of farm constraints. However, the results of the MOTAD model suggested insufficient activities to expect the total gross margin to be approximately distributed by the Central Limit Theorem.

Table 6 : Optimum Cropping Pattern for Mahaweli System C, Lowland Yala Season

Objective Function (Gross return)		Rs. 23, 300.68
Variable	Value	Reduced Cost
Paddy	0.7500	0.000
Vegetables	0.0000	18752.8400
Cowpea	0.0000	19696.5900
Chillies	0.6200	0.0000
Row	Slack or Surplus	Dual Prices
Land	0.0000	25425.0000
Fertilizer	177.1176	0.0000
Chemicals	676.3076	0.0000
Labour	99.7222	0.0000
Animal Power	17.0250	0.0000
Agricultural Credit	455.4950	0.0000
Number of iterations	2	

Ranges in which the basis is unchanged

Objective Co-efficient Ranges

Variable	Current coefficient	Allowable increase	Allowable decrease
Paddy	10049.5700	15375.4300	infinity
Vegetables	6852.1600	18572.8400	infinity
Cowpea	5728.4100	19696.5900	infinity
Chillies	25425.0000	infinity	15375.4300

Right hand Side Changes

Row	Current RHS	Allowable increase	Allowable decrease
Land	1.3700	0.4635	0.6200
Fertilizer	579.4440	infinity	177.1176
Chemicals	1946.5500	infinity	676.3076
Labour	302.5900	infinity	99.7222
Animal power	57.7000	infinity	17.0250
Agricultural Credit	1809.9800	infinity	455.4950

Table 7 : Optimum Cropping Pattern for Mahaweli System C, Highland Maha

Objective Function (Gross Returns)		Rs. 11,560.45
Variable	Value	Reduced Cost
Paddy	0.0000	11993.0200
Vegetables	0.3130	0.0000
Maize	0.0000	12162.7500
Cowpea	0.0000	13449.4400
Chillies	0.3000	0.0000
Kurakkan	0.0000	13741.0000
Row	Slack or Surplus	Dual Price
Land	0.0000	18620.7500
Fertilizer	556.8038	0.0000
Chemicals	1456.8870	0.0000
Labour	193.9652	0.0000
Animal Power	39.5818	0.0000
Number of Iterations	2	

Ranges on which the basis is unchanged

Objective Coefficient Ranges

Variable	Current coefficient	Allowable increase	Allowable decrease
Paddy	6627.7300	11993.0200	infinity
Vegetables	18620.7500	486.4297	11993.0200
Maize	6458.0000	12162.7500	infinity
Cowpea	5171.3100	13449.4400	infinity
Chillies	19107.1800	infinity	486.4297
Kurakkan	4879.7500	13741.000	infinity

Right hand Side Changes

Row	Current RHS	Allowable increase	Allowable decrease
Land	0.6130	1.3819	0.3130
Fertilizer	802.9170	infinity	556.8038
Chemicals	2225.5500	infinity	1456.8870
Labour	271.8700	infinity	193.9652
Animal power	52.7000	infinity	39.5818

Table 8 : Optimum Cropping Pattern for Mahaweli System C, Highland Yala Season

Objective Function (Gross Returns)		Rs.26,540.00
Variable	Value	Reduced Cost
Paddy	0.0000	12688.8800
Vegetables	0.3130	0.0000
Cowpea	0.0000	15024.0000
Chillies	0.3000	0.0000
Sesame	0.0000	21535.1200
Row	Slack or Surplus	Dual Prices
Land	0.0000	23024.5000
Fertilizer	528.6352	0.0000
Chemicals	1189.6950	0.0000
Labour	173.8986	0.0000
Animal power	42.6010	0.0000
Number of Iterations	2	

Ranges in which the basis is unchanged

Objective Coefficient Ranges

Variable	Current coefficient	Allowable increase	Allowable decrease
Paddy	10335.8400	12688.6600	infinity
Vegetables	23024.5000	41419.9500	12688.6600
Cowpea	8000.0000	15024.5000	infinity
Chillies	64444.4500	infinity	41419.9500
Sesame	1489.3800	21535.1200	infinity

Right hand Side Range

Row	Current RHS	Allowable increase	Allowable decrease
Land	0.6130	1.1733	0.3130
Fertilizer	710.9060	infinity	528.6352
Chemicals	1804.1100	infinity	1189.6950
Labour	232.4000	infinity	173.8986
Animal Power	56.7000	infinity	42.6010

1.5 Summary and Conclusions

There was a wide diversity of the number of cropping systems practiced by the farmers in System C. For example, in lowland and highland 7 and 12 cropping patterns respectively were adopted. Some of them were highly adaptable to the area as indicated by the high production and income generated in the farms. For example, the highest net income of Rs. 19,012/ha in the lowland was from P,S-P,S as cultivated by only 12% of the farmers. This pattern included cowpea, chillies and vegetables in both Maha and Yala. Chillies cultivated by 80% of the farmers in this pattern yielded the highest net income of Rs. 13,489/ha in Maha and Rs. 18,058/ha in Yala. The net incomes of paddy in this cropping pattern was higher than P-P pattern,. In highland the highest net income of Rs. 30,427/ha was from Pr x S - Pr x S grown by only 6.7% of the farmers. The most common cropping pattern of Pr x S - Pr as adopted by 21.3% of the farmers together with all the other highland cropping patterns did not yield even 50% of this net income. Maize, cowpea, chillies, yams, vegetables and banana were the subsidiary food crops in Maha. The Yala cultivation was limited to chillies, vegetables and sesame. Chillies received a net income of Rs. 15,355/ha during Maha, whereas in Yala the net income from chillies was about fourfold greater, vegetables also contributed much to the net incomes of this cropping pattern: Rs. 32,882 and Rs. 20,692/ha in Maha and Yala respectively. Hence further field research on higher income cropping patterns may be necessary to recommend a suitable cropping pattern to be adopted by the Mahaweli System farmers. A package of inputs (seeds, fertilizers, chemicals) and services (agricultural credit, marketing, processing) could be developed with the Research and Extension Divisions of Mahaweli Authority for the selected patterns.

The limitation of land for the optimum cropping model indicated that the land allocated for cropping in the lowland and highlands were below the optimum required to maximize farm incomes. With limited lowland available to the farmers 0.75 ha of paddy and 0.62 ha of chillies composed the optimum cropping pattern for an estimated gross return of Rs.17,004 for Maha and Rs. 23,300 in Yala. The optimum highland plans for both Maha and Yala were for 0.31 ha of vegetables and 0.30 ha of chillies. With full use of the land resources the gross returns were estimated to be Rs.11,560 (Maha) and Rs.26,540 (Yala).

Production and marketing risks, associated with profitable crops like chilli have an impact on the selection of farmers' cropping patterns. The non- availability of inputs on time, lack of technical know-how together with declining prices with extra production, are a risk to the farmer. Consequently the average farmer grew only 0.06 ha. of chillies. This in turn decreased farm income.

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