Sri Lanka Journal of Agrarian Studies 5 (1) 1984 1-31

AN ANALYSIS OF CROPPING INTENSITIES IN THE PADDY SECTOR OF SRI LANKA[1]

BY

PIYASIRI WICKRAMASEKARA
Lecturer in Economics, University of Peradeniya

ABSTRACT

Achievement of self-sufficiency in rice has been the avowed objective of almost all planning exercises in Sri Lanka since independence. The strategy for increasing paddy production has emphasised expansion of cultivated area as well as promotion of land productivity. Expansion of cultivated area could be achieved by bringing new land under cultivation and increasing the intensity of cropping on already cultivated land. The importance of the latter method has been recognised since the fifties but the actual achievements have been rather marginal. The rising cost of land development in recent years has highlighted the importance of this option. The objective of the present paper is to analyse trends in cropping intensity in the paddy sector. Conceptual and measurement problems are outlined first. Evolution of policies on the strategy of raising cropping intensity will be examined in the next section. Recent trends in cropping intensity at the national and regional levels and determinants of cropping intensity form the subject of the remaining sections.

1.0 DEFINITIONS, MEASUREMENT AND THE DATA BASE

1.1 DEFINITION AND MEASUREMENT OF CROPPING INTENSITY

The present discussion is concerned with the utilisation of paddy land usually termed as "lowland". The intensity of utilisation of paddy land could be measured in several ways and there is some ambiguity in the current literature.[2] I shall distinguish between several possible measures of the cropping index on paddy lands.

(*a*) Cropping intensity in relation to asweddumized paddy land (Crop Index A)

This is defined as follows:

$$\text{Crop Index A} = (\text{Area sown with paddy}/\text{Area asweddumized}) \times 100$$

Asweddumized area represents the maximum land area available for paddy cultivation in any given year as it refers to the area bunded and ridged for paddy cultivation at the beginning of the crop year. This index could be computed for

1 This paper draws upon some material contained in a technical note prepared for the ILO–ARTEP by the writer.

2 The actual definition used is made clear only in Socioeconomic Indicators of Sri Lanka CSD, 1983.

each season as well as for the entire crop year. The advantage of the measure is that it directly indicates the extent of unutilised paddy land in any period. This is the most popular and widely used measure.

(*b*) Cropping intensity in relation to net sown area (Crop Index B)

$$\text{Crop Index B} = (\text{Gross sown area}/\text{Net sown area}) \times 100$$

This is an annual measure and it indicates the extent of actual double-cropping of the cultivated extent. The difference between the gross sown area and the net sown area represents the extent double-cropped in a particular year. The Census and Statistics Department of Sri Lanka has recommended the use of this measure.[3] The index however, does not throw much light on the degree of utilisation of available paddy land since the net sown area may not reflect the "cultivable" (or asweddumized) paddy area. Additional information required for construction of this index are also not readily available.

(*c*) Cropping intensity in relation to the sown area during *Maha* season (Crop Index C)

It is defined as follows:

$$\text{Crop Index C} = (\text{Gross sown area}/\text{Sown area during } \textit{Maha}) \times 100$$

This measure is a crude approximation to the actual double-cropped extent in any given year in the absence of detailed disaggregated data. It yields a higher estimate of cropping intensity as the total asweddumized area is not fully cropped during *Maha*.

(*d*) Total cropping intensity or total crop area (paddy and other crops) in relation to the available lowland area or asweddumized area (Crop Index D)

$$\text{Crop Index D} = (\text{Total crop area of paddy and other field crops}/\text{Total lowland area}) \times 100$$

Other field crops (chillies, vegetables, tobacco, root crops, etc.) are cultivated in paddy fields in some districts particularly during the *Yala* season. The actual level of land utilisation is therefore, not reflected in the Cropping Index A which refers only to the paddy crop. This factor is particularly important for districts such as *Nuwara Eliya*, *Badulla*, *Kandy* and *Matale*. The above measure is the most relevant from the objective of intensifying land use through crop diversification.

These four measurements often give rise to different values of the cropping index and hence, it is necessary to specify precisely which measure is being used.

3 Census and Statistics Department (1983), Socio-economic Indicators of Sri Lanka.

The relationship between the above measures is outlined below :

Asweddumized area or net cultivable area in a given crop year :

$$A = B + C + D + E$$

where B = Single cropped area during *Maha*.
C = Double cropped area during *Maha* and *Yala*.
D = Single cropped area during Yala.
E = Uncropped area in either season.

The following definitions could now be employed:

1. *Maha* crop area = B + C
2. *Yala* crop area = C + D
3. Total annual crop area (gross sown area) = (B + C) + (C + D) = F
4. Net crop area (annual) = F — C = B + C + D

The following table illustrates the calculation of cropping indices for paddy based on the above analysis for the crop year, 1978/79:

1978/79	*Acres* (000's)
Total asweddumized (A = B + C + D + E) ..	1614.0
Single cropped : *Maha* (B) ..	871.0
Single cropped : *Yala* (D) ..	86.5
Double cropped area (C) ..	557.4
Gross sown area (B + C) + (C + D) ..	2,072.3
Net sown area (B + C + D) ..	1,514.9
Maha sown area (B + C) ..	1,428.4
Yala sown area (C + D) ..	643.9
Unsown (E) ..	99.1

1. Crop Index A (annual) = (2,072.3/1,614) × 100 = 128.4
2. Crop Index B = (2,072.3/1,514.9) × 100 = 136.8
3. Crop Index C = (2,072.3/1,428) × 100 = 145.1

Data is not available for calculation of Crop Index D.

The first measure (Crop Index A) will yield the lowest estimate of cropping intensity on an annual basis while Crop Index C will generate the highest estimate. The most relevant index from the viewpoint of utilisation of available land is the Crop Index A.

1.2 AVAILABILITY AND QUALITY OF DATA

The extent to which the above measures could be used depends on the availability of data and their quality. Information on asweddumized areas and sown areas is regularly collected and published by the Department of Census and Statistics as part of the districtwise collection of paddy statistics. Hence the cropping indices A and C could be readily calculated. Data is however, scanty on the extents double-cropped and lowland extents cultivated with other field crops. Though information on the former could be obtained from the complete enumeration of paddy parcels each season, processing of such data is not given much priority as they are incidental to the main objective of estimation of paddy output. Some data on double-cropped acreages on a districtwise basis were made available by the Department of Census and Statistics but their reliability is not known. I have reported these figures for selected years in the subsequent analysis. Data on extent of other field crops cultivated on paddy lands are almost non-existent. The Department of Agriculture is the only agency which collects this information through its extension network. The data are available only for selected crops and the quality of statistics also cannot be regarded as high since collection of data is left in the hands of divisional extension officers.[4]

The estimates of cropping intensity are as good as the primary data on which they are based. Consistent and reliable paddy statistics are available only from the crop year, 1951/52 and the present analysis has covered the same period. The basic problem in evaluation of primary data is the fact that there exist virtually no cross-checks on these statistics. The Department of Census and Statistics (DCS) is the sole agency which carries out a complete enumeration of asweddumized and sown paddy extents each season. The only conceivable cross-check is with the data generated by the periodic Census of Agriculture. The Census figures on extents asweddumized and sown with paddy deviate from the annual data but the DCS believes that the latter are more reliable.[5] There is room for variation in the quality of supervision of the work of primary reporters and the training given to the latter in compiling these statistics. The indices show no clear trend in respect of cropping intensity despite obvious increases in irrigation and improvements in crop technology over the past three decades or so. Hence some degree of caution may have to be exercised in the use of these statistics.

---

4 Available fragmentary evidence suggests that only a small extent of the totol paddy land to be under other field crops.
See, W. Abeygunawardene, Trends in the Cultivation of Subsidiary Food Crops (CFC) on Paddy Lands in the Dry Zone and Constraints to its Expansion. Technical paper for ILO—ARTEP Sri Lanka Rural Employment Mission, 1984.

5 Census of Agriculture 1982: Small Holding Sector, 1984.

2.0 EVOLUTION OF POLICY ON RAISING PADDY CROPPING INTENSITY

The role of cropping intensity in the drive towards self sufficiency was not given much attention in the initial stages of attempts at agricultural planning. For instance, the basic planning documents of the late 1940s and the early 1950s make no reference to the possibilities of double-cropping of paddy land. The IBRD Mission of 1951 (IBRD, 1952) while dealing extensively with paddy cultivation and irrigation and colonisation, did not stress this aspect. Cultivation of the maximum extent of land already available was mentioned as one means of increasing production and the need to economise on limited irrigation water was also pointed out by the Mission (p. 290—292). Yet, there was no discussion of the former strategy.

The Agricultural Plan of 1957 which outlined the basic strategy for agriculture in the Ten Year Plan (NPC, 1959) clearly recognized the potentialities of increasing cropping intensity. The former document observed that the area double cropped to paddy could be increased by 250,000 acres through "an effective system of repairs to and maintenance of existing irrigation works, both major and minor, and greater attention to minor irrigation works and flood control in already selected areas". The Ten Year Plan for the 1959—68 period accepted this estimate and planned for an extent of 250,000 acres of already cultivated land to switch-over to double-cropping over the plan period. What is more interesting is the fact that it argued against double - cropping of paddy on new lands to be developed with irrigation over the same period in favour of crop diversification.

The Ten Year Plan was however, not operational and it was followed by a three-year Short Term Implementation Programme in 1962 (DNP, STIP, 1962). The STIP placed heavy emphasis on increasing crop acreages as a strategy for the paddy sector.

> "The quickest, cheapest and most effective way of expanding the acreage under production is to encourage cultivation in two seasons, of lands which are cropped only once at present (p. 155)."

The STIP also drew attention to the cultivation of uncropped lands and reclamation of lands which had gone out of production. The STIP pointed out that economy in water use would enable cultivation of one additional acre for every two acres cultivated for *Maha*. Under major schemes, this was estimated to bring an additional 150,000 into production. A further crop acreage of 100,000 acres was believed to be feasible under minor schemes. The Programme therefore stated : "Government has therefore, decided to take immediate action legislative, and administrative — to bring about this change. A committee will be appointed in each district, headed by the Government Agent, to investigate the possiblitities of expansion of crop acreage by double-cropping and to make the necessary administrative arrangements" (p. 155). The targets were rather ambitious but it made little difference since this plan also was not implemented. It is important, however, that this plan was able to identify cropping intensity as a crucial issue.

The agricultural development proposals of the Ministry of Agriculture and Food during 1966–1970 represent the most systematic attempt at increasing cropped area under paddy (MPEA, ADP, 1966). These proposals (1966–1970) outlined a three-year programme to increase the crop area under paddy by 100,000 acres. "It is proposed that during the 3 years 1965/66 to 1967/68, the Department of Agrarian Services should undertake a programme of action which would bring under cultivation approximately 100,000 acres out of the total extent of land which was uncultivated in 1964 and which could be rendered cultivable by solution of the problems referred to earlier" (P. 159).

The ADP concluded that institutional, mangement and physical factors were responsible for the state of affairs. The Department of Agrarian Services was expected to set up 4 units to locate the uncropped land, examine causes of non-cultivation and suggest remedial action.

The line departments were expected to take corrective action for the identified problem. Strengthening of the minor irrigation section, relaxation of tractor imports and amendment of the Irrigation Ordinance to bring it in line with the Paddy Lands Act and strengthening of the Paddy Lands Act were the measures designed to achieve these ends. The expansion of the target crop area was planned as follows : 20,000 acres by the end of 1965-66 ; 50,000 by the end of 1966-67 ; and 100,000 by the end of 1967-68.

Despite this elaborate planning, implementation of this component of the programme seems to have followed the trend of earlier exercises. The sown area during *Yala* had actually increased only by 20,000 during the period. This aspect was also not given much emphasis due to the large expansion in yields and production above targetted levels. In fact, annual reviews of implementation programme and targets in 1968 and 1969 make no reference to the achievements on raising cropped area which formed a key element in the proposed strategy.

The Draft Agricultural Development Plan (1971—1977) which laid down agricultural priorities for the next plan period observed that ; "...a sustained growth in paddy production can be achieved largely to the extent that the limiting factors operative in the dry zone during the *Yala* season are removed". Yet the plan preferred to adopt the standard cropping intensity assumptions and stated as follows :

> "It is proposed that during the period of the present plan that increases in cropping intensity be not taken as a relevant factor in estimating production" (vol. 3).

This stand was influenced by two factors. First it was noted that increases in cropping intensity during the previous plan were marginal. Second, the draft plan had proposed various programmes for "large scale cultivation of these annual

crops in paddy fields which would otherwise have been left fallow". The latter did not mean a lack of emphasis on raising overall cropping intensity but only that paddy double cropping was not given high priority.

In contrast, the I.L.O. Mission of 1971 observed that : "The main land use requirement is to farm more of the already arable land... At present the farmer is offered neither the rural works nor the incentives to make such an aim worth his while".

The Five Year Plan (MEPA, 1971) however, had no special programmes for raising cropping intensity. The cropping indices stagnated during the 1970s as shown in the next section. A resurgence of interest on the role of cropping intensity has been observed in recent years. This change in emphasis may have partly resulted from massive investments in irrigation infrastructure under the Mahaweli Development Programme. There are serious physical and economic limits to the development of new irrigation works. Thus, the Public Investment Programme of 1983-1987 plans to raise cropping intensity in major schemes and minor schemes to 150 and 115 respectively by 1987. The ongoing programmes of minor tank rehabilitation and other water management programmes are expected to make this target attainable (MFP, 1983).

The review of policies highlights the following factors :

(*a*) The importance of raising cropping intensity in the paddy sector has been explicitly recognised only in a few planning exercises since Independence.

(*b*) Even these planned programmes were rarely implemented as the experience of the Agricultural Development Proposals (1966-1970) has demonstrated.

(*c*) Gains in productivity through introduction and diffusion of new technology also may have reduced the interest in raising cropping intensity to some extent.

(*d*) The utilisation of paddy land was not integrated systematically with a programme of crop diversification.

3.0 TRENDS IN PADDY CROPPING INTENSITY, 1952 TO 1982

I shall analyse overall trends in paddy cropping intensity first and go on to a discussion of variations in cropping intensity according to the source of water supply and districts next.

3.1 TRENDS IN CROPPING INTENSITY

The cropping index (as a percentage of asweddumized area) for the 1952—82 period is shown in Table 1 on a seasonal and annual basis. It is difficult to find a distinct trend and a high degree of fluctuation within a narrow range (108 to 133) is observed in regard to annual cropping intensity. The highest level observed upto

now (133) has been attained in both the fifties and the sixties as well. The *Maha* cropping index has ranged between 70—88% in the period concerned. A slight increasing trend is observed in the post—1977 period. The *Yala* cropping index shows that less than 50% of the cultivable extent has been cropped in any year upto now. The index has fluctuated in the range of 40—50% generally. Some decline in the index is observed for recent years.

These data suggest that the cropping intensities have stagnated despite the rapid expansion in both asweddumized and sown area over the period (Appendix Table A1). The growth rates of the major component elements of cropping intensities are shown in Table 2. The asweddumized area has grown at an annual compound rate of 1.9% while the sown area during *Maha* has grown even faster

Table 1—CROPPING INDICES FOR THE PADDY SECTOR

Crop Year	*Crop Index A**			*Crop Index B+*	*Crop Index C—*
	Maha	*Yala*	*Annual*		
(1)	(2)	(3)	(4)	(5)	(6)
1951/52	76.5	43.9	120.4		157.4
1952/53	67.9	40.7	108.6		159.9
1953/54	79.2	51.5	130.7		165.0
1954/55	79.9	50.6	130.5	142.4	163.3
1955/56	78.3	34.0	112.3		143.5
1956/57	71.1	39.1	110.2		155.1
1957/58	76.5	49.3	125.8		164.4
1958/59	73.6	42.0	115.6		157.0
1959/60	79.4	47.2	126.6		159.5
1960/61	79.2	45.5	124.7		157.5
1961/62	80.1	48.2	128.3		160.3
1962/63	81.3	45.6	126.9		156.1
1963/64	81.1	45.8	126.9		156.4
1964/65	77.4	40.0	114.4		147.8
1965/66	79.4	42.8	122.2		154.0
1966/67	79.2	43.9	123.1		155.5
1967/68	85.0	44.2	129.2		151.9
1968/69	85.3	38.0	123.3		144.6
1969/70	84.6	48.6	133.2		157.4
1970/71	80.8	45.6	126.4		156.3
1971/72	81.9	42.0	123.9		151.3
1972/73	81.8	42.7	124.5		152.0
1973/74	83.9	48.6	132.5	140.0	154.7
1974/75	71.4	40.6	112.0	151.7	156.9
1975/76	74.7	41.9	116.6	144.5	156.0
1976/77	83.6	45.2	128.8	145.5	154.0
1977/78	87.4	45.7	133.1	142.7	152.3
1978/79	87.5	39.0	126.5	137.5	144.8
1979/80	85.9	40.0	125.9	141.7	147.1
1980/81	85.8	39.5	125.3	143.0	146.5
1981/82	82.6	40.3	122.9	139.1	148.8
1982/83**				137.5	141.2

Source : Own calculations based on CSD data.

* Sown area as a percentage of asweddumized area.

** Aswed. area figures not still available. + Excludes *Udawalawe* and *Mahaweli* H-area from 1973/74.

at 2.34%. Yet the cropping indices show only marginal increases at less than 1% per annum. The growth rate for *Yala* is negative but it is statistically not significant.

Table 2—ANNUAL COMPOUND GROWTH RATES OF SELECTED VARIABLES, 1957—1982

Variable	Estimated Growth Rate	T-Value	R^2
(1)	(2)	(3)	(4)
1. Asweddumized area	1.89*	48.52	0.989
2. Sown area-*Maha*	2.34*	20.44	0.935
3. Sown area-*Yala*	1.71*	8.97	0.735
4. Sown area-Annual	2.12*	17.86	0.917
5. Cropping intensity—*Maha*	0.403**	3.959	0.351
6. Cropping intensity—*Yala*	—0.243	1.27	0.053
7. Cropping intensity—Annual	0.177	1.62	0.083

* Significant at 1— ** Significant at 5% Estimated by least squares method.
† Cropping intensities are in relation to asweddumized area.

These trends are confirmed by other measures of cropping intensity as well. The double-cropping index (cropping index B) shown in column 5 of Table 1 confirms that there is hardly any improvement over the period. The extent double-cropped in 1955 was 43% and it is interesting to note that the same level has been reported for 1981. The cropping index in relation to the cultivated acreage in *Maha* (Column 6 of Table 1) shows that the cropped extent in *Yala* ranged between 150—160% in most years. A decline in the index is observed for recent years which may be due to the faster rate of expansion in cropped area during *Maha*.

3.2 CROPPING INTENSITIES ACCORDING TO THE SOURCE OF WATER SUPPLY

The sources of water supply for paddy cultivation are usually classified into the three fold division : major irrigation, minor irrigation and rainfall. Data according to this division are available only from the crop year 1961 and the calculations are shown in Table 3.[6]

A prior, one would expect highest cropping intensities under major irrigation. There is however, little difference in the crop index between major and rainfed areas during the *Maha* season. This is due to the fact that most major irrigation reservoirs in the dry zone are themselves mainly dependent on rainfall in the absence of any perennial sources of water supply. The impact of major irrigation is clearly seen in the *Yala* season when water is scarce. Still the cropping index is less than 50% of the asweddumized area. In recent years, the *Maha* cropping index has moved in the range of 80—90% generally.

6 This section draws upon my earlier paper on Labour Absorption in the Paddy Sector, Wickramasekara (1980).

Table 3 : PADDY CROPPING INTENSITY* BY METHOD OF IRRIGATION AND SEASON, 1960—81

Crop Year	*Total*			*Major Irrigation*			*Minor Irrigation*			*Rainfed*		
	Annual	*Maha*	*Yala*	*Annual*	*Maha*	*Yala*	*Anuual*	*Maha*	*Yala*	*Annual*	*Maha*	*Yala*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1960/61	124.7	79.2	45.5	139.3	77.4	61.9	113.0	73.6	39.4	122.8	84.2	38.6
1961/62	128.3	80.1	48.2	143.3	78.9	64.4	121.1	75.4	45.7	123.3	84.1	39.2
1962/63	126.9	81.3	45.6	140.2	80.6	59.6	117.2	75.2	41.9	124.4	86.1	38.3
1963/64	126.9	81.1	45.8	141.0	79.2	61.8	17.5	76.3	41.2	125.6	85.9	39.7
1964/65	114.3	77.4	36.9	121.9	75.6	46.0	103.0	67.4	35.6	118.8	86.0	32.8
1965/66	122.2	79.4	42.8	138.8	78.2	60.6	109.1	73.0	36.1	116.5	83.0	33.5
1966/67	123.1	79.2	43.9	132.5	77.7	54.8	111.7	75.4	36.3	124.3	82.9	41.4
1967/68	129.2	85.0	44.2	140.9	83.5	57.4	115.0	82.4	32.6	130.2	88.0	42.2
1968/69	123.3	83.3	38.0	127.8	83.7	44.1	116.2	83.2	33.0	127.0	88.0	39.0
1969/70	133.2	84.6	48.6	147.4	82.3	65.1	124.3	83.8	40.5	128.3	86.9	41.4
1970/71	126.4	80.8	45.6	140.5	81.0	59.5	113.1	76.1	37.0	124.7	84.1	40.6
1971/72	123.9	81.9	42.0	133.6	84.2	49.4	110.5	75.1	35.4	125.7	84.9	40.8
1972/73	124.5	81.8	42.7	130.5	84.3	46.2	106.9	72.3	34.6	130.0	84.6	45.4
1973/74	136.5	87.9	48.6	139.3	85.3	54.0	120.6	79.4	41.2	135.2	87.2	48.0
1974/75	112.9	71.4	40.6	105.0	66.2	38.8	90.5	58.0	32.5	130.3	82.8	47.5
1975/76	116.6	74.7	41.9	115.5	69.7	45.8	93.2	62.4	30.8	127.2	82.3	44.9
1976/77	128.8	83.6	45.2	136.0	86.8	49.2	112.3	75.9	36.4	133.0	85.3	47.7
1977/78	133.1	87.4	45.7	147.4	89.4	58.0	116.5	84.7	31.8	131.4	86.1	45.3
1978/79	128.3	88.5	39.8	143.7	89.6	54.1	113.5	88.1	25.4	124.4	87.7	36.7
1979/30	128.1	87.0	41.1	137.4	86.4	51.0	116.2	88.0	28.2	127.1	86.9	40.2
1980/81	131.2	89.3	41.9	143.0	90.8	52.0	116.8	88.6	28.2	129.7	88.5	41.2
1981/82	122.8	82.5	40.3	133.8	88.4	45.4	99.9	70.1	29.8	127.2	85.0	42.2

Source : Calculated from CSD data.

* Cropping index A.

Minor irrigation in the form of village tanks, anicuts and streams shows the lowest level of cropping intensity generally. In good weather years the annual index seems to lie between 110 and 120. The wet zone rainfed areas record the highest cropping intensities during *Maha*. The cropped area, however falls sharply during *Yala*.

The index of double-cropping according to type of irrigation (Table 4) also confirms the lack of a consistent and strong association between irrigation and cropping intensity. Variations in this index do not show much consistency. Both rainfed and major irrigated lands show better performance than minor irrigation. Yet the level of double cropping even under major irrigation is generally below 160%. The sharp fall in the cropping index under rainfed conditions in 1982/83 cannot be satisfactorily explained. In any case the double cropping data have to be treated with some caution due to factors noted earlier.

Table 4—INDEX OF PADDY DOUBLE CROPPING (CROP INDEX B) BY TYPE OF WATER SUPPLY

Year (1)	*Major* (2)	*Minor* (3)	*Rainfed* (4)	*Total* (5)
1973/74	146.9	129.7	141.6	140.0
1974/75	163.7	137.7	152.3	151.7
1975/76	136.0	145.1	150.8	144.5
1976/77	144.2	137.9	151.7	145.5
1977/78	153.3	131.9	140.5	142.7
1978/79	144.3	127.4	137.8	137.5
1979/80	147.6	130.5	143.7	141.7
1980/81				143.0
1981/82	137.2	140.4	148.0	139.1
1982/83	157.1	128.6	124.6	137.5

Some discrepancies found in disaggregated data. Overall level based on Socio-economic Indicators (1983).

Source : Basic data from Dept. of Census and Statistics.

3.3 INTERZONAL AND INTERDISTIRCT VARIATIONS IN PADDY CROPPING INTENSITY

A more meaningful analysis of cropping intensity could be undertaken with data disaggregated at the district level. The districtwise situation is shown in appendix Table A2 for selected years. Some summary data on a broad zonal basis is provided in Table 5.

The dry zone districts carry the lowest cropping intensities while the mid-country wet zone districts of *Kegalle*, *Kandy* and *Nuwara Eliya* generally record high levels. The actual level of land utilisation in mid and hill country districts including *Matale* and *Badulla* should be higher due to cultivation of other field crops in paddy lands during the *Yala* season. The wet zone districts all show high levels of cropping intensity.

The discrepancy between the dry zone and the wet zone districts is more pronounced during the *Yala* season when water becomes a critical constraint. The dry zone districts (except *Polonnaruwa* and *Hambantota* to some extent which are better irrigated) experience a sharp fall in the extent cultivated during this season. The North Central Province fares worst in this respect. These tendencies are accentuated during adverse weather conditions.

Table 5 : CROPPING INTENSITY (CROP INDEX A) BY ZONE

Zone	*Maha*				*Yala*				*Annual*			
	1964	1968	1978	1982	1964	1968	1978	1982	1964	1968	1978	1982
Dry Zone	77.6	81.9	82.4	78.8	35.0	29.9	24.0	25.9	112.6	111.8	106.4	104.7
Intermediate	87.3	90.2	97.2	84.9	41.1	37.8	54.1	48.9	128.4	128.0	151.3	133.8
Mid-Country Wet	97.8	97.7	97.6	96.1	72.2	63.8	81.3	80.6	170.0	161.5	178.9	176.7
Low -Country Wet	78.4	84.2	91.2	88.7	69.9	81.5	81.2	77.9	148.3	165.7	172.4	166.6

Source : Calculations based on C.S.D. data.

Districtwise data on double cropping indices have been presented in Table 6. Wet zone low country districts show highest rates of double cropping along with *Kegalle* and *Ratnapura* from the mid-country. Only the districts of *Hambantota* and *Polonnaruwa* from the dry zone attain levels above 150. The *Kurunegala* district which has the largest paddy extent also has a high rate of double-cropping. The level of double-cropping in the mid-country districts could be expected to be higher if allowance is made for cultivation of other field crops during *Yala*. No reliable data exist for making an estimation of the contribution of this factor.

The other dry zone districts show a situation close to almost single-cropping with paddy. This is particularly so for northern and north-central province districts. Among these, the districts of *Anuradhapura* is the most important in terms of paddy acreage.

3.4 TRENDS IN UNSOWN EXTENTS

The obverse of low cropping intensity is a high level of uncropped land in relation to the available land. This may be the more relevant variable from a policy point of view. Districtwise data on the unsown extents are provided in appendix table A3. A summary table on uncropped extents since 1955 is provided below.

Table 6—DISTRICTWISE CROPPING INTENSITY (CROP INDEX B)*

District (1)	1955 (2)	1975 (3)	1979 (4)	1981** (5)
Sri Lanka	142	150	137	143
Colombo	144	182	147	183
Gampaha	—	—	121	162
Kalutara	177	180	187	186
Galle	187	200	173	191
Matara	179	191	187	190
Ratnapura	161	—	174	189
Kegalle	167	200	180	195
Kurunegala	148	174	146	154
Puttalam	126	120	99	121
Kandy	150	155	167	161
Matale	157	—	142	129
Nuwara Eliya	155	170	142	175
Badulla	130	137	128	130
Monaragala	—	123	114	122
Jaffna	120	—	115	100
Vavuniya	111	101	102	101
Mullativu	—	—	112	104
Mannar	103	103	—	101
Anuradhapura	117	103	125	113
Polonnaruwa	186	152	173	156
Trincomalee	134	119	142	139
Batticaloa	115	105	103	110
Ampara	—	143	126	147
Hambantota	162	173	147	166

* Cropping Intensity = (Gross Sown Area/Net Sown Area) X 100
Source : Based on data supplied by the Department of Census and Statistics.
** Socio-economic Indicators of Sri Lanka, DCS, Colombo, 1983.
Col 2 — Based on CSD (1956).

Table 7—UNCULTIVATED EXTENTS : SELECTED YEARS

Year (1)	*Maha* (*acres*) (2)	% *of aswed. extent* (3)	*Yala* (*acres*) (4)	% *of aswed. extent* (5)
1955	207,039	20.1	509,359	49.4
1964	235,545	18.9	677,569	54.2
1970	218,296	15.5	725,685	51.5
1979	185,539	11.5	970,128	60.1
1982	295,200	17.4	1000,490	59.0

Source : Based on Table A. 1

While the *Maha* situation shows a more or less stable level of uncultivated extent, the *Yala* situation shows no room for complacency. The unsown extent is almost one million acres and it has doubled in the past three decades or so.

It is possible to examine the distribution of the unsown area on a zonal basis on the basis of Table 5. The bulk of the unsown land is found during the yala season in the dry and intermediate zones. Most of the good paddy land in the wet zone is already under cultivation. Water supply may be the main limiting factor affecting this pattern.

4.0 FACTORS AFFECTING CROPPING INTENSITY

4.1 CLASSIFICATION OF FACTORS AFFECTING CROPPING INTENSITY

The previous section has highlighted the substantial variations in cropping intensity across districts and on the basis of water supply. Determinants of cropping intensity assume crucial importance in the context of attempts at raising cropped area under paddy. The factors which affect cropping intensity are basically those which influence the component elements of the cropping index (asweddumised and sown acreages). The factors which affect these variables and in turn, cropping intensity, have been broadly categorised as follows :

(1) Environmental factors including water supply and irrirrigation e.g. rainfall, weather conditions, physical properties of the soil, irrigation and water management.

(2) Technological factors : e.g. crop technology, breeding of suitable plant varieties, tillage technology, irrigation technology.

(3) Institutional factors : tenurial factors such as type of tenancy and farm size, input delivery systems.

(4) Economic factors : e.g. relative profitability of crops, labour and capital constraints, occupational pattern of farming households.

(5) Management factors : e.g. poor or indifferent management on the part of cultivators.

This is a broad grouping and some overlapping among groups is possible. In the absence of a comprehensive enquiry into this issue, it is not possible to identify the relative importance of various factors involved. I shall briefly comment on some factors listed above.

4.2 COMPONENTS OF CROP AREA AND UNDERLYING FACTORS

In explaining the levels of cropping intensity, it is important to isolate different components of total crop and uncropped area. The following general comments may be offered regarding these lands:

(*a*) *Double-cropped area :*

The major conditions for double cropping could be listed as follows : availability of assured water supply either through rainfall or irrigation ; absence of any major physical or institutional constraints.

(*b*) *Single cropping during Maha season :*

The typical case is the village tank in the dry zone of Sri Lanka. Water is assured for the *Maha* crop only due to the rainfall pattern. Location of fields at the tail-end of a major irrigation system may result in a *Maha* cropping only. The non-availability of other resources such as labour, credit or farm power may also contribute to this pattern. Intentional fallow is another possible reason (CA, 1962). Paddy single cropping may also mean cultivation of other field crops during *Yala* in the paddy field . This may apply to districts such as *Badulla, Kandy, Matale* and *Nuwara Eliya.* Such cases represent actual double cropping and hence do not constitute a problem.

(*c*) *Single cropping during Yala season :*

This affects only a small extent of the total crop area in any given year. Quite often, it may be due to factors other than a shortage of water. Water logging and drainage problems during *Maha,* lack of suitable crop varieties, or management and institutional problems specific to the lands concerned may lead to this situation. Intentional fallow is another possible reason.

(*d*) *No cropping or land left unsown during both seasons :*

This may result from serious irrigation problems such as non-irrigability, excessive fragmentation, acute tenurial problems (disputed titles, etc.) and serious physical limiting factors (continuous water logging and flooding, salinity).

Important reasons for non-cultivation of available paddy lands have been identified by the Census of Agriculture 1962 (Table 8). More recent data is not available on this aspect. Lack of water emerges as the most important reason, particularly during the *Yala* season. Almost 60% of the unsown land during the year has resulted from this cause. Other physical limiting factors (salinity, salvinia and water hyacinth) account for only a small portion of the total. Economic constraints such as lack of labour and lack of funds are also relatively less important. It is, however, interesting to note that intentional fallow figures as an important cause relative to factors other than lack of water.

4.3 SELECTED DETERMINANTS OF CROPPING INTENSITY

4.3.1 Irrigation and Water Supply

Availability of assured supply of water is clearly the most important condition for a high level of cropping. The large extent unsown during the *Yala* season is a clear reflection of this factor. Despite the expansion in irrigated area since the 1930s, only 38% of the total paddy land is still under major irrigation. The irrigation ratio (percent of asweddumized area irrigated) rises to about 63% when minor irrigation is added to this. It was noted earlier that minor irrigation in the dry zone rarely ensures a second crop during the year. Data cited earlier also showed that the level of double cropping even under major irrigation was not high. This

Table 8—REASONS FOR NOT SOWING ASWEDDUMIZED LAND, 1962

Reason	*Maha* 1961/62	*Yala* 1962	*Total*	*Percent of Total*
(1)	(2)	(3)	(4)	(5)
Lack of water	77,126	372,301	449,427	59.56
Influx of salt water	3,952	3,177	7,129	00.94
Salvinia	2,095	2,142	4,237	00.56
Water hyacinth	194	92	286	00.03
Lack of funds	21,147	13,932	35,079	04.64
Lack of labour	3,331	3,056	6,387	00.84
Intentional fallow	19,865	32,109	51,974	06.88
Miscellaneous and reasons not specified	68,547	131,496	200,043	26.51
Total	196,257	558,305	754,562	100.0

Source : Census of Agriculture 1962, Vol. 3.

is due to considerable variation in the quality of major irrigation in terms of quantum, controllability and regularity. The report of the Land Utilisation Committee (1967) observed that: "Rainfall variability is an important factor that has to be taken in agricultural planning. The term, assured water supply even in the major schemes will have to be taken in this context".

The substantial variation in cropping intensity among major schemes is illustrated by appendix Table A 4. While the data refer to different locations and time periods, considerable variation among different schemes is a feature common to all. Micro-level data from some schemes highlight the substantial variation even within a particular scheme in regard to this feature (WMSP, 1982 ; 1983).

Certain sections under the command area of major irrigation may not be fully irrigable due to anomalies in the irrigation infrastructure such as improper levelling and elevation of holdings in relation to distributory and field channels. Several micro-level studies have shown these to be important reasons for partial or non-cultivation of allotted land (Karunaratne Banda and Deegan, 1981 ; WMSP, 1982).

Poor standards of water management is another crucial aspect of the water supply problem. This has long been recognised as an important factor contributing to lower cropping intensity during the *Yala* season. Failure to make use of the initial *Maha* rains, staggering of cultivation schedules and waste of irrigation water by excessive use have been frequently mentioned as important aspects of this problem. The Ministry of Finance and Planning (1983) states as follows : "Increasing the levels of cropping intensity is mainly a function of proper maintenance of irrigation facilities and of better water control and management" (P. 80).

4.3.2. Crop Varieties and Cropping Intensity

Breeding and diffusion of short-aged crop varieties have been described as a prerequisite for raising cropping intensity and multiple cropping (Lee, T.H., 1975). Short-aged varieties will play a useful role in mitigating the constraints imposed by time and water supply.

In Sri Lanka, the development and dissemination of new paddy varieties has occurred in two distinct phases. The first stage was based on H–varieties from the late 1950s, particularly H—4, a $4\frac{1}{2}$ month variety. The next stage pertaining to "newly improved varieties", is observed from 1970 or so. It has been claimed that the spread of old improved varieties has led to substantial increases in cropping intensity (Panabokke, 1976 ; Weeraratne and Senadheera, 1981).

> "With the release of OIV., major changes in the pattern of local rice culture emerged. Losses from rice blast disease diminished, fertilizer use increased, and the traditional system of single cropping was replaced by double-cropping (H-4 for the *Maha* season and H-7 or H-10 for the *Yala* season)..... Increased cropping intensity led to increased production" (Weeraratne and Senadheera, 1981, p.19).

Panabokke (1976) also refers to the case of districts like *Kegalle* which had only one crop per year previously due to non-availability of suitable short aged varieties.

Preliminary analysis of data on this aspect however, does not lend much support to the view that the OIV raised cropping intensity in a major way. The national level data examined earlier do not point to such a trend. I have analysed the data for several districts since 1954 and the evidence is not consistent. The data for

Kegalle and *Kandy* are reported in the appendix (Table A.5). In the case of *Kegalle*, the *Maha* cropping index has consistently been close to 100%. In *Yala* however, an increasing trend in the intensity of cropping is evident since the mid-sixties. The *Yala* cropping index has moved from about 65-70% to a range above 80%. In the recent past, it has exceeded 90% on a number of occasions. This has occurred in the second phases of diffusion of new varieties. As far as *Kandy* is concerned, no consistent trend could be observed. The data for *Polonnaruwa* (not reported) also show no increasing trend in cropping intensity since the mid-sixties.

The above considerations seem broadly applicable to the next stage also. The newly improved varieties have offered much wider choice to the farmers, particularly during the Yala season. I have argued elsewhere that this wider choice has given farmers greater flexibility in their cultivation schedules. (Wickramasekara, 1980) Thus, there has been a shift to short-aged varieties even during the Maha season. Table 9 shows this trend clearly.

Table 9—AGE DISTRIBUTION OF PADDY VARIETIES

	Percent of total sown extent			
	Maha		*Yala*	
Age Group (Months)	1967/68	1982/83	1968	1983
(1)	(2)	(3)	(4)	(5)
3—3½	7.6	57.2	44.1	91.5
4—4½	83.9	42.2	53.9	8.5
5—6	8.5	0.6	2.0	—
	100.0	100.0	100.0	100.0

Sources : Cols. 2 and 4 : Draft Agricultural Development Proposals, Vol. 4 : Annual Crops
Cols. 3 & 5 : Department of Agriculture.

This shift is encouraged to some extent by official responses to anticipated water shortages since short-aged varieties may be recommended to relieve the water constraint.

4.3.3 Institutional Factors Leading To Non-Cultivation

Among the institutional factors that have a bearing on partial or complete non-cultivation, tenurial problems are the most important.

The total extent of paddy cultivation under different forms of tenure (other than owner-cultivation) is about 35% for the entire country. The proportion is higher for the wet zone.

Rotational tenure in the form of *Thattumaru* (rotation of ownership) and *Kattimaru* (rotation of plots) is one form of tenure which could have disincentive effects. A recent detailed study of this system in some villages of the wet country low zone found the main impact was on standards of cultivation and productivity. (Moore and Wickramasinghe, 1978).

Share-cropping is the more prevalent form of tenure but it is difficult to maintain that it has led to lower cropping intensities. Proper cultivation while ensuring regular incomes, may also ensure continuation of the tenancy. Diffusion of cultivation rights through share-cropping would reduce the extent of non-cultivation in cases where the owners are not able to undertake cultivation for various reasons. Excessive fragmentation of holdings may also contribute to non-cultivation as observed in some *purana* villages in the North Central Province (Water Resources Board, 1968).

An important issue to be analysed is the relationship between cropping intensity and the size of paddy holdings. The general hypothesis is that larger holdings are less intensively cultivated. Limited information on this aspect is available from the Census of Agriculture for 1962 and 1982. Some caution is necessary in the interpretation of this data. First, the range of variation in the size of paddy units cannot be considered large, especially for 1982 in which information is available only for the smallholdings sector (below 20 acres). Second, there is no information on other characteristics of these holdings and therefore, the differences may be also due to factors other than size.

The relevant data for 1982 is presented in Table 10. The data show that the highest cropping intensities are obtained in the lower holding sizes. In 1982, holdings up to 3 acres which account for 27 of the extent record a cropping index of about 145 but the group, 5—10 acres achieve 121 only. This tendency is more clear in 1962 where the variation in size is also wider.

4.3.4. Economic Factors

I shall briefly comment on certain selected factors here: part-time farming, shortage of farm power, shortages of labour and other inputs and low profitability of paddy cultivation.

Table 10—PADDY CROPPING INTENSITY BY SIZE OF PADDY UNITS CROP YEAR, 1982*

Size Class (Acres)	*Maha* 1981/82	*Yala* 1982	*Annual*	*% of total asweddumized area in group*
(1)	(2)	(3)	(4)	(5)
Less than 2	84.8	60.9	145.7	14.5
2 to less than 3	88.6	54.7	143.3	12.1
3 to less than 4	86.8	36.7	123.5	17.9
4 to less than 5	85.3	41.2	126.5	10.9
5 to less than 7	85.7	36.2	121.9	17.3
7 to less than 10	82.9	38.3	121.2	10.6
10 to less than 20	79.3	34.1	113.4	10.5
20 and above	70.3	27.5	97.8	6.1
SRI LANKA	84.2	42.1	126.3	100.0

* Small holding sector.
Source : Based on Census of Agriculture 1982. Report on Small Holdings.

(i) *Part-time farming*

A high incidence of part-time employment in agriculture is found, particularly in the wet zone . According to the 1973 Census of Agriculture, 34% of the agricultural operators were employed on a part-time basis. Availability of alternative employment is better in the wet zone districts but the problem of non-cultivation is mostly confined to the dry zone. Hence it cannot be regarded as an important factor.

(ii) *Shortage of farm power*

Shortage of farm power has been cited as a major factor for delay in commencement of cultivation operations and thereby, staggering of cultivation and resultant waste of water. The Agricultural Development Proposals of 1966-1970 recommended the import of tractors to relieve this alleged constraint. This factor is said to be especially important in major irrigation schemes with double—cropping.

Recent evidence however, has not supported this view. A large-scale study, undertaken by the Agrarian Research & Training Institute has found that there is evidence of a power surplus in terms of tillage capabilities of the available stock of draught power (Farrington and Abeyratne, 1982). Moreover, there is bound to be a large surplus of power during the *Yala* season which records lowest cropping intensities.

(iii) *Labour constraints*

The shortage of labour is another relevant factor. This shortage particularly occurs during peak cultivation periods in the major irrigation schemes of the dry zone. There is extensive migration of labourers seasonally from the wet zone to meet this demand. The impact of labour shortages will be mainly on the intensity of particular cultivation operations such as transplanting rather than on abandonment of cultivation in view of the fact that substitution possibilities that are available in operations such as land preparation. The 1962 Census of Agriculture also found that less than 1% of the total was uncultivated for this reason. Moreover, flexible tenurial arrangements may ensure continued cultivation even in cases where the owners themselves face a labour constraint.

(iv) *Lack of capital*

This factor is becoming increasingly important in the context of the rising costs of cultivation. The cost of cultivation of an acre of paddy has more or less doubled over the last five years or so (Wickramasekara, 1983 ; 1984). Access to institutional credit has also been tightened over the same period. The option of renting or leasing out or mortgaging the holding is open to these farmers and hence, there is less likelihood that plots will be abandoned especially in irrigated areas. The impact of shortage of capital may also be felt in non-adherence to recommended improved practices leading to lower yields.

(v) *Low profitability of paddy farming*

The impact of this factor depends on the availability of other opportunities. In the major irrigation schemes of the dry zone, the best crop during *Maha* may still be paddy. Other field crops such as chillies may be cultivated during *Yala* depending on the soil conditions. Hence, this may not serve as a factor for non-cultivation. In the wet zone, many operators of micro-holdings do not depend only on paddy cultivaton for their livelihood and the objective of producing their own rice may be important. In a situation of availability of family labour, cultivation of the plot ensures regular employment opportunities to family members. Hence, this factor also cannot be regarded as affecting cropping intensity in any major way.

In the light of these factors, problems relating to water supply and irrigation management could be regarded as the major constraint on raising cropping intensity in the paddy sector.

4.4 STATISTICAL ANALYSIS OF DETERMINANTS OF CROPPING INTENSITY

The relationship of cropping intensity to some relevant variables was examined using both cross section and time series data. The variables tested pertain to irrigation, new variety adoption, farm size and yield per acre or land productivity. Lack of a consistant data base has restricted the scope of the analysis in this respect.

It is hypothesised that cropping intensity is positively related to water availability. There is no satisfactory measure of water availability and proxy variables have to be used in the multiple regression analysis. The irrigation ratio and the crop failure rate have been used for this purpose. The irrigation ratio is defined as the percentage of area sown under major irrigation to total sown area. I have used the extent under major irrigation for computing the irrigation ratio since minor irrigation in the dry zone permits only single cropping in most years. In addition to the supply of irrigation water, availability of rainfall is a critical factor especially in the wet zone. The crop failure rate has been used as a proxy variable in this context. The crop failure rate is defined as the ratio of the area sown but not harvested to total sown area. It should be negatively related to the cropping intensity since a high rate of crop failure implies adverse weather conditions which affect cropping intensity. Farm size is hypothesised to be inversely related to cropping intensity. The size of paddy units in each district has been obtained from the 1982 Census of Agriculture, (DCS, 1983). A dummy variable to denote the wet zone districts has been used in the inter-district analysis. The extent under improved variety is meant to test the relation between new variety adoption and cropping intensity. The analysis also attempts to test whether stagnant levels of cropping intensity can be related to the high rate of productivity growth. The latter represents an alternative method of increasing production on which government policy has also focussed.

4.4.1 Cross-Section Analysis

The cross – section analysis was conducted on the basis of inter-district data for the crop year 1982. The objective of the exercise was to examine whether inter-district variation in cropping intensity could be explained in terms of differences in irrigation, farm size and adoption of improved variety. The results are reported in Table 11(A).

For the *Maha* season, the coefficients of farm size and the irrigation ratio carry expected signs. The ratio of improved variety adoption however has a negative sign, but none are significant. Overall, the relationship obtained for the *Maha* season is unsatisfactory. The *Yala* and the annual regressions perform better with 67% and 53% of the variation in cropping intensities explained respectively. Farm size, irrigation ratio and the wet zone dummy carry the expected signs. The coefficient for farm size is significant in both cases. The irrigation coefficient does not emerge as significant in either equation. The use of total irrigation (both major and minor irrigation) as an explanatory variable did not improve the results. The negative relationship between farm size and cropping intensity could be attributed to the relatively larger farm sizes observed in the dry zone districts which carry lower cropping intensity.

4.4.2 Time Series Analysis

Seasonal and annual cropping intensities on a time series basis were related to selected explanatory variables and the results are shown in Table 11(B).

About 72% of the variation in the *Maha* season cropping intensity is explained by the regression. Both the irrigation ratio and the crop failure rate have expected signs. The productivity coefficient is positively related which does not lend support to the hypothesised negative relation.

The results obtained for the *Yala* season cannot be regarded as satisfactory with only 16% of the total variation being explained. About 56% of the variation in annual cropping intensity is explained but only the crop failure rate and the yield variable are significant. The time trend coefficient is significant only for the *Maha* season.

These statistical results should be regarded as tentative and data of better quality at a more disaggregated level would be necessary for a more comprehensive analysis.

Table 11—REGRESSION RESULTS

A. INTER-DISTRICT ANALYSIS

Equation (1) CIM = 85.975 - 0.927 FS + 0.237 IR
(-0.247) (1.415)
- 0.033 YLD - 0.088 IVR + 7.797 WZD
(-0.129) (-0.549) (0.914)
n = 23; R^2 = 0.1467

Equation (2) CIY = 93.148 - 11.928 FS* + 0.324 IR
(-2.289) (1.26)
+ 0.145 YLD + 13.889 WZD
(0.447) (0.964)
n = 23; R^2 = 0.668

Equation (3) CIA = 131.23 - 13.09 FS + 0.306 IR + 29.218 WZD
(-1.742) (0.863) (1.42)
n = 23; R^2 + 0.529

B. TIME SERIES ANALAYSIS (ALL ISLAND)

Equation (1) CIM = 51.274 + 0.581 IR - 0.385 CFR* + 0.496 YLD*
(1.519) (-3.627) (2.804)
- 0.421
(-1.957)
n = 31; R^2 = 0.72

Equation (2) CIY = 47.539 + 0.045 IR - 0.360 CFR** - 0.068 YLD
(0.209) (-1.644) (-0.334)
- 0.047T
(0.252)
n = 31; R^2 = 0.158

Equation (3) CIA = 128.787 - 0.6102 IR - 1.279 CFR* + 0.574 YLD*
(-0.978) (-4.463) (1.929)
- 0.042T
(-0.138)
n = 31; R^2 = 0.564

CIM = Cropping intensity, *maha* season: CIY = Cropping intensity, *yala* season; CIA = Cropping intensity, annual; FS = Farm size; IR = Irrigation ratio (percent of aswed : area under major irri : to total aswed : area); IVR = Percentage of total sown area under improved variety; YLD= Yield per acre; WZD= Dummy for wet zone districts; CFR= Crop failure rate; T= Time trend.
Figures in parentheses represent T-values of the estimated coefficients.
* - Singificant at 5% ** - Significant at 10%

5.0 CONCLUDING OBSERVATIONS

The preceding review has highlighted trends and patterns of paddy cropping intensity in the country during the past three decades or so. The stagnant cropping intensities in the context of expanded irrigation facilities and other heavy investments in the paddy sector are a matter for concern. About one million acres have remained uncropped in recent years.

In order to devise measures for raising cropping intensity a more disaggregated approach will be necessary. Different categories of paddy land will have to be identified as outlined in section 4.2. The specific causes of low cropping intensities and their relative importance have to be ascertained for suggesting remedial action. The relative significance of factors will obviously vary depending on the location and the season. Table A. 6 indicates the dimensions of the problem according to agro-climatic zones for 1981. The concentration of uncropped land is in the dry zone during the *Yala* season as mentioned earlier. Shortage of water could be easily identified as the major constraint affecting this category. The solutions are therefore tied up with the more general issue of irrigation development and water management strategy of the country.

Some scope for raising cropping intensity exists under major irrigation and to some extent even under minor irrigation conditions by more judicious management of available water supplies. Several recent irrigation rehabilitation programmes have placed heavy emphasis on water management. Yet the impact of these cannot be expected to make a substantial impact on overall cropping intensity. The latest public investment document (MFP, 1984) makes the following observation :

> "The average cropping intensity for the last 10 years has been approximately 135% for all major schemes and 110% for the minor schemes. Under the assumption that the current emphasis on water management can be sustained throughout the projection period, it is expected that the cropping intensity can be raised to 150% in major schemes and 115% in minor schemes" (P.71).

To the extent that the above rehabilitation and water management improvement programmes are dependent on foreign aid, their sustainability is not clear. The scope for introduction of proper management procedures would be larger in new settlement areas especially under the *Mahaveli* programme.

With the attainment of self-sufficiency in rice, the need for crop diversification assumes greater significance. What is relevant in such a context is the raising of total cropping intensity on paddy land or lowland rather than increasing double-cropping of paddy alone. The scope for diversification of cropping on paddy land has not been exploited in a systematic way up to now. Planning of crop diversification on newly irrigated land is easier than attempting such diversification in areas under traditional double-cropping of paddy. The scope for introduction of other field crops during the *Yala* season will serve to economise on water use as well. Hence it is necessary to integrate programmes for raising cropping intensity on paddy land (low land) with crop diversification plans. At present the district agricultural implementation programmes do not generally distinguish between paddy land and highland in relation to targets and achievements in crop acreages and production.

The need for improvement of the data base for planning can hardly be over-emphasised. Attention has been drawn to serious data gaps in the preceding discussion. There exists no reliable data on the pattern of paddy land use or total cropping intensity. Information on double-cropping of paddy land is also not readily available. The location of unsown areas is known but relatively little information is available on the specific causes at the local level. Micro-level studies of the determinants of cropping intensity would prove useful in throwing light on this aspect. The 1962 Census of Agriculture sought information on reasons for non-cultivation but the subsequent Censuses of Agriculture have left out this aspect. The machinery of the Agricultural Development Authority seems highly suitable for the local level identification of ways and means of raising cropping intensity. Regular collection and publication of data on measures of cropping intensity and its component elements could be recommended.

REFERENCES

CSD (1956) *Report on Paddy Statistics*, Monograph No. 9, Census and Statistics Department (CSD), Govt. Press, 1956.

Census of Agriculture 1962, Volume 3: Asweddumized Paddy Lands, Govt. Press, Colombo, 1965.

(1983) *Socioeconomic Indicators of Sri Lanka*, Colombo.

(1984) *Sri Lanka Census of Agriculture* 1982: Small Holding Sector, Colombo, 1984.

DADP (1971) *Draft Agricultural Development Proposals*, 1971-1977, Vol. 4, Annual Crops, Ministry of Agriculture, Colombo, mimeo.

DNP (1962) *Short Term Implementation Programme*, Department of National Planning, Govt. Press, Colombo.

Farrington, J. and Abeyratne, F. (1982) *Farm Power in Sri Lanka*, Department of Agricultural Economics, University of Reading.

IBRD (1952) *Economic Development of Ceylon*, Johns Hopkins, Baltimore.

ILO (1971) *Matching Employment Opportunities with Expectations*, A Programme of Action for Ceylon, ILO, Geneva.

Karunaratne Banda and Deegan, J. (1981) *The Kalankuttiya On—Farm Research Study Report*, Part I, PGIA, Peradeniya.

Lee, T. H. (1975) *Planning Multiple Crop Diversification for Agricultural Development—Some Suggestions for Developing Countries*, The Philippine Economic Journal Vol. XIV (1 & 2) 1975.

MFP (1983) *Public Investment* 1983-1987, Department of National Planning, Ministry of Finance and Planning (MFP), Colombo.

(1984) Public Investment 1984-1988, Department of National Planning, MFP, Colombo.

Moore, M. P. and Wickramasinghe, G. (1978) *Thattumaru—Kattimaru Systems of Land Tenure*, Research Study Series No. 26, Agrarian Research and Training Institute, Colombo.

MPEA (1966) *Agricultural Development Proposals* 1966-1970, Ministry of Planning and Economic Affairs, Govt. Press, Colombo.

MPEA (1971) *The Five Year Plan*, 1972-76, MPEA, Govt. Press, Colombo.

National Planning Council (1959) *The Ten Year Plan*, Govt. Press, Colombo.

Panabokke, C. R. (1976) *The Need for Research on Cropping Systems in Sri Lanka, Proceedings of the Cropping Systems Workshop*, Maha Illuppallama, Sri Lanka.

RLU (1967) *Report of the Land Utilisation Committees*, Sessional Paper, Govt. Press, Colombo.

Weeraratne, H. and Senadheera, D. (1981) Rice Breeding at Batalagoda, *Tropical Agriculturalist Vol.* 137, Department of Agriculture, Peradeniya.

Wickramasekara, Piyasiri (1980) Labour Absorption in Paddy Cultivation in Sri Lanka, ILO-ARTEP, *Employment Expansion in Asian Agriculture;* A Comparative Study of South Asian Countries, Bangkok, PP. 179-252.

(1983) Peasantry and Development; Sri Lanka's Experience, *Research report prepared for the Project on Focus on Third World Peasantry*, UN Centre for Regional Development, Nagoya.

(1984) The Mahaweli Development Programme, Agrarian Changes and the Peasantry in Sri Lanka, *Research Report, Social Scientists Association of Sri Lanka*, Colombo.

WMSP (1982) System H of the Mahaweli Development Project, Sri Lanka: 1982 *Diagnostic Analysis, Water Management Synthesis Project* (WMSP), Colarado State University.

(1983) System H of the Mahaweli Development Project, Sri Lanka: 1983 *Diagnostic Analysis, WMSP*, Colarado State University.

Water Resources Board (1968). Report on Cultivation Habits and Practices in Toruwa Tulana, N.C.P., Colombo.

APPENDIX

Table A1—ASWEDDUMIZED AND SOWN ACREAGES — 1952-1983

('000 acres)

Crop Year (1)	*Asweddumized Area* (2)	*Sown Area*		
		Maha (3)	*Yala* (4)	*Total* (5)
1951/52	964.5	738.2	423.7	1161.9
1952/53	964.5	654.6	392.3	1046.9
1953/54	971.5	769.7	500.2	1269.9
1954/55	1031.6	824.6	522.3	1346.9
1955/56	1071.5	838.9	364.7	1203.6
1956/57	1093.6	777.5	428.1	1205.6
1957/58	1098.4	840.7	541.5	1382.2
1958/59	1133.1	833.8	475.3	1309.1
1959/60	1160.1	920.7	547.7	1468.4
1960/61	1180.0	934.5	537.5	1472.0
1961/62	1197.1	958.3	577.6	1535.9
1962/63	1230.5	1000.4	561.5	1561.9
1963/64	1249.2	1013.6	571.6	1585.2
1964/65	1272.7	984.6	470.8	1455.4
1965/66	1323.3	1050.1	566.8	1616.9
1966/67	1331.1	1053.8	585.1	1638.9
1967/68	1349.1	1147.0	595.5	1742.5
1968/69	1385.7	1182.0	527.2	1709.2
1969/70	1408.9	1191.5	684.1	1875.6
1970/71	1419.2	1147.5	646.2	1793.7
1971/72	1442.4	1186.0	608.5	1794.5
1972/73	1439.9	1179.0	613.2	1792.2
1973/74	1498.5	1317.8	720.2	2038.0
1974/75	1533.6	1095.9	623.5	1719.4
1975/76	1556.4	1147.0	641.9	1788.9
1976/77	1588.5	1328.7	717.4	2046.1
1977/78	1623.4	1420.7	742.4	2163.1
1978/79	1614.0	1428.4	643.9	2072.3
1979/80	1628.3	1417.0	670.2	2087.2
1980/81	1651.0	1474.5	692.0	2166.5
1981/82	1696.9	1401.7	684.3	2086.0
1982/83		1440.3	596.0	2036.0

Source : Statistical Abstract, various issues. Department of Census & Statistics.

Table A2 : PADDY CROPPING INTENSITY BY DISTRICT

(Sown area as percent of asweddumized area)

	1955			1962			1970			1979			1982		
District (1)	*Maha* (2)	*Yala* (3)	*Annual* (4)	*Maha* (5)	*Yala* (6)	*Annual* (7)	*Maha* (8)	*Yala* (8)	*Annual* (10)	*Maha* (11)	*Yala* (12)	*Annual* (13)	*Maha* (14)	*Yala* (15)	*Annual* (16)
Colombo	81.7	44.9	126.6	82.9	36.2	119.1	86.2	54.4	140.6	85.8	42.9	128.7	86.2	71.8	158.4
Gampha										88.3	36.5	124.8	67.9	58.4	126.3
Kalutara	79.9	78.5	158.4	81.1	78.5	159.9	81.6	80.9	162.5	84.8	75.5	160.3	86.6	8.50	167.1
Kandy	98.2	66.4	164.6	91.0	52.1	143.1	98.9	77.5	176.4	98.6	67.7	166.3	96.6	76.4	173.0
Matale	88.5	54.5	143.0	82.0	69.4	151.4	90.6	58.0	148.6	94.8	40.8	135.6	88.7	25.5	114.2
Nuwara Eliya	97.5	54.2	151.7	76.2	66.4	142.6	101.6	64.7	166.3	97.3	42.6	139.9	95.3	51.2	146.5
Galle	81.4	91.1	172.5	82.2	86.7	168.9	78.6	86.8	165.4	83.2	82.3	165.5	85.0	85.2	170.2
Matara	86.2	80.8	167.0	85.2	76.4	161.6	91.6	89.8	181.4	94.7	86.0	180.7	95.2	86.4	182.1
Hambantota	83.4	55.9	139.3	90.8	69.8	160.6	62.4	60.9	123.3	87.9	42.9	130.8	81.3	63.9	145.2
Jaffna	90.1	17.8	107.9	93.2	16.4	109.6	86.1	13.5	99.6	87.9	13.4	101.3	90.9	20.5	111.4
Mannar	89.4	13.1	102.5	84.3	15.8	100.1	96.6	14.3	100.9	76.1	—	76.1	79.9	00.6	80.5
Vavuniya	74.9	15.8	90.7	90.6	18.6	109.2	91.3	14.8	106.1	92.9	02.3	95.2	75.0	02.0	77.0
Mullaitivu										82.9	10.2	93.1	88.2	09.0	97.2
Batticaloa	67.9	36.9	104.8	68.7	20.6	89.3	73.3	19.4	92.7	84.2	15.2	99.4	82.2	14.9	97.1
Ampara				73.3	56.0	129.3	69.8	47.2	117.0	78.8	51.3	130.1	83.6	44.1	127.7
Trincomalee	69.5	45.0	114.5	79.9	44.2	124.1	85.3	46.3	131.6	90.7	39.1	129.8	81.5	24.4	105.9
Kurunegala	93.1	47.2	140.3	92.4	49.5	141.9	94.7	58.8	153.5	96.5	44.5	141.0	84.4	59.1	143.5
Puttalam	82.7	25.1	107.8	76.0	22.7	98.7	78.9	28.7	107.6	69.4	11.3	80.7	83.1	16.0	79.1
Anuradhapura	61.8	35.6	97.4	78.2	42.8	121.0	80.1	35.4	115.5	89.6	22.7	112.3	54.3	04.6	58.9
Polonnaruwa	91.2	88.3	179.5	88.7	87.7	176.4	98.2	82.2	180.4	95.6	70.7	166.3	96.9	99.8	146.7
Badulla	46.5	72.4	118.9	46.6	69.0	115.6	93.1	32.3	125.4	97.1	27.6	124.7	83.5	25.3	108.8
Monaragala				75.5	30.3	105.8	83.4	23.1	106.5	87.9	12.6	100.5	87.0	35.0	122.0
Ratnapura	78.9	75.0	153.9	62.4	74.0	136.4	80.7	70.1	150.8	92.7	74.7	167.4	93.5	88.7	182.2
Kegalle	99.4	66.9	166.3	90.1	68.3	158.4	99.4	83.2	182.6	99.3	78.9	178.2	99.5	96.4	195.9
Sri Lanka	79.9	50.6	130.5	82.1	50.1	132.2	84.7	48.6	133.3	89.4	40.1	129.5	82.6	40.3	122.9

Source : 1975 – Based on Report on Paddy Statistics, CSD 1956 ; Other years based on CSD data.

Table A3—ASWEDDUMIZED PADDY LAND UNCULTIVATED — 1978/79

(Acres)

District	1978/79 *Maha*		1979 *Yala*	
	Unsown area	*Unsown area as % of asw: area*	*Unsown area*	*Unsown area as % of asw: area*
(1)	(2)	(3)	(4)	(5)
Sri Lanka	185,539	11.5	970,128	60.1
Colombo	2,973	14.2	11,958	57.1
Gampaha	5,447	11.7	29,680	63,5
Kalutara	8,358	15.2	13,512	24.5
Kandy	806	01.4	18,095	32.5
Matale	1,886	05.2	21,342	59.2
Nuwara Eliya	313	02.7	6,722	57.4
Galle	9,867	16.8	10,432	17.7
Matara	2,770	05.3	7,310	14.0
Hambantota	6,649	12.1	31,502	57.1
Jaffna	10,196	12.1	72,934	86.6
Mannar	12,121	23.9	—	—
Vavuniya	2,969	07.1	40,843	97.7
Mullaitivu	6,638	17.1	34,853	89.8
Batticaloa	21,258	15.8	114,474	84.8
Ampara	29,336	21.2	67,227	48.7
Trincomalee	6,805	09.3	44,663	60.9
Kurunegala	6,081	03.5	94,953	55.2
Puttalam	13,644	30.6	39,554	88.7
Anuradhapura	21,631	10.4	160,175	77.3
Polonnaruwa	3,430	04.4	22,278	28.9
Badulla	1,195	02.9	30,093	72.4
Monaragala	3,377	12.1	24,399	87.4
Ratnapura	2,962	07.3	10,344	25.3
Kegalle	205	00.7	5,954	21.1

Source : Department of Census & Statistics.

Table A4—A. CROPPING INTENSITIES IN SELECTED MAJOR SCHEMES — 1955

Scheme	*Total aswed: acreage*	*C.I. 54/55 Maha*	*C.I. 1955 Yala*	*Annual*
Minipe Yoda Ela	3438	98.6	81.5	180.1
Dewahuwa	2135	99.2	35.9	135.1
Kalawewa	11813	52.5	63.3	115.8
Parakrama-Samudra	15017	91.8	94.5	186.3
Minneriya	6929	100.0	90.4	190.4
Giritale	784	100.0	100.0	200.0
Elahera	3734	100.0	67.0	167.0
Gal Oya	8216	99.1	60.1	159.2
Giant's Tank	1360	97.3	20.2	117.5

Source : Based on data given in Report on Paddy Statistics, CSD, 1956.

B. INTENSITY OF CROPPING SELECTED MAJOR SCHEMES — 1968

Scheme	*Cropping Index*
Iranamadu	159
Padaviya	196
Allai	178
Minneriya	187
Gal-Oya	206
Minipe (Govt.)	196
Minipe (Temple)	188
Hakwatunaoya	121
Rajanganaya	164
Mahawilachchiya	173

* Cultivated land as percent of alloted lowland.

Source : Jogaratnam T and Schickele, R. Socioeconomic Survey of Nine Colonisation Schemes, Peradeniya, 1969.

C. TANK MODERNISATION PROJECT : CROPPING INTENSITIES IN THE PROJECT AREA — 1981 AND 1983

(percentages)

Tank	Total Irr. Area (Ac)	Maha		Yala
		1980/81	1982/83	1981
Mahavilachchiya	2600	93	100	42
Mahakanadarawewa	6000	58	00	00
Padaviya	12500	80	61	01
Pavatkulam	4400	74	08	00
Vavunikulam	6000	66	73	

Source : Abeysekara, W. A. T., Preliminary Assessment of the Tank Modernisation Project, ARTI, 1983.

Table A5—PADDY CROPPING INTENSITY — 1961-1982 SELECTED DISTRICTS

Year	Kandy District			Kegalle District		
	Maha	Yala	Annual	Maha	Yala	Annual
(1)	(2)	(3)	(4)	(6)	(6)	(7)
1953-54	97.6	64.7	162.3	98.1	71.6	169.7
1954-55	98.2	66.4	144.6	99.4	66.9	166.3
1960-61	97.7	79.3	177.0	99.3	70.2	169.5
1961-62	97.9	74.8	172.7	99.2	72.6	171.8
1962-63	98.4	69.6	168.0	98.6	72.1	170.7
1963-64	98.4	76.4	174.8	98.9	75.6	174.5
1964-65	99.2	70.4	169.6	99.1	69.7	168.8
1965-66	96.6	55.4	152.0	99.0	65.6	164.6
1966-67	97.2	70.5	167.7	98.7	84.8	183.5
1967-68	97.7	70.5	168.2	97.7	80.8	178.7
1968-69	98.8	75.5	174.0	99.5	79.2	178.7
1969-70	98.9	77.5	176.4	99.4	83.2	182.6
1970-71	98.7	80.9	179.6	99.3	80.4	179.7
1971-72	99.2	83.8	183.0	99.2	77.3	176.5
1972-73	100.0	83.0	183.2	99.7	83.3	184.0
1973-74	99.8	91.5	191.3	99.6	97.3	196.9
1974-75	100.0	88.1	188.1	99.7	97.8	197.5
1975-76	99.8	52.9	152.7	99.9	87.9	187.8
1976-77	100.0	83.9	183.9	99.8	93.8	193.6
1977-78	99.6	84.4	184.0	99.6	92.4	192.0
1978-79	99.5	67.6	167.1	99.3	78.3	177.6
1979-80	98.6	72.0	170.6	98.6	88.6	187.2
1980-81	98.5	61.8	160.3	99.3	94.2	193.5
1981-82	96.8	76.4	173.2	99.5	96.4	196.9

* Sown area as percentage of aswe.ldumised extent.

Source : Own calculations based on data provided by the Department of Census & Statistics.

Ta ble A6 — UNSOWN AND ASWEDDUMIZED AREA BY AGROCLIMATIC ZONES

(Acres)

Agroclimatic Zone	1980/81 *Maha*				1981 *Yala*			
(1)	*Major* (2)	*Minor* (3)	*Rainfed* (4)	*Total* (5)	*Major* (6)	*Minor* (7)	*Rainfed* (8)	*Total* (9)
1. Dry Zone								
Unsown area	52,746	39,887	41,386	135,935	257,405	199,911	277,243	736,575
Asweddumized area	517,040	218,066	283,010	1020,132				
2. Low Country Wet Zone								
Unsown area	2,089	1,243	26,687	30,019	4,749	5,129	40,767	50,645
Asweddumized area	16,295	19,418	199,271	234,934				
3. Mid Country Wet Zone								
Unsown area	224	2, 237	1,308	3,767	2,661	18,642	10,187	31,458
Asweddumized area	17,403	63,180	56,821	137,402				
4. Intermediate Zone								
Unsown area	379	4,348	2,150	6,877	23,134	78,285	38,897	140,316
Asweddumized area	52,216	120,052	86,266	258,534				
SRI LANKA								
Unsown area	55,438	47,715	71,531	176,598	287,949	301,967	367,094	958,994
Asweddumized area	602,954	420,716	625,368	1651,052				

Source : Based on Department of Census & Statistics data.