CHANGES IN LAND USE PATTERN IN PADDY LANDS

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Abstract

Traditionally, all the paddy lands in Sri Lanka were used for rice cultivation. However, over the years, this land component has been used for other agricultural and non-agricultural purposes due to limitations in physical resources availability, economic and social pressures. Such land use changes have affected the national rice production. This paper reviews the changes in the land use pattern, identifies causes for such changes and suggests recommendations to mitigate adverse changes. Further, it concentrates on the need for national level policies for improvement of the present land use pattern to promote the rice sector. Our study has shown that the extent of asweddumized paddy lands has reached a plateau since 1991. In addition, the extent cultivated with rice in *maha* has reduced since 1983. This reduction is significant in the wet zone. It reveals that paddy lands are diverted to other uses or abandoned, particularly in the wet zone. The other main uses include cultivation of upland crops, clay and gem mining and land filling for infrastructure development. Abandonment occurs mainly due to long-term fallowing, seawater intrusion, water logging, development of soil related problems, use of poor quality water for irrigation purposes and poor maintenance of irrigation and drainage systems. This paper emphasizes measures to minimize alternative uses and to prevent abandonment. National level policies are proposed to protect paddy lands and to develope rice cultivation as an industry.

INTRODUCTION

Sri Lanka being an agricultural country, nearly 70 % of its lands support agriculture sector. Among agricultural land uses, rice farming occupies an extent of about 727,520 ha which is almost 50 % of total land available for agriculture in the country showing highest priority for rice farming. Traditionally almost all the paddy lands in this country were cultivated with rice. However, over the years, in certain areas, the extent under this particular land use type has been expanded while in some other areas it has been diverted for other agricultural as well as non agricultural uses. The diversion appeared due to occurrence of limitations in physical resources availability and development of social and economic pressures on lands. It created changes in the use of paddy lands and as a result in addition to rice cultivation, several land uses occur on paddy lands at present. Those land uses include cultivation of upland crops, clay and gem mining, land filling for infrastructure development. In addition, abandonment of paddy lands has also contributed to land use changes on paddy lands. This paper reviews the changes in land use pattern on paddy lands, identify causes for such changes and suggests recommendations to mitigate the adverse changes.

Distribution of paddy lands

Except for a few agro ecological regions in the wet and intermediate zone and up country regions where low temperature inhibits growth/performance of rice plant, the rice lands are distributed

in all the other agro ecological regions in the country. However, their concentration is found to be more in areas where both North East and South West monsoons experience and rainfall is adequately distributed for *yala* and *maha* season cropping. The rice lands in the mid and hill country regions are mainly confined to narrow inland valleys and terraced foot hill slopes and in the low country region, they are found in flat bottomed valleys, alluvial and/or coastal plains. High priority given to rice farming as it has been the staple food in our country from the ancient times, adaptability and stability under wide range of physical environmental conditions are the major reasons for its wide distribution. With respect to availability of irrigation water, rice farming exists under three situations namely major irrigation, minor irrigation and rain-fed (Table 1). All three situations occupy considerableland extents.

Table 1. Extents cultivated with rice in Sri Lanka.

District	Extent in Maha 1994/95 (ha)			
	Major	Minor	Rainfed	Total
Colombo	-	514	5095	5609
Gampaha	928	1851	9198	11977
Kalutara	238	2223	14247	16708
Kandy	3573	6857	6659	17089
Matale	4496	6608	3856	14960
Nuwara eliya	1163	4953	89	6205
Galle	-	49	17603	17652
Matara	4190	3806	10126	18122
Hambantota	17362	3874	1310	22546
Jaffna	-	-	9253	9253
Kilinochchi	9253	-	6653	15906
Mannar	4406	1210	29	5645
Vavuniya	2540	5052	412	8004
Mullaitivu	2970	1966	2622	7558
Batticaloa	13564	462	17914	31940
Ampara	49963	1091	4822	55876
Trincomalee	13051	2312	4933	20296
Kurunegala	12122	29259	28177	69558
Puttalam	5346	6630	1221	13197
Anuradapura	27759	30044	1490	59293
Polonnaruwa	43243	1335	818	45396
Badulla	9634	8286	2193	20113
Moneragala	4815	4688	3475	12978
Ratnapura	1581	7985	5322	14888
Kegalla	-	2552	8358	10910
Udawalawe	10103	-	-	10103
Mahaweli H	24866	-	-	24866
Sri Lanka	267166	133607	165875	566648

Source: Statistical Abstracts - 1997, Department of Census and Statistics, ministry of Finance and Planning, Colombo, Sri Lanka.

Changes in rice cultivation on paddy lands

The temporal variations in the extents of asweddumized and cultivated paddy lands for a period of 47 years since 1951 are illustrated in the Figure 1, according to which there is an year to year fluctuation in their extents. It could be attributed to two reasons. In the computation of asweddumized lands, new lands that are brought under paddy cultivation annually are included. On the other hand, lands that have not been cultivated with rice for five or more consecutive years, diverted for various other uses and affected by seawater intrusion are excluded. However, in the long-run, it shows that the asweddumized land extent in the country has increased up to 1991 and thereafter it has come to a plateau. Similarly, extents under paddy cultivation in *maha* and *yala* have increased up to 1983/84 *maha* season. Thereafter, the extent in *maha* has come to a plateau while in *yala* it tends to decrease gradually. It shows that the increasing trend in rice cultivation in *maha* and *yala* in the country has changed since 1983/84. As a result, the extent of paddy lands that is not cultivated with rice in *maha* and *yala* has been changed remarkably since 1983/84.

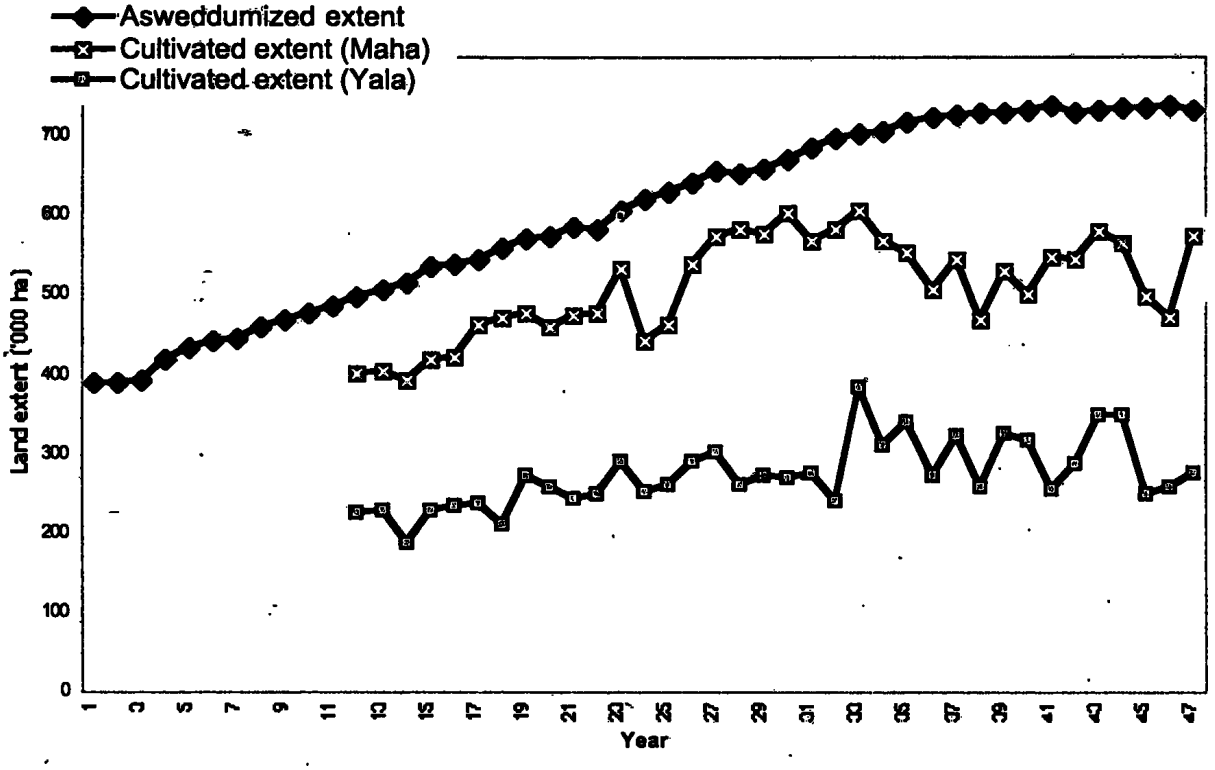

Figure 1. Changes in asweddumized and cultivated paddy land extents

Source: Statistical Abstracts - 1951 to 1998, Department of Census and Statistics, Colombo, Sri Lanka

This change varies with two major climatic regions, dry and wet zones (Figure 2). The extent cultivated with rice in both *yala* and *maha* seasons during the period from 1981/82 to 1995/96 show that there is an increasing trend with a year-to-year variation in the dry zone and a gradually decreasing trend in the wet zone. The decreasing trend in the wet zone indicates an increase in the extent not being utilized for rice farming. This under utilization results in more pronounced land use changes in the wet zone than in the dry done.

In order to investigate district wise changes in cultivated extents of paddy in the wet zone, the five districts Colombo, Galle, Gampaha, Kalutara and Kegalle were selected. These districts fall entirely within the wet zone of Sri Lanka. The analysis of cultivated extents of rice lands in the above districts show that there has been a gradual decline in their extents in both *yala* and *maha* seasons during the period of investigation (Figures 3 and 4). This trend is more pronounced towards coastal suburban areas of Colombo, Gampaha, Kalutara and Galle districts. The extent of abandoned paddy lands was found be remarkably higher in Gampaha district. However, no significant change has been observed in the cultivated extent in Kegalla district, which is located in the inland portion of the wet zone. The decrease in rice cultivation in coastal areas in the wet zone could either be due to conversion of paddy lands for other uses or long term abandonment. However, both situations have contributed to reduction of paddy cultivation in the wet zone.

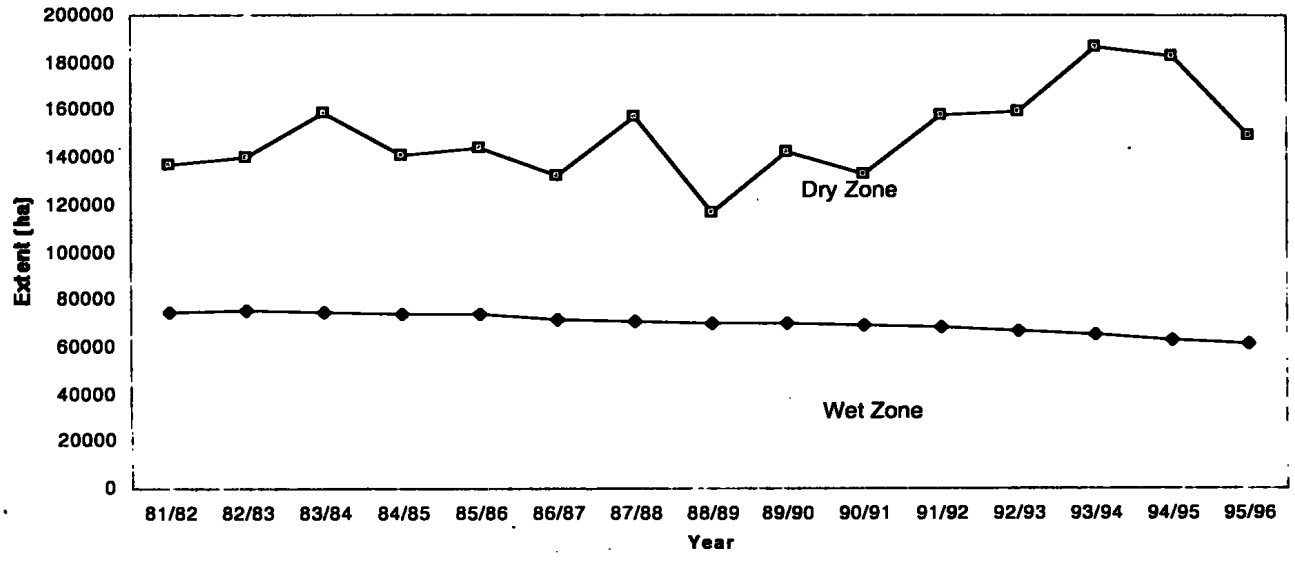

Figure 2. Extent cultivated with rice in maha in selected districts of Wet and Dry Zones

Source: Statistical Abstracts - 1981 to 1996, Department of Census and Statistics, Colombo, Sri Lanka

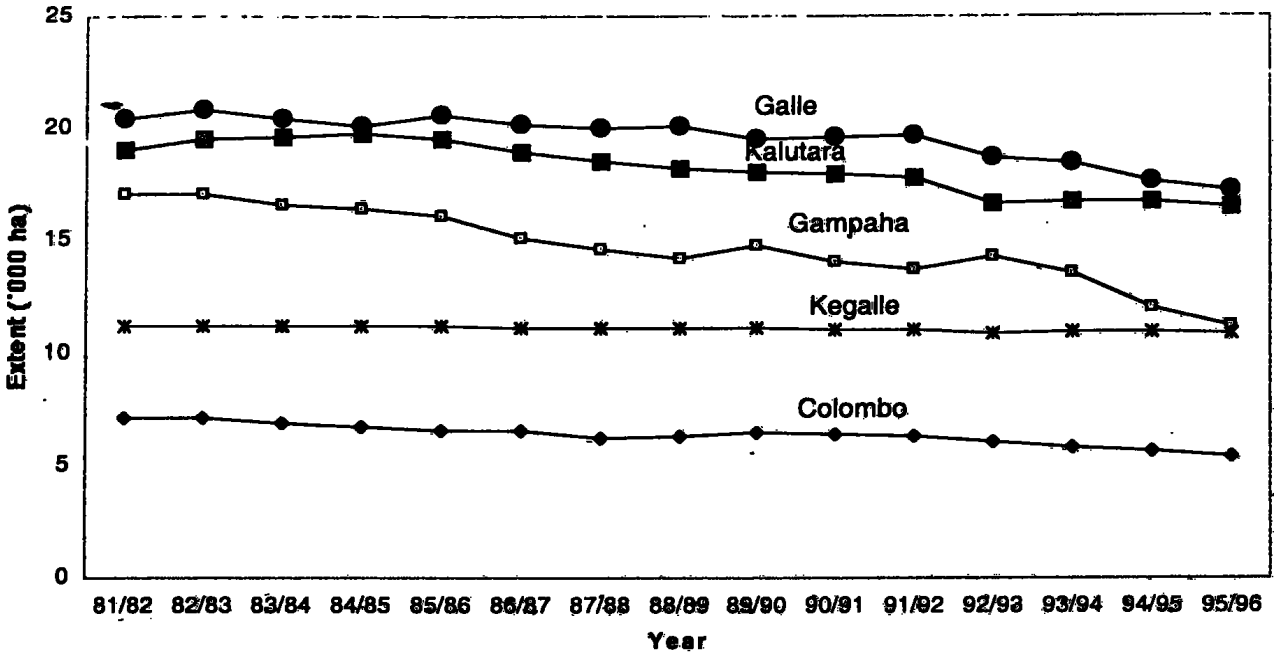

Figure 3. Extent cultivated with rice in maha in selected districts in Wet Zone
Source: Statistical Abstracts - 1981 to 1996, Department of Census and Statistics, Colombo, Sri Lanka

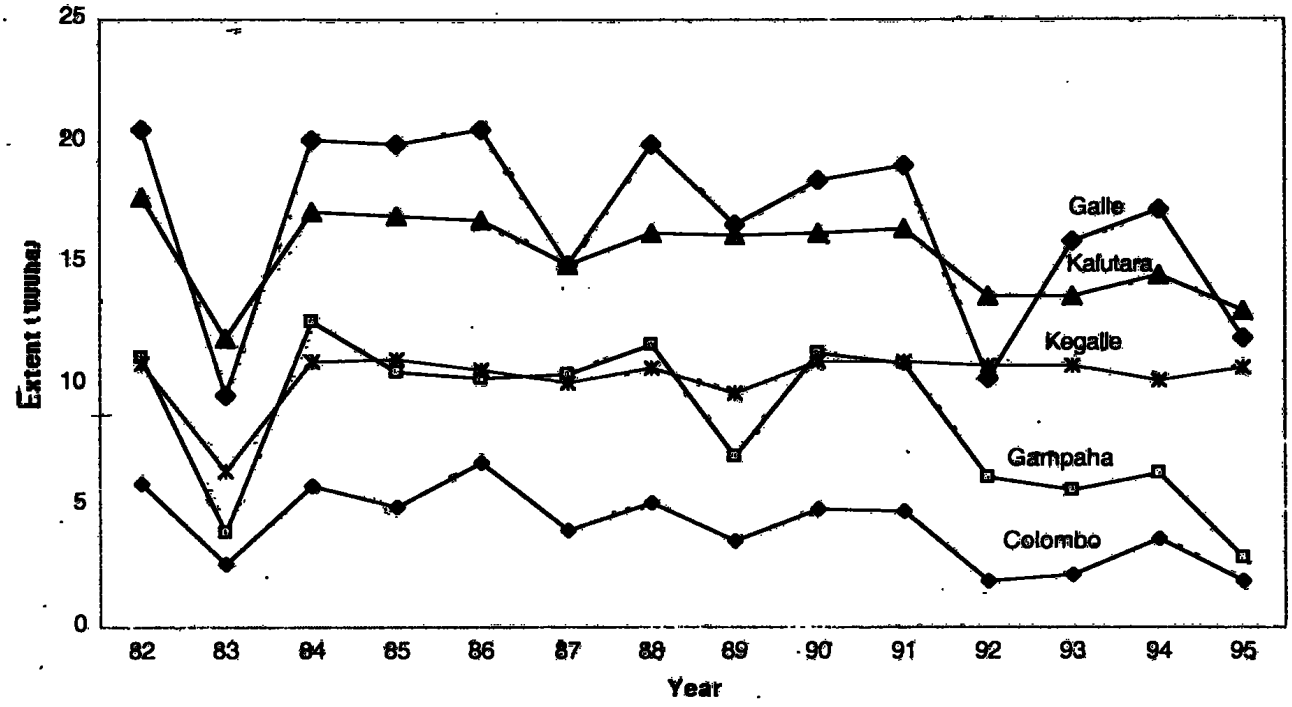

Figure 4. Extent cultivated with rice in yala in selected districts in Wet Zone
Source: Statistical Abstracts - 1982 to 1995, Department of Census and Statistics, Colombo, Sri Lanka

The analysis of the extents of paddy lands in some of the dry zone districts like Ampara, Anuradapura, Hambantota and Polonnaruwa show that there is an increasing trend in the cultivated extent in both *yala* and *maha* seasons during the period of investigation (Figures 5 and 6). It is mainly due to bringing of new lands under rice cultivation with the launching of major irrigation schemes like Mahaweli Development Program during this period. In the Anuradapura district, a wide fluctuation in the cultivated extent has been observed. It could possibly be due to dependency of a greater portion of paddy lands on local rains. This situation is highly evident under minor irrigation systems where paddy is cultivated in cascade systems in the district. In the other districts namely Ampara, Hambantota and Polonnaruwa paddy cultivation mainly depends on major supplementary irrigation facilities and as such a fluctuation does not occur in the extent annually cultivated with rice.

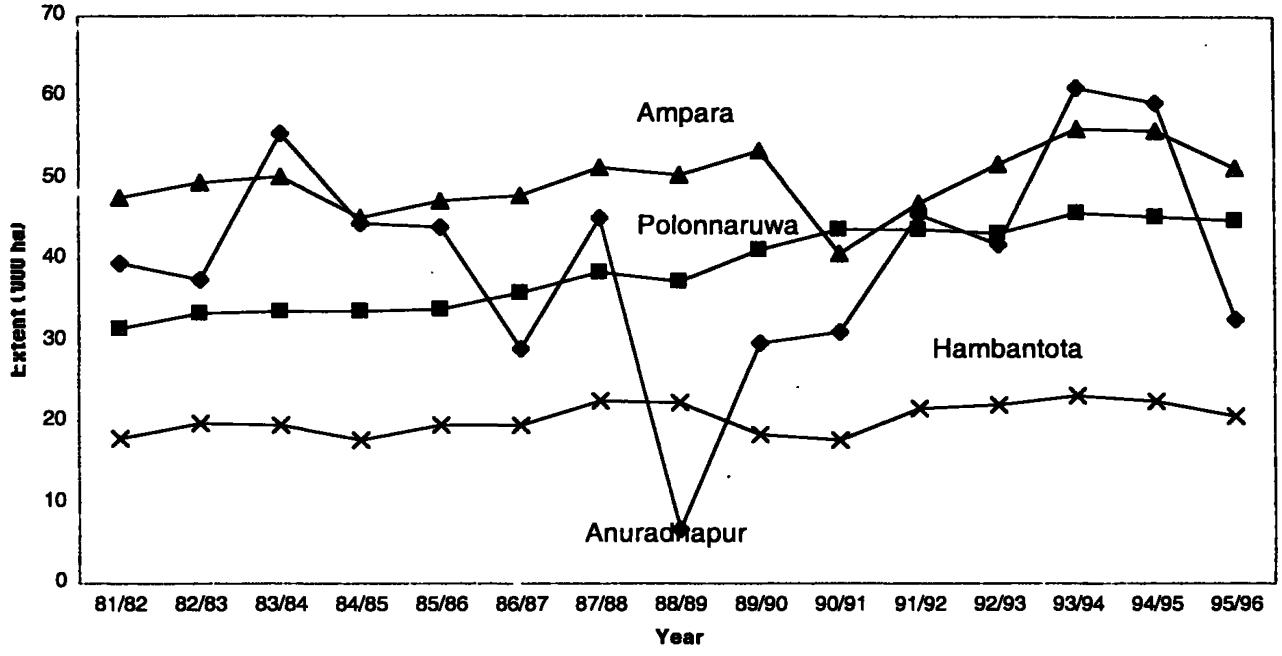

Figure 5. Extent cultivated with rice in maha in selected districts in Dry Zone
Source: Statistical Abstracts - 1981 to 1996, Department of Census and Statistics, Colombo, Sri Lanka

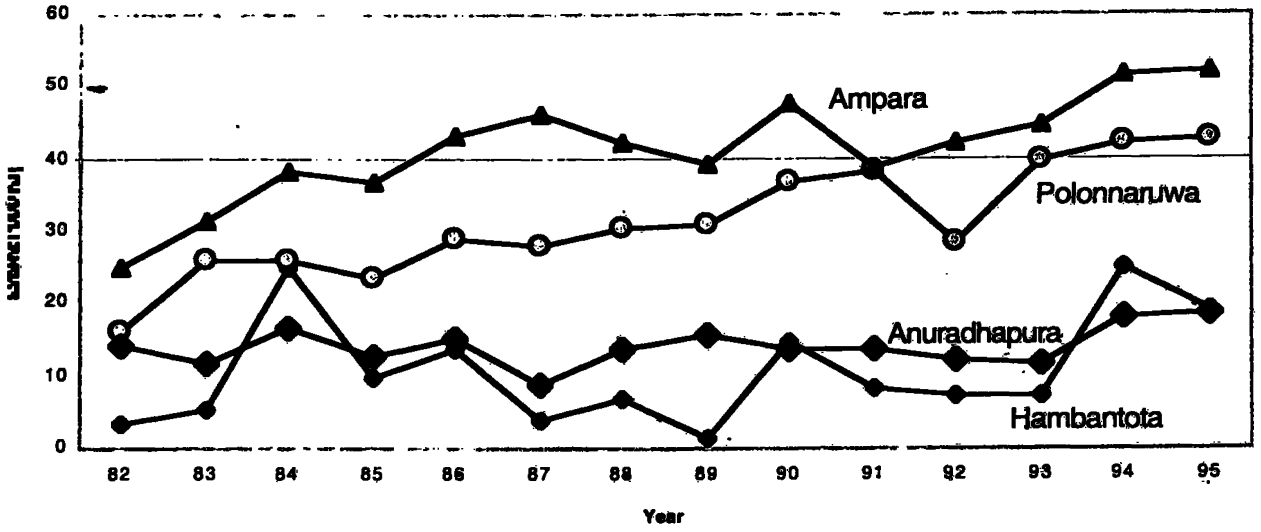

Figure 6. Extent cultivated with rice in yala in selected districts in Dry Zone
Source: Statistical Abstracts - 1982 to 1995. Department of Census and Statistics, Colombo, Sri Lanka

Changes in land use pattern on paddy lands

Land use changes on paddy lands occur basically as a result of alternative uses and abandonment. Alternative use appear as there is a demand for paddy lands for meeting some of other human needs with the increase of population pressure on lands. Abandonment occurs mainly due to development of socio economic and environmental conditions those are not favorable for continuation of paddy-farming on those lands.

1. Alternative uses

Alternative uses include cultivation of upland crops, filling up of lands, gem and clay mining etc.

1.1. Cultivation of upland crops

Cultivation of upland crops in paddy lands has been a long- standing practice among farmers. This practice has evolved as an adaptation to water scarcity (Handawela *et. al.*, 1995). During the *yala* season, irrigation water is not adequate for cultivation of rice over the entire extent of asweddumized lands, as it consumes more water compared to highland crops. This situation is very common in the dry and semi dry areas of the country. As such, farmers are compelled to cultivate seasonal upland crops such as condiments, grain legumes and vegetables or semi perennials like banana in paddy lands with well drained or imperfectly drained soils. The paddy lands with poorly drained soils are cultivated with rice or kept fallow in the *yala* season, depending on availability of water.

Further, the extent cultivated with above crops tends to vary from season to season. It could possibly be due to variations in the amount of supplementary irrigation available,

fluctuation of farmgate prices of agricultural goods, periodic emergence of pest and diseases etc. The extents cultivated with other field crops in the Mahaweli area H very clearly exemplify this situation (Figure 7). Since few decades back, cultivation of banana on paddy lands has been a common practice. This situation is clearly evident in the Udawalawa area (Figure 8). The banana cultivation has gradually increased up to about 3475 ha in year 2000 in this area.

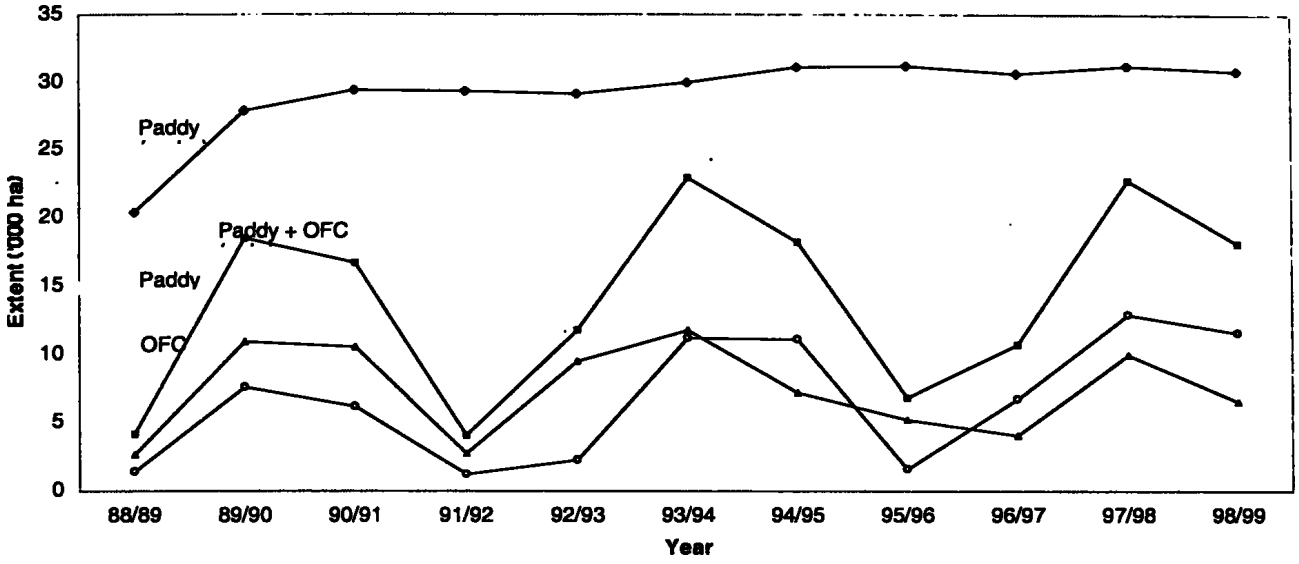

Figure 7. Cultivated extents of rice and other field crops on paddy lands in Mahaweli H area
Source: Mahaweli Authority of Sri Lanka, Thambuttegama, Sri Lanka

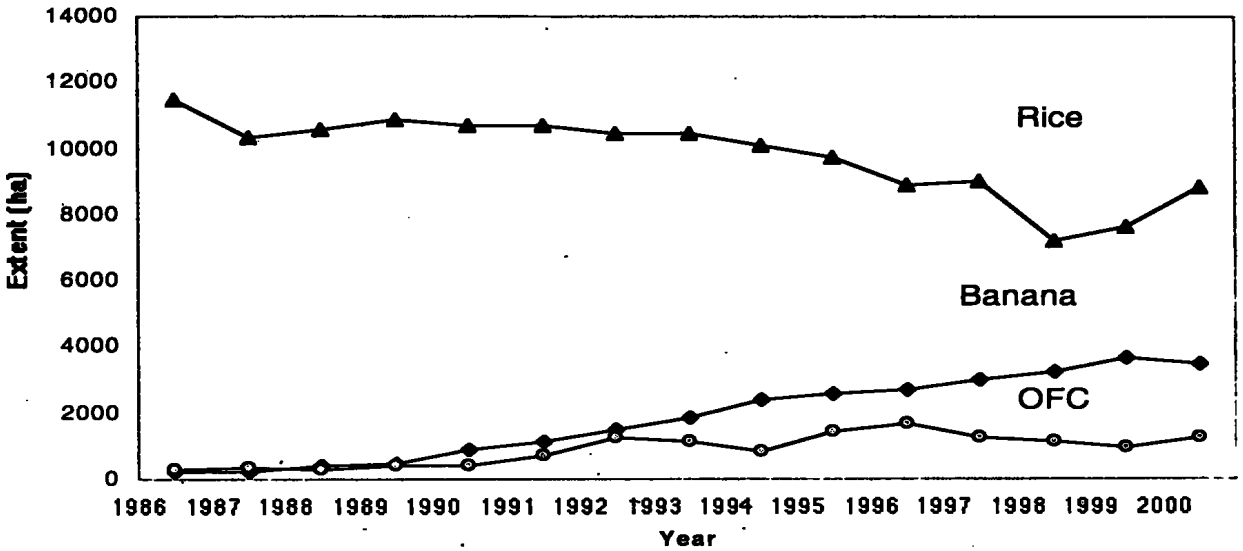

Figure 8. Cultivated extents of crops grown on paddy lands in yala in the Mahaweli (Walawa) area
Source: Mahaweli Authority of Sri Lanka, Udawalawa, Sri Lanka

This extent covers nearly 25 % of the total paddy lands in the above area.

1.2. Filling up of paddy lands

Filling up of paddy lands mainly occurs in urban areas of Colombo, Gampaha, Kandy and Kurunegala districts in the wet and semi wet regions of the country. The use of rice lands for housing and other infra structure development activities in highly populated areas in the above districts are the major contributory factor for this. The large scale abandonment of rice lands in these areas may have instigated people further to use these rice lands for various other uses which would otherwise remain idle for a long period of time.

Under the Agrarian Services Act 1951, regulations have been imposed in order to control filling up of rice lands. However, illegal land filling is still a major threat to rice farming. For example, the Department of Agrarian Services has granted permission for filling up of only about 10.5 ha of paddy lands during the year 1999. However, field observations reveal that, due to illegal land filling, the extent that is being filled annually far exceeds the extent for which permission has been granted. According to the officials of the Department of Agrarian Services, the support of the local level Government organizations such as Pradeshiya Saba is very essential by timely identifying such illegal activities to enable authorities to take stern actions against violators. Further, the authorities granting permission for land filling very often overlook the productivity potential of rice lands and hence the following deficiencies exist at present permission granting procedure.

- Productivity of rice lands is not considered in the identification of sites for land filling. As a result, some of the good fertile paddy lands are lost. Therefore, land filling should be allowed only in areas of low suitability ranking for agriculture.

- At present, site selection for land filling in rice tracts is carried out in an ad hoc manner. It affects the effective functioning of irrigation and drainage network thus creating poorly drained conditions and other associated problems in rice lands adjacent to filled up areas.

Having considered above two reasons, it is suggested that there is an urgent need to consider land productivity and ill effects on irrigation and drainage network in granting permission for land filling. It paves the way for reservation of productive lands for continuation of paddy cultivation and protection of irrigation and drainage structures.

In the present land market, there is a huge price gap between the paddy lands and uplands. For example, in the Gampaha area, one acre of paddy land would cost about Rs. 200,000.00 while the cost of one acre of high land would be around Rs. 1200,000.00.

Therefore, for obtaining the benefit of this value difference, land sellers purchase paddy lands, fill them up for value addition and sell the land for higher prices. Now it has become a large-scale business mainly in urban areas of the country. Therefore, restrictions need to be imposed in order to avoid filling up of paddy lands for business purposes. It is suggested that taxation system should be worked out when granting permission for rice lands to be filled up after taking into consideration the value difference between the above two land components.

1.3. Gem and clay mining

The large- scale gem mining takes place in selected areas of Ratnapura, Matale and Moneragala districts. The clay mining is a common practice particularly in river levees and flood plains in the wet and intermediate zones where some of the most productive agricultural lands in the country are found. Land use survey carried out by the Natural resources Management center of the Department of Agriculture in 1999 in selected Divisional Secretariat (DS) Divisions in Gampaha district reveal that clay mining is practiced in certain areas of the district (Table 2). For example in Biyagama DS Division, about 30% of the total paddy extent has been lost due to clay mining. Both clay and gem mining have lead to large- scale abandonment of paddy lands in the wet zone. In order to avoid over exploitation of such prime agricultural lands, the following measures are suggested;

- Up date existing regulations on Clay and gem mining.
- Popularize the use of other materials for brick and tile production and thereby reducing the demand for clay.

Table 2. Paddy lands affected by clay mining and water logging in selected Divisional Secretariat Divisions in the Gampaha district

Divisional Secretariat Division	Paddy land				
	Total (ha)	Percent distribution			
		Rice	Clay mining	Water logging	Other
Divulapitiya	2760	80.0	00	11.9	8.1
Mahara	1670	90.4	0.2	9.4	00
Gampaha	2750	91.3	00	8.7	00
Biyagama	1250	55.5	32.3	12.2	00
Negambo	650	00	00	00	100

- Permission for clay mining should be granted based on land suitability evaluation so that fertile agricultural lands could be preserved for agricultural uses.

2. Abandonment

Abandonment results from sea water intrusion, water logging, soil related problems, flood hazards, use of poor quality irrigation water, poor maintenance of irrigation and drainage systems, water stagnation as a result of infrastructure development and also due to lands not being cultivated for longer period of time. The sabandonment mainly confines to the wet zone.

2.1. Long-term fallowing

Long-term fallowing is mainly evident in the wet zone of Sri Lanka. In spite of their good agricultural potential, large extent of rice lands in these areas remains uncultivated due to numerous socio economic and climatic constraints. This situation is more pronounced in some of the low country wet zone districts such as Colombo, Gampaha and Kalutara. For example, in the Gampaha district, nearly 25 % of paddy lands are not cultivated in maha season. The long-term fallowing has resulted in significant changes in the rice growing environment due to rapid invasion of rice fields by hedges and other semi perennial tree spices. Further, during the fallow period, the land bunds are subject to damage by domestic and wild animals while irrigation and drainage network remain unattended. The collective effects of these conditions will lead to a situation where large scale investments are needed on repairs to damaged bunds and dilapidated irrigation and drainage net work. According to the land use survey conducted, the geographical distribution of fallow paddy lands in the Gampaha area shows that the long-term fallowing is not confined to any specific geographical positions in the rice lands but occur in an ad hoc manner indicating the domination of localized problems rather than factors related to water sheds. The localized problems includes

- Irrigation and drainage problems due to damages on irrigation and drainage network.
- Social problems such as family labour shortage since younger generations' reluctance to get involved in paddy farming, economical non-viability of employment of hired labour in paddy farming and mechanization of paddy cultivation has not been fully devel oped in those areas.
- Economic problems such as availability of better employment opportunities, farmer's preference to look for less tedious jobs with more economic returns like working in textile factories, property construction sites, private passenger transport services and public and private offices *etc.*

2.2 Sea water intrusion

Seawater intrusion has been one of the problems in declining of paddy cultivation in the coastal belt of wet and semi wet areas of Galla, Kalutara, Colombo and Gampaha districts. A similar situation has also been reported in Jaffna, Mannar, Puttalam and Trincommallee districts of the dry zone of Sri Lanka (Gangodawila, 1994). The construction of inland channels directly connected to sea and removal of soil and sand materials from river levees and coastal sand dunes are some of the reasons for seawater intrusion. Some claim that Muthurajawila, once a flourishing paddy field during the time of kings had turned in to a salt marsh as a result of construction of inland channel connected to sea (NARESA, 1991). De Silva (1977) suggested that some preventive measures such as construction of seawater exclusion bunds and establishment of regulators are needed in order to avoid seawater intrusion in the rice lands.

2.3. Water logging

Water logging is induced by blocking of natural drainage due to disturbances caused in the natural landscape. It has been a major problem in the south -west coastal belt in the country. It is found mainly in districts such as Gampaha, Colombo, Kalutara, and Galle. Formation of bog and half bog soils is the ultimate result of water logging. Rice production has been constrained on those soils due to development of unfavorable soil characteristics (Somasiri and Ratnayake, 1988). De Silva (1977) has suggested several engineering measures for improving drainage conditions of those lands. Dimantha (1977) proposed agronomic measures for the management of bog and half bog soils in rice cultivation.

In addition to above, to a small extent, water logging also occurs in inland valleys in the low country wet zone. For example a survey conducted in selected DS Divisions in the Gampaha district reveals that about 10 % of paddy lands in the area has been affected with this problem (Table 2). Construction of adequate number of culverts with proper dimensions when roads are constructed over paddy tracts and providing adequate ways to drain off water through paddy tracts when paddy lands are filled in large scale are some of the remedial measures that could be adopted in order to avoid human induced water logging conditions of this nature.

2.4 Soil related problems

The major soil related problems that affect rice production in Sri Lanka include development of salinity conditions in the coastal and inland paddy lands, emergence of bronzing and formation of acid sulphate. Such problems occur commonly in the coastal areas in the country.

Salinity problems have been reported in the dry and semi dry zone districts in the country in Ampara, Batticcaloa, Hambantota, Moneragala, Polonnaruwa and trincommallee. Inland

salinity is developed under poorly drained conditions in low lying paddy lands in the dry and semi dry areas. Sikurajapathy *et. al.* (1983) reported that about 5% of the total extent of poorly drained paddy lands in Mahaweli H area is affected by inland salinity. Punyawardane *et al.* (1989) reported that about 30% of poorly drained soils in newly developed paddy lands in Kirindi Oya project area are affected with salinity. In addition, natural soil conditions (Solodized solonets) also cause this salinity problem. Jeganathan and Adam Pain (1982) reported that salinity and sodicity conditions do occur on Grumusols of Murunkan area as well and showed the potential of using tolerant rice varieties.

Bronzing has been a common problem in the ill drained areas of the wet zone and it has been reported by Ponnamperuma *et al.* (1955), Ponnamperuma (1968), Ota and Yamada (1962), Inada (1965). Various stress conditions in rice lands have been attributed to this problem. The formation of ferrous iron (Ponnamperuma, 1955), excess alluminum together with inadequate calcium (Ota and Yamada, 1962: Yamada, 1959), excess hydrogen sulphide and inadequate potassium (Mulleriyawa, 1966) are some of the problems associated with bronzing. Among those problems, ferrous iron toxicity dominates and widely occurs in districts such as Gampaha, Colombo, Kalutara and Galle. The use of resistant varieties, tailoring fertilizer management practices and timing of sowing or planting are some of measures presently recommended to mitigate this limitation.

The occurence of acid Sulphate soils are limited to about 400 ha of rice lands in Kirala Kele in the Matara district. The excessive drainage conditions that have been created with the implementation of flood protection project could be the major causative factor for this. Weerasinghe (1994) suggested some measures such as maintenance of flowing water regime with continuous submergence and the application of lime to neutralize the acidity as promising reclamation measures to restore these soils. Further in the recent past, stagnation or reduction of paddy yields on poorly drained soil has been reported from areas like Polonnaruwa (Handawela, 1994). It could also be on another reason which might lead to large-scale abandonment of paddy lands.

2.5 Flood hazards

Flood hazard is a common problem in the low country wet zone rice lands and mainly in higher order valleys. The significant damage due to flooding has been reported in Gampaha, Colombo and Kalutara districts (Somasiri and Ratnayake, 1988). In fact this has been one of the major reasons for seasonal abandonment of paddy lands in those areas. De Silva (1977) suggested several flood protection measures such as pumping, construction of flood protection bunds, channel improvement and improvement to sea outfall etc. According to Dimantha (1977) an

improvement to drainage system, timing of crop sowing and introduction of flood resistant varieties (tall varieties) are other possible approaches that could be adopted in order to reduce the damage caused by floods. The use remotely sensed data in combination with GIS technology would be very useful in the identification flood prone areas and assessment of the severity of damage caused by floods.

2.6. Use of poor quality water for irrigation

The use of poor quality irrigation water with excessive quantities of salts has been a common problem in selected areas in the dry and semi dry zones of Sri Lanka. This problem is quite evident in areas such as Tissamaharama in the Kirindi Oya irrigation basin, Rajanganaya in the Kala Oya basin, Inginipitiya irrigation scheme and paddy fields in the eastern part of the Polonnaruwa district. It is resulted due to reuse of irrigation water in major irrigation systems. In Kala Oya irrigation system, an increasing trend in tank water salinity was observed towards the Rajanganaya and Angamuwa areas (Kendaragama and Joseph, 1994). The Kirindi Oya irrigation system provides water to about 5260 ha of newly asweddumized lands and 4200 ha of old paddy fields. The paddy lands in old area receive water from both direct supply from Kirindi Oya and drainage water of the newly developed paddy lands. Water draining from the new paddy lands contains excessive levels of salts and as a result, about 375 ha of land in the Older system has become unsuitable for paddy cultivation (Field observations of local Agricultural Extension Officers). It is reported that about another 1000 ha of paddy lands has been affected due to this problem and yield reduction has been observed. As a solution to this problem, some of the farmers use salt resistant varieties such as AT 354 and AT 401. The dilution of salt rich drainage water with fresh river water to a desirable level could be another ameliorative measure that could be adopted in salt affected areas.

RECOMMENDATIONS

Wet zone paddy lands

A decline in the paddy cultivation of the wet zone is evident. Therefore, priority attention is needed to develop national level strategies in order to protect wet zone rice farming

Non-agricultural uses of paddy lands

Presently, paddy lands are used for various non-agricultural purposes without taking their agricultural productivity into consideration. As a result, the large extents of highly productive agricultural lands are lost for paddy cultivation. Hence, the use of marginally suitable lands for non-agricultural purposes while reserving highly productive lands for continuation of rice farming needs no overemphasis.

The information on illegal land filling is not readily available with the Department of Agrarian Services, which is the authorizing agency for granting permission for filling up of paddy lands

in the country. The Department of Agrarian Services should seek the support of other local level government organizations such as Pradeshiya Saba to obtain timely information on such activities. In this regards, effective coordination of the Department of Agrarian Services with local level government organizations is very essential.

The government annually receives large number of applications seeking permission for land filling. This is not mainly due to lack of adequate uplands for development activities in those areas but land filling and subsequent fragmentation has become a lucrative business among business men. Hence, taxation scheme should be worked out regarding land filling so that exploitation of rice lands could be controlled at least up to a certain extent.

Another non-agricultural use of paddy lands has been the use of highly potential agricultural lands for clay and gem mining. Present regulations related to clay and gem mining on paddy lands need to be updated with very strict control measures.

Soil related problems

Increased soil related problems have been another reason for gradual declining of the extent of land under paddy cultivation. The poor drainage induced by mismanagement of low lands is one of the major causative factors for this. However, it must also be stressed that the mismanagement of upland directly or indirectly contributes to this problem. Therefore, micro catchment wise development strategies are needed in order to restore and rejuvenate the areas affected by problem soils. If the restoration process is not feasible, such lands should be used for other activities with precaution taken to prevent further degradation in rice growing environment.

Providing of land use rights

The lack of family labour, reluctance of young family members to get involved in paddy farming, high cost of production and lower prices for the produce compel farmer to gradually wean away from paddy cultivation. Under such circumstances, it is highly opportune to explore the possibilities of providing land use rights to landless farmers who are willing to practice rice farming.

Another reason for reduction of cultivated paddy extent is the cultivation of other field crops in rice lands. It is not possible to completely rule out cultivation of other field crops in paddy lands as they provide better economic returns compared to that of paddy. However, as a means of controlling other field crops cultivation in paddy lands, a system of issuing crop cultivation permits could be adopted.

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CHAPTER 3

TECHNOLOGY GENERATION