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Efficiency of Resource Utilisation in Paddy Production on Settlement Farms in Sri Lanka

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Introduction

One way to approach the problem of economic growth is through the theory of production. The relevant question then is how to increase the output per unit of input. The conceptual alternatives are (a) changing the production surface or (b) reorganising production inputs within a given production possibility curve. Moving the production surface or technological change implies changing the parameters of the production function, usually by introducing new kinds of inputs of production. Given the production function, i.e. ruling aside technological change, output per unit of input may be increased by improving the efficiency with which existing inputs are allocated. If such reshuffling of resources are possible, achieving allocative efficiency represents a relatively costless way of obtaining growth. This problem is of topical interest due to the current shortages of essential inputs which threaten to thwart economic development. Moreover, the question of how efficiently farm resources are used in peasant agriculture has been a topic of substantial academic interest to agricultural economists, some of whom contend that peasant farmers are "efficient but poor," given the state of the arts (reference nos. 4, 9, 12, 15, 16, 19 & 21).

The object of this paper is to examine the efficiency of resource utilisation of paddy farmers in a 'special project' in Sri Lanka, where concerted efforts have been made since the inception of such projects in 1967/68 to intensify paddy production (Seminar on Special Projects, 1970). In this study we shall concentrate on the orthodox static concept of allocative efficiency, i.e. attempt to identify any disequilibria that may exist in the utilisation of the existing factors of production, with the given techniques and methods of organisation. It would be expedient for policy makers to know whether there is a potential for increasing farm incomes and bringing about economic development by merely adjusting present resource use patterns. On the other hand, if an efficiency of resource use is indicated, economic development will be possible only by introducing "non-conventional" inputs and new techniques.

The Data

The analysis is based on data collected by the writer at the Minipe Colonisation Scheme in Sri Lanka, on weekly visits to farmers, throughout the cropping year September 1971 to October 1972. Farm records covering all aspects of the farm business were maintained for a sample of forty farmers.

A small sample was considered desirable for several reasons, viz. accuracy of data which necessitated the measurement of some inputs and outputs, the assurance of cooperation by the farmers to participate in the study for a full cropping year and above all the availability of limited funds to undertake an intensive examination of a large sample. Since the farming conditions on settlement schemes in Sri Lanka do not vary widely, it is felt that a small sample would not vitiate useful policy guidelines being drawn from the analysis. The data used in the analysis are reported in tables A1 and A2.

Production Function Analysis

Linear and Curvi-linear (Cobb-Douglas) production functions are estimated from the data, for both the *Maha** and *Yala** cultivation seasons, using the Ordinary Least Squares estimation procedure. The dependent variable considered is the production of paddy per farm in bushels.

The independent variables analysed could be broadly classified into the conventional variables land, labour and capital. Cultivated land in acres and not the physical area per settlement farm is considered relevant for the analysis. Different categories of labour and their productive capacities were explicitly recognised in the data collection and processing phases. Conversion to standard man-days of the different categories of labour employed have been made with reference to sex, age and task differences. Labour enters the production function as a flow rather than a stock concept and is quantified as the actual man-days involved in paddy production.

In the collection of data, sex-age differentials in labour use were considered important. The work hours expended by men, women and children were noted separately. Sex-task differentiation in paddy production was also commonplace. Traditionally the transplanting, weeding and reaping operations are performed by women. Various weighting procedures have been adopted by researchers for converting labour hours to standard man-days. Some have assumed an equivalence in efficiency between the work performed by men and women, but children to be only half as efficient (references 5 & 13). Others have assumed an arbitrary scale based on age and sex (references 5 & 8). A weighting system based on differential wage rates has also been adopted (references 3 & 4), on the tacit assumption that wage rates reflect the contributions to productivity by the different sexes. A combination of these procedures is used in the present study, in an attempt to introduce some degree of reality into the weighting procedure. In the case of weeding, transplanting, reaping and threshing operations, a woman-hour was considered equivalent to a man-hour. In the case of all other operations, a woman-hour was considered equivalent to 0.77 man-hours, on the basis of the differential wage rates paid to men and women. A child hour is defined as work done by those below sixteen years of age and considered to be equivalent to 0.67 man-hours, which

* *Maha* is the the major cultivation season and corresponds to the North-east Monsoon from October to April. While the *Yala* season corresponds to the South-west Monsoon period from May to September.

is based on the differential wage rates for men and children. In the conversion to man-days, a conventional standard man-day of eight hours is assumed. The fluctuation in the length of a work day is commonplace depending upon requirements. Since there is no entirely satisfactory standardisation procedure, all operations exceeding four hours a day were considered equivalent to a standard man-day. It is assumed that this procedure would compensate to some extent, the effect of the longer and shorter work days. The importance of family, hired and exchange labour in paddy production have been examined separately as well as aggregatively.

With regard to capital, working capital is more important than fixed capital in paddy production. Production expenditure expressed in value terms has been considered. This variable includes all production, marketing and transport costs involved in the production of paddy. The importance of fertiliser expenditure has also been examined.

To evaluate the importance of the HYV seeds, a dummy variable has been employed. As it is not possible to divide the farmers into adopters and non-adopters, since all the farmers belong to the former category, it is felt that some insight might be obtained by dividing the farmers into two groups based on the level of adoption of the new HYV seeds. The sample has been divided into two mutually exclusive groups, those with more than two-thirds the cultivated area under HYVs and those with less.

The functional form of the production model estimated could be represented as follows:

$$Y = a + \Sigma \beta_i X_i + e$$

Where, Y = production in bushels of paddy in Maha/Yala season

a = Constant or intercept term

X_i = Farm inputs (land, labour, production expenditure etc.) in natural or log form in Maha/Yala seasons

β_i = Production coefficients

e = Stochastic error term.

The main question to which this paper is addressed is to ascertain the efficiency of resource use. The answer to this question is approached through the computation of an efficiency index. Under the assumptions of perfect competition and constant returns to scale or that decreasing returns to scale eventually prevail, maximum efficiency in resource use occurs when the value of the marginal product from the use of one or more resource units is equal to the cost of the additional unit. If the ratio of the marginal value product (MVP) to marginal factor cost (MFC) is less than one, it indicates that too much of a particular resource is being used under the prevailing price conditions and level of utilisation of other inputs. The converse is true if the ratio is greater than one.

The marginal product of a factor can be computed as the product of the factor's elasticity times its average product. In general, the marginal productivity of any resource depends on the quantity of it that is already being used and on the levels of the other resources with which it is combined in the process. The estimates with the widest applicability are those at the mean input levels. When Cobb-Douglas functions are used, the most accurate estimates are obtained at the geometric means of the inputs (Heady & Dillon, 1961). Therefore, in this analysis the MVPs for the respective inputs are computed at the geometric means.

The marginal factor costs employed in the analysis are the market prices that prevailed in 1971/72. The market price of land has been taken as the cost of renting an acre per season, since we are interested in land productivity. In the case of settlement schemes, the rent payable per annum amounts to Rs. 10 per acre. Additionally, Rs. 6 per acre is charged as irrigation dues by the Cultivation Committees. Hence, the rent payable per acre per season amounts to Rs. 11. In the case of labour, the opportunity cost of labour is assumed to be the average wage rate paid to hired labour. This is based on the tacit assumption that the opportunity cost of family labour is equivalent to the wages paid to hired labour. This assumption has been used in previous studies of peasant agriculture (references 4, 15, 19 & 21). In the case of production capital, the marginal factor cost was computed as the average interest rate (9 per cent) plus a unit of production capital. The marginal factor cost of an additional rupee spent on production is therefore Rs. 1.09.

The Results

The main results of estimating production functions are reported in tables 1 and 2. It is evident that the Cobb-Douglas type production functions give a better fit to the data in both the *Maha* and *Yala* seasons.

In the *Maha* season, the results indicate that regression equation R1 gives the best fit (table 1). The coefficient of determination (R^2) indicates that 83 per cent of the production of paddy in the sample of paddy farms examined could be explained by the independent variables, land cultivated (X_1), total labour employed (X_2), expenditure on fertilisers (X_5) and the dummy variable representing the large scale adoption of HYVs (X_7). With the exception of the total labour variable, all the other variables are significant at the 5 per cent level of probability and conform to *a priori* expectations with regard to the directions of change. The production coefficients in the case of Cobb-Douglas functions could be interpreted as the respective production elasticities (Heady & Dillon, 1961). It is clear that the production elasticity for land is the largest in magnitude (0.65), while that of fertiliser expenditure (0.25) is next. However, contrary to expectations the production elasticity of labour is very low (0.10) and indicates that the potential contribution to paddy production by increasing the labour input *per se* would be small, given the present resource endowments and state of technology. The magnitude of the coefficients represent the share of the factors of production contributing to output, assuming

TABLE 1

Production Functions and Related Statistics – Maha Season

Regression No.	*Constant Term*	*Independent*			*Variables*		R^2	$\bar{R}^2$
+ R1	3.621* (0.803)	0.651 X_1* (0.151)	0.109 X_4 (0.182)	0.256 X_5* (0.142)	0.332 X_7* (0.063)		0.83	0.81
R2	–46.54 (30.22)	47.26 X_1* (12.34)	0.065 X_4 (0.218)	0.148 X_5 (0.210)	91.245 X_7* (17.318)		0.79	0.77
+ R3	4.109* (0.853)	0.793 X_1* (0.150)	0.023 X_4 (0.175)	–0.007 X_6 (0.055)	0.368 X_7* (0.065)		0.82	0.79
R4	–47.78 (29.97)	55.86 X_1* (10.59)	0.123 X_4 (0.199)	–0.026 X_6 (0.036)	95.60 X_7* (16.47)		0.80	0.77
+ R5	3.597* (0.683)	0.669 X_1* (0.149)	0.043 X_2 (0.085)	–0.110 X_3 (0.104)	0.216 X_5 (0.139)	0.336 X_7* (0.063)	0.84	0.82
R6	–47.065 (30.328)	47.697 X_1* (12.397)	0.213 X_2 (0.276)	–0.029 X_3 (0.243)	0.252 X_5 (0.211)	91.54 X_7* (17.38)	0.82	0.77
+ R7	3.412* (1.07)	0.374 X_1 (0.190)	–0.181 X_4 (0.244)	0.478 X_5* (0.182)			0.69	0.66
+ R8	3.974* (1.187)	0.538 X_1* (0.199)	0.081 X_4 (0.243)	0.057 X_7 (0.075)			0.63	0.60

Note: An asterisk indicates significance at 5 per cent level.
Standard errors appear in parentheses.
+ indicates curvilinear (Cobb-Douglas) Models estimated in logarithmic form. The HYV variable is in the natural form.

Key to Variables

X_1 = Irrigated paddy land cultivated per farm in acres

X_2 = Family labour employed for paddy cultivation in man-days per farm

X_3 = Hired labour employed for paddy cultivation in man-days per farm

X_4 = Total labour employed for paddy cultivation in man-days per farm

X_5 = Fertiliser expenditure on paddy cultivation per farm in rupees

X_6 = Total Production Expenditure on paddy cultivation per farm in rupees

X_7 = Dummy variable representing more than two-thirds of the farm under high yielding varieties (HYVs) of paddy

Y = Production of paddy in bushels per farm

perfect competition (Yotopoulos, 1967). The results indicate the predominant contributions of land (65 per cent) and fertiliser (25 per cent), and the relatively small contribution of labour (10 per cent) to paddy production. The upshot of this finding is that the relatively costless inputs contribute most to production and should therefore be used to their maximum capacities. According to the results obtained, a 1 per cent increase in the acreage cultivated would lead to a 0.65 per cent increase in production *ceteris paribus.*

The conventional test of significance on the HYV dummy variable (X_7), indicates whether there is any significant difference in the production levels of the large scale and small scale adopters of the HYVs. The results obtained for the *Maha* season are consistent with *a priori* expectations that there is a significant difference in the level of production between the large scale and small scale adopters of the HYVs. For the purpose of examining this hypothesis further, regression equation R2 which is linear and in the natural form is employed for the convenience of interpretation. The interpretation of the intercept term and the dummy variable is similar to that suggested by Johnston (1972). Accordingly, the conventional significance test on the intercept term would indicate whether the intercept of the producers with less than two-thirds the area under HYVs was sigificantly different from zero. While, the conventional test of significance on the dummy variable (X_7) would indicate whether there is a significant difference between the two groups of producers. The results for the *Maha* season are consistent with the hypothesis that there is a significant difference in production levels between the two groups of adopters. The results also indicate that the small scale adopters have a negative intercept which is significant at the 10 per cent level and that the difference in intercept terms is positive and significant at the 1 per cent level.

The importance of family labour (X_2), hired labour (X_3) and total production expenditure (X_6) are also examined in different production models. They were, however, not found to be statistically significant at any acceptable level of probability.

In the *Yala* season, regression equation R1 was found to be best in terms of statistical reliability and *a priori* expectations (table 2). The explanatory power of the model is high as indicated by the coefficient of determination (0.957). The cultivated acreage (X_1), expenditure on fertilisers (X_5) and the dummy variable representing the large scale adoption of HYVs (X_7) are significant at the 5 per cent level. The total labour (X_t) variable is not statistically significant at any acceptable level of probability. The production elasticity for the land variable is very high (0.97) and accounts for a major share of production. But the production elasticities for labour (0.08) and fertiliser (0.06) are much below *a priori* expectations. These results indicate that the gains to additional labour or fertiliser inputs will be small, other conditions remaining the same in the *Yala* season. The main thrust of the findings is clearly the need to ensure the maximum cultivation of land, since, the returns to land are very rewarding given the level of utilisation of other resources and state of technology at the present time. The coefficient of the dummy variable representing the large scale adoption of HYVs is significant at the 5 per cent level. This indicates that, as in the *Maha* season, the difference in the production levels of the large scale and small scale adopters of HYVs is significant. Family labour (X_2), hired labour (X_3) and production expenditure (X_6) variables tested were not statistically significant.

The importance of the HYVs is further examined by analysing the linear functional form R2 (table 2). The intercept term is significant and has a negative sign, indicating that reductions in the area under HYVs would reduce production significantly. Again the difference in intercepts of the large scale and small scale adopters is positive and highly significant. It is interesting to note that the magnitude of the coefficient is markedly different between the two seasons. The smaller difference observed in the intercepts of the two groups as indicated by the coefficient of the dummy variable in the *Yala* season could be attributed to the lower adoption of the necessary complementary inputs.

The main object of this paper is to examine the efficiency of resource utilisation in paddy production on settlement farms. Within the limits of statistical reliability the efficiency indexes reported in table 3 indicate the level of efficiency of resource use on average throughout the sample of farms examined. The indexes clearly show the disequilibria which exist in the use of the two major resources, land and labour, for both seasons of cultivation. An underutilisation of the land resources and an overutilisation of the labour resources are indicated, given the resource endowments of the farms and state of technology. In the case of fertiliser use, an underutilisation is indicated in the *Maha* season. Although an efficiency in fertiliser use is indicated in the *Yala* season, this cannot be *prima facie* accepted, since, there are possibilities for better utilisation of this costly input. It is also imperative to note that the marginal factor cost of fertiliser used in this analysis (Rs. 1.09) does not reflect the real cost.* If the real cost of fertiliser i.e. the price at FEEC rate is

* Fertiliser has been subsidised at 50 per cent of market price to farmers. This subsidy will be inoperative from *Maha* 1974.

TABLE 2

Production Functions and Related Statistics – Yala Season

Regression No.	*Constant Term*	*Independent*			*Variables*		R^2	$\bar{R}^2$
+ R1	* 3.73 (0.31)	* $0.972\ X_1$ (0.084)	$0.08\ X_4$ (0.07)	* $0.059\ X_5$ (0.02)	* $0.146\ X_7$ (0.037)		0.957	0.943
R2	* –38.972 (12.36)	* $54.24\ X_1$ (6.85)	$0.119\ X_4$ (0.121)	$0.174\ X_5$ (0.084)	* $28.34\ X_7$ (7.75)		0.95	0.94
+ R3	* 3.564 (0.461)	* $0.980\ X_1$ (0.111)	$0.028\ X_4$ (0.082)	$0.052\ X_6$ (0.065)	* $0.171\ X_7$ (0.041)		0.94	0.93
R4	* –43.96 (13.12)	* $62.51\ X_1$ (7.48)	$0.160\ X_4$ (0.127)	$-0.007\ X_6$ (0.023)	* $32.48\ X_7$ (8.49)		0.94	0.93
+ R5	* 3.78 (0.25)	* $0.992\ X_1$ (0.098)	$-0.017\ X_2$ (0.067)	$0.007\ X_3$ (0.046)	* $0.059\ X_5$ (0.021)	* $0.145\ X_7$ (0.038)	0.95	0.94
R6	* –44.36 (12.99)	* $58.41\ X_1$ (7.60)	$-0.191\ X_2$ (0.276)	$0.250\ X_3$ (0.159)	$0.155\ X_5$ (0.084)	* $29.35\ X_7$ (7.71)	0.95	0.94
+ R7	* 3.623 (0.563)	* $0.96\ X_1$ (0.13)	$-0.041\ X_4$ (0.098)	$0.12\ X_6$ (0.07)			0.91	0.87

Note: The key to table 2 is similar to that adopted for the previous table.

used (Rs. 2.30), an excessive use of fertiliser would be indicated in both seasons, which is not borne out by the field observations. A plausible explanation for the low MVPs is the inefficient use of fertilisers in terms of timeliness of application and placement, and also the incomplete adoption of the necessary complementary inputs. In fact, the return for each rupee expenditure under experimental conditions has been as much as 7.5 : 1 (Weerawickrema & Constable, 1967).

Policy Implications

Subject to the assumptions and other limitations of the model, the results of this analysis clearly indicate that there is on average, scope for profitable and better use of farm resources in paddy production on the settlement farms examined. This does not imply that all farmers are inefficient in the use of farm resources. Nevertheless, having found that "on the average" they are inefficient, we may assign a high probability value to the extent that they are individually inefficient. This is the usual interpretation of a stochastic relationship (Valvanis, 1959). The purpose of this section is to examine the disequilibria in resource use and possibilities that exist for rectifying the situation.

The marginal value productivity (MVP) of land is high for both seasons (table 3). According to these results, each additional unit of land cultivated in the *Maha* and *Yala* seasons would result in an additional income of Rs. 607.60 (43 bushels of paddy) and Rs. 850.92 (60 bushels of paddy) respectively, *ceteris paribus*. This clearly reflects the high level of the other resources presently in use. Despite the high MVP for land, it is imperative to note that the available land is not utilised to its full capacity. The cropping intensities for the *Maha* and *Yala* seasons are 94 and 93 per cent respectively at Minipe (Amerasinghe, 1974). This seems a satisfactory level of land use in the light of the findings of a recent study on six special projects, where the cropping intensities for both seasons varied between 171 and 103 per cent (Jogaratnam, 1974). The lower intensity in the *Yala* season was attributed to the lack of irrigation facilities (Jogaratnam, 1974.) However, it is important to note that even when such facilities have been available, other considerations such as the paucity of credit, inadequate extension effort and psychological factors such as risk and uncertainty have precluded the full utilisation of available land. At Minipe, a satisfactory supply of irrigation water has led to high cropping indexes in both seasons. Yet, the land is neither cultivated to its maximum extensive nor its intensive margins. While yield increases of 84 per cent in the *Maha* and 83 per cent in the *Yala* seasons have been reported at Minipe after the advent of the so called "green revolution," a wide achievement distribution has also been noted. Yield variations between 30 and over 100 bushels per acre have been reported (Amerasinghe, 1974). This variability could be attributed in the main to the piecemeal adoption of the 'package' of improved inputs. The lack of capital, larger risks associated with the adoption of the full package, lack of confidence in the extension services and inadequate extension follow up could be adduced as some reasons for the partial adoption of the package.

TABLE 3

Efficiency Indexes of Resource Use and Related Information

	Inputs		*Geometric Mean*	*Marginal product*	*Marginal Value products* in Rupees*	*Marginal Factor costs in Rupees*	*Efficiency Index***
1.	**Maha season**						
	Land (X_1) cultivated in Acres	..	3.429	43.40	607.60	11.00	55.23
	Total Labour Utilised (X_4) for farming in Man Days	..	212.7	0.1171	1.64	4.50	0.36
	Total Expenditure on Fertilisers in Rs (X_5)	..	198.5	0.295	4.06	1.09	3.72
2.	**Yala season**						
	Land (X_1) Cultivated in acres	..	3.037	60.8	850.92	11.00	77.35
	Total Labour Utilised (X_4) for Farming in Man Days	..	156.7	0.097	1.36	4.50	0.30
	Total Expenditure on Fertilisers in Rs. (X_5)	..	131.3	0.085	1.19	1.09	1.092

* Marginal Value Products have been calculated at the geometric means of the inputs and output.

** The efficiency index is defined as the ratio of the marginal value product to marginal factor cost.

A study in depth into the behavioural aspects of farmers, socio-economic factors and physical constraints preventing the adoption of the full package of inputs will be required. In other words explanations should be sought for the gap that exists between actual and potential yields. Although a high proportion of the farmers now use recommended fertilisers, they are at sub-optimal levels and do not extend over the entire farm. On average 80 per cent of the farmers at Minipe applied the recommended dosage of basal fertiliser, while 87.5 per cent applied the recommended top dressing. Also 65 per cent of the farmers transplanted their crop, the proportion being higher in the *Maha* than in the *Yala* season. Pest and disease control measures were adopted by 60 per cent and chemical fertilisers by 55 per cent of the farmers. In the study of six major special projects, fertiliser use, transplanting, hand weeding and chemical weed control were reported by 66, 44, 36 and 46 per cent of the farmers (Jogaratnam, 1974). The adoption of improved seed varieties have been widespread due mainly to the fact that it constitutes the cheapest element in the package of improved inputs. However, the level of adoption of the associated inputs leaves much to be desired. In view of the limited availability of land on settlement schemes, every effort should be made to encourage the use of land augmenting inputs, both on economic grounds due to possibilities that exist for more intensive use as discussed above and on social grounds to off-set the pressure on the land.

In the case of labour inputs, it is evident that an over-utilisation is indicated, *ceteris paribus*. It is evident that each additional unit of labour in the *Maha* and *Yala* seasons could lead to improvements in income of Rs. 1.64 and Rs. 1.36 respectively (table 3). Clearly this return is below the wage rate payable to hired labour and brings into focus the "irrational" use of hired labour which accounts for 51 per cent of the labour force employed in paddy production. In fact, it is surprising to observe that in a system of peasant agriculture, hired labour should form the most important component of the labour force. The importance of accomplishing farm operations in time and consequently the necessity to hire labour exists, but the use of such a high proportion of hired labour in peasant farming seems to require an explanation beyond economic reasoning. This brings into perspective sociological considerations such as farmers work-leisure preferences and social status which might explain the negative attitudes to manual work by family labour. A study of the demand for labour after the introduction of the HYVs showed a distinct trend away from the use of exchange labour mainly towards hired and to a lesser extent family labour (Central Bank of Ceylon, 1969). In the case of hired labour, a more than 100 per cent increase in demand occurred in the post-HYV period (Amerasinghe, 1974). The shift away from the use of exchange labour could be attributed to the need for greater timeliness required in performing cultivation operations and also the greater ability of farmers to pay for services following the adoption of the improved rice technology. The improvement in social status as a result of the enhanced farm incomes together with the traditional apathy towards manual work could have contributed to the dependence on hired labour. As observed above, the opportunities available through the adoption of the improved technology for better utilisation of farm labour are by no means exhausted and would provide a relatively costless way by which productivity of labour resources, particularly family labour with virtually no opportunity costs could be improved.

An insufficient expenditure on fertilisers or an underutilisation of resource capacity is indicated in the *Maha* season, where the ratio of MVP/MFC is greater than unity. However, during the *Yala* season, the marginal value product and factor cost are more or less in equilibrium (table 3). The MVP is Rs. 4.06 in the *Maha* season, which indicates the possibility of obtaining a fourfold increase in income for each additional rupee expenditure. A higher return in the *Maha* season could be attributed to the higher level of adoption of the improved practices. The lower MVP for fertiliser in the *Yala* season could be due to a complexity of factors such as short-aged traditional varieties cultivated, lack of sufficient irrigation facilities, lower adoption of improved cultural practices such as transplanting and weed control and also less fertiliser usage. A study in depth will be required to evaluate the impact of the individual elements in the 'package' of inputs on production. It would also be necessary to examine the possibilities of improving or at least maintaining present levels of productivity through the use of relatively cheap inputs vis-a-vis more expensive inputs particularly those which are likely to be in short supply in the near future. The possibilities of improving the efficiency of using the more expensive and potentially scarce inputs such as fertilisers, through more timely applications, appropriate methods of application and so on need further study. Also the possibilities of substituting or supplementing the potentially scarce inputs by relatively cheap sources have to be investigated.

It is interesting to note that according to this analysis, fertiliser was more important in determining output than total production expenditure, in both seasons of cultivation. Of the total production expenditure in paddy cultivation, hired labour is the most important element (36.2 per cent) and the failure of the total expenditure variable to be significantly reflected in the models could be attributed to the overemployment of hired labour which negates the contributions of the other elements to productivity in the aggregate production variable.

Conclusions

The findings of this study are of significance to settlement planners and policy makers in Sri Lanka as they shed light on the possibilities that exist for bringing about change and development in a relatively "costless" way. Although the results are in relation to one special project, due to the similarities in the production and institutional backdrop of such schemes in Sri Lanka, it is felt that valid generalisations could be made. Moreover, since the Minipe Colonisation Scheme is one of the better special projects, the disequilibria in resource utilisation identified in fact suggests that the problem elsewhere might be more evident. The results clearly demonstrate that the two major resources, land and labour, which account for approximately 75 and 97 per cent of the production in the *Maha* and *Yala* seasons respectively, are inefficiently utilised from an economic standpoint. In the case of land, it is clear that substantial opportunities exist for better utilisation of the resource by extending cultivation to its maximum extensive and intensive margins. With regard to labour use, although an overutilisation is evident, it was observed that this is largely due to the high proportion of hired labour in the labour force. Due to the lack of alternative employment opportunities for family labour the use of hired labour in such proportions seems irrational on economic grounds. Negative attitudes towards manual labour and factors such as social status evidently impede the greater utilisation of family labour. It is also imperative to note that, though excessive use of labour has been indicated there is scope for intensifying production by the adoption of improved labour intensive technology. such as transplanting and weed control, which have been only partially adopted at the present time. With regard to the other major determinant of paddy production, namely fertilizer, an underutilisation was indicated in the *Maha* season. However, economic efficiency in the use of fertilizer was indicated in the *Yala* season. It is important to bear in mind that due to the highly subsidised fertilizer price operative, these results are subject to more than the usual caveat. It was observed that there might be possibilities for improving the efficiency in use of the more expensive purchased inputs. Studies in depth would be necessary to examine these possibilities.

The results of this study are also of interest since they are at variance with a widely held view that peasant farmers are efficient in the utilization of resources (references 4, 9, 12, 16, 19, 21). The upshot of this finding is that policy makers should attempt to maximize the efficiency of abundantly available resources by education and encouragement and by the provision of adequate incentives to motivate farmers, rather than be pre-occupied with modernising farming. This is particularly relevant in the context of most developing countries today and Sri Lanka is no exception, where a shortage of foreign exchange to purchase modern farm inputs threatens to thwart economic development. This does not mean that policy makers should stop looking for opportunities to transform traditional agriculture. On the contrary, a correct balance in the programmes for modernising farming with adequate awareness of resource endowments and the potential that exists for greater efficiency within existing farming situations cannot be overemphasised. As Myint (1965) points out "......................... underdeveloped countries are too poor to put up with preventable waste that arises even within the static framework of given wants, techniques and resources."

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TABLE A1

Cross-Section Data from Settlement Farms – Maha 1971/72

Total Production in Bushels	*Land Cultivated in Acres*	*Family Labour in m.d.*	*Hired Labour in m.d.*	*Total Labour in m.d.*	*Production Expenditure in Rs.*	*Cost of Fertilizer in Rs.*	*HYV Dummy Variable*
160.0	2.0	35.65	102.0	137.63	309.50	126.00	1
137.0	2.0	60.13	128.40	188.53	627.00	123.50	1
180.0	2.5	124.10	50.7	174.8	384.00	160.50	1
158.0	2.0	41.45	115.45	156.9	412.00	130.50	1
272.0	4.0	49.20	244.53	293.73	354.75	232.72	1
175.0	2.0	38.87	83.28	122.15	553.25	139.00	1
159.9	3.0	50.20	159.06	209.26	46.85	168.24	0
150.0	2.0	39.63	157.72	197.35	328.25	156.00	1
150.0	2.0	58.85	104.55	163.4	367.50	126.00	1
351.0	5.0	151.81	234.45	386.26	591.00	315.00	1
300.0	4.0	57.73	189.6	247.33	722.75	297.48	1
120.0	1.0	55.23	42.2	97.43	136.70	73.50	1
180.0	5.0	64.30	165.4	229.70	614.75	284.50	0
340.02	6.0	86.45	237.6	324.05	960.45	287.96	1
300.0	6.0	92.45	215.55	308.00	1043.50	228.00	0
220.0	5.0	171.45	144.6	316.05	1051.25	264.00	0
169.99	3.5	93.5	155.7	249.2	765.10	220.50	0
450.0	5.0	99.98	209.10	309.08	761.00	326.00	1
300.0	3.0	69.23	159.9	229.13	587.75	188.76	1
140.0	3.0	34.95	113.95	148.9	466.50	85.98	1
318.98	6.0	102.73	217.05	319.78	731.50	294.00	0
330.0	5.0	114.09	201.05	315.14	916.50	290.75	0
240.0	3.0	41.02	111.68	152.7	324.02	188.49	1
160.0	2.5	53.08	102.5	155.58	262.75	85.75	1
280.0	2.5	92.40	47.7	140.10	538.50	200.50	1
300.0	5.0	47.65	165.45	213.10	847.50	222.50	1
359.97	6.5	100.15	235.4	335.55	908.50	357.50	1
232.0	4.0	95.13	156.85	251.98	399.45	220.20	0
180.0	2.5	64.81	142.48	207.29	541.25	179.25	1
290.0	4.0	102.93	126.7	229.63	529.50	231.00	1
220.0	5.0	115.07	189.28	304.35	1038.75	282.75	0
204.99	3.0	57.33	116.73	174.06	573.00	166.74	1
255.01	3.5	70.26	143.6	213.86	959.50	230.72	1
215.01	3.0	56.48	133.6	190.08	601.50	179.49	1
420.0	5.0	128.95	147.8	276.75	534.75	222.75	1
320.0	5.0	114.80	138.55	253.35	1046.50	261.50	1
220.0	4.0	103.86	152.88	256.74	614.25	243.24	0

TABLE A2

Cross-Section Data from Settlement Farms - Yala 1972

Total Production in Bushels	*Land cultivated in Acres*	*Family Labour in m.d.*	*Hired Labour in m.d.*	*Total Labour in m.d.*	*Production Expen-diture in Rs.*	*Cost of Ferti-liser in Rs.*	*HYV Dummy variable*
110.0	2.25 .	35.64	83.61	119.25	340.0	117.99	0
130.0	2.0	43.34	93.68	137.02	300.0	112.00	1
130.0	2.0	30.79	56.51	87.30	302.0	114.00	1
160.0	2.0	29.33	72.45	101.79	481.25	114.00	1
90.0	2.0	34.05	64.86	98.91	232.00	10.00	0
130.0	2.0	17.85	82.75	100.6	305.50	113.50	1
130.0	2.0	28.63	71.30	99.93	281.00	93.00	1
190.0	3.0	47.82	103.55	151.37	381.00	168.00	1
110.0	2.0	28.22	94.86	123.08	286.00	112.00	0
130.0	2.0	41.91	53.68	95.59	292.50	113.50	1
280.0	4.0	73.74	139.90	213.64	486.00	224.00	1
190.0	4.0	70.61	111.14	181.75	380.98	168.00	0
100.0	1.5	27.01	9.75	36.76	212.75	67.50	1
290.0	5.0	112.71	132.61	245.32	745.00	280.00	1
370.0	5.0	90.91	136.58	227.49	737.00	280.00	1
260.0	4.0	75.51	138.58	214.09	957.00	212.00	1
310.0	5.0	100.63	103.00	203.63	1167.00	280.00	1
190.0	3.0	57.63	84.58	142.63	515.00	168.00	1
360.0	5.0	109.30	186.75	296.05	844.00	280.00	1
210.0	3.0	66.91	119.82	186.73	502.99	168.00	1
140.0	3.0	60.51	91.60	152.11	480.00	60.00	0
330.0	5.0	105.91	175.73	281.64	679.50	286.00	0
125.0	2.0	73.59	129.33	202.92	357.00	112.00	0
120.0	2.0	366.66	74.2	110.86	291.00	112.00	1
145.0	2.5	72.29	114.4	186.69	209.50	47.00	1
210.0	3.0	53.14	63.9	117.04	708.00	168.00	0
310.0	5.0	97.40	150.85	248.25	786.00	280.00	1
355.0	5.0	77.47	148.75	226.22	466.50	170.50	0
220.0	4.0	74.38	129.33	203.71	419.50	218.00	0
180.0	2.5	34.57	80.85	115.42	258.50	155.00	1
180.0	3.0	87.66	68.04	155.70	310.00	111.99	1
300.0	5.0	92.77	122.07	214.84	957.00	130.00	1
180.0	3.0	76.58	119.34	195.92	443.00	138.00	1
150.0	2.5	42.47	99.85	142.05	565.00	143.00	1
200.0	3.0	62.52	112.17	174.69	559.00	168.00	1
340.0	5.0	114.55	134.37	248.92	539.00	224.00	0
270.0	4.0	79.10	129.57	208.67	894.00	224.00	1