LABOUR UTILIZATION IN FIELD-CROP AGRICULTURE

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INTRODUCTION

The main subject of this paper is the relationship between production and labor use in crop agriculture (excluding perennial crops such as tea, rubber and coconut). The analysis is limited to three traditional crops and a few export crops and does not do adequate justice to the entire field-crop sub-sector, which comprises over sixty seasonal crops. It is hence more of an illustrative study than an exhaustive review.

The reason for undertaking this study is that output-labor coefficients for commercial field crops, even if known, are not fully appreciated; the full employment potential of import substitution or export promotion in agriculture• thereby not receiving the attention it deserves. We have focused on this issue because it does not appear that rural unemployment could be reduced significantly through industrialization alone. As we shall see, the problem is so vast that whatever the calculus, it is not likely to work if the potential role of agriculture in reducing rural poverty and unemployment is ignored.

One author, who is an authority on the development experiences of the newly industrialized countries of Asia ("Asian NICs"), states that:

"... both the static unskilled-labor-intensity and the dynamic unskilled-labor-intensity of total-factor-productivity change are considerably higher for agriculture than for industry. This implies that in the search for solutions to poverty and unemployment problems, the a priori case for continued agricultural development is quite strong. It also casts doubt on the proposition that industrialization is the answer to poverty alleviation and unemployment reduction (1, p.5), and goes on to argue that an agricultural-development-led industrial strategy would be more appropriate for Sri Lanka than an export-led industrial strategy. The purpose of this study is not to examine or defend the merits of the "agricultural-development-led-industrialization" thesis, but rather to demonstrate (with specific examples from the field-crop sub-sector) that significant employment, income and foreign exchange benefits will be realized if agricultural development is continued, even on a modest scale. This analysis is confined to seasonal crops, but if indeed, the other sub-sectors (perennial crops, livestock, forestry, fisheries, etc.) are also brought into the calculus, the above benefits are likely to greatly exceed expectations."

Sri Lanka is yet a long way from achieving an agricultural transformation. Perhaps the reason is that the case for continued agricultural development has not been made strongly enough, given our eagerness to catch up with the Asian NICs through rapid industrialization and export-led growth.

SCOPE AND OBJECTIVES

The main objective of this study is to estimate the impact of increased production on labor-use in agriculture, and to assess this impact in relation to the problem of unemployment in the rural sector. Given time and data constraints, the study is limited in scope to seasonal crops, and within this sub-sector, only to those crops with significant import substitution or export potential.

We have relied primarily on time series data to derive the relevant elasticity coefficients and related statistical parameters.The bulk of the analysis has been devoted to selected traditional crops given the absence of a time series for new export crops and difficulties with assessing the demand for these commodities overseas. Hence more or less by default, we have focussed mainly on import substitution. The three main crops in this regard are paddy, onions and chillies. Wheat, sugar and cowpea also have significant import substitution possibilities (at least in theory), but are not considered for reasons described below.

In most areas of Sri Lanka, the climate is unsuited for wheat cultivation, and even in the cooler areas where it is possible to grow wheat, land is exceedingly scarce. Thus all of Sri Lanka's annual wheat requirements are imported. Since bread and other products made from wheat flour have become firmly established in the Sri Lankan diet, it is unlikely that any other commodity can displace wheat from the consumer's "indifference map".

Sugar is grown in Sri Lanka mainly under irrigated conditions. Since the country is only 15-20% self-sufficient in production, there is very large scope for import substitution. But Sri Lanka is one of the least efficient sugar producers in the world, and can only achieve self-reliance in this crop at a high international opportunity cost.

Cowpea and other pulses, such as mung bean and soya bean, are grown extensively in certain areas of the dry zone, but local producers have to contend with masoor dhal imports, which exceed 40,000 metric tons a year (Masoor dhal, or red lentils, is not grown in Sri Lanka because it does not perform well on local soil). Masoor dhal is the preferred food item and it is not possible to bias consumer demand toward the locally grown pulses except through protective tariff mechanisms, which are incompatible with current free-market policies.

In addition to estimating the additional labor requirements for paddy, onions and chillies, we have also estimated the additional (a) land requirements, (b) contributions to the gross domestic product (GDP), and (c) foreign exchange savings, resulting from a self sufficiency drive in production. Paddy has been included in this analysis because it is the "alpha and omega" of consumption and production. The average consumer obtains more than 40% and 30% of his daily intake of energy and protein, respectively, from rice and depends on local producers to supply about 85% of his annual rice requirement. The area planted with paddy (annually) far exceeds the area planted with the other field crops (OFCS) collectively. Hence in aggregate terms, paddy is the largest employer of seasonal labor in the field-crop sub-sector, even though it uses considerably less labor per unit of land than the other leading commercial crops, such as chillies and onions.

THE UNEMPLOYMENT PICTURE

As we have seen, this study seeks to assess the extent of agricultural unemployment in Sri Lanka (non-estate sector) and to ascertain, through analysis of labor-output relations, what impact self-reliance in selected field crops will have on this problem.

This is not an easy task because the rural unemployment picture is extremely sketchy - i.e., published data on rural unemployment are not sufficiently disaggregated to provide information separately on the agricultural (non-estate) sector. Therefore agricultural planners and analysts at the macro level are at a disadvantage, as they do not know to what degree the supply of agricultural labor exceeds demand, what level of investment and output is required to correct this imbalance, and which subdivisions within the agricultural sector have the best income and employment-generating potential.

Our study has relied primarily on the findings of a Labor Force Survey conducted in 1985-86 for quantifying the unemployment problem in the agricultural sector (7).* This survey reported that there were 5,131,749 employed persons in Sri Lanka, of whom 49.3% were employed in the agricultural sector (including animal husbandry, forestry, fisheries and perennial crops.) The urban sector had the highest unemployment rate — 19.5%, as compared to 13.2% in the rural sector and 7.8% in the estate sector. On the other hand, the rural sector had the highest number of unemployed persons — 567,064, as compared to 236,350 in the urban sector and 36,843 in the estate sector. The number of unemployed persons totalled 840,252, which translated into a national unemployment rate of 14.1%.**

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* A more recent source are the quarterly Labor Force Surveys conducted in 1990, which were recently published (9). These reports, however, do not have data pertaining to the agricultural sector. Another survey conducted in 1986/87 was also published recently (3), but unfortunately it could not cover the seven districts (located in the Northern and Eastern provinces) adversely affected by the security situation. Moreover, the survey report contains only tables and no analysis - i.e., "population" estimates of unemployment are not available from this report. Another study, however, states that (based on the findings of this survey) the unemployment rate in Sri Lanka in 1987 was 15.5% (4).

** The 1990 Labor Force Survey (first quarter) states there were 1.01 million unemployed persons in Sri Lanka and that the unemployment rate was 14.4%. This suggests that the unemployment problem has worsened in absolute terms, but not in relative terms. During the period 1986-90, growth of real 1986-90 per capita gross domestic product (GDP) averaged only 2.0% per annum, as compared to 3.7% per annum in the previous five years; it is surprising therefore that there was no significant increase in the unemployment rate.

These (unemployed) individuals were distributed among the three main sectors as follows: urban — 28.1%, rural — 67.5%, and estate — 4.4%.* Hence in the mid-1980s, more than two-thirds of the unemployed were rural job-seekers.** But what proportion of the rural unemployed were agricultural (non-estate) workers? The survey report unfortunately does not provide the answer and as there are no alternative estimates, we have to resort to conjecture. Even though more than half a million workers were unemployed in the rural sector in the mid-1980s, it cannot be assumed that they were all (or mostly) agricultural workers, for the reason that 36.7% of the rural unemployed had studied up to Grade 10 (or above), and were in all probability searching for permanent white-collar jobs. The survey, however, reported that of the 3,716,847 persons employed in the rural sector, 2,017,299 persons (54.3%) were agricultural workers (owner-operators, tenant cultivators, hired laborers, etc.). Now, if it could be assumed that a similar proportion, say 50%, of the unemployed rural workers were agricultural workers (not a scientific assumption but a convenient one under the circumstances), it could be concluded that in the mid-1980s, there were 283,532 unemployed persons in the agricultural (non-estate) sector, representing 33.7% of the national total.

It is likely that the number of persons currently unemployed in the agricultural (non-estate) sector is at least 300,000, and in the rural, at least 600,000. The urban sector had 236,350 persons unemployed in the mid-1980s; hence the current figure probably exceeds quarter million. It is evident that the urban sector has a huge problem of its own and cannot be expected to productively absorb surplus labor from the rural areas, at least for the remainder of this decade. The problem of rural unemployment therefore has to be solved within the rural sector. It is critical to assess what contribution the agricultural sector could make in this regard, the lack of data notwithstanding.

BENEFITS OF SELF-SUFFICIENCY IN RICE PRODUCTION

EMPLOYMENT

To estimate, with some degree of accuracy, the labor demand for achieving 100% import substitution in paddy production, it is necessary to quantify the relation between employment and output in aggregate terms - i.e., estimate the output elasticity of paddy with respect to labor, which could serve as an overall "index" for Sri Lanka. Experimental data are not satisfactory for this purpose, because the methods of cultivation tested in research stations are often at variance with those actually practised by farmers, given the less than ideal (and diverse) conditions under which they operate. Hence measures of factor productivity, such as capital:output ratios and labor:output ratios, obtained from "controlled" situations are rarely the same as those obtained from "actual" situations.

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* We note that the share of the estate sector in national unemployment was negligible.
** The 19867/87 survey (3) shows this share having increased to nearly three-fourths.

We have accordingly used empirical, time-series data as the basis for calculating the various production coefficients of relevance to this study.

LABOR AND LAND UTILIZATION IN THE PADDY SUB-SECTOR

Figures on total mandays employed in paddy cultivation are not readily available and had to be obtained indirectly from published (district-wise) data on seasonal labor use per unit of land, covering the period Maha 1978/79 to Maha 1989/90 (5) (data for 1991 was not available at the time of this study). Based on this data, the average number of mandays utilized per hectare of paddy land was calculated separately for the irrigated and rainfed areas, per season (variables M3 and M4 of Table 1). The total mandays for the irrigated and rainfed areas (M5 and M6) were calculated by multiplying the average by the respective area sown (H4 and H3). The total mandays per season (M7) were thus obtained by summing variables M5 and M6.

The total output of paddy per season (P1) is also shown in Table 1. Data on area sown, area harvested, average yield and total yield — by district and according to source of water supply — are available in published form (10). Table 1 also includes the mandays utilized per hectare of paddy land by season (all-island average), also displayed in Figure 1. The regression on which this plot is based is shown below (M8=mandays per hectare, T1=trend variable).

Equation: M8 =CO+(C1•T1)
Result: CO =134.46 C1=-0.15
T-stat(C1)=-0.41 2-tail sig(C1)=0.7 R2=0.01

The graph reveals that M8 has been fluctuating a great deal since the late 1970s. But the trend line, or fitted line, is flat, which means that over time, M8 has remained constant in the statistical sense. It could be argued that M8 is an all-island average, which does not adequately capture regional variations in intensity of labor use. But the regression model applied separately to the irrigated and rainfed areas produced the same statistical result - i.e., C1 not significantly different from zero.

Total labor use in paddy cultivation, per season, is shown in Figure 2, which is based on the following regression (M7=total mandays, T1=trend variable).

Equation: M7 =C0+(C1*T1)
Result: CO =62485903 C1= -380105
T-stat(C1)= - 0.46 2-tail sig(C1)= 0.7 R2=0.01

In this case also the trend line is flat (slope coefficient not significantly different from zero), which is a surprising result, because it suggests that there has been no significant increase in total labor use during the period of this study. This is explained by the fact that the total area cultivated under paddy has also not increased significantly (in the statistical sense) during the same period (Figure 3). This result is demonstrated by the following regression (H5=total area sown, T1=trend variable).

Equation: H5=C0 + (C1 * T1)
Result: C0=469957 Cl= -2440
T-stat (C1)= -0.36 2-tail sig (C1)= 0.7 R2=0.01

The above findings suggest that land and labor utilization in the paddy sub-sector has been remaining more or less constant since the late 1970s (in other words, at the same time that new paddy land has been developed in some areas, a similiar extent of existing land has been "abandoned" in other areas). In all three regressions, as displayed above, the slope coefficient (with respect to time) was not significantly different from zero. A further regression of production on time (Figure 4) produced the same result (P1=production, T1=time; these regressions are all based on seasonal data. A trend analysis performed on annual data yields the same conclusions).

Equation: P1=C0 +(C1* T1)
Result: C0=1118450 C1=9077
T-stat (C1)= 0.47 2-tail sig(C1)= 0.6 R2=0.01

These are disappointing outcomes in view of the fact that vast sums of money have been spent on irrigation, land development and settlement (a total exceeding $2 billion since 1977). This investment appears to have had a high opportunity cost considering the impact on total production, income and employment, which has not been significant.

It is, of course, possible that the situation would have been different had there been no civil strife. Around one-third of the "asweddumized" paddy land - i.e., land permanently bunded and levelled for paddy cultivation, is located the Northern and Eastern provinces, which are the principal areas affected by the adverse security situation.

THE EMPLOYMENT IMPACT OF INCREASED PADDY PRODUCTION

The relationship between employment and production is normally described in terms of the elasticity of output with respect to labor, which is a coefficient derived through ordinary least squares analysis - i.e., from regressing production (dependent variable) on labor (independent variable). The model used is the log-log function, which gives the percentage change in production output expected from a one percent change in labor input. The elasticity coefficient is not an absolute truth but a probabilistic estimate, the reliability of which depends a great deal on the quality of the data, "goodness of fit", and the degree to which the model conforms to the classical assumptions, such as the absence of multicolinearity and serial correlation.

The Cobb-Douglas production function is frequently used for measuring the elasticities of output with respect to labor and capital (11, pp.107-109); it is expressed in the logarithmic form as LogY=C0+(C1*LogX1)+(C2*LogX2), where Y=output, X1=labor input, X2=capital input, and C0=log of the intercept. However, this study is concerned primarily with the relationship between output and labor, hence capital is excluded from the model. Moreover, what we wish to measure is the employment impact of increased production rather than the production impact of increased employment. Therefore in this instance, labor is treated as a dependent variable and production as an independent variable. Labor is a production input, not an output, and switching the two variables (output and labor) around in this manner may not be in accordance with conventional practice. But in the statistical sense (or theoretical sense, for that matter) no great harm is done by treating employment as a product (or by-product) of growth, which is the approach taken in general equilibrium analysis.

Using the same data series as above (Maha 1978/79 to Maha 1989/90), the elasticity of labor with respect to (paddy) output was measured as follows (LOGM7=labor, LOGPI=output).

Equation: LogM7=C0 +(C1* LogP1)*
Result: C0=6.72 C1=0.80
T-stat(C1)=10.16 2-tail sig(C1)=0.00 R2=0.87

The regression produced a (highly significant) elasticity coefficient of 0.80, which means that if production is increased by 10%, labor absorption is likely to increase by about 8%. This is a satisfactory result, since it indicates that substantial seasonal employment could be created through the growth of the paddy sub-sector.

Based on the relationship LogM7=6.72+0.80*LogP1, it is possible to estimate roughly how much (seasonal) employment will be generated if Sri Lanka attains complete self-reliance in paddy production. The self-sufficiency level was calculated on the basis of the following three assumptions: (a) growth of the population will remain constant at 1.5% (2, p.1), (b) apparent per capita consumption of rice will remain constant at 110 kg per annum (including the standard seed-feed-wastage factor of 10%)** and (c) self-sufficiency could be reached by 1995 (involving a 20% increase in production).

Results of the forecasting exercise (log-log model) are shown in Table 2, where LOGP1=log of paddy production in metric tons, and HLOGM7=log of mandays utilized (forecasted values). Observations 19 and 20 show the reported production level for 1991 (base year) and the targeted production level for 1995, and the corresponding labor forecasts. When the log values are transformed, we get the following results.

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* See ennexed legned on variables

** Income and price-elasticities of demand were not considered due to the lack of data. The figure of 110 kg of rice is based on data provided by the Central Bank Annual Reports and other published sources (7), for the past 10 12 years.

	Paddy Production (metric tons)	Employment (man days)
1991	2,389,000 (114,481,000 bu)	101,973,140
1995	2,879,000 (137,962,000 bu)	118,342,083

The estimated increase in (seasonal) employment therefore is 16,368,943 mandays, which are equal to 163,689 persons, assuming that 100 mandays (i.e., 25 mandays per month x 4 months) are equivalent to one unit of labor. In other words, approximately 164,000 additional persons (agricultural laborers) could find employment for four months of the year through achievement of self-sufficiency in paddy production.

We saw that there are probably around 300,000 persons unemployed in the agricultural (non-estate) sector, comprising one-third of the national total. The above analysis suggests that a 55% reduction in seasonal agricultural unemployment could be realized through attainment of rice autarky. A 20% increase in paddy production (over four years) therefore is quite significant in relation to the unemployment problem in field crop agriculture.

It is not possible to say (given lack of information) what percentage of the unemployed job-seekers in the agricultural sector (excluding plantations) are unskilled laborers, but our guess is that it is very high (over 80%). These workers would benefit significantly from expanded seasonal employment opportunities in the agricultural sector.*

LAND REQUIREMENT FOR INCREASED PADDY PRODUCTION

It has been assumed in the above (self-sufficiency) analysis that paddy yields will remain constant. During the past ten years (1982-91), the highest (average, annual) yield was obtained in 1983 (3,606 kg per hectare), and the lowest yield, in 1984 (3,076 kg per hectare). The mean and coefficient of variation for this period are 3,411 kg per hectare and 4.5%, respectively, the latter indicating that productivity has been "stuck" around the mean and that the probability of this mean increasing significantly in the 1990s is low.

To attain the goal of self-sufficiency in rice therefore Sri Lanka will have to rely primarily on an expansion of the area cultivated each year. Little new land is available for this purpose, which leaves intensification of land use as the only alternative. It will be seen that the existing land base is, in fact, considerably underutilized. In 1991, the total area sown was 817,000 hectares, of which 501,000 hectares (61%) were

* The 1990 Survey, Quarter I (9), reported that of the persons employed in the agricultural sector (including estates), 52% were skilled workers and 46 were unskilled workers (the remaining 2% comprising government officials, professionals, technicians, etc.).

cropped in the major season (Maha 1990-91) and 316,000 hectares (39%), in the minor season (Yala 1991). However, according to official statistics, the total asweddumized area for 1991 was around 778,000 hectares (12, p.4). Hence in the Maha of 1990-91, around 277,000 hectares (34%) of existing paddy land were not cultivated. The distribution of unutilized land by district (Maha 1989-90) is shown in Figure 5.

To quantify the relationship between production and land use, sown area (H5) was regressed on production (P1) in the log-log form. The model produced an excellent goodness of fit and an elasticity coefficient for land with respect to output of 0.88, as shown below.

Equation: LogH5=C0+(C1•LogP1)
Result: C0=0.69 C1=0.88
T-stat (C1)=12.06 2-tail sig(C1)=0.00 R2=0.90

Using the function LogH5=0.69+0.88 LogP1, the forecasted values of sown area (HLOGH5) were obtained in the same manner as for labor, which results are shown in Table 3. Observations 19 and 20 show the reported production level for 1991 (base year) and the targeted production level for 1995, and the corresponding sown area forecasts. Transforming the log values gives the following results.

	Paddy Production (metric tons)	Sown area (hectares)
1991	2,389,000	817,000
1995	2,879,00	962,000

The official figure for the cultivated area in 1991 is 817,000 hectares. The forecasted value for the same year (derived from the above model) is also 817,000 hectares, which is indicative of its strong predictive power. We saw that the total asweddumized area is around 778,000 hectares. Thus in 1991, the cropping intensity of paddy was only 105% (i.e., 817/778 x 100). To achieve self-sufficiency in paddy production, a cropping intensity of around 118% will be required (i.e., 962/778 x 100), which involves the cultivation of an additional 145,000 hectares, amounting to 52% of the unutilized asweddumized land area (of 277,000 hectares). The balance 48% (132,000 hectares) could be considered surplus paddy land (which is only a rough approximation).

The above findings suggest that there has been over-development of land in the paddy sub-sector. It is beyond the scope of this study to undertake a classification of this land in terms of its hydrological properties. But if the bulk of this land is poorly drained, it cannot be planted with other crops, which means it will lie in fallow indefinitely.

Of the 277,000 hectares of asweddumized land not cultivated in Maha 1990/ 91, approximately half was located in the North and East. The other half was thus located outside the "war zone".* We have estimated that achievement of self-sufficiency in paddy by 1995 (assuming no change in productivity) involves increasing the sown area from 817,000 hectares to 962,000 hectares (i.e., by 145,000 hectares). This may be difficult in view of the war situation in the North and East. If this war ends, there is likely to be a substantial increase in paddy production. But production outside the war-torn areas will also have to increase simultaneously for Sri Lanka to <u>achieve and sustain</u> autarky in rice.

It is interesting to note that under the Mahaweli Program, 68,140 hectares and 50,894 hectares of irrigated land was cultivated in Maha 1990-91 and Yala 1991, respectively, giving a total of 119,034 hectares (2, p.75). Ninety percent of the land cultivated in the Maha was planted with paddy, with the corresponding figure for Yala being 72%. The total extent planted with other crops during the 1990-91 cultivation year was about 21,000 hectares (18%). It may be possible to increase this fraction to about 40% (48,000 hectares) in the future. But any further increase is likely to be difficult, considering the soils, topograpgy and hydrological properties of the Mahaweli command area, which tend to favor rice monoculture.

If Sri Lanka becomes a surplus producer of rice (which is not likely to happen as long as the North-East war continues), prices will start to fall and force many small farmers to diversify or go out of business. But we have just seen that in the Mahaweli areas, the bulk of the land is suited only for rice cultivation. The Accelerated Mahaweli Program (AMP) was designed primarily to promote paddy production and the landscape was developed accordingly, at a cost of approximately Rs 500,000 per hectare of irrigated land (13, p.5). This may have been a costly mistake in the long run, considering that (according to our findings) more paddy land has been developed than is necessary to feed the population of Sri Lanka. On the other hand, it could be argued that the Mahaweli Program is playing an important "buffer" role by compensating for the war-torn areas where a relatively large amount of paddy land has been forced out of cultivation (though, of course, this is not the purpose for which it was designed).

NATIONAL INCOME

We have calculated that to attain self-sufficiency in paddy by 1995, production has to increase by about 490,000 metric tons. In 1991, farmers produced 2.389 million metric tons of paddy and contributed Rs 6,301 million to the national income accounts, amounting to 4.7% of the gross domestic product (2, p.3). The net return on a metric ton of paddy (at 1982 constant factor cost prices) was therefore Rs 2,637. Hence by increasing paddy production by 490,000 metric tons, farmers would be contributing an additional Rs 1,292 million to GDP. This is only a rough estimate, but

* It is not clear why this land is not being cultivated. One possible reason is that it is unproductive (poor soils, salinity, acidity, regular flooding, etc.); a second is the scarcity of water, draft power, etc.; a third is rising production costs, which may be driving the smaller producers out of business.

it serves to illustrate the impact on national income of a 20% increase in paddy production (In 1991, GDP was Rs 135,389 million and agricultural GDP, Rs 30,869 million at 1982 constant factor cost prices).

FOREIGN EXCHANGE

In 1991, Sri Lanka imported 132,962 metric tons of paddy at a cost of Rs 1,589 million, or Rs 11,950 per metric ton (2, pp.94-95). If production remains static, the import requirement will increased to about 500,000 metric tons by 1995. If, on the other hand, self-sufficiency is attained and sustained, about Rs 6,000 million ($136.4 million) in foreign exchange will be saved annually.

During the period 1988-90, the annual import price of rice (C&F) averaged Rs 9,856 per metric ton (2, Table 44), as compared to a domestic producer price of Rs 10,117 for parboiled rice (6). Our rice imports come from the Asian region (mainly Pakistan and Indochina). The case for 100% import substitution would be stronger if Sri Lanka were a more-efficient producer of rice. The above data suggest that we are a moderately high-cost producer of rice by Asian standards, a problem that could be rectified through a modest increase in productivity (output per unit of land).

BENEFITS OF SELF-SUFFICIENCY IN ONION PRODUCTION

EMPLOYMENT

Quantifying the relationship between labor-use and production (in the aggregate) for onions is not as straightforward as for rice because (a) there are two types of onions produced, namely small (red) onion and large (Bombay) onion, and (b) reliable time-series data on large onion production and related features, such as factor inputs and per unit costs, are not available (for the reason that it has emerged as a commercial crop only in recent years).

The quantity of large onions annually imported is considerably greater than that locally produced, on the average. For instance, between 1988 and 1991, annual imports averaged 34,056 metric tons while annual production averaged only 9,767 metric tons.✧ On the other hand, no small onions have been imported for several years, which suggests the country has become self-sufficient in this crop (or it may simply reflect the decision of the government to fill the overall demand-supply gap with the import of large onions). If this import policy correctly reflects consumer preference, it means that the potential for import substitution is greater for large onions than for small onions. In 1991, Sri Lanka was only about 60% self-sufficient in the production of onions.

✧ Data on imports (values and quantities) of other food crops (OFCs) supplied by the Cooperative Wholesale Establishment (unpublished). Data on domestic production, sown area and yields of OFCs supplied by the Department of Census and Statistics (unpublished). The production of OFCs tends to be underestimated because in recent years, the DCS has been unable to collect statistics from the war-torn areas.

Both small and large onions are important in terms of consumption, though historically the former has been consumed in much greater quantities than the latter. However, the recent trend indicates that this pattern is changing - i.e., the relative share of large onions in the gross available supply is increasing while that of small onions is correspondingly decreasing. This may suggest that small onions are an inferior good relative to large onions - i.e., more and more consumers are switching from small onions to large onions because of rising real incomes. on the other hand, this may have nothing to do with economics but simply reflect the fact that owing to the war situation in the North and East, the normal "quota" of red onions is not being produced. But if in fact a qualitative change in consumer demand is occurring, it means that over time price signals will also change and that producers will adjust accordingly - i.e., they will produce more large onions and less small onions (the cultivation techniques for the two crops are similar, but the cropping calender for large onions is about two weeks longer than that for small onions).

What we are interested in is the growth of aggregate demand for onions, the projected increase in production, and its likely employment impact. For estimating the employment impact, a labor-output coefficient derived from a time series on small onions will serve as a proxy for onions in general due to the absence of a reliable time series on large onions, it was not possible to establish a labor-output relationship for this crop). Using a proxy in this instance, however, may not involve any serious methodological errors as the elasticities of labor with respect to output are likely to be similar for the two crops (If at all, the employment impact will be underestimated because it takes less time to produce a crop of small onions than a crop of large onions).

LABOR UTILIZATION IN ONION CULTIVATION

As with paddy, total mandays employed in (small) onion cultivation were calculated indirectly from published (district-wise) data on seasonal labour use per unit of land for the period Maha 1978/79 to Maha 1989/90 — irrigated land (5). For certain years where irrigated cultivation data was not available, rainfed data was used as proxies. Based on these data, the average number of mandays utilized per hectare of onions was obtained for each season (variable M14 of Table 4). The total mandays per season (M15) was obtained by multiplying the average by the respective area sown (H6). The total output of small onions (P2) is also shown in Table 4.

The trend in small onion cultivation is similiar to that of paddy-cultivation in that no significant increase in sown area or production has occurred during the period of study. For example, a regression of production on time (semi-log) yielded the following results (LOGP2=total production, T1=trend variable).

Equation: LogP2=C0+(C1*T1)
Result: C0=34543 C1=-404.54
T-stat(C1)= - 0.94 2-tail sig(C1)= 0.54 R2=0.05

Though not statistically significant, (C1) is negative, which suggests that red onion production is on a downward track. As we saw, one possible reason is the disruption of cultivation in the war-torn districts, where small onions are normally widely grown, combined with statistical underreporting in these areas. Another is that more and more cultivators may be switching from small onions to large onions in response to changing consumer demand patterns. Perhaps both factors are in operation simultaneously.

THE EMPLOYMENT IMPACT OF INCREASED ONION PRODUCTION

We observed earlier that onion imports have been averaging around 34,500 metric tons per annum in recent years. Hence there is substantial scope for import substitution in onions, particularly large onions. It should be possible to increase production significantly in areas, such as systems B, C and H of the Mahaweli Program, where irrigation water is available for both seasons.

The elasticity of labor with respect to onion production was calculated in the same manner as for paddy - i.e., by regressing total mandays on total output in the log-log form, using the Maha 1978/79 to Maha 1989/90 data series. The outcome was as follows (LOGM15=labor, LOGP2=output).

Equation: LogMI5=C0 +(C1*LogP2)
Result: C0=1.28 C (1)=1.27
T-stat(C1)=4.75 2-tail sig(C1)= 0.00 R2=0.58

The labor-output coefficient is equal to 1.27, which means that if onion production is increased by 10%, labor absorption is likely to increase by about 13%. Thus labor use in onion cultivation is elastic with respect to output, a favorable result from the point of view of employment creation. The following assumptions were made in measuring the probable employment impact of a self-sufficiency drive in onion production: (a) population growth will remain constant at 1.5% per annum, (b) apparent, per capita consumption of onions will remain constant at 7.8 kilograms per annum (see Table 5),* and (c) autarky could be reached by 1995.

The forecasting exercise, utilizing the log-log function LogMI5=1.28+1.27*LogP2, yielded the results shown in Table 6, where LOGP2=onion production and HLOM15=mandays utilized (forecasted values). Observations 19 and 20 pertain to the reported production level for 1991 (base year) and the targeted (self-sufficiency) level for 1995, and the corresponding labor forecasts. The following results were obtained when the log values were transformed.

* Income and price elasticities of demand were not taken into consideration due to the lack of data.

	Onion Production (metric tons)	Employment (mandays)
1991	53,397*	3,815,720
1995	142,779	13,362,596

The model implies that attainment of self-sufficiency in onions will generate an additional 9,546,876 mandays of employment, equal to 95,469 units of labor (i.e., 25 mandays per month for 4 months). In other words, approximately 95,500 agricultural workers will find employment for about four months of the year if onion production is increased from the present level of 53,397 metric tons to the self-sufficiency level of 142,779 metric tons (by 1995).

However, a downard adjustment of this estimate is required in view of the fact that the reported production level for 1991 does not include the contribution from the war-torn areas. It is likely that onion production for 1991 was underestimated by about 30%,** which means that the employment benefit of 100% import substitution in onion production (as calculated above) is probably overestimated by about 38% (given an elasticity coefficient of 1.27). The forecast has accordingly been reduced from 95,469 to 69,180 additional (seasonal) jobs created.

We have estimated that there are probably around 300,000 unemployed persons in field-crop agriculture, the majority of whom are likely to be unskilled, underemployed agricultural workers. our findings suggest that a self-sufficiency drive in onions will realize a 23% reduction in seasonal agricultural unemployment. To achieve autarky in onions by 1995, production will have to more or less double in four years.

LAND REQUIRED FOR INCREASED ONION PRODUCTION

Like paddy yields, onion yields (output per unit of land) have also been stagnating during the past several years. It is therefore assumed that increased production will result primarily from an expansion of the area cultivated.

To estimate the additional extent required for attaining self-sufficiency in onion production, sown area (H6) was regressed on production (P2) in the log-log form. The model produced an elasticity coefficient for land with respect to output of 0.86, as shown below.

Equation: LogH6=C0+(C1*LogP2)
Result: C0= -0.62 C1=0.86
T-stat(C1)=6.26 2-tail sig(C1)=0.00 R2=0.71

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* Provisional.

** According to the Central Bank (2, Table 16), onion production was 72,700 metric tons in 1991, as compared to our figure (Department of Census and Statistics) of 53,397 metric tons. The revised estimate (accounting for 30% underreporting) is 69,416 metric tons.

The forecasts of sown area (HLOGH6) were obtained using the equation LogH6= - 0.62 +0.86 LogP2 (see Table 7 for results). Observations 19 and 20 represent the reported production level for 1991 (base year) and the targeted level for 1995, and the corresponding sown area figures. Transforming the log values yields the following outcomes.

	Onion Production (metric tons)	Sown Area (hectares)
1991	53,397	7,589*
1995	142,779	14,184**

The above analysis indicates that 6,595 hectares of additional land will be required for reaching self-sufficiency in onion production (given the problem with underreporting of production and cultivated extents in recent years, this forecast may err on the high side). If peace is established in the North and East, fallow lands will be brought into production and this target will be easily reached. In the meantime, however, import-substitution opportunities need to be explored elsewhere. In areas, such as the Mahaweli, where crops are grown under irrigated conditions, it should be possible to expand onion cultivation in both the Maha and Yala seasons. Farmers will do so only if there are adequate incentives, the creation of which is the domain of policy analysts and decision-makers.

NATIONAL INCOME

The contribution of onions to GDP is not available from the Central Bank Annual Report, where it is subsumed under a line-item called "Other", comprising minor food crops, forestry and fisheries. However, from other 1990 data sources (5) we have obtained a rough estimate of Rs 17,910 and Rs 9,414 as the (average) net returns per metric ton of small and large onions, respectively, including imputed family labor costs. (1991 cost of cultivation data was not available at the time of this study).

In 1990, production of small and large onions was 57,600 metric tons and 15,350 metric tons, respectively. Given the problem with statistical underreporting, we have adjusted these figures upward by 30%. The new figures are therefore 74,880 metric tons (for small onions) and 19,955 metric tons (for large onions), giving a total (revised) estimate of 94,835 metric tons for 1990.* ** It was accordingly calculated that in the same year, onions would have contributed around Rs 1,529 million to GDP at current prices, or Rs 680 million at 1982 constant factor cost prices.

As we saw, the production target for 1995 (i.e., the self-sufficiency level) is 142,779 metric tons, which exceeds the 1990 production level by 47,944 metric tons. If the desired target is reached by 1995 (through import substitution of large onions),

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* Actual.

** Forecasted.

* ** The figure given by the Central Bank Annual Report (2, Table 16) is 92,800 metric tons.

the additional contribution to GDP will be around Rs 451 million at current prices, or Rs 201 million at 1982 constant factor cost prices.

FOREIGN EXCHANGE

In 1991, 47,189 metric tons of large onions were imported at a cost of Rs 845 million (C&F), or Rs 17,907 per metric ton. In that year, however, the world price of onions was unusually high. During the period 1988-90, the import price averaged Rs 11,735 per metric ton. If production remains static at the 1991 level (69,416 metric tons),* the country will be importing 73,363 metric tons of onions by 1995. Rs 861 million ($ 19.6 million) in foreign exchange will therefore be saved by Sri Lanka achieving self-sufficiency in onions by 1995 (on the basis of the average import price just calculated).

During 1987-89, the annual producer price of red onions averaged Rs 9,480 per metric ton (6), which is significantly lower than the average import price of large onions (Rs 11,145) for the same period. A time series on the domestic producer price of large onions is not available, but cost of production data for certain years indicate that large onions are generally cheaper to produce than red onions (5). It would be thus tempting to conclude that Sri Lanka is reasonably competitive in the production of large onions. However, since 1990, both small and large onions have been recording abnormally high producer price levels (probably on account of adverse weather conditions), thereby raising the international opportunity cost of import substitution. It remains to be seen whether this domestic price aberration is temporary or permanent.

BENEFITS OF SELF-SUFFICIENCY IN CHILLI PRODUCTION

EMPLOYMENT

Chillies, like onions, are a commercial crop with a relatively high intensity of labor-use.** During the past 4-5 years, production has been fluctuating greatly because of a disease problem (which has so far defied diagnosis). Production has also been affected by drought and the war situation in the North and East. These factors nothwithstanding, Sri Lanka has achieved about 85% self-sufficiency in dried chilli production. With the population growing at 1.5%, there appears to be modest scope for import substitution.

Even though the quantity of chillies imported annually is much smaller than that of onions,*** it is still significant in terms of the foreign exchange cost as the average world price of chillies is 3-5 times than that of large onions. In 1991, the country imported 47,189 metric tons of large onions and 8,350 metric tons of dried chillies at a cost of Rs 845 million and Rs 694 million, respectively. Though in terms

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* Revised estimate.

** The bulk of the chillies produced are consumed in the dried form. Production data published by the Department of Census and Statistics pertain to green chillies, and a standard conversion factor of 25% is used to obtain the dried chilli equivalent.

*** Chillies are imported in the dried form.

of import volume, the difference between onions and chillies was 565%, in terms of import value, it was only 122%. Increased chilli production will, therefore, realize substantial foreign exchange savings. There will be significant income and employment benefits as well, given that chillies are a high-value, labor-intensive crop. However, for the country to attain and sustain self-sufficiency in chilli production, the aforementioned disease problem will have to be effectively combated.

LABOR UTILIZATION IN CHILLI CULTIVATION

Total mandays employed in chilli cultivation was estimated in the same manner as for paddy and onions, covering the period Maha 1978/79 to Maha 1989/90 (irrigated land). In instances where irrigated cultivation data was not available, rainfed data was used as proxy. The average number of mandays utilized per hectare of chillies was calculated for each season on the basis of these data (variable M13 of Table 4). For the reference period, the mean and seasonal variability index (coefficient of variation) are 362.59 and 32.2%, respectively. As shown below, among the three crops, paddy, onions and chillies, the second ranks highest in terms of intensity of labor use per unit of (irrigated) land.

	Average Labor-use (Mandays per Ha)	Coefficient of Variation (%)
Paddy	132.60	8.70
Onions	516.35	32.02
Chillies	362.59	32.20

For chillies, total mandays per season (MI6) were obtained by multiplying the above average by the respective area sown (H7). The total output of dried chillies (P4) is also shown in Table 4.*

Analysis indicates a very slight (but statistically significant) increase in cultivated area and production of (dried) chillies since 1979. For example, a regression of production on time (in the semi-log form) shows production increasing by about 0.1% per annum over the reference period (LOGP4=total production, T1=trend variable).

Equation: LogP4=C0 + (C 1*T1)
Result: C0=8.33 C1=0.06
T-stat(C1)=3.34 2-tail sig(C1)= 0.00 R2=0.42

THE EMPLOYMENT IMPACT OF INCREASED CHILLI PRODUCTION

This impact was estimated using the same methodology as for paddy and onions. In other words, total mandays were regressed on total output in the log-log

* The production estimates for dried chillies were obtained using the standard conversion factor of 25%, as explained earlier.

form to estimate the elasticity of labor with respect to output. In this instance, however, given lack of data on irrigation for many cultivation seasons (which would have necessitated the excessive use of proxies), the time series was restricted to the period Maha 1983/84 to Maha 1989/90. Results of the regression are as follows (LOGM16=labor, LOGP4=output).

Equation: LogMI6=C0 +(C1•LogP4)
Result: C0=4.35 C1=1.20
T-stat(C1)=6.65 2-tail sig (C1)= 0.00 R2=0.86

The elasticity coefficient is equal to 1.20, which suggests that a 10% increase in chilli production will contribute to a 12% increase in seasonal labor use. The output elasticity of labor for chillies is thus of similiar magnitude to that of onions.

In measuring the probable employment impact of a self-sufficiency drive in chilli production, the following assumptions were made: (a) population will grow at 1.5% per annum, (b) gross per capita availability will remain constant at 2.12 kilograms per annum (see Table 8),* and (c) autarky could be reached by 1995.

Results of the forecasting exercise, based on the log-log function LogM16=4.35 +1.20 Logp4 (where LOGP4=dried chilli production and HLOM15= mandays utilized), are shown in Table 9. Observations 19 and 20 pertain to the reported annual output for 1991 (base year) and the targeted ouput for 1995, and the corresponding labor forecasts. The antilog values are as follows.

	Chilli Production (metric tons)	Employment (mandays)
1991	24,800**	14,613,846
1995	38,807	25,014,094

The model suggests that an additional 10,400,248 mandays of seasonal employment could be generated through attainment of self-sufficiency in dried chilli production, equal to 69,335 units of labor, assuming that 150 mandays (i.e., 25 mandays per month for 6 months) are equivalent to one unit of labor.

As with onions, a downward adjustment of this estimate is necessary to account for under reporting in the war-torn areas. The 1991 output of dried chillies was also probably underestimated by about 30%, which means that the projected employment benefit should be reduced by about 36% (given a labor-output elasticity

* Income and price elasticities of demand were not considered due to the lack of data.
** Provisional

coefficientof 1.2). The revised forecast is thus 50,982 mandays. In other words, roughly 51,000 additional agricultural workers will find employment for six months of the year if chilli production is increased from the current level of 32,240 metric tons (adjusted for underreporting)* to the self-sufficiency level of 38,807 metric tons, by 1995.

Attainment of autarky in dried chillies will thus contribute to a 17% reduction in seasonal agricultural unemployment. This will entail chilli production increasing by approximately 20% over four years.

Our findings suggest that if combined autarky is attained in paddy, onions and chillies, seasonal jobs will be created for approximately 284,000 unemployed agricultural workers. Assuming there are about 300,000 unemployed workers in the field-crop sub-sector, this problem will be solved to a very high degree (95%) through a self-sufficiency drive in field crop agriculture. According to our estimates, there are about 600,000 unemployed persons in the rural sector, of whom around 50% are seasonally unemployed agricultural workers. Hence rural unemployment could be reduced by 47% if combined autarky is attained in the above three crops.

LAND REQUIRED FOR INCREASED CHILLI PRODUCTION

The model (log-log) shown below would be the basis for forecasting the additional extent required for attaining self-sufficiency in chillies, assuming constant yields (LOGH7=sown area, LOGP4=production).

Equation: LogH7=C0+(C1*LogP4)
Result: C0=6.52 C1=0.33
T-stat(C1)=2.16 2-tail sig(C1)=0.06 R2=0.40

However, this model has a poor goodness of fit and is not suitable for forecasting purposes. The additional land requirement was hence estimated using a simpler method. The average annual yield of dried chillies for the past two cultivation years (1989/90 and 1990/91) was around 0.84 metric tons per hectare. At this same level of productivity, the extent required to produce 38,807 metric tons of chillies (i.e., the self-sufficiency level) by 1995 would be 46,199 hectares. During the past two years, the average annual extent of land cultivated was 29,753 hectares. The difference between the current level and the targeted level is hence 16,446 hectares. This estimate may err on the high side, given the problem with underreporting in recent years.

Our analysis indicates that approximately 168,000 hectares of additional land will have to be cultivated to achieve combined autarky in paddy, onions and chillies. A major barrier to increased production of these crops is the war situation in the North and East, which has taken at least 150,000 hectares of productive land out of

* The Central Bank (2) gives a figure of 31,800 metric tons.

cultivation. Therefore while there is considerable scope for increased double cropping of rice, onions and chillies in the Mahaweli areas, a successful self-sufficiency drive may have to await the establishment of normalcy in the war-torn districts.

NATIONAL INCOME

As in the case of onions, it was not possible to ascertain the contribution of chillies to GDP directly from the Central Bank Annual Report. However, it was roughly estimated from other data sources (5) that the average net return per metric ton of dried chillies in 1990, including imputed family labor costs, was-around Rs 29,260 (1991 data was not available at the time of this study) Total production of dried chillies was 32,500 in 1990 (including the 30% adjustment factor). Thus, in that year, chillies would have contributed Rs 951 million to GDP at current prices, or Rs 423 million at 1982 constant factor cost prices. We have estimated the 1995 self-sufficiency level for chillies at 38,807 metric tons. The additional contribution to GDP would, therefore, be Rs 192 million at 1990 prices, or Rs 82 million at 1982 factor cost prices.

The above findings suggest that approximately Rs 1,600 million will be added to GDP (at constant factor cost prices) if complete self-reliance is attained simultaneously in paddy, onions and chillies.

FOREIGN EXCHANGE

In 1991, 8,350 metric tons of dried chillies were imported at a cost of Rs 694 million (C&F), or Rs 83,114 per metric ton. This price, however, was abnormally high. During the period 1988-90, the annual import price averaged Rs 55,548 per metric ton. The estimated self-sufficiency level of production is 38,807 metric tons. If production remains static at the current level (32,240 metric tons), the country will be importing 6,567 metric tons by 1995.* Rs 365 million ($8.3 million) will therefore be saved by Sri Lanka achieving self-sufficiency in chilli production. Autarky in all three crops, rice, onions and chillies (by 1995), will thus realize approximately Rs 7,200 million ($ 164.3 million) in foreign exchange savings with the main contribution, of course, coming from rice.

During the period 1988-90 (as we just saw), the annual import price of dried chillies averaged Rs 55,548 per metric ton, as compared to an average domestic producer price of Rs 59,063 (6). Thus Sri Lanka does not appear to be an efficient producer of dried chillies by world standards, which weakens the case for import substitution. It is probably because of the disease problem (which has been depressing yields quite severely in some areas) that Sri Lanka is producing dried chillies at a high international opportunity cost. If this problem is resolved, the country could become a competitive producer of chillies.

* It is possible (considering the 1991 level of imports) that we have substantially understimated the self-sufficiency level for dried chillies.

Summarized below are the estimated benefits of a successful and sustained self-sufficiency drive in paddy, onions and chillies.

	Additional Seasonal Employment (Persons)	Additional GDP (Rs Million)	Foreign Exchange Savings (Rs Million)
Paddy	163,689	1,292	6,000 ($ 136 million)
onions	69,180	201	861 ($ 19.6 million)
Chillies	50,982	82	365 ($ 8.3 million)
Total	283,851	1,575	7,226 ($ 164.3 million)

We have asserted that a principal constraint on increased production of paddy and OFCs is the war in the North and East, which has taken at least 150,000 hectares of tillable land out of cultivation. It could be posited that the war has cost, inter alia, approximately 300,000 seasonal jobs in the agricultural sector (let alone jobs in the other sectors, which this paper has not attempted to calculate). If civilian life returns to normal in the North and East, self-sufficiency could be attained and sustained in paddy and the other leading commercial field crops, such as chillies and onions.

A comparison of the actual with the hypothetical "if-not-for-the-war" situation has given us a rough idea of the benefits foregone (in terms of production, income and employment generation, and foreign exchange savings) due to civil disturbances in the North and East.

ECONOMIC AND EMPLOYMENT POTENTIAL OF NEW EXPORT CROPS

Several new crops (such as gherkin, cantaloup, butter nut, zucchini and sweet corn) have been introduced to Sri Lanka in recent years with a view to exploiting growing markets in Singapore, the Middle East, the Far East, etc. These crops are currently being tested and grown (on a trial basis) in the Mahaweli areas, with small amounts exported when the opportunities arise. The research, extension, production and marketing programs are concentrated in System B with support from the AID-financed Mahaweli Agriculture and Rural Development (MARD) project.

Cost of production data for a range of commercial crops (both new and traditional) tested in Sytem B have been assembled by MARD (14), but due to the absence of a time series, it is not possible to derive production functions for the new export crops (NECs). Nor is it possible to assess how competitive Sri Lanka is in the production of these crops since C&F prices (Colombo) are not available. Quality control factors also need to be borne in mind (size, shape, taste, texture, color, condition of produce, etc.), in which respects Sri Lanka is relatively undeveloped. Another constraint is that though there is a growing market overseas for high-value fruits and vegetables, it is open only to those countries that have successfully transformed their agricultural sectors and established powerful linkages among small farmers, exporters and the various intermediaries.

It will take time for Sri Lanka to break into the world scene and secure exclusive "niche" markets, since the country has not yet advanced to this level of development. To secure a "niche" market, the exporter must guarantee to the importer that a minimum quanitity of a given high-value, high-quality product will be supplied year after year according to the conditions specified in the "contract" -a tough proposition for a country like Sri Lanka, where drought is frequent, food production highly atomized and erratic, the rate of technical and institutional innovation low, quality control lacking, entrepreneurial skills limited, and the chain linking producers, exporters and intermediaries (vertical integration) relatively weak. Thus it is premature at this time to predict how successful Sri Lanka will be in the penetration of export markets for fruits and vegetables, or to forecast the quantity of exports from areas like System B (of the Mahaweli Program) over the next 3-5 years.

This is not a pessimistic outlook but a realistic assessment of the current state of the art. Projects like MARD are working intensively toward commercializing agriculture and promoting exports of fruits and vegetables and there is no reason to believe that Sri Lanka could not become a successful "niche" market producer over time. A general indication of progress in this area is that the value of exports of minor agricultural products (including fruits and vegetables) has doubled in the past ten years (2). The future horizon is therefore bright even though progress toward that point is somewhat slow.

Shown below is selected data for System B (14), for the purposes of illustrating how the NECs (butternut, Yala cantaloup, Yala sweet corn, and zucchini) compare with existing OFCs (chilli and large onion) in respect of labor use, unit cost, and expected yield. Unfortunately, because unit price data is not available, it is not possible to calculate the expected net returns on each of these crops. Nevertheless, we could surmise that chilli is probably the least profitable crop, considering that it has the lowest expected yield and the highest unit cost. In terms of labor use also, it ranks fairly low relative to the other crops. Zucchini and large onion are equal in terms of expected yield and labor use, but the former has a lower unit cost and is hence likely to yield a higher net return that the latter.

	Labor Use (md/ha)	Unit Cost (Rs/kg)	Expected Yield (kg/ha)
Butternut	250	3.09	10,000
Yala Cantaloup	1,600	8.23	12,000
Yala Sweet corn	400	2.84	7,000
Zucchini	800	2.06	10,000
Chilli	400	19.03	1,000
Large Onion	800	3.71	10,000

Cantaloup has a high unit cost because of the exceptionally high intensity of labor use, but it also commands a premium price overseas (Singapore, Dubai, etc.). Among the crops listed. cantaloup has the highest expected yield, with a quality product being supplied by small farmers in System B. If cantaloup achieves rapid export market penetration, it could well become a "winner" for Sri Lanka. Its high labor intensity also makes it a very appealing crop from the point of view of employment generation. A negative feature is the high unit cost, which may discourage small farmers from growing this crop. But evidence to the contrary is the bumper crop produced in the Yala of 1991.

All in all, the NECs appear to have significant income and employment potential, particularly cantaloup (Gherkin was not included in this analysis as cost of production data was not available). Unfortunately, since data is not readily available, we are unable to assess whether Sri Lankan farmers are producing these crops at internationally competitive prices, and whether the products satisfy the quality criteria imposed by the affluent Eastern and Western nations.

CONCLUSION

This paper has examined labor-output relations of paddy and selected other field crops (OFCs) in the context of the rural unemployment problem in Sri Lanka and shown that it could be reduced significantly through a rapid and sustained increase in food production. New export crops (NECs) were also assessed briefly in terms of their income and employment potential. The adverse impact on agricultural production and employment of civil disturbances in the North and East was roughly calculated and found to be substantial.

The three crops chosen for in-depth economic analysis were paddy, onions and chillies. OFCs compete with paddy for land, water and labor,* of which labor is abundant relative to the other two factors of production. Per unit of land, paddy generally uses more water and less labor, and yields less net income than the OFCs. The case for crop diversification is therefore strong. On the other hand, the collective production base of OFCs (in terms of cultivated area) is miniscule compared to that of paddy. As we have shown, in the aggregate, paddy contributes more to GDP, seasonal employment, and foreign exchange savings (or earnings) than OFCs. (See page 37.)

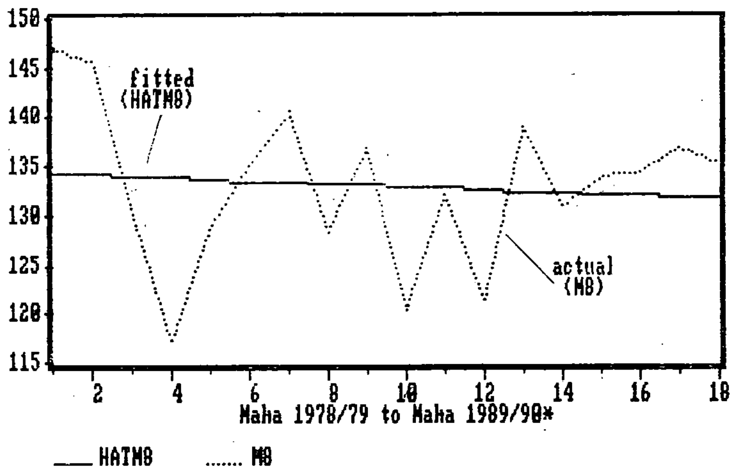
This is not to suggest that Sri Lanka should maintain its rice monoculture bias. Crop diversification is the foundation for commercial agriculture and the development of agro-industrial linkages, and it is obvious that a rapid agricultural tranformation cannot be realized on the basis of rice monoculture alone. However, given the multiple benefits that will be realized through a sustained increase in rice production, the goal of rice self-sufficiency should be aggressively pursued. Our analysis suggests that Sri Lanka will be spending around $ 136 million on rice imports by 1995 (as compared to $ 36 million in 1991) if rice production remains at the current level.

Prospects for import substitution as well as for export promotion were examined (the latter part of the analysis, however, was hampered by the lack of data). It is beyond the scope of this study to determine whether export promotion should be favored over import substitution in agriculture, but there is no reason to think in such narrow (zero sum) terms. Since economic growth is predicated on production for both domestic and foreign markets, combining import substitution and export promotion in a manner that yields more benefits than if only one option is pursued to the exclusion of the other (i.e., a positive sum approach) would be a more rational way to develop field-crop agriculture.* Our contention is that a rice-based crop diversification strategy will contribute more to economic growth and the reduction of rural unemployment than a strategy that excludes rice. We also believe that in determining priorities for field crops, both domestic and foreign markets should be considered, without exclusive focus on either import substitution or export promotion.

It is concluded that the best conceptual approach to crop diversification is the three-dimensional "rice-existing OFCs-NECs" calculus, in that it is likely to produce more income growth, labor absorption and poverty alleviation than any other reductionist approach.

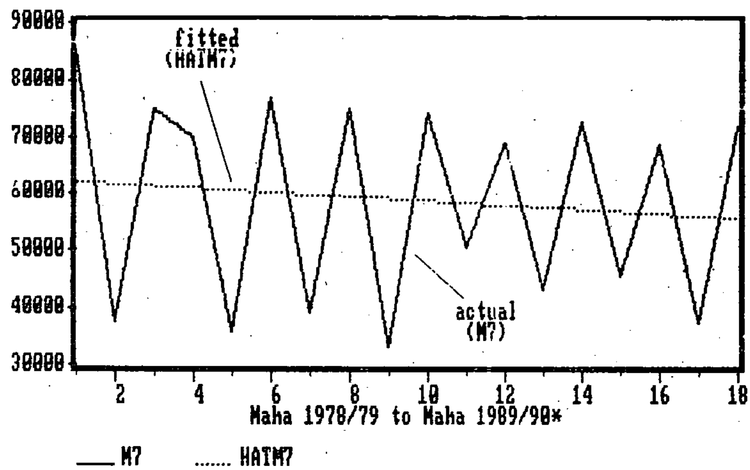
* This is only partly true with respect to land. More than half the land under paddy cultivation is classified as poorly drained, which makes it unsuitable for other crops.

FIGURE 1. LABOR UTILIZATION IN PADDY CULTIVATION
(Man days per Hectare)



* Data for Yala 1980, Maha 1987/88, Yala 1988, Maha 1988/89 and Yala 1989 was not available at the time of this study.

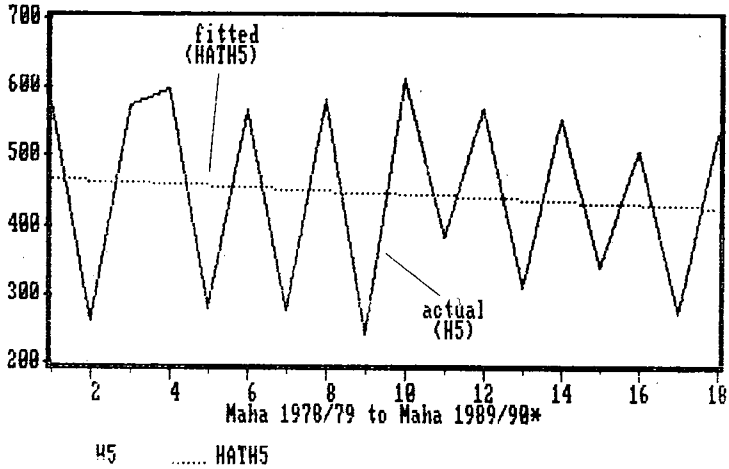
FIGURE 2. LABOR UTILIZATION IN PADDY CULTIVATION
(Thousands of Man days)



* Data for Yala 1980, Maha 1987/88, Yala 1988, Maha 1988/89 and Yala 1989 was not available at the time of this study.

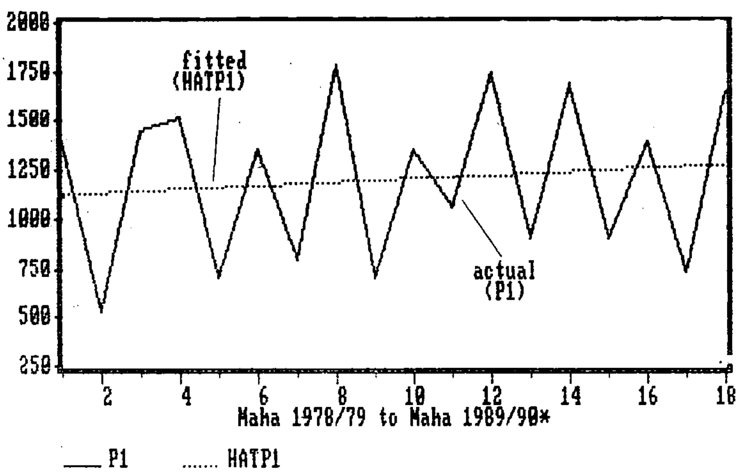
◆ For a cogent discussion of the power of positive sum thinking and its relevance to the social sciences, see Uphoff (15, pp.277-289).

FIGURE 3. AREA SOWN UNDER PADY
(Thousands of Hectres)



* Data for Yala 1980, Maha 1987/88, Yala 1988, Maha 1988/89 and Yala 1989 was not available at the time of this study.

FIGURE 4. PRODUCTION OF PADDY
(Thousand Metric Tons)



* Data for Yala 1980, Maha 1987/88, Yala 1988, Maha 1988/89 and Yala 1989 was not available at the time of this study.

FIGURE 5

Legend	District
a	Colombo
b	Gampaha
c	Kalutara
d	Galle
e	Matara
f	Hambantota
g	Badulla
h	Moneragala
i	Kegalle
j	Ratnapura
k	Kandy
l	Matale
m	Nuwara-Eliya
n	Kurunegala
o	Puttalam
p	Anuradhapura
q	Polonnaruwa
r	Jaffna
s	Killinochchi
t	Vavuniya
u	Mulaitivu
v	Mannar
w	Trincomalee
x	Batticaloa
y	Ampara
z	Kalawewa
aa	Uda Walawe

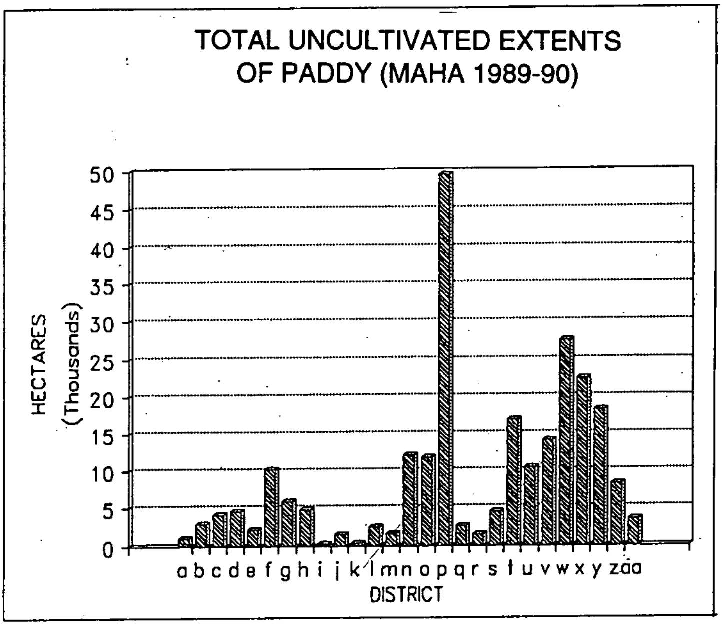


TABLE 1. EMPLOYMENT LAND USE, AND PRODUCTION IN THE PADDY SUB-SECTOR BY SEASON
(Maha 1978/79 to Maha 1989/90)*

obs	M3	M4	M5	M6	M7	M8	H5	P1
1	124.5384	182.9281	44293080	40687420	84980496	147.0045	578081.0	1392948.
2	159.1324	121.3261	26617280	11319480	37936760	145.5954	260563.0	524052.0
3	132.9395	126.2681	47192040	27584650	74776688	130.3981	573449.0	1453223.
4	107.2908	133.2363	39973120	29825210	69798328	117.0288	596420.0	1522241.
5	115.3957	151.6206	20256330	15847690	36104020	128.9153	280060.0	707759.0
6	149.0013	112.8753	52172800	24506130	76678928	135.1747	567258.0	1362765.
7	132.8163	152.4854	22422310	16573940	38996248	140.5199	277514.0	793235.0
8	138.4007	111.9857	50046940	24779970	74826912	128.3729	582887.0	1785924.
9	132.4703	148.7789	23407240	9599363.	33006600	136.8325	241219.0	698076.0
10	120.8566	119.7941	47453620	26341160	73794784	120.4752	612531.0	1353354.
11	130.3699	136.4980	35435192	15282730	50717920	132.1578	383768.0	1066646.
12	128.9615	106.7966	47840200	21154060	68994256	121.2461	569043.0	1751029.
13	133.9776	149.8414	28460730	14915060	43375792	139.0392	311968.0	909971.0
14	134.5460	123.8218	49902312	22822220	72724528	130.9859	555209.0	1688138.
15	134.1753	133.5328	31697840	13869790	45567632	133.9791	340110.0	899862.0
16	140.7976	121.8697	47326720	20924660	68251376	134.3981	507830.0	1392468.
17	134.6695	141.7119	25314360	12105310	37419672	136.8699	273396.0	735532.0
18	136.4733	132.8657	48502340	23295080	71797424	135.2815	530726.0	1647000.

* Data for Yala 1980, Maha 1987/88, Yala 1988, Maha 1988/89 and Yala 1989 were not available at the time ofthis study (with regard to labor-use variables).

TABLE 2. FORECASTED EMPLOYMENT IMPACT OF INCREASED PADDY PRODUCTION (log-log)

obs	LOGPL	HLOGM7
1	14.14693	18.00976
2	13.16935	17.22969
3	14.18929	18.04356
4	14.23569	18.08059
5	13.46986	17.46949
6	14.12503	17.99228
7	13.58387	17.56046
8	14.39545	18.20807
9	13.45608	17.45849
10	14.11810	17.98675
11	13.88003	17.79679
12	14.37571	18.19232
13	13.72117	17.67002
14	14.33914	18.16313
15	13.71000	17.66111
16	14.14659	18.00949
17	13.50835	17.50020
18	14.31447	18.14345
19	14.68639*	18.44022
20	14.87295**	18.58909

* Paddy production, 1991, actual (log).

** Paddy production, 1995, targeted (log).

TABLE 3. FORECASTED SOWN AREA FOR ACHIEVING SELF-SUFFICIENCY IN PADDY PRODUCTION (log-log)

obs	LOGP1	HLOGM5
1	14.14693	13.13820
2	13.16935	12.27780
3	14.18929	13.17548
4	14.23569	13.21632
5	13.46986	12.54229
6	14.12503	13.11892
7	13.58387	12.64263
8	14.39545	13.35693
9	13.45608	12.53016
10	14.11810	13.11282
11	13.88003	12.90329
12	14.37571	13.33955
13	13.72117	12.76347
14	14.33914	13.30737
15	13.71000	12.75364
16	14.14659	13.13790
17	13.50835	12.57616
18	14.31447	13.28565
19	14.68639*	13.61299
20	14.87295**	13.77719

* Paddy production, 1991, actual (log).

** Paddy production, 1995, target*bd (log).

TABLE 4. EMPLOYMENT, LAND USE AND PRODUCTION BY SEASON (MAHA 1978/79 TO MAHA1989/90): ONIONS AND CHILLIES*

obs	M14	M15	H6	P2
1	255.9956	1274858.	4980.000	37000.00
2	662.5245	2696475.	4070.000	30900.00
3	368.7721	1641036.	4450.000	33100.00
4	624.4464	3034810.	4860.000	30600.00
5	537.6649	2113023.	3930.000	28500.00
6	494.3483	2521176.	5100.000	35000.00
7	684.9859	2719394.	3970.000	32500.00
8	455.1335	2562402.	5630.000	54500.00
9	531.1168	2119156.	3990.000	40800.00
10	181.8656	361912.5	1990.000	13200.00
11	463.3125	871027.5	1880.000	23500.00
12	349.1276	1166086.	3340.000	20500.00
13	700.3061	1568686.	2240.000	21200.00
14	551.2060	1714251.	3110.000	23300.00
15	844.7360	2965024.	3510.000	33800.00
16	431.0165	1836130.	4260.000	34700.00
17	514.8823	1338694.	2600.000	21500.00
18	643.0036	3150718.	4900.000	38000.00

obs	M13	M16	H7	P4
1	330.1256	7332090.	22210.00	8625.000
2	307.9360	4234120.	13750.00	2975.000
3	523.7037	12317510	23520.00	8350.000
4	222.3900	5295106.	23810.00	5675.000
5	413.6701	7106853.	17180.00	3700.000
6	184.8308	4020070.	21750.00	5575.000
7	508.8530	7836336.	15400.00	3550.000
8	240.7001	4809188.	19980.00	5475.000
9	519.1571	7673142.	14780.00	4675.000
10	212.3330	3168008.	14920.00	6650.000
11	507.1975	7349292.	14490.00	11750.00
12	338.7247	4782793.	14120.00	8725.000
13	493.8541	8267118.	16740.00	15950.00
14	250.3370	3910264.	15620.00	9975.000
15	450.8834	9040212.	20050.00	16475.00
16	292.1710	4005664.	13710.00	8625.00
17	347.0519	3963333.	11420.00	9750.000
18	382.7579	6265747.	16370.00	11575.00

* Data for Yala 1980, Maha 1987/88, Yala 1988, Maha 1988/89 and Yala 1989 were not available at the time of this study (with regard to variables M13 and M14).

TABLE 5. TOTAL AND PER CAPITA AVAILABILITY OF ONIONS (1988-91)

	1988	1989	1990	1991	Average (1988-1991)
Production (m.t.)	63500	77300	72950	53397	66787
Imports (m.t.)	34642	22949	31447	47188	34056
Gross supply	98142	100249	104397	100585	100843
Population ('000)	16586	16806	16993	17247	16908
Per capita availability (kg.)	5.92	5.97	6.14	5.83	6.00*

* Not adjusted for 30% underreporting of production. The revised figure (our estimate) is 7.68 kilograms.

TABLE 6. FORECASTED EMPLOYMENT IMPACT OF INCREASED ONION PRODUCTION (log-log)

obs	LOGP2	HLOM15
1	10.51867	14.68718
2	10.33851	14.45760
3	10.40729	14.54525
4	10.32876	14.44517
5	10.25766	14.35457
6	10.46310	14.61636
7	10.38900	14.52194
8	10.90596	15.18070
9	10.61644	14.81176
10	9.487972	13.37375
11	10.06476	14.10876
12	9.928180	13.93471
13	9.961757	13.97750
14	10.05621	14.09786
15	10.42822	14.57192
16	10.45450	14.60540
17	9.975808	13.99541
18	10.54534	14.72116
19	10.88551*	15.15464
20	11.86905**	16.40797

* onion production, 1991, actual (log).
** onion production, 1995, targeted (log).

TABLE 7. FORECASTED SOWN AREA FOR ACHIEVING SELF-SUFFICIENCY IN ONION PRODUCTION (log-log)

obs	LOGP1	HLOGMH6
1	10.51867	8.401973
2	10.33851	8.247487
3	10.40729	8.306466
4	10.32876	8.239127
5	10.25766	8.178160
6	10.46310	8.354322
7	10.38900	8.290782
8	10.90596	8.734070
9	10.61644	8.485809
10	9.487972	7.518161
11	10.06476.	8.012751
12	9.928180	7.895634
13	9.961757	7.924426
14	10.05621	8.005419
15	10.42822	8.324413
16	10.45450	8.346948
17	9.975808	7.936475
18	10.54534	8.424842
19	10.88551*	8.716535
20	11.86905**	9.559909

* Onion production, 1991, actual,.(log).

** Onion production, 1995, targeted (log).

TABLE 8. TOTAL AND PER CAPITA AVAILABILITY OF DRIED CHILLIES (1987-91)

	1987	1988	1989	1990	1991	Average (1987-1991)
Production (m.t.)	18375	20675	16975	25000	24800	21165
Imports (m.t.)	2100	11406	6301	3487	8350	6329
Gross supply (m.t.)	20475	32081	23276	28487	33150	27494
Population ('000)	16361	16586	16806	16993	17247	16799
Per capita availability (kg)	1.25	1.93	1.38	1.68	1.92	1.63*

* Not adjusted for 30% statistical underreporting. The revised figure (our estimate) is 2.12.

TABLE 9. FORECASTED EMPLOYMENT IMPACT OF INCREASED CHILLI PRODUCTION (log-log)

obs	LOGP4	HLOM16
10	8.802372	14.91756
11	9.371609	15.60084
12	9.073948	15.24354
13	9.677214	15.96767
14	9.207837	15.40425
15	9.709600	16.00654
16	9.062420	15.22970
17	9.185022	15.37687
18	9.356603	15.58282
19	10.11860*	16.49748
20	10.70199**	17.19775

* Chilli production, 1991, actual(log).

** Chilli production, 1995, targeted (log).

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LIST OF VARIABLES

M3	= Man days per hectare (irrigated paddy land)
M4	= Man days per hectare (rainfed paddy land)
M5	= Total man days (irrigated paddy land)
M6	= Total man days (rainfed paddy land)
M7	= Total man days (irrigated+rainfed paddy land)
M8	= Man days per hectare (irrigated+rainfed paddy land)
M13	= Man days per hectare (irrigated chillies)
M14	= Man days per hectare (irrigated red onions)
M15	= Total man days (onions)
M16	= Total man days (chillies)
H5	= Total extent sown under paddy (hectares)
H6	= Total extent sown under red onions (hectares)
H7	= Total extent sown under chillies (hectares)
PI	= Total paddy production (metric tons)
P2	= Total red onion production (metric tons)
P4	= Total chilli production (metric tons)
T1	= Trend variable