Rice import substitution and employment in Papua New Guinea

John Gibson

Overcoming the economic and technical obstacles to local rice production might be justified if the local rice industry created jobs in Papua New Guinea. But this research shows that increased rice production in Papua New Guinea is likely to destroy, not create jobs.

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Policymakers in Papua New Guinea want to expand the local rice industry. Currently, imports from Australia meet 99 per cent of rice demand. The Papua New Guinea government has an initial goal of reducing imports by 40 per cent. This self-sufficiency drive is fuelled by the size of the rice import bill, the desire for more jobs and the worry that it is wrong to import food. Concern over rice imports also motivates food and trade policy in other Pacific island countries (Foy 1992; Parton and Fleming 1992).

World price movements help explain why Papua New Guinea imports rice and exports tree crops. The international terms of trade between tree crop and rice prices has risen at an average annual rate of 2.7 per cent since 1948. Rice production has also suffered because it does not mesh with local root crop farming systems. However, consumption has increased due to rice’s low price and convenience. Rice now provides 40 per cent of dietary energy for urban residents (Gibson 1994).

Efforts to overcome the economic and technical obstacles facing local rice production might be justified on income distribution grounds if expanding the rice industry creates jobs. Setting up new industries is not normally an efficient job creation method because of the by-product cost of subsidies to scarce capital and the distortion in consumer choice. Still, exceptions occur, especially in developing economies with only a limited range of industries. Hence, the impact of each new industry should be studied empirically.

This paper shows that increased rice production in Papua New Guinea is likely to destroy not create jobs. Commercial rice farming systems are less labour-intensive than the export tree crop industries. Producing tree crops and importing rice thus uses more labour than producing rice at home. Econometric results show that the output of tree crops (and hence employment) is sensitive to the tree crop/rice terms of trade. Making rice more expensive to protect local rice growers...
would cause labour use in tree crop production to fall by more than rice production causes it to rise.

Import substitution and labour demand

In many developing economies, the import-substitution sector is more capital-intensive than the rest of the economy. Developing economy imports tend to be produced where capital is plentiful and labour is scarce. Inducing a factory to migrate from its industrial economy location is the easiest way to substitute for imports. The ‘new industry’ is simply an enclave of industrial economy technology, inappropriate to local factor proportions. In the same manner, food policymakers frequently opt to replace imports with large-scale ‘commercial’ farms that economise on labour.

The first task of this paper is to measure the labour utilisation of tree crop exports. This sets a benchmark for comparing the labour-intensity of a rice (or indeed any) import substitution industry. Given international exchange ratios (the terms of trade), the implied labour content of a tonne of rice under the export-to-earn-cash-to-import-rice method can be compared with the labour content under direct production. This static comparison identifies which sector exports or imports substitutes and which creates more jobs per unit of output.

There is also a general equilibrium argument. Exporters face elastic demand so have no chance to pass on cost increases. Rice prices, wages and other non-traded good prices will increase if rice production is protected. These higher costs act as a disincentive for export producers because their profitability is squeezed. Thus, export production and employment falls. Even if the government pays subsidies to the rice industry, the increased budget deficit will put upward pressure on interest and exchange rates, adversely affecting the export sector.

The labour content of tree crop exports

Cost-of-production studies are used to estimate the number of unskilled labour days used in the growing, processing and exporting of one tonne of tree crop. The original sources and details of calculation are listed by Gibson (1993), who also estimates the import and local non-labour content and disaggregates labour into on-farm and off-farm components. Estimates for unskilled labour days in smallholder and plantation sectors are listed in Table 1. The estimates may also apply to other Pacific Island countries that export some of these commodities but lack their own cost of production studies.

Table 1  Unskilled labour days required per tonne of tree crop export

<table>
<thead>
<tr>
<th>Export volume weight</th>
<th>Smallholder production</th>
<th>Plantation production</th>
<th>Weighted average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude palm oil</td>
<td>0.53</td>
<td>16 (0.40)</td>
<td>15 (0.60)</td>
</tr>
<tr>
<td>Copra</td>
<td>1.11</td>
<td>106 (0.65)</td>
<td>34 (0.35)</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>0.09</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Coffee</td>
<td>0.15</td>
<td>360 (0.75)</td>
<td>200 (0.25)</td>
</tr>
<tr>
<td>Tea</td>
<td>0.01</td>
<td>..</td>
<td>..</td>
</tr>
</tbody>
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Note: Figures in parentheses are the share of production from each sector (smallholders and plantations).
Oil palm

The estimated labour-intensities for smallholders and plantations are similar. The reason is the small share of costs incurred in the production of fresh fruit bunches. After that stage, costs are common. Palm oil has the lowest labour content at 15.4 days per tonne.

Copa and coconut oil

Estimates for smallholders and plantations are based on intercropping of copra with cocoa. The one coconut oil producer is supplied with copra from its own plantation and from the Copra Marketing Board. If smallholders and plantations are assumed to supply equal quantities of copra, an extraction rate of 0.62 implies a labour content of 117 days per tonne oil.

Coffee

Coffee is the most labour-intensive tree crop, with a weighted average of 320 unskilled labour days per tonne (green bean). It is also the crop for which smallholder production is most important. Estimated labour input by smallholders must be interpreted with some caution. It is based on a survey carried out in 1976 and then up-dated without additional survey work in 1993. Plantation costs are from a 1992 survey.

Labour content of one tonne of tree crop exports

The results for each tree crop are aggregated using 1992 export volume weights. In 1992, a weighted average tonne of tree crop exports had a labour content of 104 unskilled labour days. Labour intensity was the same in 1991. Before that it was higher (approximately 120 days per tonne) due to the larger share of coffee and the smaller share of oil palm.

At world prices, this tonne of average tree crop exchanged for 2.26 tonnes of Thai rice in 1992. The export-to-earn-cash-to-import method of gaining command over rice thus employs 46 = (104/2.26) unskilled labour days per tonne rice. Hence, the task for a domestic rice industry is to employ more than 46 unskilled labour days per tonne of rice. This is a conservative estimate of the labour requirement.

Substituting for a higher cost rice like Australian 'Trukai' requires a more labour-intensive system because one tonne of tree crop buys less than 2.26 tonnes of Trukai.

The labour intensity of rice production

The main commercial rice growing area in Papua New Guinea has been the Mekeo district in Central Province. A survey of 41 Mekeo rice farmers in 1978/79 shows that machinery was used for all farming operations except weeding and plant protection (FAO 1986). Labour inputs (69 days/ha) and yields (3.2 tonne/ha) were highest on the smallest farms (capacity 1.3 ha). The largest farms (capacity 13 ha) had the lowest labour inputs (17 days/ha) and yields (1.6 tonne/ha). The range of labour intensities thus was 11 to 22 days per tonne paddy.

The labour content of the milled rice was, at most, 41 unskilled days per tonne. This is derived from

- a milling rate of 0.6

- a labour content for processing of two days per tonne milled rice.

Rice produced by the large, labour-intensive farms had a labour content of only 21 unskilled days. The survey shows that these larger farms gave the highest returns to family labour and management. Therefore, large farms might be expected to grow at the expense of their smaller neighbours. If so, the average labour-intensity of rice would move toward the lower estimate.
The labour content of the Mekeo rice was less than the implied labour content of the imported rice. Beyond the milling stage, there are no operations that a domestic rice industry would carry out that are not already carried out to handle imports, so there are no further employment effects. Also, switching to local rice would cause a loss of jobs at the Lae mill which processes imported rice.

Details of other, mainly hypothetical, rice production models were considered by a 1986 FAO technical mission (Table 2). Only two of the rice production models are more labour-intensive than the implied labour content of imported rice purchased with the cash earned from tree crop exports. Upland, rainfed rice, grown with traditional technology (1a), as used in East Sepik Province, uses a lot of labour but provides poor returns (K0.99/day in 1986 terms). Technological improvements in this model (1b) could give returns to labour that are competitive with the low end of the range of returns from tree crops.

The highest returns to labour were predicted to come from double-cropping, with irrigation provided by diverting perennially flowing streams. Whether this could occur in practice is unclear because many Papua New Guinea rivers are so flood prone that irrigation capital works would be frequently inundated or else left high and dry as the river bed shifted.

The two commercial rice growing systems make no meaningful contribution to employment. The labour intensity is about one-tenth that of tree crop exports. FAO (1986) also expected that these systems would require large subsidies to be privately profitable.

### Table 2: FAO rice production models

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Labor and Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Upland rainfed, traditional</td>
<td>110 days/tonne paddy (80 days/tonne rice) K0.99/day return to labour</td>
</tr>
<tr>
<td>1b</td>
<td>Upland rainfed, improved</td>
<td>50 days/tonne paddy (80 days/tonne rice) K2.28/day return to labour</td>
</tr>
<tr>
<td>2</td>
<td>Irrigated: smallholder, semi-mechanised</td>
<td>19 days/tonne paddy (34 days/tonne rice) K3.34/day return to labour</td>
</tr>
<tr>
<td>3</td>
<td>Rainfed: smallholder with mechanised services (ca. Bereina)</td>
<td>24 days/tonne paddy (42 days/tonne rice) K2.35/day return to labour</td>
</tr>
<tr>
<td>4</td>
<td>Rainfed: commercial, mechanised</td>
<td>2 days/tonne misc. labour management labour unquantified (ca. 3 days/tonne)</td>
</tr>
<tr>
<td>5</td>
<td>Irrigated: large commercial</td>
<td>135 unskilled/semi-skilled full time staff target output 14,800 tonnes per annum 2.5 days/tonne paddy (5 days/tonne rice)</td>
</tr>
</tbody>
</table>

*Not currently used in Papua New Guinea.*

demand for an extra one million unskilled labour days (Table 3). This target would provide 50 days of cash employment for 20,000 people, a modest achievement given expected labour supply growth in Papua New Guinea. The statistic captures two aspects that limit job creation: choice of technique and market size. If it takes a large share of the market to achieve the employment target, it might be better to direct production elsewhere or consider using more labour-intensive technology.

Most of the rice growing systems require a large share of the domestic market to achieve this target. The commercial rice farming systems could only achieve this if Papua New Guinea were to become a rice exporter! In contrast, it takes just an extra 3000 tonnes of coffee (0.06 per cent of the world market) to meet the target. Suggestion of expanding coffee output may seem foolish in an era of low world prices. Nevertheless, Colombia, Papua New Guinea’s main competitor as a producer of mild arabicas, expanded production from 660,000 tonnes in 1989 to 960,000 tonnes in 1992.

Estimates of job losses following protection for rice growing

The importance of rice in cash expenditures for smallholders and plantation labourers makes the tree crops-to-rice relative price an important influence on the volume of tree crop production. Increases in the relative price of rice, to protect an inefficient domestic industry, reduce the incentives facing tree crop producers. Output, and therefore employment, will be less than it otherwise would have been. These job losses in tree crop production should be counted against the jobs created in the domestic rice industry.

The total volume of Papua New Guinea’s exports of coffee, cocoa, copra, coconut oil, palm oil and tea was regressed on the tree crops/rice terms of trade. The data period was 1948–92.

There is no obvious misspecification of the regression model. All the variables are statistically significant at conventional levels. Unit root tests suggested that Q and TOT were trend stationary so the time trend controls for their shared time-series properties. Results from the regression model are robust. Using the average retail price of rice in urban areas of Papua New Guinea (sample period 1965–91) gives similar results to the equation reported above (Gibson 1993).

There is a strong autoregressive element in tree crop export volumes; last year’s exports are a good predictor for this year’s. Alternatively, this implies a distributed lag effect on the terms of trade, as shown by substituting the lagged equation for Qt-1 into the right hand side. Producers place the highest weight on this year’s relative prices and a geometrically declining weight on the information from previous years. If one evaluates elasticities

| Table 3 Required increase in market share to create work for an extra one million unskilled labour days (per cent) |
|-----------------|-------|
| Palm oil        | 0.8   |
| Copra           | 4.5   |
| Coconut oil     | 0.6   |
| Coffee          | 0.06  |
| Cocoa           | 0.2   |
| Rice: improved upland (1.b.) | 10.0   |
| Rice: smallholder irrigated (2) | 23.0   |
| Rice: commercial (4 or 5) | >100.0 |
at the long-run position where output is stable, the effect on exports of a one per cent increase in the terms of trade is 0.08 per cent (0.04/(1-0.52)). Hence, if the tree crops-to-rice relative price fell by 10 per cent, tree crop exports would fall below trend by 0.8 per cent. With exports of approximately 350,000 tonnes, the reduced production would be 3000 tonnes. The implied employment loss is 300,000 unskilled labour days.

An 11 per cent tariff on rice imports would cause the terms of trade to fall by 10 per cent. A commercial, mechanised rice industry would need to produce 60,000 tonnes of rice to create enough jobs to offset this loss of tree crop employment. A smallholder mechanised industry (model 3, Table 2) would need to produce 7000 tonnes of rice to replace the lost jobs. Important trade-offs thus arise between rice development and employment in the traditional export industries.

**Employment effects of substituting cereal imports with root crop products**

Increasing the demand for root crops may be a better way to create jobs. Production is labour-intensive and forms the heart of local farming systems. It takes 300 unskilled labour days to plant, maintain, harvest and re-establish one hectare of sweet potato (Densley 1976). If the average yield is 15 tonnes per hectare, the labour requirement is 20 days per tonne. One tonne of rice gives the energy of at least three tonnes of sweet potato, implying a labour content of 60 days per equivalent tonne of rice. This is more labour-intensive than most rice production systems.

Processing root crops to give them the attributes of cereals—low weight, storability—is one way to increase demand. But wheat imports are a more likely option for this form of substitution. A previous attempt to sell dried sweet potato chips as ‘Kaukau rice’ failed because consumers preferred real rice. Wheat differs from rice because it is consumed in a transformed state. This allows some non-wheat ingredients to be added without consumers objecting. Several countries now use sweet potato as a substitute for wheat flour in bread making, for example, bread in Burundi is made from a mix of 70 per cent flour and 30 per cent mashed sweet potato (Berrios 1992).

There are also market demand and technology advantages in substituting for wheat flour. Per capita rice consumption has grown by 1.2 per cent per annum since 1980, but wheat consumption has grown by over 6 per cent per annum. Selling homemade bread and scones is now a common source of income for women, especially in the highlands and even outside of the main towns. Adding sweet potato to bread dough is simple. If pale skinned varieties are used, it requires only two extra operations—washing and grating.

Even with the ‘correct’ characteristics of labour-intensive, low technology production, making bread with sweet potatoes is not going to create a massive number of jobs. Wheat imports are equivalent to about 75,000 tonnes of flour. Much of this is sent to Port Moresby where flour is cheap and sweet potato is expensive. Perhaps 15,000 tonnes of flour are available to be mixed with sweet potato to make bread. The extra 5000-6000 tonnes of sweet potato would create demand for 100,000 unskilled labour days. This is helpful but is still insignificant beside the employment contribution that the tree crops make.

**Conclusions**

Papua New Guinea currently supplies itself with rice by producing tree crops for export and using the foreign exchange to pay for imported rice. At the current output mix, one tonne of average tree crop exports has an unskilled labour content of
104 labour days. This tonne of export exchanges on world markets for 2.26 tonnes of rice. This system of commanding rice via exchange thus implies a labour content of 46 unskilled labour days per tonne rice. In comparison, most of the actual and potential rice production systems in Papua New Guinea use less labour.

Econometric estimates suggest that a 10 per cent fall in the tree crop terms of trade, caused by increasing the rice price, would reduce tree crop exports by 3000 tonnes. Labour demand would fall by 300,000 labour days. At least 7000 tonnes of rice would need to be produced (under smallholder conditions) for the economy to regain this lost employment.

The labour intensities calculated here can also be used to evaluate other import substitution projects. Job creation is almost always given as a reason for protected, import-substitution industrialisation. Yet many of the new industries use labour far less intensively than do the established export industries.

References


Densley, D., 1976. ‘Marketed fruit and vegetables’, Agriculture in the Economy, Department of Primary Industry, Konedobu.


