Rice demand in Papua New Guinea

John Gibson

Concern over rice imports is a long-standing feature of food policy in Papua New Guinea. Despite the failure of previous attempts at local rice production, policymakers are again setting ambitious targets for import replacement and are committing large budgets to rice projects. This article shows that rice consumption in Papua New Guinea is growing much more slowly than previously thought. If self-sufficiency efforts are motivated by the belief that the population increasingly depends on rice, they appear to be based on incorrect assumptions. Moreover, econometric evidence suggests that the income elasticity of rice demand has fallen rapidly over time and may even be negative. Hence a local rice industry may face static or even declining markets, making it harder to achieve efficiencies and increasing the risk of relying on protective barriers that will harm consumers and the rest of the economy.

John Gibson is a Senior Lecturer in the Department of Economics, University of Waikato.

Importing rice is one of the most contentious food policy issues in Papua New Guinea. For at least two decades, politicians and other commentators have suggested that the local population is becoming too reliant on imported cereals (Flores and Temu 1984). Concern over rice imports also motivates food and trade policy in other Pacific island countries (Foy 1992). Prompted by these concerns, in the early 1990s Papua New Guinea policymakers set ambitious targets for local rice production of approximately 50,000 tonnes by the end of the decade, to provide 40 per cent of national requirements. But in spite of those goals, rice production in Papua New Guinea has never exceeded more than a few hundred tonnes per year (Blakeney and Clough 2001). Several economists have previously explained why rice development is unlikely to be successful in Papua New Guinea, focusing on the low returns to labour (Hale 1979), the lack of comparative advantage (Temu 1997), the falling terms of trade relative to the export tree crops (Shaw 1985; Gibson 1993) and the adverse effects on employment (Gibson 1994).

But undaunted by these economic arguments and the poor results to date, the PNG Parliament recently endorsed a Food Security Policy which calls for Papua New Guinea to bring 100,000 hectares of rain-fed lowland rice into production. It is hoped that this industry (or an alternative industry with 45,000 hectares of double-cropped irrigated rice) will produce 150,000 tonnes of milled rice (Papua New Guinea 2000), which would imply complete self-sufficiency. Although no timetable is set for when this level of production is to be reached, another part of the Food Security Policy calls for a 20 per cent replacement of rice imports by the year 2010. Moreover, the Food Security Work Program for 2001–10 has budgeted over K40 million for grain and rice development.

Rather than simply repeat previous arguments about why these production targets are unlikely to be met, and why investment in rice development is unlikely to be as rewarding as investment elsewhere, this article documents a feature of rice demand which has been largely ignored in debates about self-sufficiency. The evidence from Papua New Guinea points to a dramatic slowing in the growth of rice demand over the last four decades. Consequently, average rice consumption per capita is now considerably lower than had been predicted by previous forecasts. It is possible that these exaggerated forecasts have helped fuel the demand for self-sufficiency policies, so the aim of this article is to provide the factual information that is needed for a more reasoned assessment to be made.

In addition to descriptive evidence on trends in rice demand, this article also reports some econometric evidence on the determinants of average rice consumption. This econometric modelling is motivated by the question of whether rice is becoming an inferior good in Papua New Guinea, as has been suggested for some Asian countries (Ito, Peterson and Grant 1989). The econometric results suggest that the income elasticity of demand for rice has fallen rapidly over the last four decades. Once other influences on rice demand—such as exchange rates, tree crop prices and climate shocks—are controlled for, the relationship between aggregate income growth and rice consumption becomes negative. Hence, any local rice industry is likely to face difficult market conditions and may be unlikely to earn the returns on investment that producers in other, growing, industries earn.

Trends in rice demand

Data on rice imports and production (from which consumption was derived as the sum) for the period 1961–99 were obtained from the agricultural statistics division of the Food and Agriculture Organization (FAO), from Bourke (1988) and Blakeney and Clough (2001). Data were also obtained from the major rice importer and distributor to update the series to the year 2000 and to check the accuracy of the previous sources. A detailed description of this data comparison and merging process is provided by Gibson (2001).

Population data were obtained from the FAO statistics division, and for more recent years were also obtained from the National Statistics Office. These recent data are based on the preliminary population count of 5.1 million from the 2000 Census. This Census estimate suggests that the population growth rate rose from 2.3 per cent per annum between 1980 and 1990 to 3.0 per cent between 1990 and 2000. However, there is some doubt about this change because the 1990 Census appears to have had some undercounting (Callick and Tait 1993). If the increased population growth rate since 1990 is due to an initial undercount, it will tend to lower the estimated growth rate of per capita rice consumption over that period. To ensure that estimates of changing rice demand are not just due to uncertainties about the population growth rate, a constant population growth

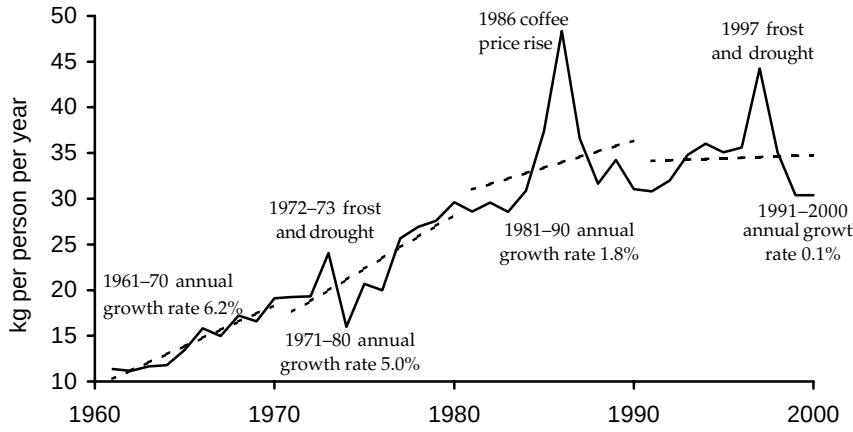
rate of 2.65 per cent per annum for both the 1980–90 and 1990–2000 periods is used here (starting from the 1980 base, this growth rate results in the estimated population of 5.1 million in year 2000).

Changes in average per capita rice consumption in Papua New Guinea over the 40 year period from 1961–2000 are shown as trend growth rates for each decade (where these growth rates are estimated from a regression of the logarithm of per capita consumption on a time index) (Figure 1). Descriptive indicators for three periods when rice consumption appears to deviate significantly from the trend growth rates are included—the 1972–73 frost and drought, the 1986 coffee price rise,[1] and the 1997 frost and drought.

Average rice consumption was 30.4 kilograms per person in 2000 (corresponding to aggregate consumption of 154,000 tonnes). This estimate is reasonably robust to uncertainties about the size of the population in that year. For example, if the population count was only 5 million, the per capita consumption of rice would only rise slightly, to 30.8 kilograms per person. Thus, despite the concerns about the rapid growth in rice demand highlighted by the Food Security Policy, average rice consumption in Papua New Guinea is no higher than it was 16 years earlier, in 1984. Moreover, the consumption of 30 kilograms per person in 2000 was achieved only with the introduction of a new, cheaper, brand of rice into the PNG market. If specifications had been maintained at the level of the previously dominant Trukai brand, per capita consumption may only have been 27 kilograms per person in year 2000 (Gibson 2001).

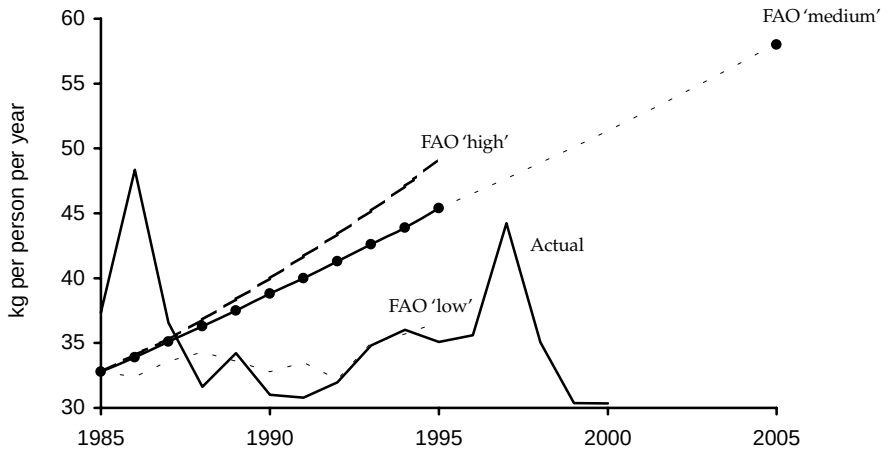
Trend growth rates for each of the four decades provides more formal evidence on the slowing of the growth in rice demand. Between 1961 and 1970, per capita consumption increased by 6.2 per cent per annum; from 1971 to 1980 it increased by 5 per cent per annum, in the following decade by 1.8 per cent per annum, and since 1991 by only 0.1 per cent per annum.[2] With such modest growth in consumption, the rice

Figure 1 **Average per capita rice consumption in Papua New Guinea, 1961–2000**



Source: Author's calculations from data reported in Gibson, J., 2001. *Food Security and Food Policy in Papua New Guinea,* Institute of National Affairs, Discussion Paper, Port Moresby.

Figure 2 **Actual versus forecast rice consumption in Papua New Guinea**



Source: Author's calculations from data in FAO (1986).

market in Papua New Guinea can be considered to have entered a 'mature' phase, with likely implications for any attempts at replacing imports with local production.

Comparisons with previous forecasts

This slowing of the growth in rice demand means that previous forecasts of future rice consumption in Papua New Guinea have proven to be considerably exaggerated. The most careful forecasts were made by the 1986 FAO technical mission on rice production and considered 'low', 'medium' and 'high' growth. The FAO mission concluded that 'it is more probable that future rice demand will fall between the medium and high scenarios, especially if the recent trend to prefer rice over traditional staples continues' (FAO 1986:11).

The rice consumption forecasts of the 1986 FAO technical mission are presented in Figure 2 along with the actual path of per capita rice consumption. Even under the 'medium'-growth scenario, which was considered to be below the most probable path, Papua New Guineans were predicted to eat an average of over 50 kilograms of rice per capita in year 2000, rather than the 30 kilograms that they actually consumed. In fact, it is apparent that consumption has tracked much more closely to the 'low'-growth scenario, and even the unusually high consumption in 1997 caused by the El Niño frost and drought is below the 'medium'-growth scenario.

Implications of the trends in rice consumption

The failure of actual rice demand to increase anywhere near as fast as forecast demand should concern policymakers intent on greater local production of rice. At the very least it may undermine the assumptions that fuel the demand for self-sufficiency policies. But more practically, if Papua New Guinea had developed a large-scale rice industry based on the previous forecasts, it is likely to have suffered from lack of demand with

consequences for reduced productive efficiency due to low capacity utilisation.

If there was ever an optimal time to introduce rice-growing as an infant industry in Papua New Guinea, that time appears to be well past. An infant industry is one that is initially uncompetitive but which, over time, will hopefully become internationally competitive. Leaving aside the point of whether rice could be considered an infant industry, having been grown in Papua New Guinea for a century (see Hale 1979), when rice consumption was growing rapidly in previous decades, some initial inefficiencies in production might have been tolerable because there would be the reasonable expectation of greater demand in future. These additions to demand might enable unit costs to fall, particularly for a large-scale mechanised rice industry. But with stable demand, the initial inefficiencies may be more likely to persist, making it difficult for local rice producers to compete with the long-established and efficient Australian exporters.

Another implication of rice consumption patterns (Figure 1) concerns the impact of the recurring droughts and frosts associated with the El Niño phenomena. In both 1973 and 1997, per capita rice consumption rose by about one quarter over its level in the previous year, due to food shortages resulting from the El Niño conditions. Hence, if Papua New Guinea is to become self-sufficient in rice production, as is often advocated, it will need to run either a buffer stock scheme, or else it will need to maintain production at approximately 125 per cent of usual consumption levels, so as to have sufficient rice on hand to cover the El Niño years.

To avoid these costly choices, policymakers intent on self-sufficiency might hope that the international aid community can provide the extra rice needed during an El Niño year. But there are considerable risks in adopting such a strategy, as shown from the experience in 1997. In that year, rice consumption rose by about 50,000 tonnes, with more than three-quarters of this extra rice distributed through private channels from July onwards (Whitecross and Franklin, 2001). In contrast, the first 'aid' rice was not distributed until October and the bulk of this rice was not distributed until after January 1998. Hence, relying on the aid community may expose the population to a significant risk of starvation because of delays in response. Moreover, it is not certain that the same speedy delivery of rice through private channels that occurred in 1997 would reoccur if Papua New Guinea had substantially withdrawn from world rice markets because suppliers would cater to the needs of their long-term customers first.

Is rice becoming an inferior good?

The transition from rapid growth to slow growth in per capita rice consumption raises the question of whether rice is becoming an 'inferior good' (that is, one that has a negative income elasticity of demand). To examine this question, the demand model used by Ito et al. (1989) for studying declining income elasticities of rice demand in Asian countries is adapted to the study of rice demand in Papua New Guinea. The regression model is

$$\ln Q_t = a - b\left(\frac{1}{Y_t}\right) - c\ln Y_t + \text{control variables}$$

where Q_t is the average per capita consumption of rice in year t, Y_t is the value of GDP, in real per capita terms, and 'ln' denotes the natural logarithm. This 'log-inverse-log' specification allows rice consumption to be positively related to income up to a certain level, after which an inverse relationship may occur. The income elasticity of rice demand is calculated as $b/Y - c$, and this elasticity will vary from year to year as the value of per capita GDP changes.

The variables used in the various specifications of the regression model are

- real GDP per capita (deflated using the 1971 Consumer Price Index as a base)
- the retail price of rice in Papua New Guinea urban areas, in logarithms (also deflated by the Consumer Price Index[3])
- an index of world prices for the major tree crops (cocoa, coffee, tea, copra, copra oil, and palm oil), in logarithms and weighted by their value share in exports each year
- an indicator for the El Niño drought and frost years (1973 and 1997)
- a time trend variable (1965=1, .., 2000=36)
- the exchange rate (A$/K).

The basic model has only income and prices, but to guard against mis-specification, results with the control variables included are also reported.

The behaviour of rice demand in Papua New Guinea appears similar to what has been found in some Asian countries, with demand increasing with rising per capita GDP up to a certain point, but beyond that point further increases in average incomes cause rice demand to fall (Table 1). Thus, when real per capita GDP was low but rising in the years leading up to Independence, the income elasticity of rice demand was positive but falling rapidly and eventually becoming negative. During the subsequent period when real average income largely stagnated, the elasticity increased slightly, to around 0.3 in the 1990s. But even with this elasticity, rice demand can be expected to respond only sluggishly to any future increases in average incomes.

The negative income elasticity occurred during the 1970s because rice consumption was growing rapidly while real income was declining slightly. It is possible that the growth in demand was not related to changes in income, but rather to other factors that were trending upwards, such as urbanisation and improvements in market access. But even when the control variables for the tree crops price index, for the El Niño shocks and for the time trend are added, the income elasticity of rice demand is still negative during the 1970s. Moreover, adding the control variables causes the income elasticity in the other decades to be reduced as well, with it falling to –0.12 during the 1990s.

To check whether the finding of a low and often negative income elasticity of demand for rice is robust, an alternative functional form—the log-quadratic—was also used, with the results reported in Column (iii) of Table 1. The elasticity estimates from this regression model were very similar to those from the log-inverse model in Column (ii), lending support to the finding of a falling and negative income elasticity of rice demand.

In Columns (ii) and (iii), two of the three control variables that are added appear to be highly significant predictors of average rice demand, and the addition of all three variables increases the explanatory power of the model (that is, the R^2 increases to 0.91). Hence, the fall in the income elasticity does not seem to be due to the addition of some irrelevant variables. In terms of the interpretation of the control variables, it appears that a 10 per cent increase in the price index for tree crops increases average per capita rice consumption by about 2 per cent. The other important elasticity is for the own-price of rice demand, where it appears that a 10 per cent rise in real rice prices would reduce the average consumption level by about 7 per cent.

Because rice is imported, the rice price variable in the model may also be picking up exchange rate influences so an exchange rate variable is added to the model (see Column iv). The results suggest that a 10 per cent appreciation of the kina against the Australian dollar would raise per capita rice consumption by about three per cent holding all other variables constant. But the coefficient on the price of rice becomes smaller

and statistically insignificant because this variable is now just picking up variations in price not due to exchange rate fluctuations. However, perhaps the most important finding from Column (iv) is that even with this re-specification of the model, there is no change to the basic result of falling and ultimately negative income elasticities of rice demand across the last four decades.[4] This robust finding seems to reflect the role of rice as an energy staple that people in Papua New Guinea can 'retreat' to when their incomes are under stress.

Table 1 **Regression estimates of the determinants of average per capita rice consumption in Papua New Guinea, 1965–2000**

	(i)	(ii)	(iii)	(iv)
ln *Y*	-6.474 (2.51)*	-4.148 (2.52)*	21.869 (2.51)*	-3.549 (2.78)*
1/*Y*	-1572.050 (2.82)**	-936.365 (2.74)*		-784.739 (2.95)**
$(\ln Y)^2$			-2.015 (2.48)*	
Tree crops price index		0.201 (3.46)**	0.200 (3.44)**	0.147 (3.24)**
El Niño drought years		0.155 (1.32)	0.158 (1.31)	0.242 (2.84)**
Real rice price (log)	-1.326 (8.27)**	-0.664 (5.42)**	-0.657 (5.33)**	-0.189 (0.84)
Time trend		0.009 (4.33)**	0.010 (4.51)**	0.018 (4.79)**
log exch. rate (A$/K)				0.324 (2.60)*
Constant	43.207 (2.60)*	28.474 (2.73)*	-57.504 (2.47)*	25.156 (3.11)**
R^2	0.78	0.91	0.91	0.93
F-statistic	37.89**	117.10**	119.60**	284.52**
RESET statistic	4.04*	2.65+	2.80+	1.45
Average income elasticity				
1965–70	1.48	0.59	0.53	0.42
1971–80	-0.55	-0.62	-0.62	-0.59
1981–90	0.41	-0.05	-0.02	-0.11
1991–2000	0.30	-0.12	-0.09	-0.17

Note: Absolute value of *t*-statistics in parentheses are calculated from Newey-West standard errors that are robust to heteroscedasticity and autocorrelation with one lag length.
+ significant at 10 per cent confidence level; * significant at 5 per cent; ** significant at 1 per cent.
The RESET (regression specification error test) statistic tests for omitted variables by adding powers of the fitted values to the model's explanatory variables.

Conclusions

Despite previous failures, and many arguments by economists, policymakers in Papua New Guinea appear intent on increasing local rice production. This article has described the rapid slowing in the growth of rice demand over the last four decades. This maturation of the rice market in Papua New Guinea means that actual demand is now considerably lower than previous forecasts suggested. Consistent with this trend, the income elasticity of demand for rice has fallen rapidly over the last four decades and once other influences on rice demand are controlled for it appears that the relationship between aggregate income growth and rice consumption is negative. Hence a PNG rice industry is likely to face difficult market conditions, making it harder to achieve efficiencies and increasing the risk of relying on protective barriers that will harm consumers and the rest of the economy.

Notes

[1] There is some uncertainty about imports for 1986, which appear as 170,000 tonnes in official government publications and in Blakeney and Clough (2001). However, in the early 1990s when the author collected data from importers, estimates for 1986 were less than 130,000 tonnes. Despite efforts of people in both the importing company (Trukai Industries) and the major exporter in Australia (Rice Growers Cooperative) it proved impossible to remove this uncertainty. But other than removing the 'spike' in the graph, few other results change if 130,000 tonnes is used in place of 170,000 tonnes for 1986. In particular, the trend growth rate of per capita consumption in 1981–90 falls only slightly, from 1.8 per cent to 1.7 per cent.

[2] If the population growth rates of 2.3 per cent and 3.0 per cent between 1980–90 and 1990–2000 are accepted, these decadal trend rates of per capita rice consumption change to 2.2 per cent and –0.2 per cent.

[3] The price data from the Consumer Price Index and earlier Retail Price Index are available only since 1965, limiting the time series for estimating the model to 36 years.

[4] One other change is that the regression specification test (RESET) no longer reflects any mis-specification in the model when the exchange rate is added in column (iv).

References

Blakeney, M. and Clough, R., 2001. 'An assessment of grain production and imports in PNG, 1975–2000,' in R.M. Bourke, M.G. Allen and J. Salisbury (eds), *Proceedings of the Papua New Guinea Food and Nutrition 2000 Conference: Food Security in Papua New Guinea*, Australian Centre for International Agricultural Research, Canberra.

Bourke, R.M., 1988. *Taim Hangre*: variation in subsistence food supply in the Papua New Guinea highlands, PhD Thesis, The Australian National University, Canberra.

Callick, R. and Tait, M., 1993. 'Population', in *The Papua New Guinea Handbook 1993 Edition*, National Centre for Development Studies, The Australian National University, Canberra:23–29.

Flores, A. and Temu, I., 1984. 'Policies and planning strategies for agricultural development in Papua New Guinea', in D. Gupta and S. Polume (eds), *Economic Policy Issues and Options in Papua New Guinea*, Development Studies Centre, The Australian National University, Canberra.

Food and Agricultural Organization (FAO), 1986. *Rice Development Policy: an analysis of the options for meeting future rice consumption requirements in Papua New Guinea*, in cooperation with the Papua New Guinea Department of Primary Industry, Port Moresby.

Foy, T., 1992. 'Food security in a South Pacific context: the case of rice in Vanuatu', *Pacific Economic Bulletin* 7(1):32–38.

Gibson, J., 1993. *Rice Self-sufficiency and the Terms of Trade: why rice is a good thing to import*, Economics Division Working Papers 93/6, Research School of Pacific Studies, The Australian National University, Canberra.

——, 1994. 'Rice import substitution and employment in Papua New Guinea', *Pacific Economic Bulletin*, 9(1):46–52.

——, 2001. *Food Security and Food Policy in Papua New Guinea*, Institute of National Affairs, Discussion Paper, Port Moresby.

Hale, P., 1979. 'Rice', in D.R.J. Densley (ed.), *Agriculture in the Economy: a series of review papers* (Vol. 3), Department of Primary Industry, Port Moresby.

Ito, S., Peterson, W. and Grant, W., 1989. 'Rice in Asia: is it becoming an inferior good?' *American Journal of Agricultural Economics*, 71(1):32–42.

Papua New Guinea, 2000. *Papua New Guinea National Food Security Policy 2000-2010*, Department of Agriculture and Livestock, Konedobu.

Shaw, B., 1985. *Agriculture in the Papua New Guinea Economy*, Discussion Paper No. 20, Institute of National Affairs, Port Moresby.

Temu, I., 1997. 'Agriculture, forestry and fisheries', in I. Temu (ed.) *Papua New Guinea: a 20/20 vision*, National Centre for Development Studies, Research School of Pacific and Asian Studies, The Australian National University, Canberra.

Whitecross, N. and Franklin, P., 2001. 'The role of rice in the 1997 PNG drought', in R.M. Bourke, M.G. Allen and J. Salisbury (eds), *Proceedings of the Papua New Guinea Food and Nutrition 2000 Conference: food security in Papua New Guinea*, Australian Centre for International Agricultural Research, Canberra.

Acknowledgments

I am grateful to Neville Whitecross, Phil Franklin, Michael Blakeney, Mike Manning and Mike Bourke for assistance with obtaining data and for helpful comments.