

# Agricultural productivity change in Pacific island countries

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Agricultural productivity growth in Fiji, Papua New Guinea, Solomon Islands, Tonga and Vanuatu is estimated for the period 1970 to 2002. The multiple factor productivity measure, total factor productivity (TFP), and two partial productivity measures, labour productivity and land productivity, are calculated. None of the five countries achieved significant TFP growth over the period studied. Papua New Guinea achieved growth in labour productivity, and land productivity grew significantly in Papua New Guinea and Solomon Islands. Favourable resource endowments appear to be necessary but not sufficient to achieve substantial productivity growth. The country best endowed with natural resources, Papua New Guinea, achieved gains in all three productivity measures after 1974, as did Solomon Islands after 1987.

Several options for raising farm-level productivity are briefly canvassed, including investment in human capital and rural infrastructure, agricultural research and extension, land tenure reform, provision of financial services, diversification of farming activities, management of natural resources, and institutional reform.

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A liberalised world trading environment has pressed Pacific island countries to orient agricultural production towards greater international competitiveness in existing markets while searching for new markets. Also, import-competing food producers have come under increasing pressure from food imports to keep costs down and cater for an increasingly broad range of consumer demands. These endeavours rely on increased agricultural productivity as the springboard for greater competitiveness.

Trends in productivity are presented and analysed for five Pacific island countries possessing a range of natural resource endowments for agricultural production. Three measures of productivity are calculated: a multi-factor productivity measure, total factor productivity (TFP), and two partial productivity measures, labour productivity (LP) and land productivity (AP). Factors influencing farm-level productivity are surveyed and then some suggestions are made for ways to improve productivity and competitiveness.



## Estimates of trends in agricultural productivity

### Method of analysis

Farm-level productivity changes are analysed for the five Pacific island countries for which full data sets on inputs and outputs are available over the period from 1970 to 2002: Fiji, Papua New Guinea, Solomon Islands, Tonga and Vanuatu. Data for the productivity estimates were obtained using the FAOSTAT data source of the Food and Agriculture Organization of the United Nations, as follows. Output aggregates were obtained from Rao (1993:Table 5.4) and constructed using international 1990 prices denominated in US dollars.<sup>1</sup> Livestock output data are unavailable for the five countries and so productivity estimates were based on crop production only. The number of inputs used was dictated by the availability of data. Four categories were included: land area, the economically active population engaged in agriculture, tractors as a proxy for machinery, and fertiliser as a proxy for purchased inputs used in production (Coelli and Rao 2005). A full series of data on fertiliser is unavailable for Vanuatu and so only three inputs were used for this analysis. Given our interest in a number of tree crops, it would have been desirable to include a tree inputs variable but data on seedlings are not available. In any event, the two most important inputs in the establishment and maintenance of tree crops are labour and fertiliser, which were both included in the input set.

A Fisher index was constructed to obtain an agricultural output index for each country. The index was initially estimated for output data in 1990, following the approach adopted by Coelli and Rao (2005). FAO production indices were then used to calculate crop output data for each year in each country back to 1970 and from 1991

onwards. Some but not all data are available from 2003 onwards, so the study period ends in 2002.

The data were used to construct Malmquist indices to measure TFP changes in the agricultural sector in each selected developing country over the study period. In this respect, the same methodological path was followed to calculate agricultural TFP change as that used by Coelli and Rao (2005). An advantage of estimating a Malmquist index is that it assumes an underlying translog production function that allows flexibility in the relations between outputs and inputs in production technology. Coelli and Rao (2005) provide a detailed description of the estimation procedure to obtain a Malmquist TFP index by applying data envelopment analysis.

### Results of productivity estimates

Results of estimated linear time trends in the three productivity measures are summarised in Table 1 for the five countries included in the study. Annual rates of change are reported in percentages with *t*-ratios in brackets. Estimates of TFP show that no country managed to achieve significant TFP growth over the study period. There was no significant trend in TFP in either direction in Papua New Guinea or Solomon Islands, and a decline in TFP in Fiji, Tonga and Vanuatu. Papua New Guinea achieved growth in labour productivity, and land productivity grew significantly in Papua New Guinea and Solomon Islands.

The evidence is not conclusive that productivity performance was superior for countries with richer endowments of natural resources, but Tonga, with the most limited natural resource base, experienced deterioration in TFP and labour productivity. The country best endowed with natural resources, Papua New Guinea, achieved gains in all three productivity measures after 1974.

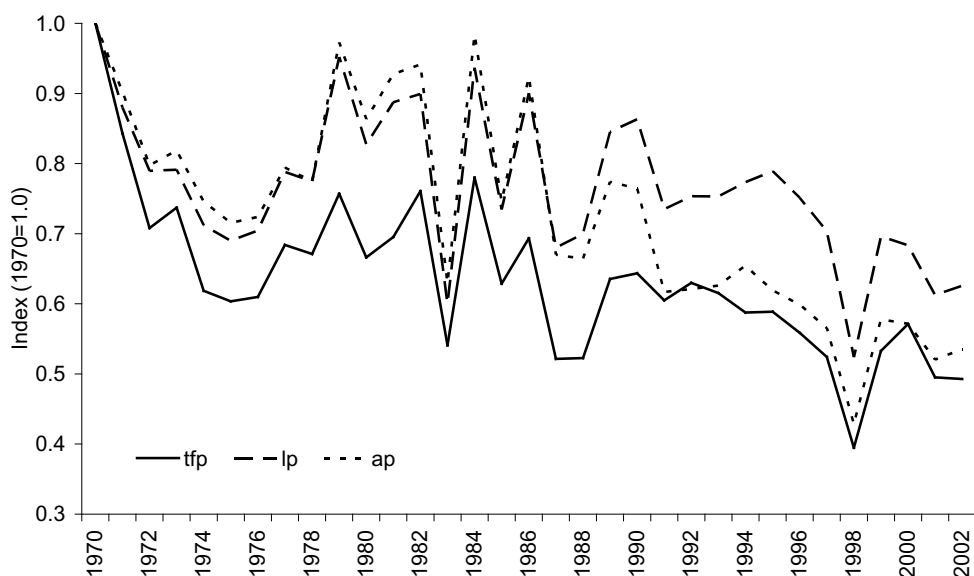


Table 1 Linear trends in agricultural productivity, 1970–2002

	Annual percentage changes (t-ratios in brackets)		
	Total factor productivity (per cent)	Labour productivity (per cent)	Land productivity (per cent)
Fiji	-1.35 (-6.01)	-0.07 (-3.25)	-1.68 (-6.82)
Papua New Guinea	0.28 (1.11)	0.38 (6.27)	0.79 (15.46)
Solomon Islands	-0.11 (-0.62)	-0.14 (-0.81)	1.05 (4.89)
Tonga	-2.90 (-13.91)	-0.51 (-1.98)	0.10 (0.39)
Vanuatu	-0.73 (-2.95)	-0.63 (-2.88)	-2.07 (-10.17)

Source: Author’s own estimates using FAOSTAT data.

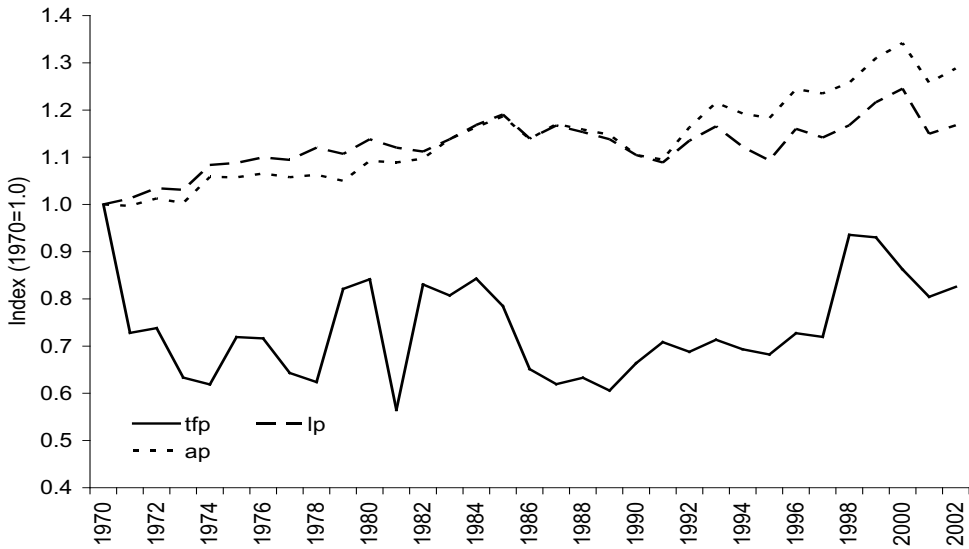
Figure 1 Agricultural TFP and partial productivity trends in Fiji, 1970–2002



Source: Author’s estimates.

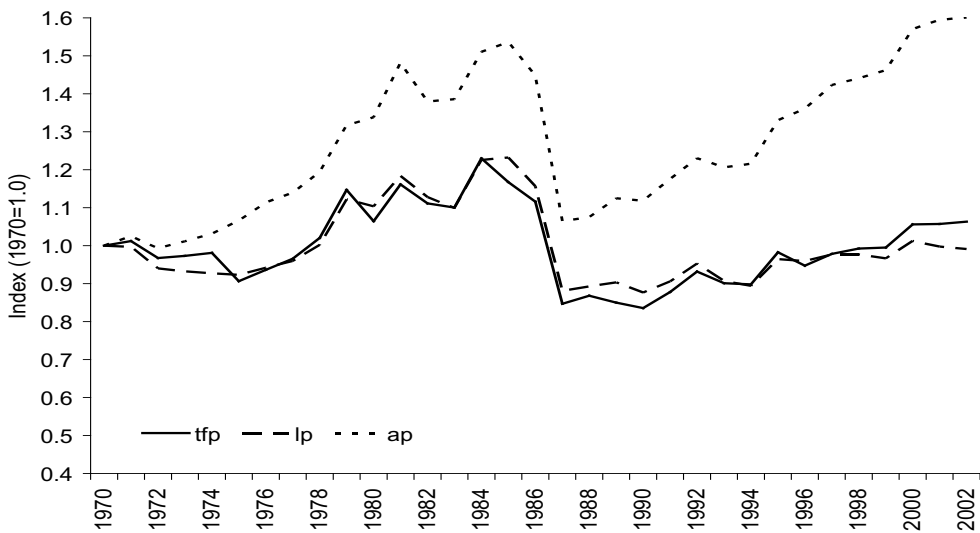


Figure 2 Agricultural TFP and partial productivity trends in Papua New Guinea, 1970–2002



Source: Author's estimates.

Figure 3 Agricultural TFP and partial productivity trends in Solomon Islands, 1970–2002



Source: Author's estimates.



## Country case studies of productivity change

The general picture in the agricultural sector of Fiji has been one of substantial fluctuations around declining productivity trends (Figure 1). Adverse production trends in the sugar industry have been the major contributory factor causing productivity declines. All three productivity indices show a significant downward trend, with the annual rate of decline in TFP, measured at  $-1.35$  per cent, greater than declines in the partial productivity indices until mid-way through the period when the rate of decline in land productivity increased markedly. There was little to separate the trends in TFP and land productivity indices over the final decade of the study period.

Trends in the productivity indices in the agricultural sector in Papua New Guinea are presented in Figure 2. The coefficient on the trend variable is positive but small for TFP ( $0.28$  per cent) and significant at only a very low significance level. Dividing the study period into two sub-periods from the mid 1970s is instructive as the insignificant estimate of rate of TFP change camouflages a significant change in productivity performance that took place after independence. During the 1960s and into the early 1970s prior to independence, agricultural TFP fell precipitously. It began to increase slowly from 1975 onwards and a significant  $0.59$  per cent annual rate of increase was recorded between 1974 and 2002, due in large part to advances made in the oil palm industry. Significant growth occurred in labour productivity ( $0.79$  per cent per year) and land productivity ( $0.38$  per cent per year), following consistent paths, but both rates of increase are in the low range. During the sub-period 1974–2002, the estimated annual rate of increase in labour productivity fell to  $0.24$  per cent

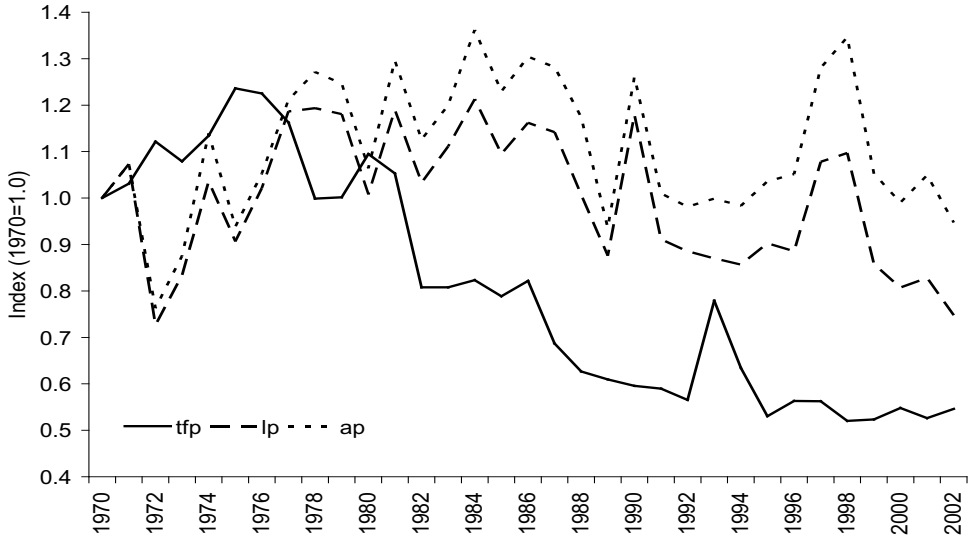
while that for land productivity increased slightly to  $0.76$  per cent.

In Solomon Islands, TFP and labour productivity tracked each other very closely, with no significant growth throughout the study period (Figure 3). As in Papua New Guinea, it is useful to divide the study period into two sub-periods, in this case from 1986 when cyclone Namu badly disrupted farming activities and damaged perennial crops. Significant TFP growth occurred between 1970 and 1986 at an annual rate of  $1.37$  per cent and from 1987 to 2002 at a rate of  $1.66$  per cent per annum, demonstrating the recovery from the effects of the cyclone after 1987. But TFP and labour productivity have never regained the levels that prevailed prior to the cyclone. Land productivity growth was substantially higher at  $1.05$  per cent per annum, with the gap increasing as the period drew to a close. For the period, 1987–2002, the annual growth rate in land productivity was high at  $2.93$  per cent due to progress made in the cocoa industry in particular.

Trends in productivity indices in Tonga presented show a marked difference between TFP and the two partial productivity indices (Figure 4), a consequence of increased substitution of purchased inputs for land and labour over the study period. TFP declined at an annual rate of  $-2.91$  per cent whereas labour productivity declined by only  $-0.5$  per cent per annum and there was no significant trend detected in land productivity. The divergence in estimates reflects the replacement in importance in the farming system of tree crops such as coconuts by more intensive farming activities such as squash production. Initial gains in TFP were made until 1977, arising from buoyant conditions in the coconut industry in the middle of the decade following depressed conditions at its beginning, and growth in the small but high value-adding industries

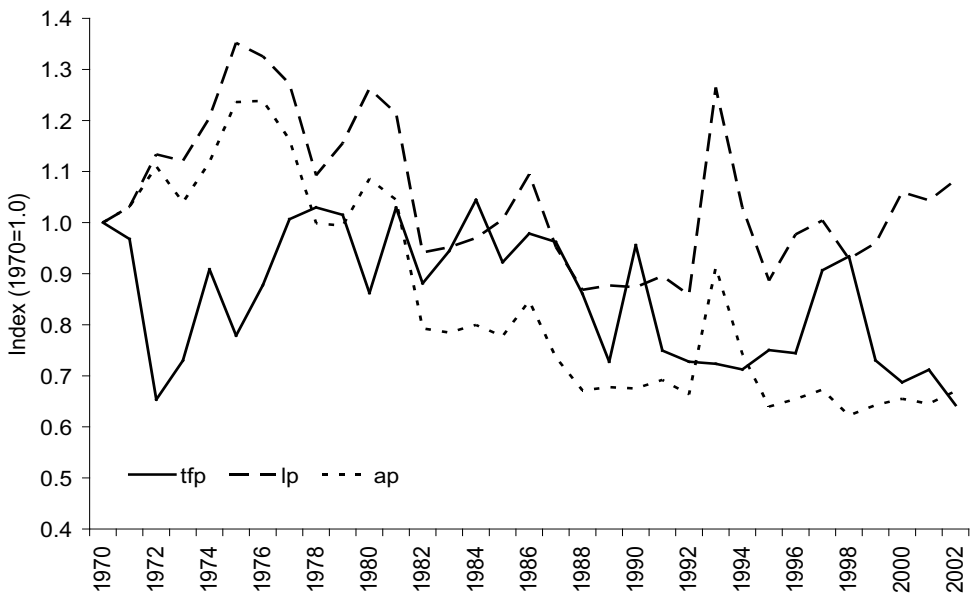


Figure 4 Agricultural TFP and partial productivity trends in Tonga, 1970–2002



Source: Author's estimates.

Figure 5 Agricultural TFP and partial productivity trends in Vanuatu, 1970–2002



Source: Author's estimates.



of vanilla, kava and watermelon. Towards the end of the decade, the latter industries were in trouble and the coconut industry had slumped into decline. The only recent bright spot was the arrest of the downward trend in TFP in the early 1990s: there was no significant trend for the period from 1995 to 2002. The most likely explanation for this outcome is improved cultivation practices in the squash industry.

Agricultural TFP in Vanuatu fluctuated around a slightly declining trend of  $-0.7$  per cent per year over the study period (Figure 5). Labour productivity showed a similar fall, averaging  $-0.6$  per cent per year. After initially increasing quite substantially in the first half of the 1970s as a consequence of the boom in copra prices, land productivity decreased at a substantial rate and averaged a rate of change of  $-2.07$  per cent per annum for the whole period. However, the decline was arrested by the mid 1990s and land productivity revealed no trend in the final seven years of the study period. The well-documented problems experienced during the 1980s by the copra industry and, to a lesser extent, the cocoa industry (see, for example, Fowler 1985, Weightman 1989) were the main reason for these productivity declines. The copra industry was depressed for much of the decade with the only relief coming during the world commodity boom in the middle of the decade, and it continued to decline during the 1990s.

## Ways to improve agricultural productivity

Productivity change can arise from four sources

- technological change, incorporating the introduction of new products
- change in technical efficiency
- change in scale efficiency
- change in diversification economies.

Each of these sources is now briefly explored for farming systems in Pacific island countries in general.

### Generating technological progress and introducing new products

The main avenue available to governments to assist farmers raise productivity and improve the returns to farm resources is likely to be through the introduction and uptake of improved production technologies. Technological progress can occur in two main ways in a farming system: by improving production methods for existing farming activities and introducing new, higher value-adding farming activities.

Farmers can adopt an improved method in the farming system to raise the production frontier in an existing farm activity. This approach remains an important avenue for Pacific island countries and relies on effective national agricultural research institutes with strong links to regional and/or international research institutes. It will continue to offer greatest potential for productivity increase into the future in all countries.

Future prospects are difficult to assess given the likely continued heavy reliance of tree crops, root crops and sugar in Pacific farming systems. Limited progress has been made in developing new high-yielding varieties that are well adapted to these systems. It is apparent that major efforts are needed to invest in science and technology and the development of agricultural research institutes in the region.

Fleming et al. (2005) argued that the technical advances in tree crop production have lagged behind other crops in four ways. Perhaps the main reason is that less progress has been made internationally in genetic and other research work for tree crop production than for other crops, with the possible exception of root crops. A second factor particularly pertinent to Pacific



farming systems is that crops were planted in the 1960s and 1970s on previously forested land that initially yielded high outputs from fertile soils. Yields have not been sustained as soils deteriorated with continuous production over a number of decades in humid tropical climates (Gallup and Sachs 2000). Sugarcane yields in Fiji are also declining. Third, many tree plantations are getting older and trees have not been replaced, leading to declining yields. It will occur sooner with commercial oil palm plantations than other tree crops because of shorter production cycles. Aging trees has been a particular problem with coconut palms where replanting has long been discouraged by very low returns. Where new plantings have been of improved dwarf varieties, they were often unsuitable to local conditions. Problems have also been experienced with improved cocoa varieties in Papua New Guinea that suffered deterioration in yields after a decade (Fleming and Yala 2002). Finally, increased incidences of pests and diseases have affected the yields of tree crops and bananas, especially among smallholders.

New industries with higher value-adding potential have been and continue to be introduced into Pacific farming systems, either through altering the final product of an existing farm activity or introducing a new activity. A common recent example of the former is the shift to organic farming, which provides higher returns even though the production frontier has not been raised and, indeed, might even have been lowered. Introduction of new crops is more common, such as niche export crops with higher returns than traditional export commodities.

### **Increasing technical efficiency**

A technically efficient farm is one that achieves best practice for given production technologies available for their use. Most farms in Pacific island countries fall well

below best practice for a variety of reasons, indicating that considerable scope exists to reduce technical inefficiency by closing the gap between their current practices and the best farms. The fragmentary evidence that exists in the region suggests there is considerable potential to increase technical efficiency in both food and cash crop production by making better use of farm resources, given existing technologies. Overfield and Fleming (2002) and Coelli and Fleming (2004) found that the technical efficiency indices range widely among farmers producing a combination of coffee and food crops in Papua New Guinea. Kufinale and Fleming (2002) reported a similarly wide range of technical efficiency indices in estate coffee production. Fleming and Lummani (2001) and Omuru and Fleming (2003a) found substantial inefficiencies in smallholder copra and cocoa production on the Gazelle Peninsula in East New Britain Province in Papua New Guinea.

### **Exploiting scale economies**

Even among smallholders, there is evidence of the potential to exploit scale economies in tree crop production. Omuru and Fleming (2003b) observed high levels of scale inefficiency in cocoa and copra production on the Gazelle Peninsula in East New Britain Province in Papua New Guinea. This inefficiency was due overwhelmingly to the presence of increasing returns to scale in both enterprises.

### **Exploiting diversification economies**

The farming systems in the Pacific are suited to diversification economies, where synergies between different farming activities can be exploited to achieve greater output at the same cost than by undertaking these activities separately. Few empirical studies have been undertaken and so evidence is scanty. Coelli and Fleming (2004)



identified modest diversification economies between subsistence food production and coffee and cash food production in Papua New Guinea. But slight diseconomies of diversification were observed between coffee and cash food production.

### **Options for government assistance**

Governments in Pacific island countries have a variety of tools at their disposal to encourage technological progress in agriculture, and to help farmers improve technical efficiency and exploit scale and diversification economies. They include national programs in health, education, nutrition and infrastructural development, economic growth and diversification, as well as programs specific to the agricultural sector such as research, extension, land tenure reform, farm diversification, the provision of financial services and natural resource management. Each of these options justifies a major study in itself, and only brief comments are made below. Successful government assistance requires the effective performance of their duties by staff in government organisations, a situation not always present in Pacific island countries in recent years.

### **Human capital and infrastructure investment**

It remains as true today as it has been throughout the study period that a better educated, healthier and more adequately fed rural population will achieve much higher rates of productivity growth. Government programs to develop and maintain rural infrastructure generate all types of technological progress but are especially important for high value-adding industries. Lack of rural effective rural infrastructure perpetuates the difficulties

farmers face in sending products to market and obtaining key agricultural inputs, resulting in high input costs and lack of timeliness in input application.

### **General economic growth and diversification**

A favourable economic climate in which to farm is crucial, as a prosperous economy increases the rewards and reduces the risks of adopting improved technologies. Pacific island economies have struggled to create a virtuous cycle of cumulative causation, where agricultural productivity drives rural economic development that in turn creates a favourable economic climate in which to farm, generating higher growth rates in agricultural productivity and export values. In none of the countries under study for productivity change have the returns to resource used in agriculture improved significantly over the past three decades (Fleming and Fleming 2005).

Governments can aid the introduction of new farming activities by implementing economic diversification programs. There is virtually no prospect of success from diversification through import substitution. But efforts to diversify into export niche markets for agricultural commodities with high income elasticities of demand and less intense competition offer hope even though they have so far met with limited success among Pacific island countries. Narsey (2004) identified few agricultural industries in which these countries have a comparative advantage. As Duncan observed, 'I have no doubt that there are lots of competitors also searching for these market niches' (2007:173). Grynberg and Razzaque highlighted the difficulties that small states encounter in attempts to diversify their economic base, given their narrow resource base, particularly in diversifying their agricultural export sector. They exhorted the international



community to 'recognise that market friendly interventions are necessary to assist small states to diversify their export base'. Otherwise, 'marginalisation will only serve to erode support for globalisation in small states' (2004:51).

### **Agricultural research and extension**

It is axiomatic that governments have a key role in assisting farmers to raise productivity by developing improved production technologies through the activities of national agricultural research institutes, given the public good nature of such research. Also, organisations such as the Australian Centre for International Agricultural Research have a pivotal role to play in providing financial and human support for national research institutes, and facilitating links with regional and international organisations.

A sustained improvement is needed in the extension services for the diffusion of improved practices to farmers. Essentially the same types of government programs that enable the adoption of improved technologies apply to assist farmers reduce technical inefficiency. Extension programs loom largest in bringing farmers closer to the production frontier whereas, by definition, research activities are more concerned with lifting the frontier. A focus on improving extension services is therefore warranted, but this approach will require an overhaul of present disappointing extension efforts.

### **Land tenure reform**

Suitability of a communal land tenure system for generating agricultural productivity is a controversial institutional issue in most Pacific island countries. The land tenure system has frequently been blamed for the inadequate use of existing land resources (for example, Chandra 1983; Syed and Mataio 1993; Economic Insights 1994; Hughes 2004; Curtin and Lea 2004).

Economic Insights (1994) highlighted an apparent paradox in Papua New Guinea where the area of land per head is very high by developing country standards whereas the area of agricultural land per worker is very low, attributing this discrepancy to the effects of land tenure arrangements.

On the other hand, apart from the political difficulty of discarding communal land tenure systems in Pacific island countries there are strong arguments in favour of retaining and improving them, at least until the stifling effects of market imperfections on commercial development in rural areas are assuaged. This is an issue of enormous contemporary importance. Binswanger and Deininger (1997) presented a summary of the evidence on welfare gains from land reform involving the assignment of property rights in developing countries that is pertinent to the countries under study. Their findings suggest that customary tenure should not deter the economic development of agriculture to any significant extent. It can provide security of tenure at a relatively low cost and offers advantages that would be lost with the introduction of private property rights. Furthermore, tenure systems in Pacific island countries often work much better in practice than might be expected from a literal interpretation of the regulations (Hardaker and Fleming 1994).

The above arguments do not rule out improvements in the operations of land tenure systems within the context of customary land ownership and use, along the lines suggested by Fingleton (2007) and Yala (2006) for Papua New Guinea although from different perspectives. Various initiatives, legal or otherwise, often lead to better use of the land and suggest that a gradualist approach to tenure reform is preferable. For example, Allen (1993) identified initiatives resulting in marginal improvements that would enable



more secure and longer-term tenure to the users of land. Such improvements are only likely to be achieved as a result of careful planning, cultural sensitivity and detailed understanding of the practical rules governing the existing tenure system.

### **Financial services**

A gradualist approach to land reform should also help alleviate the problem of lack of access by smallholders to affordable rural credit, which is especially important for the adoption of improved technologies and entry into high value-adding industries. Skully (1997) contended that this lack has been caused by an absence of an effective leasehold title system rather than the communal land tenure system itself. But agricultural credit should not be isolated from the more general concern about the need to provide effective financial services in rural areas. Skully concluded that the provision of financial services was reasonable by developing country standards. The more limiting constraint tended to be shortcomings in the ability of borrowers to apply for and service loans, suggesting greater need to train farmers in basic skills in business management and financial analysis.

### **Institutions and public sector governance**

Easterly and Levine (2002) concluded from their empirical study of 72 countries that institutions matter most for development; geographic endowments are only important to the extent that they foster long-lasting institutions. The sorts of elements that Easterly and Levine identified as discouraging the 'planting' and growth of long-run institutions—climate, pests and diseases, and inhospitable farming environment for crops—did not have adverse effects on the early development of institutions in Pacific island countries to

the extent that they did in much of Africa, Asia and Latin America. As a consequence, institutions in these countries became reasonably well established and functioned quite effectively in the early years of the study period. Some institutions that managed to retain a strong degree of independence, such as many central banks, continue to operate effectively. But many institutions critical to farm-level productivity growth have undergone substantial deterioration in structure and performance over the study period (Reilly 2001). This deterioration has had a deleterious effect on the ability to implement policy reforms effectively and maintain law and order, and has hindered agricultural export development in general and agricultural productivity growth in particular.

As the land tenure debate demonstrates, improving institutional support for agricultural development is one of the most important but difficult actions to specify. While sound organisational performance is integral to each of the above avenues for progress outlined above, the more general issue of institutions and governance in the public sector has a large influence on the ability of individual organisations to perform well in their particular sphere.

### **Encouraging diversified farming systems**

It is conceivable that existing diversification economies could be lost if commercialisation of agriculture results in greater specialisation among farming activities. Perhaps the most promising way forward is through the more widespread use of highly productive intercropping systems as part of a program to replant trees and palms. Intercropping has traditionally been at the core of traditional farming systems in Pacific island countries, and is well suited to the production environment. Scope exists for improving productivity through the application of known research outputs



that can result in higher farm output while still allowing a diversified farming system that enables small farmers to manage their risks effectively.

### **Overcoming constraints imposed by smallness and remoteness**

Whether the conclusion by Easterly and Levine (2002) that institutions matter more than geographic endowments in developing countries is open to question in the case of small Pacific island countries. The limitations placed on farm productivity increases by smallness are manifested in two ways: at the farm level and at the economy level. At the farm level, a debate has continued for decades on the relative merits of smallholders and estates as the appropriate production model for Pacific agriculture. The empirical evidence on the relationship between farm size and productivity is inconclusive throughout the developing world, and tends to be compounded by a variety of factors (Fan and Chan-Kang 2005).

The costs of services provided by the private sector and public utilities to agricultural producers and marketers of their export products are high by international standards, and progress is likely to be slow in reducing these costs. Scale diseconomies are especially prevalent in the collection of small surpluses from many smallholders (Hardaker and Fleming 1994). High production costs mean that Pacific island countries tend to have a comparative disadvantage in the processing of raw materials produced by their agricultural industries. Firms exporting agricultural commodities suffer twice in that they tend to be small, making it difficult to internalise agglomeration economies, and are more prone to external diseconomies in rural areas where they typically face high transaction and communication costs, and lack affordable access to venture capital. In

these difficult circumstances, a strong case can be made for regional specialisation to encourage international competitiveness, with a heavy reliance on products and markets for which the required knowledge and experience already exist.

The fragmented nature of internal markets also makes the costs of doing business high. The archipelagic nature of the five countries under study creates segmented domestic markets that are not suitable stepping stones to the development of an export industry. This segmentation imposes barriers to agricultural development, making internal transport costs high. The region is also located relatively far from the world markets, which, when combined with small export volumes, results in high external transport costs per unit of export. It has long been considered that the constraint imposed by remoteness has put countries in the region at a relative disadvantage. Gibson (2006) studied remoteness as a cause of slow economic growth and found that, contrary to conventional wisdom, spatial remoteness is not a major impediment to economic growth. But he does make the important caveat that his conclusions are based on a physical rather than economic measure of remoteness.

Another obstacle to the attainment of cost reductions is the small population base of the countries. Gibson (2006) reported that population has a significant and positive impact on economic growth. A small population leads to small domestic markets and difficulties in achieving critical mass, scale economies and agglomeration economies that constrain the development of international trade and investment flows.

Gibson (2007) recommended regional solutions to problems of slow economic growth, but the track record for regional cooperation has been mixed. Narsey (2004) examined the prospects for regional trade agreements, covering 'the recently signed regional trade agreement amongst the



Pacific island countries themselves—the Pacific Island Countries Trade Agreement (PICTA), the Pacific Agreement on Closer Economic Relations (PACER)—which includes Australia and NZ—and the Cotonou Agreement, which is the successor to the Lomé Agreement between the African Caribbean Pacific States (ACP)’ (Narsey 2004:1). His prognoses for success are not encouraging, perhaps best summed up by his comments on the disappointing outcome for the export of one of the few agricultural products identified as having export potential, kava. Exports from Fiji were reduced by bans obtained by European pharmaceutical countries while the EU authorities stood by and took no action despite the Cotonou Agreement.

### Management of natural resources

Management of natural resources is fundamental to efforts to increase agricultural productivity in Pacific island countries; in some instances, even maintaining productivity requires attention to the quality of these resources. The supply of new farmland is virtually exhausted and in most areas land is being farmed more intensively, with shorter fallow cycles. Even in relatively resource-rich Papua New Guinea, Allen, Bourke and Hide (1993:301) reported over a decade ago that, in some agricultural areas, ‘there are suggestions that this process of intensification will be unsustainable and, in the absence of significant changes in technology, will lead to long-term environmental damage that could jeopardise continued agricultural production’. Maintaining resource quality will become integral to the activities of national agricultural research institutes.

Should more be done to reduce the effects of natural and biological disasters? Natural disasters include drought, cyclones, flooding, frosts, volcanic eruption, earthquakes and landslides while biological

disasters cover pest and disease outbreaks. Their adverse effects on agricultural production are evident in virtually all Pacific island countries. Chung (1996, cited in McGregor and McGregor 1999:5) assessed the degree of vulnerability to various natural disasters of all Pacific island countries, including those under study. He found that agricultural systems are surprisingly resilient to natural disasters. Where natural disasters have led to the termination of an agricultural industry, pre-existing maladies of the industry were the underlying reasons for failure; the natural disaster tended to be ‘the straw that broke the camel’s back’. Two contrasting examples in Solomon Islands during the 1980s are illustrative of this point. A major cyclone temporarily damaged the otherwise healthy oil palm industry in 1986, and production rebounded quite quickly (see Figure 3). On the other hand, the rice industry, which suffered from lack of profitability, intractable pest problems and difficulties in machine maintenance, was destroyed.

In general, agricultural systems in the Pacific tend to recover more quickly and at lower cost from natural disasters than they do from biological disasters. This is evident from the calamitous impact in Samoa in 1993 of taro leaf blight on the taro industry that had recovered quickly from the earlier effects of Cyclones Ofa and Val in 1990 and 1992. But a worrying consequence of export expansion through the commercialisation of agricultural production is that it can leave farming systems more prone to damage from both natural and biological disasters. McGregor and McGregor (1999:23), for example, contended that the move towards taro monoculture in Samoa, abetted by Cyclones Ofa and Val, caused imbalances in the agroecological system that triggered the outbreak of taro leaf blight. They also observed that the disappearance of the robustness that characterises traditional



farming systems exposes agricultural systems to greater environmental disasters and degradation, and retards their ability to recover from them (McGregor and McGregor 1999).

## Conclusion

The fortunes of farmers in agricultural sectors in five Pacific island countries are traced in this article by estimating agricultural productivity change over the period from 1970 to 2002. The evidence is not encouraging, and greater investment is needed in agriculture in all countries in the region if the sector is to contribute to economic development in the region. Most potential to increase TFP lies with the national research institutes, along with continuance of the valuable assistance currently being provided to them by aid agencies, and greater transfer of improved technologies from international research centres than has occurred to date.

The areas in need of government intervention to facilitate agricultural development have long been clearly delineated by development analysts: greater human capital investment in rural areas; better rural infrastructure; more effective agricultural research and development; an improved general economic climate for agricultural production; more suitable rural financial services; modifications to the land tenure system; and overcoming problems of smallness in size and fragmented land masses. The disappointing productivity performance reported in this article suggests that most governments have so far failed to rise to the challenge to make these improvements. Unless they do, the prognosis for agricultural productivity growth is not bright.

## Note

- <sup>1</sup> Estimation of non-marketed agricultural output in the FAOSTAT data set is suspect; the estimation procedure might have produced inaccurate results in some instances and altered over the study period. Bourke and Vlassak (2004) estimated national food crop production and its energy content for Papua New Guinea, asserting that their estimates are likely to be more reliable than the FAO estimates (Bourke and Vlassak 2004:14). They found that crops of New World origin had increased markedly and the estimate of sweet potato output was more than double that of previous estimates. It would be useful to re-estimate the FAOSTAT output figures for agricultural output using this approach for the whole series but it would take a great deal of effort to complete for all Pacific island countries.

## References

- Allen, B.J., 1993. 'Issues for the sustainability of agriculture systems in Papua New Guinea, 1990–2015', in *Issues in Papua New Guinea Agriculture*, AusAID, Canberra.
- Allen, B.J. Bourke, R.M. and Hide, R.L., 1995. 'The sustainability of Papua New Guinea agricultural systems: the conceptual background', *Global Environmental Change*, 5(4):297–312.
- Binswanger, H.P. and Deininger, K., 1997. 'Explaining agricultural and agrarian policies in developing countries', *Journal of Economic Literature*, 35(4):1958–2005.
- Bourke, R.M. and Vlassak, V., 2004, *Estimates of Food Crop Production in Papua New Guinea*, Land Management Group, The Australian National University, Canberra.



- Chandra, S., 1983. *Agricultural development in Fiji*, Australian Universities' International Development Program, Canberra.
- Chung, J., 1996. Mitigating disasters in agriculture: South Pacific Disaster Reduction Programme, Paper presented to the South Pacific Commission PHALPS Conference, Rarotonga.
- Coelli, T. and Fleming, E., 2004. 'Diversification economies and specialisation efficiencies in a mixed food and coffee smallholder farming system in Papua New Guinea', *Agricultural Economics*, 31(2/3):229–39.
- Coelli, T.J. and Rao, D.S.P., 2005. 'Total factor productivity growth in agriculture: a Malmquist index analysis of 93 countries, 1980–2000', in D. Colman and N. Vink (eds), *Reshaping Agriculture's Contributions to Society, Proceedings of the Twenty-Fifth International Conference of Agricultural Economists, Durban, 16–22 August 2003*, Blackwell, Oxford, 115–34.
- Curtin, T. and Lea, D., 2006. 'Land titling and socioeconomic development in the South Pacific', *Pacific Economic Bulletin*, 21(1):153–80.
- Duncan, R., 2007. 'Enhancing the labour absorption capacity of Pacific agriculture', *Pacific Economic Bulletin*, 22(1):164–74.
- Easterly, W. and Levine, R., 2002. *Tropics, germs and crops: how endowments influence economic development*, NBER Working Paper No. 9106, National Bureau of Economic Research, Cambridge.
- Economic Insights, 1994. *Papua New Guinea: The role of government in economic development*, International Development Issues No. 33, AusAID, Canberra.
- Fan, S. and Chan-Kang, C., 2005. 'Is small beautiful? Farm size, productivity, and poverty in Asian agriculture', in D. Colman and N. Vink (eds), *Reshaping Agriculture's Contributions to Society, Proceedings of the Twenty-Fifth International Conference of Agricultural Economists, Durban, 16–22 August 2003*, Blackwell, Oxford:135–46.
- Fingleton, J., 2007. 'Rethinking the need for land reform in Papua New Guinea', *Pacific Economic Bulletin*, 22(1):115–21.
- Fleming, E. and Fleming, P., 2005. A reappraisal of the role of agriculture in economic growth in Melanesian countries, Paper contributed to the 26th International Conference of International Association of Agricultural Economists, Brisbane, August.
- Fleming, E. and Lummani, J., 2001. *Technical efficiency of smallholder cocoa and copra producers in Papua New Guinea*, Occasional Paper 7, ACIAR Project on Understanding the Smallholder Cocoa and Coconut Sector in Papua New Guinea, Cocoa and Coconut Research Institute, Keravat.
- Fowler, M.H., 1985. 'Cocoa in Vanuatu', *Cocoa Growers' Bulletin*, 36:17–22.
- Gallup, J.L. and Sachs, J.D., 2000. 'Agriculture, climate, and technology: why are the tropics falling behind?', *American Journal of Agricultural Economics*, 82:731–37.
- Gibson, J., 2007. 'Is remoteness a cause of slow growth in the Pacific: a spatial-econometric analysis', *Pacific Economic Bulletin*, 22(1):101.
- Grynberg, R. and Razzaque, M.A., 2004. *The trade performance of small states*, Economic Paper 59, Commonwealth Secretariat, London.



- Hardaker, J.B. and Fleming, E., 1994. *Strategies for Melanesian Agriculture for 2010: tough choices*, National Centre for Development Studies, The Australian National University, Canberra.
- Hughes, H., 2004. *Can Papua New Guinea come back from the brink?*, Issues Analysis No. 49, Centre for Independent Studies, Sydney.
- Kufinale, K. and Fleming, E., 2002. *Analysis of the technical efficiency of estate coffee production in Papua New Guinea, 1993–1999*, Discussion Paper No. 27, Industry Affairs Division, Coffee Industry Corporation, Goroka.
- McGregor, A. and McGregor, I., 1999. *Disaster and agriculture in the Pacific Islands*, South Pacific Disaster Reduction Program, UN Department for Economic and Social Affairs, New York.
- Narsey, W., 2004. Regional integration or remittances: what options?, Paper presented at the Workshop on Remittances, Microfinance and Technology: Leveraging Development Impact for Pacific States, Brisbane, 10–11 June.
- Omuru, E. and Fleming, E., 2003a. *Technical efficiency of smallholders producing copra in the Gazelle Peninsula, East New Britain Province: a stochastic frontier production analysis*, Occasional Paper 13, ACIAR Project on Understanding the Smallholder Cocoa and Coconut Sector in Papua New Guinea, Cocoa and Coconut Research Institute, Keravat.
- Omuru, E. and Fleming, E., 2003b. *Technical and scale inefficiencies in cocoa and copra production and choice of peer smallholders in East New Britain Province: a data envelopment analysis approach*, Occasional Paper 12, ACIAR Project on Understanding the Smallholder Cocoa and Coconut Sector in Papua New Guinea, Cocoa and Coconut Research Institute, Keravat.
- Overfield, D. and Fleming, E., 2002. 'Analysis of the technical efficiency of food crop production in a sweetpotato/coffee-based farming system in the Highlands of Papua New Guinea', in M. Nakatani and K. Komaki (eds), *Potential of root crops for food and industrial resources: proceedings of the Twelfth Symposium of the International Society for Tropical Root Crops (ISTRC)*, 10–16 September 2000, Tsukuba:179–87.
- Reilly, B., 2001. 'Trouble in paradise: the Africanisation of the South Pacific', *Policy*, 17(1):3–7.
- Skully, M.T., 1997. *The South Pacific: finance, development and the private sector*, International Development Issues No. 48, AusAID, Canberra.
- Syed, S. and Mataio, N., 1993. *Agriculture in Cook Islands: new directions*, Institute of Pacific Studies and the Cook Islands Centre of the University of the South Pacific, Suva and Rarotonga.
- Weightman, B., 1989. *Agriculture in Vanuatu: a historical review*, British Friends of Vanuatu, Cheam.
- Yala, C., 2006. 'Rethinking customary land tenure issues in Papua New Guinea: the big challenge', *Pacific Economic Bulletin*, 21(1):1–13.