Saving a staple crop: impact of biological control of the banana skipper on poverty reduction in Papua New Guinea

ACIAR

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SAVING A STAPLE CROP: IMPACT OF BIOLOGICAL CONTROL OF THE BANANA SKIPPER ON POVERTY REDUCTION IN PAPUA NEW GUINEA

ACIAR project CS2/1988/002-C

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Contents

Box

Summary

Poverty in PNG

▶▶▶▶ Poverty through income deprivation is a significant problem in Papua New Guinea (PNG). Estimates from a 1996 household income survey suggest that around 30% of the PNG population have household incomes below the poverty line. The poverty line is set according to the amount of income needed to sustain 2200 calories per day of food consumption and cover the cost of essential non-food items.

▶▶▶▶ With PNG's continued poor economic performance since 1996, it is likely that the extent of poverty is now higher, perhaps significantly so, than the 1996 estimate.

▶▶▶▶ Most income-poor households live in rural areas and have a heavy reliance on subsistence agriculture. It follows that measures that raise the productivity of subsistence agriculture, or avoid losses in subsistence agricultural production that would otherwise occur, could make a significant contribution to poverty reduction in PNG.

The banana skipper project

▶▶▶▶ An example of such a measure is ACIAR project CS2/1988/002-C, which ran from 1988–89 to 1990–91. This project led to the successful introduction of a biological control agent for the banana skipper (*Erionota thrax* (L.)), an introduced butterfly pest of bananas that was doing considerable damage to PNG's banana crops. The biological control agent proved to be highly effective. The 30% production loss occurring before biological control was reduced by 95% with biological control.

▶▶▶▶ The Initial Impact Assessment (No. 12 in the series) covered the economic benefits to PNG and Australia.

The project involved collaboration with CSIRO Entomology and the key involvement of two very experienced entomologists (F.M. Dori of Papua New Guinea and D.P.A. Sands of CSIRO).

▶▶▶▶ Bananas are an important subsistence food crop in PNG. They are grown in all parts of the country up to 2200 m altitude and account for around 8% of PNG's staple food crop production. For 26% of Papua New Guineans, bananas make up at least 10% (by value) of their food consumption.

▶▶▶▶ The biological control has had a significant impact on the effective incomes of most PNG households by improving the supply of the country's second-most important staple food crop (after sweet potato) and by lowering the price of bananas to purchasers.

Subsistence growers benefit …

▶▶▶▶ Subsistence banana growers are the major beneficiaries from the biological control. How much their incomes are improved depends on the extent to which they would have diverted resources from banana growing to other crops if the skipper had not been controlled.

- Assuming no diversion, we calculate that their annual consumption in kina market value terms increases by 2.2% (from 657 kina to 680 kina).
- Assuming 30% diversion, their annual consumption increases by 0.9% (from 669 kina to 680 kina).
- This puts around 15 000 people (no diversion) to 6000 (30% diversion) people above the poverty line who would otherwise have been below it.
- In addition to these people who move over the poverty line due to the biological control, every subsistence banana producer will experience an increase in consumption of between 0.9 and 2.2%. This means that poverty among all banana producers is reduced.

▶▶▶▶ These estimates assume that all production is consumed in the household. Growers who sell some of their surplus product at the market will receive a larger benefit in terms of increased income and consumption prospects.

… as do urban consumers

▶▶▶▶ The ACIAR project has also contributed to lower urban banana prices, in that the fall in supply of bananas caused by the skipper would have forced banana prices up. By how much, depends on the price elasticity of demand for bananas in PNG, a parameter that is not known with certainty. The higher the price elasticity of demand, the lower the increase in prices caused by a reduction in banana production as consumers switch to other sources of food. Even with a price elasticity at the high end of the likely range, banana prices are likely to have risen by around 15% had the

biological control of the skipper not been achieved. Lower market prices for bananas of around 15% would result in around 28 000 purchasers of bananas living just above the poverty line when they otherwise would have been below it.

- These estimates of numbers raised above the poverty line, between 6 000 and 15 000 banana growers and approximately 28 000 banana purchasers, seem small when compared with the 1.4 million people considered to be below the poverty line. However, this head count ratio measure takes no account of the amount by which people fall short of the poverty line or are above it. Since the program has prevented a banana shortage and price rise, all banana consumers will benefit from more affordable bananas. The banana skipper control program has increased effective incomes across all income levels of banana producers and banana consumers.

- Roughly 700 000 banana growers live in poverty, as do around one million banana consumers. These banana growers will become less poor as a result of increased banana production from the program, and the banana consumers living in poverty will be better off because of lower banana prices.

1 The banana skipper project

Bananas are a key subsistence food crop in Papua New Guinea (PNG). They are grown in all parts of the country up to an altitude of 2200 m and account for around 8% of PNG's staple food crop production (Bourke 2002). Only sweet potato, which accounts for more than 60% of staple food crop production, is more important.

The banana skipper, *Erionota thrax (L.),* is a butterfly native to Southeast Asia, where it is controlled by native predators and is of little economic consequence. In other countries where its natural predators are absent, it can do significant damage to banana crops.

The larvae of the butterfly make rolls in the banana leaves for shelter and sustenance, consuming the leaf as they develop. An infestation of the banana skipper can cause significant defoliation of banana plantations. While the skipper does no direct damage to the banana fruit, the defoliation reduces fruit yields and delays maturation.

The skipper had plagued banana crops on several islands in the Pacific before being discovered in PNG in 1983. Over the next six years, it spread across the mainland and to the New Guinea islands, establishing itself as a major pest of PNG bananas.

Control of the banana skipper

Islands in the Pacific affected by the skipper had successfully used biological control agents. For example, natural predators such as the egg parasitoid *Ooencyrtus erionotae* and the larval parasitoid *Cotesia erionotae* were established in Hawaii to great effect.

Soon after the discovery of the banana skipper in PNG, the very favourable prospects for its biological control in that country, based on experiences in other affected countries, were documented. ACIAR funded a project that led to the successful introduction of an effective biological control agent to PNG.

Three parasitoids were released in the Morobe and Eastern Highlands provinces in 1988. Of these, only *Ooencyrtus erionotae* had any significant effect, causing skipper mortality of around 30%. However, these initial biological control methods had little effect overall, and the banana skipper continued to spread.

The key difference in successful suppression on Pacific Islands compared with PNG was the presence of the larval parasitoid *Cotesia erionotae*. It took two years to establish that, in order to obtain quarantine permission, the introduction of *C. erionotae* would be unlikely to detrimentally affect native species considered to be of importance. The parasitoid was then released in 1990. The biological control then proved to be highly successful with banana leaf damage reduced from about 60% to around 5%.

The effects of leaf damage by the banana skipper

Banana trees produce more leaves than are needed for fruit production, so a defoliation of up to 20% will not cause a significant loss in fruit weight. The continuous defoliation occurring as a result of banana skipper infection is likely to have a more significant effect. Fruit weight loss begins when leaf loss exceeds 16%. The results from field surveys suggested an average defoliation from the skipper of 60%, resulting in banana yields falling by 30% on average (a conservative estimate). The impact of the loss in fruit weight was a reduction in the quantity of food available in PNG, a reduction in incomes and consumption prospects for banana growers, and an increase in the price of bananas.

Papua New Guinea agriculture

Most of PNG's food requirements come from village gardens. Low intensity subsistence and semi–subsistence shifting cultivation farming systems dominate. Locally grown staple food is very important to the PNG economy. Most is consumed by the producing household or shared with relatives. Surpluses are sold in local markets. The 1996 Papua New Guinea Household Survey valued annual household food production at K1299 million, with staple crops valued at K672 million (World Bank 1996; J. Gibson and S. Rozelle, unpublished data).

Rural areas primarily rely on production of staple crops for their food supply, while urban areas place a greater importance on imported food. The importance of each staple crop depends largely on the region in which it is grown. The coastal areas and New Guinea islands primarily rely on mixed-crop gardens with bananas a key feature, while the Highlands are dependent on sweet potato and pig farming.

In addition to subsistence farming, many rural families grow cash crops for export. The major export crops include coffee, cocoa, copra, oil palm, tea and rubber. These crops provide an important source of cash income, facilitating spending on imported food, clothing and school fees. For many

farming families, subsistence farming provides a greater source of implicit income than the cash crop.

Sweet potato is the dominant food staple in rural areas (30% of total calories), while rice, most of it imported, is the dominant food staple in urban areas, representing around 28% of total calories consumed. Bananas amount to 7.4% of rural calories and 3.9% of urban calories (Gibson 2001). For 26% of Papua New Guineans, bananas make up at least 10% of the value of their food consumption.

The true size of the banana crop in PNG is uncertain. Since most bananas grown are eaten by the families that grow them or are sold at small local markets, banana production is not accurately recorded. Estimates of annual production range from 292 000 tonnes (Bourke 2002), which the author says was a very conservative estimate, to 413 000 tonnes (Gibson 2001) to 700 000 tonnes (FAO 2002).

This report

An earlier benefit–cost analysis of the ACIAR project (Waterhouse et al. 1999) found significant economic benefits to PNG from the successful biological control of the banana skipper. In this report, we assess the impact the project has had on poverty in PNG. This requires establishing:

- the present level of poverty in PNG; and
- the level of poverty that would have existed in the absence of the banana skipper project.

2 Poverty in Papua New Guinea

Pearce (2002) points out that there are many dimensions to poverty. Easiest to measure, and the focus of most quantitative analyses, is the notion of poverty as income deprivation: the inability to generate sufficient income to meet the basic needs of the household. These basic needs include food, water, shelter and clothing, access to health and education, accountable state institutions, and freedom from excess vulnerability to adverse shocks.

Agricultural research can influence poverty in a variety of ways (Pearce 2002). The impact of research such as the banana skipper project is primarily on agricultural productivity and thus the enhancement of real household incomes.

ACIAR's qualitative criteria for assessing poverty impacts include:

1. improvement of poor producers' incomes
2. provision of benefits for rural and urban consumers through reduced food prices
3. provision of improved health benefits
4. provision of environmental benefits that improve sustainability of income generation and enhanced quality of life
5. promotion of policies and institutional change that favour the poor
6. empowerment of poor people, particularly women and children
7. reduction in the impact of unforeseen events.

The criteria most likely to be affected by the banana skipper biological control project are 1, 2 and 7.

In recent years, the issue of poverty in developing countries and how best to tackle it has received a stronger focus in international development organisations and in country aid agencies. An example is World Bank (2000), a World Bank Development Report devoted entirely to attacking poverty.

For years it was widely believed that despite PNG's poor growth performance the extent of poverty was small. The abundance of land and the strong subsistence production base for the majority of the population were the main reasons for this view. But the findings in the 1996 World Bank Assessment for Papua New Guinea (World Bank 1996) contradicted this view.

The poverty measures used in this report are derived from the 1996 World Bank assessment. In the survey conducted for that assessment, around 1100 households were interviewed, with data collected on household consumption levels, adult and child health, education and employment levels. For the purpose of the survey, the country was divided into five general regions: the National Capital District; Papuan/South Coast; Momase/North Coast; the Highlands; and the New Guinea Islands.

Poverty lines for these five regions were measured, based on the cost of a typical local food basket providing 2200 calories per day (the food poverty line), plus an allowance for essential non-food items, calculated from the typical value of non–food spending by households whose total expenditure just equals the cost of the food poverty line.

The poverty lines are highest in the National Capital District due to the arid climate and poor links to the rest of the economy, which contribute to higher food prices, and are lowest in the Momase/North Coast regions where food is abundant. Table 1 shows the food poverty lines and total poverty lines.

Table 1. Poverty lines (kina/year) for Papua New Guinea (1996)

	National Capital District	Papuan/South Coast	Highlands	Momase/ North Coast	New Guinea Islands
Poverty line	799	496	390	280	424
Food poverty line	543	391	288	218	326

Source: Gibson (2000).

In 1996, around 30% of PNG's population of 4.4 million people lived in poverty; that is, their incomes fell below the poverty line. Another 300 000 were marginally above the poverty line, and thus vulnerable to environmental and economic shocks. Of these people, 94–97% lived in rural areas, relying on subsistence agriculture, cash crops and small businesses for survival (Duncan 2001). With PNG's extremely poor economic performance since 1996, the percentage of the population below the poverty line is likely to have increased, perhaps significantly.

Food security in PNG is somewhat vulnerable for a number of reasons. Increasing volumes of food imports and the declining value of the kina in a country that is a net importer of foodstuffs means that many households, especially rural households, do not have 'physical, social and economic access to sufficient, safe and nutritious food'. The information in Bourke et al. (2000) suggests that the areas most vulnerable to food insecurity are high altitude locations, highland fringe locations and small islands, which do not have significant banana-growing activity.

The link between poverty and banana production

Since most rural dwellers are subsistence farmers and many people live around the poverty line, any factor that reduces the production of a staple crop, such as bananas, could be expected to have a significant impact on poverty in PNG. It follows, therefore, that measures that can raise the productivity of subsistence agricultural production, or avoid it falling, are likely to be effective in preventing and reducing poverty. Furthermore, if these could be combined with measures that facilitate more trade in basic foodstuffs, then the impact on poverty alleviation would be even greater.

Gibson and Olivia (2002) calculate that a transfer of around 150 million kina per year to those below the poverty line would be needed to eliminate the 1996 level of poverty. This represents about 11.5% of the estimated 1996 value of annual household food production.

Table 2. Distribution of income for persons whose banana consumption exceeds 10% of food consumption

Income range	Percentage of heavy banana consumers (cumulative) %	Number of heavy banana consumers (cumulative) '000 people
Less than 50% of the poverty line	37.9	432.5
Less than 75% of the poverty line	47.9	545.9
Less than 90% of the poverty line	57.3	653.3
Less than the poverty line	61.3	696.2
Up to 10% more than the poverty line	64.8	736.1
Up to 25% more than the poverty line	69.6	791.3
Up to 50% more than the poverty line	73.7	837.3
Up to 100% more than the poverty line	79.8	904.8

Sources: World Bank (1996); CIE calculations.

The survey results from the 1996 World Bank assessment (Table 2) show that households with a high proportion of bananas in their diet have, on average, lower incomes than other PNG residents. These households live

mainly in the coastal areas of mainland PNG and the northern tip of New Britain (Hanson et al. 2001). These households are likely to be subsistence farmers with some degree of dependence on bananas as a food crop. In 1996, around 60% of households for whom bananas consisted of more than 10% of food consumption lived below the poverty line. Banana producers are thus a group with a high incidence of poverty, and a worthy target for a poverty reduction program.

3 Impact of the project on poverty reduction

In analysing the contribution of the project to poverty alleviation, we adopt the same key assumptions used in the earlier benefit–cost analysis, namely:

- banana production losses of 30% as a result of the skipper;
- ACIAR's control program reduces total damage to banana yields by 95%;
- 10% of banana production is wasted and 10% is fed to animals: around 80% of production is consumed as human food; and
- banana supply is perfectly inelastic: if the banana skipper was not controlled, banana growers would not pull out banana trees or plant new ones. The price of bananas would rise, and those who had the resources to do so would consume more of other goods, such as sweet potato or rice.

Effects on banana growers

The 1996 World Bank survey did not provide an indication of whether the respondents' banana consumption was purchased or from the household's own production. If a household purchases bananas, in the event of a fall in banana supply it will pay more for bananas or purchase other foods, and is unlikely to suffer a significant increase in poverty. A family that grows bananas on a subsistence basis is likely to suffer more. They lose an important source of food, and while their labour can be diverted into producing other goods, their land is unlikely to be diverted to another form of food production. Bananas may also be a source of cash income for some subsistence growers, if they regularly sell surplus fruit at the market.

For this analysis, we assume that a household engages in some subsistence banana production if bananas represent more than 10% of the value of their consumption. Some 26% of households growing bananas in Papua New Guinea fall into this category.

Box 1. Transferring banana production resources to production of other goods

If the banana skipper were not controlled in Papua New Guinea, banana growers would have to deal with the fact that their banana trees would yield around 30% less than before the skipper's introduction. This reduction in yield might cause banana growers to consider transferring factors of production used in banana growing to the production of other goods.

Land

It is fairly safe to suggest that a reduction in banana yield of 30% is unlikely to cause banana growers to remove trees and plant other crops. The trees are still a productive asset, and the time investment involved in growing the trees in the first place is significant enough that banana growers will not remove the trees unless the fall in yield is very large. The reduction in banana yield of 30% is unlikely to result in any land being transferred to other production.

Labour

The reduction in yield means that less time will be required to harvest, transport and sell the banana crop. The labour saved may be directed towards production of other staple crops, cash crops, animals or small businesses; or it may be used for leisure time or non–production activities. The reduction in banana yield of 30% may cause 30% of labour previously used in banana production to be transferred to other production, or 15%, or 0%, depending on the grower's preferences.

Capital

Tools used in banana production will be used less if banana yield falls by 30%. Tools used exclusively for the harvest, storage, transport and sale of bananas will be used 30% less, and so will depreciate up to 30% more slowly than if the banana skipper were controlled. These capital savings may be diverted towards production of other goods, or personal consumption.

The resources diverted away from banana production in the event of a 30% fall in yield will depend on the mix of land, labour and capital used in banana production, the grower's preferences and the depreciation of capital used in banana production. The percentage of resources diverted to other production may come close to 30% if the grower diverts all his or her spare capital and labour to the production of other goods, or it may be nothing if spare capital and labour is diverted to leisure or non-productive activity.

The reduction in banana yields of 30% will result in up to almost 30% of resources used in banana production becoming available to produce other goods (see Box 1). We analyse what would have happened to the poverty levels of these growers if:

- none of the resources formerly used in banana production were directed to other production; and
- 30% of the resources used in banana production were directed to alternative production that produced goods to half the value that banana harvesting would.

Results are set out in Tables 3 and 4.

In the first scenario, the introduction of banana skipper control measures reduces the number of banana growers living in poverty by 2.2%, putting an extra 15 000 people out of poverty. That is, without the ACIAR project, 62.6% of persons engaged in subsistence banana production (714 600 people) would have incomes below the poverty line. With the project, the corresponding estimates are 61.3% and 699.3 thousand people. Average consumption expenditures for banana growers increase from 657 kina to 680 kina.

If growers are able to divert their resources to other production, as described in the second scenario, the impact of the skipper on poverty is less severe. The banana skipper control measures reduce the number of people living in poverty by 0.9%, taking around 6000 people out of poverty. The average banana grower's income increases from 669 kina to 680 kina.

Note that these figures will understate the effect of the control program on poverty reduction if these households sell significant portions of the bananas they produce. The effects on poverty levels of leaving the banana skipper uncontrolled will be higher if a household depends on the sale of bananas at the market to buy other foods or essential household items.

Table 3 shows the impact of the ACIAR banana skipper control program on the expenditure levels of banana producers in PNG. Both mean and median expenditures were measured, so the skewness of the income distributions could be taken into account.

Table 3. Mean and median incomes (kina/year) of banana growers, with and without the banana skipper control program

	National Capital District		Papuan/South Coast		Highlands		Momase/North Coast		New Guinea Islands	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
With the ACIAR program	754	491	683	410	513	305	1100	385	933	519
Without the ACIAR program and no diversion of resources	731	478	660	390	496	294	1068	374	906	500
Without the ACIAR program and 30% diversion of resources	742	484	672	400	505	300	1084	379	919	509
Poverty line		779		496		390		280		424

Sources: World Bank (1996); CIE calculations.

In the National Capital District, the Papuan/South Coast and Highlands regions, most banana producers live well below the poverty line. On the North Coast and the islands of New Britain and New Ireland, most banana

producers live above the poverty line. The significant difference between mean and median values is the result of a handful of households in each region surveyed that have very high expenditures; the majority have low expenditures.

In kina terms, the effect of the banana skipper control program does not appear large, amounting to an increase in expenditure of only 11– 23 kina per year, depending on the region. This amounts to an expenditure increase of around 3–5%. A grower who produces bananas surplus to his or her own requirements to sell at the market will receive a greater benefit than this.

Table 4 and Figure 1 show the effect that the banana skipper control program has had on banana growers' expenditure relative to the poverty line. The benefits of the program are felt at all levels of the poverty spectrum. Across all levels of wealth, the banana skipper control program has pushed a small percentage of people into a higher expenditure bracket. For example, as a result of the ACIAR project, the number of banana growers with incomes less than 50% of the poverty line is estimated to have fallen by around 12 000.

Table 4. Impact on banana growers: expenditure distribution with and without biological control of the banana skipper

	Expenditure as a percentage of the poverty line							
	Less than 50%	Less than 75%	Less than 90%	Less than 100%	Less than 110%	Less than 125%	Less than 150%	Less than 200%
Percentage of banana growers								
With the ACIAR program	37.90	47.85	57.26	61.29	64.78	69.62	73.66	79.84
Without the ACIAR program and no diversion of resources	38.98	50.27	58.87	62.63	66.13	70.16	75.00	81.18
Without the ACIAR program and 30% diversion of resources	38.71	48.92	57.80	61.83	65.59	69.89	74.73	80.65
Number of banana growers ('000)								
With the ACIAR program	432.5	545.9	653.3	699.3	739.2	794.4	840.4	910.9
Without the ACIAR program and no diversion of resources	444.7	573.5	671.7	714.6	754.5	800.5	855.7	926.2
Without the ACIAR program and 30% diversion of resources	441.7	558.2	659.4	705.4	748.4	797.4	852.6	920.1

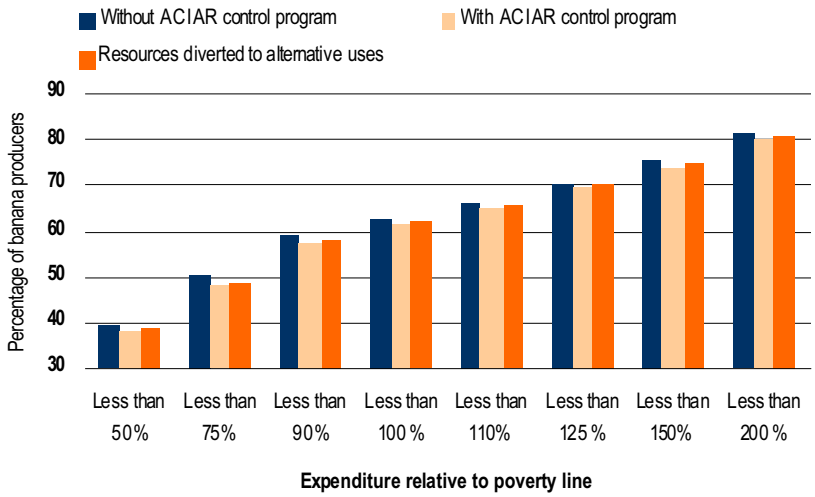
Sources: World Bank (1996); CIE calculations.

The increase in banana production from the introduction of banana skipper biological control increases incomes of all banana growers, moving them into higher income brackets.

Susceptibility to adverse shocks

Improving the reliability and productivity of one of PNG's most important staple crops improves the ability of all PNG residents to weather shocks that affect food production. The shocks that the PNG food supply is most vulnerable to are drought, frost, disease and pest attack.

Figure 1. Expenditure distribution with and without biological control of the banana skipper. Data sources: World Bank (1996); CIE calculations.



Drought

Banana trees provide a steady stream of food all year round. In the event of drought, banana yield declines. Production may cease depending on the severity of the drought, but when the rains come again, yields quickly return. This is an advantage that bananas have over other staple crops such as sweet potato, which take 3–5 months to begin producing again after a drought. Improving the reliability of banana production thus improves food supply immediately following a drought.

Frosts, pests and disease

Frosts are not a significant issue for banana production, as they tend to occur primarily in the highlands regions of mainland PNG, while most bananas are grown in the lowlands. In the event of frosts in the highlands damaging the sweet potato crops there, residents of the highlands will seek foods such as bananas from lower lying areas. The existence of a reliable, healthy banana crop improves the ability of mainlanders to produce sufficient food during frosts.

As in most countries, there is a range of pests and diseases that attack crops. An attack or outbreak that reduces the yield of a staple crop increases reliance on other crops to provide enough food. A diverse range of reliable, productive food crops helps to reduce the poverty associated with these attacks. The banana skipper control project has improved the productivity of PNG's banana crop, and so reduces the poverty that inevitably results from a pest or disease attack on another major crop.

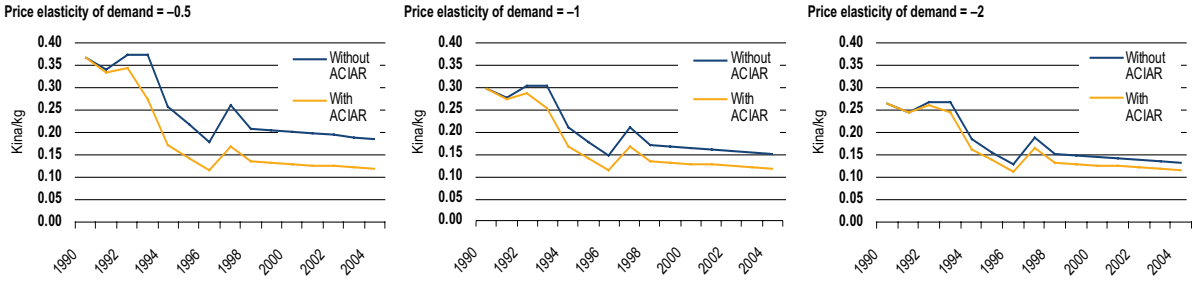
Reduction in food prices

A reduction in the supply of bananas of close to 30% will push up their price. While this is a small piece of good news for banana growers who have had a substantial proportion of their crop wiped out, it will result in higher food prices for consumers in PNG.

The ACIAR benefit–cost analysis of the banana skipper control program provided estimates and projections of banana production, consumption, prices and the gross value of production to banana producers. We use these data to estimate the effects of the banana skipper on the price of bananas in the absence of biological control.

In order to estimate price responses, we need to have an idea of the price elasticity of demand for bananas in PNG. This is not known with certainty. We calculate prices based on elasticities of –0.5, –1 and –2. Figure 2 shows the movement of prices over time, with and without the banana skipper control program and with these three different elasticities. Prices refer to the weighted average market price of bananas across all urban centre markets.

Figure 2. Banana price movements with and without the ACIAR banana skipper control program. Data sources: Waterhouse et al. (1999); Bank of Papua New Guinea (2002).



The banana skipper control program has reduced the price of bananas relative to the prices that would have prevailed if no control were achieved. In 1996, the program saved purchasers at urban markets 6 toea/kg if a price elasticity of demand of –0.5 is assumed, 3 toea/kg with

an elasticity of –1 and 2 toea/kg with an elasticity of –2. With the price elasticity of demand for bananas at –1, the total expenditure per year on bananas remains the same, but the quantity of bananas received for this expenditure is reduced, which means real consumption declines.

Table 5 Impact (in kina) on banana purchasers: reduction in consumption and increase in poverty from the banana skipper (price elasticity of demand –1.0)

	National Capital District	Papuan/South Coast	Highlands	Momase/ North Coast	New Guinea Islands	Total
With ACIAR's banana skipper control project						
Average consumption per adult equivalent	1226	902	860	1007	642	
Banana consumption per adult equivalent	21	82	37	85	27	
Without ACIAR's banana skipper control project						
Average consumption per adult equivalent	1220	879	849	983	634	
Banana consumption per adult equivalent	15	58	27	61	19	
Percentage increase in the number of people below the poverty line without the control program	4.8	3.9	1.7	0.0	0.0	
Number of people removed from poverty by the banana skipper control program	5 192	8 076	15 215	0	0	28 483

Sources: World Bank (1996); CIE calculations.

Reducing the price of bananas will lower the poverty line for regions whose diets include bananas purchased at markets, or increase the real level of consumption of households in these regions. Table 5 shows banana consumption and total consumption for the five regions of PNG with the banana skipper biological control program in place, and the effective reduction in consumption without the program in place.

The change in the number of people living below the poverty line is most noticeable in the Highlands, where, although bananas are not produced, incomes are relatively low and people trade food with other regions. The increase in consumption from controlling the banana skipper ranges from 6 kina/year in the National Capital District to 24 kina/year in the North Coast and South Coast regions.

Overall, around 28 000 more people are living above the poverty line than if the banana skipper was not controlled.

The increase in banana prices from leaving the skipper uncontrolled reduces the affordability of a basic food for all Papua New Guineans. This increases hardship for those already in poverty and is an unwelcome expense for those living above the poverty line.

Conclusion

Poverty is a major concern in PNG, affecting about 30% of the population. Most of this poverty is concentrated in rural areas among people who rely on subsistence crops for their food requirements and a small amount of cash income. Bananas are one of the major subsistence crops in PNG, so protecting banana production will have benefits for those living in poverty.

Subsistence banana growers benefit from an improvement in banana yields. Controlling the banana skipper has increased the value of banana growers' consumption by 11–23 kina per adult equivalent. Growers who regularly sell surplus bananas at market will experience a greater increase in income.

Banana consumers experience a reduction in the price of bananas due to the control of the banana skipper. This price reduction varies depending on the region of PNG. In urban areas, it is expected to be worth between 2 and 6 toea/kg. Increasing the affordability of a major food staple improves the ability of banana consumers to purchase essential food, clothing, education and other items.

ACIAR's work helping PNG to control the banana skipper has increased the production of a major food staple that is an important source of income and consumption for people in poverty.

In many countries, increased agricultural productivity (especially for subsistence farmers) has been a major pathway out of poverty. Whether this will prove the case in PNG remains to be seen, as there are many other factors currently at play. Regardless of what happens on the broader development front, however, projects such as this that save a stable crop make a fundamental contribution to the wellbeing of the population.

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