

Integrated Assessment of Trade-Related Policies and Biological Diversity in the Agricultural Sector in Papua New Guinea

A Case Study on agro-biodiversity in the food-crop sector: Sweet potato and taro

Summary

1 Introduction

In Papua New Guinea (PNG), the Integrated Assessment (IA) sought to assess the impact of trade policies and practices on agro-biodiversity through a case study in the food-crop sector. The specific trade-related policy examined in the IA was PNG's Tariff Reduction Programme (TRP), which was introduced in 1999. Agriculture has traditionally been the driver of PNG's economy in terms of employment, income, infrastructure development and foreign exchange earnings. It is divided into two broad sectors: the export commodity sector and the food-crop (semi-subsistence) sector. The case study involved an assessment of the semi-subsistence food crops of sweet potato and taro, selected because they are among the country's most important staple crops in terms of food security; the vast majority of the population depend on them for food. They are considered semi-subsistence crops because excess production can be sold in the markets to generate additional personal income, which has an impact on poverty reduction.

Since sweet potatoes and taro are neither imported nor exported, they were examined in relation to two major export crops – coffee and oil palm, respectively – to determine how trade affects the production, consumption and diversity of the food-crop sector. Coffee and oil palm were selected because they are the most successful of the agricultural commodities and are increasingly favoured by the government under its export-driven economic recovery strategy. The two crops also make an important contribution to the economic and social development of PNG in terms of income, employment, and foreign exchange earnings. Export crops compete with the food crops for land and labour resources. As the production of export crops expands, the resources available for the maintenance of food crops and food-crop diversity is reduced, weakening the resilience of the food crops.

The relationship between biodiversity, trade and agriculture is important in PNG. The country hosts a rich diversity of species, many of which are endemic. Forests are the foundation of PNG's economy, society, ecology and its wealth of biodiversity. However, PNG has been losing its forests at a rapid rate. In 1972, there were roughly 33.3 million hectares of intact rain forest in PNG. By 2002 this had been reduced to 25.3 million hectares. Both subsistence agriculture and plantations contribute to the degradation of existing forests and to deforestation. This impact is aggravated by recent increases in the population of PNG, which doubled between 1972 and 2002, increasing the demand for food and the area of land under food production.

2 The context of the integrated assessment

2.1 Biodiversity in Papua New Guinea

PNG is home to over six per cent of the world's biodiversity and contains some of the world's most biologically diverse communities. The humid tropical and subtropical forests in the lowlands have been ranked among the world's ten most ecologically distinctive forest regions. The mangrove forests are recognized as the most extensive and species-rich in the world; the tropical savannah woodlands are considered globally important because of their many endemic species; and its riverine ecosystems are recognized for their high levels of fish endemism.

The country has a rich faunal biodiversity and high degree of endemism. It has at least 191 species of mammals (of which over 80 per cent are endemic), 750 bird species (over half are endemic), 300 species of reptiles, 197 species of amphibians, 3 000 species of fish, and an estimated 200 000 to 400 000 species of insects, most of which have yet to be described and classified.

Although the status of many vertebrate species is currently unknown, some species are extremely rare. The International Union of Conservation of Nature's list of most threatened animals in PNG includes 38 species of mammals, 26 species of invertebrates, 22 species of birds, and eight species of reptiles.

2.2 Sweet potato and taro in Papua New Guinea

PNG is a major centre of sweet potato diversity, home to an estimated 5 000 cultivars. Sweet potato is grown predominantly in the highland regions (Eastern Highlands, Western Highlands, Southern Highlands, Enga, and Simbu provinces) where 40 per cent of the country's six million people live. Most of the 5 000 cultivars come from Eastern Highlands Province (EHP), which is the geographic focus for the case study on the genetic diversity of the sweet potato crop. In EHP, the two major forms of land use are subsistence agriculture and coffee production, with coffee being produced as the predominant cash crop. The EHP was selected primarily as a result of its vulnerability to soil erosion due to hilly terrain, and its high population density. Arable land for development of large coffee plantations and food crops is limited and all coffee farmers, which are typically small holders, also grow sweet potatoes on their land. This suggests that there is competition for land between coffee production and sweet potato production.

In this specific geographical setting, the IA explores the hypothesis that sweet potato diversity is being eroded by a thriving coffee industry, of which most production is exported. It also takes into account that income earned from coffee production is used to purchase imported rice and wheat, which are substitutes for sweet potato. This could further reduce demand for food-crop production and increase the risk that the genetic base of the sweet potato will shrink, making the food-crop sector increasingly vulnerable to pests and disease. In the future this could have a negative impact on food security.

The IA also examined taro production in conjunction with oil palm production. Taro is consumed by almost 22 per cent of the population in PNG, predominantly in rural areas. For this part of the IA, the West New Britain Province (WNB) was selected as the geographical focus because it is an area where taro and oil palm are both produced and because it was considered an area where data would be readily available. Land for food production in WNB is increasingly under pressure as a result of increasing family size and increasing pressure from oil palm production as a way to sustain family incomes.

2.3 Trade-related policy: the Tariff Reduction Programme

The specific trade-related policy examined in the IA was the TRP, which was introduced in 1999. It was selected for assessment because it is one of the central strategies of PNG's 'Export Driven Economic Recovery Policy', a major pillar of the country's Medium Term Development Strategy (MTDS). Trade can affect food-crop diversity in two ways: first, through the increased production of export crops (as a result of the increased productivity and access to markets) and, second, through the liberalization of imports of competing food products.

The TRP reduced tariffs to zero on all agricultural inputs. This measure was expected to lower the costs of production, leading to an increase in agricultural productivity and more competitive exports. To the extent that the country's exports become more competitive and increase in volume, this could be beneficial to farmers in terms of their opportunities to earn income. However, as farmers move out of production of traditional crops to grow more crops for export, this could have a negative impact on rural communities, on food security and on the genetic diversity of food crops, if new varieties or exotic crops are introduced, or traditional cultivars abandoned.

Therefore, in addition to the TRP, the IA examined the following other factors that might encourage the loss of food-crop diversity: (a) the introduction of 'other' sweet potato and taro cultivars into the garden; (b) local production of rice (an introduced crop); and (c) increased consumption of imported foods, particularly rice and wheat.

Taking into account the impacts of increased competition from imported foods was considered important because PNG's agricultural system is dynamic, with farmers moving from traditional farming practices to the adoption of innovative farming technology, including new varieties and/or exotic crops. Income from cash crops is used to buy imported food, while exotic food crops are grown either to supplement the food supply or to sell for cash.

The removal of tariffs could make imported food more affordable for consumers in PNG. To the extent that increased consumption of imported food, particularly rice and wheat, leads to a reduction in demand for traditional staple foods (and an associated reduction in the production and maintenance of the crops), the local food crops could eventually be lost through neglect. While imports of food can contribute to food security, increasing volumes of imported food can also present a risk to food security in times of crisis. The main consumers of imported foods are typically the 10 to 15 per cent of the population living in major towns. A nation-wide drought in the late 1990s showed that imported food could not support the entire population, and that a healthy local food economy is vital to ensure food security in all parts of the country on a consistent basis.

3 The integrated assessment

3.1 The process

The IA in PNG was undertaken under the direction of two key institutions. The Department of Foreign Affairs and Trade (DoFAT) was the lead government agency and the National Agriculture Research Institute (NARI), a statutory organization that is mandated to conduct basic and applied research in agriculture, was charged with its implementation. The core

project team, responsible for the research, was made up of individuals from NARI and DoFAT. A National Steering Committee (NSC) was established prior to launching the project and included representatives from several government departments, the United Nations Development Programme, and the private sector.

Since trade policies could have an impact on food security, poverty alleviation, agriculture and the conservation of biological diversity, a wide range of stakeholders representing different interests were involved in the IA process through national consultations. These stakeholders included other departments and agencies with responsibility over issues associated with the IA.

The project was launched at a national stakeholder workshop on 17 April 2007 with the general objective to present the IA and identify important trade, development, and biodiversity issues relevant for the study. Representatives from the public sector, private sector, statutory organizations, research institutions, civil society and non-governmental organizations attended. Following the launch, a Capacity Building Workshop was held on 18 and 19 April 2007. The main objective of the workshop was to train the stakeholders in the processes of incorporating biodiversity into IAs of trade policy in the agricultural sector. Several other meetings were held during the course of the project including three NSC meetings and two national review meetings. Further, the core project team attended three international review meetings, which were organized by UNEP and held in Geneva.

3.1 Methodology

To assess the impact of trade-related policies on the food-crop sector, particular attention was paid to changes in the structure of the agricultural sector (particularly the export crop and subsistence crop sectors) that had occurred since the introduction of the TRP.

The methodology employed in the IA involved several steps. The core project team assessed various dimensions related to the TRP and trade, including the proportion of imported food (mainly rice) consumed, the area of land under coffee and oil palm production, and levels of use of agricultural inputs. The team also sought to establish the current state of taro and sweet potato diversity, the income and food generated from these crops, and the area of land under sweet potato and taro cultivation.

A review of relevant national policies was undertaken by the project team and a conceptual framework was developed, which highlights the relationship between export crops and food crops and imported foods and staple foods. Based on the conceptual framework, several indicators were selected to cover the economic, social and environmental impacts of the TRP.

Economic indicators	Social indicators	Environmental and biodiversity indicators
<ul style="list-style-type: none"> • export share of GDP; • production of coffee and oil palm; • export revenue from agriculture including coffee and oil palm; • tariff information; • employment share of agriculture in total employment; 	<ul style="list-style-type: none"> • access to social services (such as education, health, banking and communications); • population dynamics; • Human Development Index (HDI). 	<ul style="list-style-type: none"> • overall PNG land-use map and the main drivers of change for forest cover; • land area under coffee and oil palm production; • land area under semi-subsistence crops (including sweet potato and taro); • inventory of sweet potato and taro varieties;

<ul style="list-style-type: none"> income from local crops versus commodity crops. 		<ul style="list-style-type: none"> potential growing areas of taro and sweet potato using Geographic Information System mapping; rate of use of agricultural chemicals and machinery; price changes of agriculture inputs (that impact on agricultural development).
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The research relied on both primary and secondary data. A literature review of secondary sources was employed to assess the impacts of export crops on the economy of PNG and on living standards. The IA employed primary data, collected through surveys, to determine, from an environmental perspective, how export crops had affected food-crop diversity. The survey was carried out in two areas: the EHP (for sweet potato and coffee), and WNB (for oil palm and taro). A total of 100 smallholder farmers – 50 in each area – were surveyed.

Interviews with farmers addressed issues including a comparison of numbers of crop cultivars, income levels, willingness to grow more food crops and more cash crops in the future, and accessibility to road infrastructure. The use of inputs (and their prices) was assessed to explore the impacts of the TRP. Also examined were population densities, accessibility to social services (such as health care), intensity of coffee and/or oil palm activity, and intensity of subsistence farming. Despite the absence of systematic data for advanced econometric analysis, the data collected during the field survey were sufficient to draw generic statistical summaries of the existing situation with respect to each pairing of crops.

However, the researchers had difficulty establishing a baseline for the IA. The TRP had been introduced well before the study began, and no data existed with respect to the state of the relevant indicators at the time the policy was first introduced. Therefore, it was not possible to quantify any changes to specific indicators from the time that the policy began, particularly with respect to prices of agricultural inputs before and after the TRP.

Along with a lack of baseline data, the researchers faced several challenges with respect to the field surveys, including:

- Insufficient, and sometimes imperfect, data from farmers on agricultural input costs that could help determine the effect of the tariff on the prices of inputs.
- A lack of data on land under coffee, sweet potato and taro production. This was mitigated to some extent through the field survey, although the data collected was subject to the specific knowledge of the limited number of farmers involved in the survey and was not necessarily broadly representative for all production.
- Differences in names of the same crop cultivars due to different language, which may have led to counting a particular food crop cultivar more than once.
- The indirect link between food crops and export crops.
- Difficulty in accessing some survey sites, resulting in a smaller sample size than originally planned, which was not sufficient to reflect the full range of impacts.

Despite the difficulties associated with data availability, five situations were identified to analyze the potential direct and indirect impacts of the TRP on agro-biodiversity in the food crop sector. Situations 1 and 2 addressed the increased production of export crops, while situations 3, 4 and 5 were developed to take into account increased competition from imported substitute foods.

- **Situation 1: Increasing export crops on existing agricultural land area.** Production of export crops can be increased without converting any new land. This means that increased production would occur through more intensive farming practices, such as by increasing the use of fertilizers (which are available at a lower price because of reduced tariffs). In this situation there may be a limited impact on food genetic diversity, and the intensification means that no additional land would need to be put under agricultural production.
- **Situation 2: Increasing production of export crops through conversion of land to agriculture.** The additional land could come either from existing subsistence garden land or forest land, or both. If additional production occurs on current subsistence land, the food garden may then be redeveloped by converting forest land. Both of these options will reduce arable land available to farmers for food crops, limiting their choice of food-crop cultivars.
- **Situation 3: Local production of rice and wheat may result in declining crop diversity.** The effect would be similar to that in situation 2 as the cultivation of rice and wheat would take land out of subsistence farming or would convert forest land.
- **Situation 4: Certain varieties of staple foods preferred in the market would take land away from subsistence gardens and/or encourage the conversion of forest land as in situation 3.**
- **Situation 5: Imported foods attract consumers of staple foods leading to reduced demand for certain food crops leading to the neglect and eventual loss of some varieties.** This would have a direct impact on the genetic erosion of food crops, although land use would not necessarily be affected.

3.2 Findings

The IA identified several linkages between trade liberalisation and agriculture. Trade liberalization leads to improved prices and markets for oil palm and coffee products, which enhance choices for export-crop production. In addition, lower prices for imported agricultural inputs lead to intensification in export-crop production, further affecting the extent of garden land (in addition to other existing pressures), thereby putting downward pressure on the genetic base of food crops. The export sector also attracts the labour force away from the food-crop sector, reducing capacity for *in situ* conservation as the younger generation moves into modern economic sectors. Moreover, competitive prices for imported substitutes of staple foods encourage consumers to purchase the imported food, thus reducing demand for staple food production. In the wider biodiversity context, cultural, aesthetic and spiritual values, including those of existence and option, can deteriorate if the integrity of ecosystem services is not protected.

The field survey produced a general finding common to both pairings of agricultural goods in the IA. Farmers have experienced a general increase in the price of inputs – most pronounced between 2006 and 2008 – since the TRP was put in place. This is contrary to the finding that had been expected, which was that lowering tariffs would result in a decrease in the price of inputs. This suggests that tariffs are not necessarily the most important influence on the prices of inputs and additional key factors identified were the exchange rate and the value added tax

(VAT). Despite the increase in prices, the results of the survey reflected a general increase in the use of certain inputs.

3.2.1 Sweet potato and coffee

In 2002, export earnings from coffee represented about 4.7 per cent of total exports. Approximately 270 000 families depend on coffee as a source of income and well over one million people derive a direct benefit from the industry. Around 80 per cent of the county's coffee is grown by smallholders on plots averaging 0.5 hectares. The price of coffee has been increasing steadily since 1990, which can be correlated with declining sweet potato diversity.

In the EHP, 274 varieties of sweet potato cultivar have been found to be either lost or missing. This figure represents about 53 per cent of the original local stock and three quarters of what is currently maintained in farmers' fields. Of the 414 varieties that are still maintained, 60 per cent are of 'local' origin, while 40 per cent are native stock 'introduced' from elsewhere in the country. Twenty-eight per cent of the farmers who responded to the survey noted that some of the missing varieties were maintained by neighbouring communities and could be recovered.

For farmers taking part in the survey, the total land area under sweet potato production was roughly one-third of the land under coffee production. The production volume of sweet potato increased between 2003 and 2008. Almost half of the farmers had increased the production of sweet potatoes, close to a third had remained constant, and 18 per cent had reduced their production. The field survey showed that land area under coffee production also increased, although the rate of growth has dropped in recent years.

The survey showed that much of the sweet potato production is consumed at home. This includes farmers located near major road infrastructure, although they consume less of what they produce at home compared to farmers located further from roads and markets.

In EHP, particularly in rural areas, rice is not a staple food. Since 2000, there has been a general increase in the price of rice. Less than one-third of the farmers surveyed said that they had increased their consumption of rice between 2003 and 2008, due to rising incomes. However, because the price of rice had risen during this period, the increase in consumption was not caused by the TRP and its associated reduced tariff levels. However, 46 per cent of respondents noted that if their incomes were to rise, they would increase their consumption of rice, but by less than the amount of the growth in their incomes.

Roughly one-fifth of the respondents indicated that their consumption of rice had declined over the same period. These individuals cited the increase in the price of rice as the main reason and the fact that the price of other food crops, such as sweet potato, had improved relative to the price of rice. Forty per cent of the respondents indicated that a rise in the price of rice would result in their increased consumption of sweet potatoes. The survey showed that rice and sweet potatoes are substitute goods and if the price of one rises, consumers will switch to the other.

According to the farmers the main reason for the loss of sweet potato varieties is the competition by superior varieties that taste better, offer higher yields, have a shorter growing period, are less susceptible to disease, and are preferred in the market. As the sweet potato

becomes a cash crop, market preference is becoming increasingly important, which leads to the abandonment of varieties that are not preferred in the market.

3.2.2 Taro and oil palm

Oil palm production is PNG's most successful industry. It provides direct employment for over 20 000 people and indirect employment for over 150 000. In 2000, there were over 14 500 smallholders growing oil palm, which accounts for 35 per cent of total agricultural exports. At present, oil palm cultivation in WNBPN represents less than one per cent of PNG's total land area and 1.4 per cent of the province's total area. The land under oil palm production in WNBPN increased at the average rate of 2.7 per cent per year between 2006 and 2008. If this trend was to continue, by 2050 just over 103 000 hectares (or four per cent of the WNBPN's 25 000 km² of land) would be under oil palm cultivation.

Taro production has been increasing since 2003. According to the survey, despite this increase 422 varieties of taro have either been lost or are missing in WNBPN. At the time of the survey, 968 varieties of taro were maintained by local farmers of which 729 were of local origin and 239 had been introduced. Important reasons reported for the loss of traditional taro varieties are the introduction of superior varieties that taste better, have higher yields and are generally preferred in the market. Some farmers responded that loss of diversity was a result of shortage of land for gardening. A significant number of respondents indicated that a key reason for the loss of taro diversity was the socio-cultural factor whereby when a local person with a strong cultural connection to a taro variety dies, the community feels compelled to destroy that taro variety as part of the mourning process. This was not the case for sweet potatoes, nor is it a common practice in other parts of the country.

Among the taro producers, there was a strong correlation between the price of rice and consumption levels. If the price of rice rises, consumers will decrease their consumption disproportionately. Seventy per cent of farmers in WNBPN would cut their consumption by over 10 per cent in response to a 10 per cent rise in the price of rice.

The survey generated very little information with respect to the loss of taro diversity to oil palm production. Given the current Government's efforts to promote oil palm production in several provinces where taro is grown, further research is required to assess the impacts of the policy on taro and other important food crop production.

3.3.3 Conclusions

With respect to the specific case studies involving sweet potato and taro, it was difficult to link the loss of genetic diversity to tariff reductions due to the absence of sufficient data.

Nevertheless, some key points emerged from the analysis:

- 1) A decline in genetic diversity was due to the introduction of superior varieties of the same crops for sweet potato;
- 2) Socio-cultural factors played a role in the decline of taro cultivars in particular; and
- 3) Where coffee is grown intensively, there appear to be a lower number of sweet potato varieties which suggests that a rise in the cultivation of crops for export contributes to a decline in food-crop diversity.

No clear causal connection was established between the loss of cultivars and trade. However, the lack of such an extended analysis is partly the result of a lack of data. Any links to trade should not be dismissed, although any discernable benefits of the TRP are thought to have been realized by the major plantation companies. The cost of inputs for smallholders has increased, despite the tariff reductions. The TRP may have mitigated further price increases and large increases in costs for large and smallholders alike, influenced by the VAT and the unfavourable exchange rate.

The qualitative evidence of an indirect relationship between trade policy and genetic food-crop diversity suggests that trade in agricultural commodities should be pursued with attention to safeguarding the diversity of food-crop cultivars that are not traded, but are important for maintaining a healthy genetic base for food crops and for food security.

4 Policy recommendations

In conjunction with further data gathering and analysis, the study recommends that the Government of PNG should consider adopting a balanced approach to its export driven economic recovery strategy so as not to compromise the country's rich stock of food-crop diversity, which supports 85 per cent of the population. Export crops have encouraged economic development in PNG. Coffee, and more recently oil palm, has been the principal contributor to economic development from the agriculture sector. The area of land dedicated to these crops is likely to increase in the future. Appropriate assistance measures should be put in place to protect the production of food crops, in conjunction with the development of the export-crop sector and other extractive industries for export. Moreover, the introduction of any new crop varieties should include a clear message that those crops are an addition to the existing stock of food crops, and should not displace them.

The policy recommendations developed from the IA are meant to encourage further research in this area to allow for a more in-depth analysis of some of the issues raised and to further overcome the difficulties associated with gathering data.

- Further studies should be initiated to assess the impacts of trade taking into account a broader range of biodiversity (forest, aquatic, marine, all food crops).
- New policies should be developed and existing policies should be strengthened with respect to domestic legislation in the following areas:
 - (a) Encouraging sustainable farming practices with a focus on revenue and combined farming systems options.
 - (b) Strengthening the national capacity for robust research, development and maintenance of food-crop cultivars.
 - (c) Implementing the current export-crop rehabilitation and expansion plan with due consideration to maintaining food-crop diversity.
- Legislation should be developed to protect food-crop biodiversity through agricultural and forest certification standards.
- A new study should be undertaken to examine the status of the diversity of all important traditional food crops in order to develop baseline information. In addition, a monitoring system should be established to track changes in diversity, including in relation to developments that include plantation crops.

- The following measures should be put in place, because the decline of diversity in taro and sweet potato are not associated only with the expansion of export crops, but also with the introduction of new varieties:
 - (a) An awareness-raising effort to focus on the importance of traditional food crops and an action plan that addresses root causes of declining diversity.
 - (b) Providing a clear message that the introduction of new crop varieties is in addition to existing crops and that they should not replace the existing stock of food crops.
- Environmental impact assessment and strategic environmental assessment for cash crops should be commissioned by the Government of PNG as way to balance the interests of export crops with the food crops.

The main challenges associated with the IA in PNG involved difficulties establishing a baseline, fully exploring the multidimensional nature of the issues, accessing information from some agencies, and sustaining interest among stakeholders, along with challenges related to resources. Despite this, several achievements were identified by the project team. Among them were: capacity building with respect to the economic, social and environmental impacts of trade, improved networking among stakeholders, and the generation of adequate and very useful information through the survey, despite the challenges related to data, logistics and cultural barriers. The IA is considered a useful tool and its continued use is important to build experience in its application. This case study should provide a solid practical basis for those seeking to employ an IA in a similar project in PNG in the future.