# ASSESSING THE BENEFITS OF DOMESTIC TUNA PROCESSING IN THE PACIFIC ISLANDS REGION

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## ABSTRACT

The paper presents a spreadsheet based benefit-cost framework for assessing the net benefits of domestic tuna processing to the resource-owning nation. The framework has a number of advantages including transparency, flexibility, and a check on internal consistency. The case study examines the effects of a range of tax, access fee and other concessions on the size and range of net benefits from domestic tuna processing in the south west Pacific.

**Keywords:** benefit cost domestic tuna processing developing country Pacific Islands Region

## INTRODUCTION

The tuna fisheries in Papua New Guinea's Exclusive Economic Zone (EEZ) are exploited largely by distant water fishing nations (DWFNs), with the economic return to PNG taking the form mainly of access fees, which currently constitute around 2% of annual government revenues. PNG has adopted a policy of gradually domesticating the tuna industry in order to obtain additional returns, such as employment benefits: currently only 25,000 tonnes of catch is processed annually in PNG but there are proposals to increase this amount to over 100,000 tonnes, which represents around half the sustainable catch from the EEZ. Since the current catch of some tuna species is believed to be around the maximum sustainable level, implementation of this policy may involve replacing DWFN activity with a series of domestic projects.

To obtain full value from its tuna fisheries PNG needs to achieve the appropriate balance between foreign and domestic exploitation. On the one hand, authors such as Munro [1] argue that a modern industrial fishing industry is capital and skill intensive and that, given the relative endowments of developing and developed economies, the distant water fishing nations (DWFNs) may have a comparative advantage in the fishery. This argument suggests that the appropriate strategy for PNG may be to use its fishery to generate access fees from DWFNs. On the other hand, authors such as McCoy and Gillett [2] argue that domestication of the tuna fishery will potentially generate employment benefits, technology transfer and forward and backward linkages which will promote economic development. Since processing, as opposed to harvesting, requires a large amount of unskilled labour the principle of comparative advantage may also favour domestication in some cases. Both arguments have some validity and the issue for a developing country, such as PNG, is to find the appropriate balance between domestic and international operations.

The above principles may be useful in helping to set policy, but when it comes to approval of individual projects they need to be examined on a case-by-case basis. The National Fisheries Authority (NFA) regularly receives proposals to establish domestic processing and harvesting facilities, conditional on access to PNG's tuna resources. A recent stock status report (Langley and Park [3]), however, has recommended no further increase in the level of purse seining in PNG's EEZ on associated sets (logs and FADs) because of the high level of fishing mortality on juvenile yellowfin and bigeye tuna. This suggests that catches by new domestic operations may have to be offset, at least to some extent, by reduced catches

by DWFNs, with the consequent reduction in access fee revenues. A analytical framework is required which takes into account the full range of benefits and opportunity costs of domestic processing, and provides a detailed account of the net benefits to various groups within the host nation.

A paper by Landu, Troedson and Waugh [4] presented a financial and economic analysis of a hypothetical tuna cannery situated in the western Pacific region. The model was spread-sheet based and included an analysis of the sensitivity of the results to the values of key variables. While the analysis established the viability of a tuna cannery under a set of reasonable assumptions, the data used and the results obtained were not detailed enough to guide public policy in particular cases. The present paper adapts a spread-sheet based benefit-cost framework, recently developed by Campbell and Brown [5,6], for use in analyzing proposals for domestic tuna projects. The study is based on the operations of a cannery in PNG but the method, and to some extent the data, are applicable to similar projects elsewhere in the Pacific Islands Region.

## CASE STUDY

The case study is based on a tuna fishing and canning operation in Madang, Papua New Guinea (PNG). Two related foreign owned companies are involved – RD Fishing, which catches the tuna, and RD Canning which processes them. While the case study is based on these operations [7], some of the data used are from other sources and the study should not be interpreted as a detailed analysis of the RD operation.

### Fishing

Twelve second-hand purse seiners, together with support vessels, will be imported and allocated to tuna fishing in PNG's EEZ using fish attracting devices (FADs) known as payaos. The vessels will have access to all waters of PNG including the Territorial Sea and the Mogardo Square, the Archipelagic Waters and the off-shore areas of the EEZ. They will catch skipjack and yellowfin tuna in the approximate proportions 80% and 20%, and in quantities sufficient to supply the cannery with 32,000 metric tons of raw tuna per year, based on an eleven month operating year. The fleet is valued at US$14.5 million (2004 US$). Onshore facilities consisting of a wharf and an ice plant, together with pre-production expenses, will cost an additional $3 million. Operating costs, excluding fishing licences, are estimated at $133,000 per month. The vessels will crewed by foreign labour, although it is recognized that jobs for local residents could become available over time.

### Canning

The processing capacity of the cannery is rated at 24,000 metric tons of raw tuna per year, but it is expected to operate at 32,000 tons. The cost of capital items, including land, improvements, buildings, other fixed investment and working capital, will be $7.85 million. Production costs, including the cost of raw tuna purchased from the fishing operation, labour, materials, water, electricity and miscellaneous items will be $6.17 million per annum. Administrative and selling costs, including marketing, freight and security, will be $4.51 million per annum.

### Markets

At full operation 97.5% of the fishery revenues will come from sales to the cannery; the balance is from the sales of by-catch and by-products. The cannery will get 96% of its revenue from sales of canned tuna to the United States (77%) and the EU (19%); the balance will be obtained from exports of fishmeal.

**Employment of Local Labour**

There are 2530 PNG nationals currently employed by the operation, predominantly in the cannery, and this represents 1.6% of Madang Province's total labour force.  Of these employees, 555 hold positions which can be classified as skilled and 1975 hold unskilled positions. There are three shifts per day – a permanent day shift and two other shifts which rotate every fortnight. The total annual wage bill for local labour is 6.14 million Kina (which amounts toUS$1.9 million at the exchange rate of $0.31 to the Kina): this consists of administrative and marketing payroll – 1.29 million Kina (21%); skilled production workers – 0.86 million Kina (14%); and unskilled production workers – 3.99 million Kina (65%).  These figures include the 7.7% employer superannuation contribution to the National Provident Fund (NPF). The average wages of skilled and unskilled workers are 163.92 and 78.50 Kina per fortnight respectively (as compared with a minimum wage of 74.40 Kina (US$23)). The breakdown between skilled/unskilled and male/female workers is reported in Table 1.

**Table 1: Composition of the Domestic Labour Force of the Tuna Cannery**

|                | Percentages of Total Labour Force | |
| -------------- | ------ | ------ |
| Type of Labour | Male   | Female |
| Skilled        | 11.66  | 10.65  |
| Unskilled      | 11.70  | 65.98  |

**THE RANGE OF POTENTIAL BENEFITS TO THE HOST COUNTRY**

**Tax Revenues**

The PNG national government could expect to collect import duties on equipment and materials and export duties on tuna products. However the importance of this source of revenue will decline over time because PNG is carrying out a Tariff Reform Program that will see the average tariff reduced from 22% in 1999 to 6.4% in 2006. In particular tariffs on capital equipment, inputs and raw materials will be reduced to zero. The national government can also expect to receive business income tax revenues. The Madang Provincial Government could expect to receive the revenues from the10% VAT on sale of goods and services within the province, and the 5% tax levied on the value of land used for commercial purposes.

**Employment Benefits**

The net benefit of a job to the employee is defined as the difference between the take home pay, net of any costs associated with employment, and the value the employee places on his time in alternative activities. In the case of subsistence agriculture the latter value may exceed the social opportunity cost of labour and there may be additional social benefits from employment. Any income taxes paid by employees and employer NPF contributions are also included as a benefit to PNG.

The 2000 Census records the labour force of Madang Province at 155000. While unemployment rates are reported as relatively low for both males (4.3%) and females (1.4%) (Gumoi [8]), employment includes work in both the monetary and non-monetary sectors. Monetary employment in the rural sector is mainly in commercial agriculture, forestry and mining, and in the urban sector it is mainly in manufacturing, trade and business services. Non-monetary employment is common in the rural sector and refers partly to subsistence activities. As reported in Gumoi [8] 70% of employed males and 83% of employed females are working in the non-monetary sector. These figures suggest that most of the PNG nationals working in

the cannery have alternative employment opportunities, but that these are predominantly in the non-monetary sector where the benefits of working are relatively low.

Given the relatively low density of population in Madang Province and the significant proportion of the provincial labour force employed in the cannery and related operations, the total daily distance traveled by employees to and from work is substantial and may represent a significant cost associated with employment.

**Fishing Licence Fees**

Domestic and foreign fishing vessels are subject to different fee schedules. For domestic fishing vessels there is a schedule of annual licence fees set according to the size of the vessels. Applying this schedule to the proposed fishing fleet gives a total annual licence fee of around K96000 (US$32000). Foreign purse seine vessels pay a licence fee set at 6% of the estimated value of their annual catch. Price is the Bangkok CIF price, calculated on the basis of an assumed 80/20 split between skipjack and yellowfin. Prices quoted in Reid et al. [9] are $730 per metric ton (mt) for skipjack and $1061 per mt for yellowfin, giving a weighted average of $796.50. The estimated annual catch is based on average catch over the previous twelve months, and generally varies from around 2000 mt for small purse seiners to 4400 mt for large vessels. For the medium and small purse seiners considered in the case study the benchmark annual catch per vessel would be set at around 2000 mt. This figure would give a royalty of $1.15 million pa for the 12 vessels. In addition to the royalty there is a series of other charges which could add an extra $200,000 to the annual cost of licencing a foreign fleet in PNG's EEZ, bringing the total fee to around $1.35 million. To put this figure in perspective, annual DWFN licence fees associated with 8 bilateral agreements for the 2005-06 licensing period were $8.43 million

**Skills Acquisition and Rents**

The company promises to train PNG nationals, including enrollment in appropriate external training programs, and to purchases tuna from local suppliers. The latter could be small scale artisanal fishermen or a domestic company set up to operate a fleet of purse seiners. Skill acquisition and technology transfer is often cited as a benefit of foreign involvement in the domestic fishing industry, but Campbell and Hand [10] could find no evidence of efficiency gains in a study of the Solomon Islands pole-and-line tuna fishery. Suppliers of other inputs, such as security and transport services, may benefit in the form of producer rents. The company will generate its own electricity and may sell surplus power to the regional grid at a price which is lower than the public utility's marginal cost of production.

**Environmental and Social Costs**

A sociocultural study (Sullivan et al. [11]) was conducted to survey local communities to determine what changes had been observed over the first seven years of the company's fishing operation. Local residents claimed that fish populations had declined in the lagoon because of habitat loss and over-fishing. Habitat loss is attributed to pollution from the fishing and canning operations, principally oil and chemical spills and human waste. Noise pollution was also cited as a serious problem. The study also identified strains in the relationships between younger and older generations, as well as between men and women. Employment has given younger people, especially young women, a degree of independence they did not have before and this has created stress. There have also been tensions between traditional and new residents of the region, the latter consisting of migrants from other regions seeking employment as well as foreign workers.

**Multiplier Effects**

As noted above the cannery injects close to US$2 million per annum into the local economy through its payroll and also purchases a limited range of goods and services from local suppliers. This information provided in the benefit-cost analysis could be used as a basis of an economic impact analysis.

## SIGNIFICANT CONCESSIONS REQUESTED

**Access to tuna stocks**

The company wishes its vessels to be PNG flagged, and all relevant licences, permits and approvals required for the fishing and canning operations to be issued on a 5 year basis and renewed for up to 20 years. According to the calculations reported earlier, domestic status would have the company pay $32,000 per annum for access to the fish stocks instead of the DWFN fee of $1.35 million. To the extent that tuna stocks in the EEZ are fully exploited this represents a significant opportunity cost to the host country.

**Import and Export Duties**

The company requests exemption from customs duties for a wide range of imports of capital goods, materials and tunas. It also requests that it can market and export its products (canned tuna, frozen tuna in excess of the requirements of the cannery, other fish incidentally caught as by-catch, pet food, fish meal, cooked or raw tuna loins, and canned mackerel) free and clear of any tax. It also wishes PNG to secure agreement from the European Community (EC) for the company to export tuna under Protocol 1 of the Lome IV Convention to the EC member states free of any tax, levy or impost. This will give the company's products exemption from a 24% tariff.

**Other Taxes**

The company asks to be treated as a resident company for tax purposes (which involves a 25% tax rate instead of the foreign company rate of 48%) and to be accorded a five-year exemption from company tax. It also requests flexible depreciation provisions and double deductions for certain categories of expenditure such as export market development and staff training expenditure. It also asks for exemption from Value Added Tax (VAT) which is levied at a 10% rate by the provincial government.

## NET BENEFITS OF DOMESTIC PROCESSING: A SPREADSHEET MODEL

The design of a framework for analyzing the net benefits of a tuna processing project is guided mainly by the information requirements of the decision-makers in the host country. To assess the project they require a detailed account of net domestic benefits in the form of employment benefits, rents and tax revenues, among others, and also an account of any disadvantages such as, for example, environmental costs. This net benefit account is termed the Referent Group Analysis.

The decision-makers are also involved in negotiating with the foreign fishing and processing firm. It would be helpful to have a detailed analysis of the net benefits of the project from a private sector viewpoint. Two ways of looking at this are from the viewpoint of the equity holders (the Private Analysis) and from the more general viewpoint of the market (the Project Analysis). The net benefits calculated in the Private Analysis are usually those identified by the Project Analysis net of tax and debt flows. The reason for distinguishing between these two viewpoints is that a project which would fail the test of the market can pass the test imposed by the equity holders because of overly-generous finance and tax arrangements, and *vice versa*.

Finally the framework includes an economic model which assesses the project in terms of economic efficiency. The Efficiency Analysis is the traditional cost-benefit model in which inputs and outputs are shadow-priced to correct for market failure arising from the traditional kinds of problems: incomplete property rights, market power, and distortions resulting from the tax and regulatory framework in the economy. Shadow-prices may be used to adjust an observed market price or to place a value on a non-marketed output or input. As well as indicating whether the proposed project is an efficient use of scarce resources the Efficiency Analysis plays an important role in the spread-sheet framework, providing a check on the internal consistency of the analysis.

Since the Efficiency Analysis measures the net benefits of the project to whomsoever they accrue – the host country, the foreign processing firm, the banks and any other entity involved – and whether or not they are measured by market prices, there is an important adding up property: the total Efficiency Net Benefit equals the sum of the net benefits to the host country (the Referent Group), the foreign processor, the foreign banks and any others affected by the project. This suggests that there are two ways to measure the Referent Group net benefits: firstly by subtracting all the *non-* Referent Group net benefits from the Efficiency net benefits; and secondly, in the traditional way by measuring the net benefits to each group in the host country affected by the project. The sum of the disaggregated net benefits calculated by the latter approach should equal the aggregate net benefit calculated by the former.

This framework, which is described in detail in  Campbell and Brown [5,6], will be used to develop the case study of a proposal to establish a foreign owned tuna fishing and canning operation in a Pacific Island country. Because the case study is necessarily quite complex and detailed, the analysis of a simple hypothetical project, in which the fishing and canning operations are merged, will be developed to illustrate the way in which the benefit-cost model is implemented within the spreadsheet framework, and how it is used in decision-making.

Suppose that a foreign company proposes to invest $100, a portion of which will be financed by a foreign bank, to set up an operation which will harvest and process 50 tons of tuna per year over a five year period. In addition to the raw tuna input, the operation will use 20 units of local labour and 50 units of imported materials per annum, and some water pollution will be caused. The company stresses the employment benefits of the project and asks for exemption from DWFN access fees, import duties and business income tax over the life of the project. Under what circumstances, if any, will this project confer a net benefit on the host country?

The spread-sheet model of this simple project is reported in Figure 1. The results of the Project, Private, Efficiency and Referent Group Analyses are summarized by net present values and internal rates of return where appropriate. An important feature of the spread-sheet is that project data are entered only once, in the Data section: all the cells in the Project, Private, Efficiency and Referent Group sections of the spread-sheet consist of references to the cells in the Data section. This means that the model can be used to conduct a sensitivity analysis to assess the implications for the host country and the private proponent of the concessions requested. The sensitivity of the results to the estimated shadow-prices of labour and raw tuna can also be calculated.

Since this is a simple model developed for the purposes of illustration it has omitted many of the details and features than might be included in a full-scale model, but these features can readily be incorporated in the spread-sheet model. Because of the disaggregated nature of the results of the Referent Group Analysis the model can also be used to assess the income distributional implications of the project, and the data reported by the model can be used as the basis of an economic impact model.

**Fish Cannery Example**

| Data | | | | Results |
|---|---|---|---|---|
| Capital Cost ($) | 100.00 | Wage ($/unit) | 5.00 | Tariff Rate | 0.10 | **RG NPV** |
| Labour Input (Units) | 20.00 | Input Price ($/unit) | 3.00 | Business Tax | 0.25 | $168.91 |
| Other Inputs (Units) | 50.00 | Access Fee ($/t) | 1.00 | Depreciation | 0.20 | **Private IRR** |
| Raw Fish (Tons) | 50.00 | Conversion Factor | 0.90 | Output Price ($/t) | 7.75 | 9.55% |
| Debt Proportion | 0.60 | Debt Interest Rate | 0.10 | Discount Rate | 0.05 | |
| SP Fish ($/t) | 1.00 | SP Labour ($/unit) | 3.00 | Externality($/t) | 0.25 | |

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Project Analysis** | | | | | | |
| Capital Cost | -110 | | | | | |
| Operating Cost | | -265 | -265 | -265 | -265 | -265 |
| Access Fee | | -50 | -50 | -50 | -50 | -50 |
| Revenue | | 349 | 349 | 349 | 349 | 349 |
| Project NCF | -110 | 34 | 34 | 34 | 34 | 34 |
| IRR (real) | 8.73% | NPV | 10 | | | |
| **Private Analysis** | | | | | | |
| Project NCF | -110 | 34 | 34 | 34 | 34 | 34 |
| Debt (Principal) | 60 | -10 | -11 | -12 | -13 | -14 |
| Debt (Interest) | | -6 | -5 | -4 | -3 | -1 |
| Operating Profit | | 34 | 34 | 34 | 34 | 34 |
| Depreciation | | -20 | -20 | -20 | -20 | -20 |
| Business Tax | | -2 | -2 | -2 | -3 | -3 |
| Private NCF | -50 | 16 | 16 | 15 | 15 | 15 |
| IRR (real) | 9.55% | NPV | 55 | | | |
| **Efficiency Analysis** | | | | | | |
| Capital Cost ($) | -100 | | | | | |
| Operating Cost | | -210 | -210 | -210 | -210 | -210 |
| Raw Fish Cost | | -50 | -50 | -50 | -50 | -50 |
| External Cost | | -13 | -13 | -13 | -13 | -13 |
| Revenue | | 349 | 349 | 349 | 349 | 349 |
| Net Benefits | -100 | 76 | 76 | 76 | 76 | 76 |
| IRR (real) | 66.27% | NPV | 170 | | | |
| **Referent Group Analysis** | | | | | | |
| **Aggregate RG** | 10 | 44 | 45 | 45 | 45 | 46 |
| **Disaggregated RG** | | | | | | |
| Access Fees | | 50 | 50 | 50 | 50 | 50 |
| DWFN Opp Cost | | -50 | -50 | -50 | -50 | -50 |
| Business Income Tax | | 2 | 2 | 2 | 3 | 3 |
| Tariff Revenue | 10 | 15 | 15 | 15 | 15 | 15 |
| Employment Benefits | | 40 | 40 | 40 | 40 | 40 |
| External Cost | | -13 | -13 | -13 | -13 | -13 |
| **Total RG Net Benefits** | 10 | 44 | 45 | 45 | 45 | 46 |
| **CHECK** | 0 | 0 | 0 | 0 | 0 | 0 |
| IRR (real) | NA | NPV | 169 | | | |

**Figure 1: Illustrative Spread-sheet Benefit-Cost Model of a Fishery Project**

As an example of the way the model might be used by the decision-makers in the host country, consider the opportunity cost of the raw tuna: assuming that the fishery resources in the EEZ are fully exploited an allocation of 50 tons of tuna per annum to this project will cost the host country $1 per ton as indicated by the shadow-price. If the cannery is charged this amount in the form of an access fee, as indicated in the Data Section there is no net loss to the host country. But suppose the concession is granted that the foreign owned venture is treated as a domestic rather than a DWFN harvester? The access fee can be set to zero and it will immediately be seen from the Results Section that the Referent Group NPV falls from $169 to $36 and the foreign firm's IRR rises from 9.6% to 99.9%.

Having discussed the structure and use of the spread-sheet benefit-cost model the paper now turns to the analysis of the benefits and costs of the Case Study described above.

**RESULTS OF THE CASE STUDY**

In the Case Study the fishing and canning operations are modeled separately, linked by a materials balance condition and an internal transfer price. The fishing operation supplies the cannery with its capacity input of raw tuna and sells any surplus directly as unprocessed tuna. The fishing and canning models are each allocated five sheets of the Excel file, one for each of the five sections identified in the illustrative example described above. In addition there is a sheet containing all the data relating to the fiscal environment; by altering these data the model can be made to conform to the tax systems of different countries. Finally a Summary sheet is devoted to the control variables, values of shadow-prices, and results. The control variables are policy settings that the decision-maker can vary such as tax rates and exemptions and conditions of access to fish stocks. The results section details the Referent Group net benefits under each set of conditions chosen for the fiscal and policy environments. The model is described in detail in Campbell [12].

The host country decision-maker can now calculate the results of agreeing to various requests for concessions: resident status for business income tax, a 5 year tax holiday, full loss carryover, exemption from land tax, insurance tax, import duties, export tax, VAT, fuel tax and DWFN access fees. The advantage to the firm of access to EC markets under the Lome Convention can also be calculated. Recognizing the degree of uncertainty that is attached to estimates of opportunity cost in an imperfect market economy, the effects of varying the shadow-prices of labour, land, utilities, security costs, licence and access fees can also be calculated. Finally the size of the environmental cost can be varied to establish a threshold value.

The summary sheet also contained a check on the internal consistency of the modeling. The Efficiency Net Benefit is calculated in two ways, from the Efficiency Analyses and by adding up the net benefits to all those affected by the project, in this case the host country, the private firm, the foreign banks, and the EC in the event that exemption from tariffs is not granted. Because the model assumes that the project has no effect on the price of any input or output, the size of the Efficiency Net Benefit is invariant to the values of the control variables.

**CONCLUSIONS**

Two kinds of conclusions can be drawn from the spreadsheet model: first, how sensitive are the estimates of the net benefits of the cannery to the values chosen for the shadow-prices? and, secondly, what are the costs to the host country of offering the concessions requested by the foreign investor, and are these concessions necessary for the viability of the project from a private viewpoint? It should be noted that changes to the values chosen for the shadow-prices will change the overall net benefit of the project, whereas varying the tax or fee structure simply redistributes net benefits amongst stakeholders.

**Summary of Net Benefits and Control Variables**

**Tax&Fee Variables**

*Direct Taxes*

| | | | |
|---|---|---|---|
| Corp. Inc. Tax | Res. Status | Yes=0,No=1 | 1 |
| | 5 Yr Tax Hol. | Yes=0,No=1 | 1 |
| | Loss carryover | Yes=0,No=1 | 1 |
| Land Tax (Cannery) | Exempt | Yes=0,No=1 | 1 |

*Indirect Taxes*

| | | | |
|---|---|---|---|
| Non-res.Insurance Tax | Exempt | Yes=0,No=1 | 1 |
| Import Duty Export Tax (Cannery) | Exempt | Yes=0,No=1 | 1 |
| | Exempt | Yes=0,No=1 | 1 |
| VAT | Exempt | Yes=0,No=1 | 1 |
| Fuel Tax | Exempt | Yes=0,No=1 | 1 |
| EU Duty (Cannery) | Exempt | Yes=0,No=1 | 1 |
| EEZ Access (Fishery) | | Dom=0,For=1 | 1 |

**Shadow-Prices**

| | | |
|---|---|---|
| Labour | Prop'n After Tax Wage | 0.3 |
| Land (Cannery) | Prop'n Market Price | 1 |
| Power (Cannery) Light&Water | Prop'n Market Price | 1 |
| Cannery) | Prop'n Market Price | 1 |
| Security (Cannery) | Prop'n Market Price | 1 |
| Licenses&Rego Fees | Prop'n Market Price | 0 |
| DWFN Fee | $US pa | 1350000 |
| Opp Cost of Catch | Prop'n DWFN Fee | 1 |
| External Cost Cannery | $US/mt pa | 10 |
| External Cost Fishing | $US/mt pa | 10 |
| Discount Rate (Real) | Percent pa | 5% |

| Foreign Firm Net Benefit | IRR | NPV (m$US) |
|---|---|---|
| Fishery | 2% | -$4.71 |
| | | |
| Cannery | 3% | -1.60 |
| Total | 2% | -6.31 |

| Other Net Benefits | NPV (m$US) |
|---|---|
| Foreign Bank (Fishery) | $0.22 |
| Foreign Bank (Cannery) | $0.66 |
| EC Tariff | $23.68 |
| **Total NPV Check** | |
| Efficiency analysis | $127.07 |
| Aggregate Groups | $127.07 |

**Host Country Net Benefit**

| Fishery | NPV (m$US) | Cannery | NPV (m$US) |
|---|---|---|---|
| Direct Taxes | $13.78 | Direct Taxes | $26.38 |
| Indirect Taxes | $15.54 | Indirect Taxes | $32.50 |
| NPF | $1.46 | NPF | $1.26 |
| Access Fees | $15.43 | Lic&Rego Fees | $0.07 |
| Access Cost | -$15.43 | | |
| | | Rents | $0.00 |
| Employment | $7.76 | Employment | $16.95 |
| External Costs | -$3.66 | External Costs | -$3.22 |
| Total | $34.88 | Total | $73.94 |

| Total RG Net Benefit | NPV (m$US) | Percent |
|---|---|---|
| Direct Taxes | $40.16 | 36.90% |
| Indirect Taxes | $48.04 | 44.15% |
| NPF | $2.72 | 2.50% |
| Access&License Fees | $15.51 | 14.25% |
| Access Cost | -$15.43 | -14.18% |
| Rents | $0.00 | 0.00% |
| Employment | $24.70 | 22.70% |
| External Costs | -$6.87 | -6.32% |
| Total | $108.82 | 100.00% |

**Figure 2: Summary of Results of the Case Study**

The critical shadow-prices are those for labour, access to tuna stocks and environmental costs. Because of the relative openness of the PNG economy no attempt is made to allow for a premium on domestic savings, and, consequently the shadow-price of labour is set equal to the value of its marginal product in its alternative activity (Little and Mirrlees [13]). For the purposes of this paper the value of the marginal product was set at 30% of the market wage, although this figure is the subject of further research. Using this figure the estimate of present value of employment benefits is $24.7 million, which is 19.4% of the project net benefit as calculated in the Efficiency Analysis and 22.7% of host country net benefit. Access to tuna stocks is costed at the value of the DWFN fees that would have been levied. If tuna stocks were assumed not to be fully exploited this estimate could be lowered, adding up to $1.35 million net benefit per annum to the Referent Group net benefit. There is currently no information available about the environmental costs of the project. Figures of $10 per metric ton of tuna harvested and $10 per metric ton of tuna processed were used as proxies for the environmental costs of the harvesting and processing operations. These figures can be altered to produce a threshold value – the value environmental costs would have to take to render the project uneconomic, given the values of the other variables; this calculation yields a threshold value of $195 a metric ton in each operation.

The results reported in Figure 2 are those of the base case - the net present values to the principal stakeholders (excluding the foreign banks and the EC) when no concessions are granted. Concessions can be granted singly or in combination. For reasons of space only the results of granting selected concessions singly, or of granting all concessions together, are considered here and reported in Table 2. It should be noted that the effects of concessions are interdependent and that the results reported in Table 2 cannot be used to estimate the effects of multiple concessions. However any combination of concessions can be entered in the Summary sheet by choosing appropriate values of the control variables.

**Table 2: Allocation of Efficiency Net Benefits under Various Concessionary Arrangements**

| Concession Awarded | Percentage of Net Present Value | | Company IRR |
| --- | --- | --- | --- |
| | Host Country Share | Company Share | Real % Rate |
| Base Case (No Concessions) | 86 | -5 | 2 |
| Resident Tax Status | 73 | 8 | 9 |
| Import Duty Exempt | 83 | -2 | 4 |
| Export Duty Exempt | 75 | 6 | 8 |
| Lome Tariff Exemption | 86 | 14 | 12 |
| VAT Exemption | 84 | -4 | 3 |
| Fuel Tax Exemption | 81 | -1 | 5 |
| Exemption from DWFN Fees | 79 | 1 | 6 |
| All Concessions | 31 | 69 | 35 |

The net present value (NPV) results reported in Table 2 are calculated using a 5% real rate of discount, which explains why the firm' share of NPV is negative when the internal rate of return (IRR) is less than 5%. It can be seen from the results that resident tax status, export duty exemption and import duty exemption under the Lome Convention are the most significant individual concessions. However it is likely that the firm's cost of capital will be in excess of 15% and that none of these concessions will be sufficient, on its own, to make the project viable from a private viewpoint. On the other hand, granting all the concessions would raise the internal rate of return to 35% which is most likely in excess of the

required rate. In the latter case the host country net benefit would consist mainly of business income tax revenues (levied at the domestic company rate) and employment benefits less forgone DWFN access fees.

The benefit-cost model can be used as a negotiating tool by the host country. Alternative scenarios can be explored with the foreign firm in a process leading to improved revenue and cost estimates as well as assessing the effects of variants in the set of concessions which might or might not be offered. The model provides estimates of various kinds of government revenues which will flow from the project and these can be used for planning purposes.

The results of the model are only as reliable as the information used to generate them. In particular, further research is required on the values of the shadow-prices. The spreadsheets are set up in a way that makes it easy to up-date the data files as new information becomes available and the model structure lends itself to sensitivity and risk analysis. Sensitivity analysis of the effect of a variable can be conducted by changing a single cell in the Summary or Variables sheets, and point estimates can be replaced by probability distributions using add-on software such as @RISK. Finally additional shadow-prices, such as those for government revenues or foreign exchange earnings can easily be included in the Efficiency and Referent Group analyses.

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