



**DEPARTMENT OF AGRICULTURE AND LIVESTOCK
GOVERNMENT OF PAPUA NEW GUINEA
1993**

POLICY DISCUSSION PAPER

**FOOD SECURITY :
RICE PRODUCTION POLICY
IN PAPUA NEW GUINEA**

PREPARED BY

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This paper is published with the intention of making the policy discussions and analysis available to a wider public. This, however, does not constitute an expression of support by the Department of Agriculture and Livestock for any policies that are recommended. All opinions expressed remain those of the author and do not necessarily represent the views and policies of either the Department or any of its Division. Comments are welcome and should be addressed to the author.

PREFACE

In this Working Paper the author discusses the various aspects of domestic rice production policy and importance of rice production for long term sustainable development of Papua New Guinea. Subsistence rice cultivation has a very long history in PNG; but due to poor support and resources allocation, domestic rice production is almost stagnating at 1000 tonnes per year and this accounts for 1 % of the imports. The rice import is increasing at about 8 % per annum and has reached the level of 150,000 tonnes per year.

In the year 1985, the Food and Agriculture Organization (FAO) Mission evaluated the options for meeting future rice production in PNG and their findings includes:

- Commercial rice production in PNG is not viable
- Domestic rice production needs heavy subsidy
- No foreign exchange savings due to domestic production
- Rice import is cheaper than domestic rice.

The author discusses how these findings were found to be not valid. His revised and updated analysis indicates that commercial rice production is viable without any subsidies; domestic rice production is having competitive and comparative advantages, domestic rice production will be cheaper than import and will result in savings in foreign exchange.

The author evaluates rice policy under the following scenario:

- Financial and economic viability of rice cultivation
- Capacity to pay for the growing rice import bills in the long-run
- Declining trade balance under primary sector
- Debt-service obligations of the country
- Terms of trade vis-a-vis the capacity to import and trade-off
- Technical feasibility of rice cultivation in PNG
- Food security and other socio-economic desirability

The author concludes that domestic rice production is the right option for a sustainable future and for a broad based economic development. The best starting point is to invest in areas with favourable agro-climatic potential. Appropriate design and technology should be adopted to increase productivity.

This publication reflects an ongoing economic research programme being conducted by the Department on the prospects for food security and rice self sufficiency. The views expressed in this paper do not necessarily reflect the views and policies of the Department. Mr.C.Kannapiran is the Acting Chief Project Economist with Project Preparation Branch of DAL.



MIRI SETAE
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EXECUTIVE SUMMARY

Food security refers to availability of food in sufficient quantity and quality and people have both physical and economic access and affordability to the basic food when and where they need.

Papua New Guinea is the only country in the Asia-Pacific region, where the roots and tubers (Sweet Potato, Taro, Tapioca etc.) supply more than 45 % of the food energy for the people. The rice as a main source of food has started dominating the food intake of the people in PNG. The rice import is increasing at about 8 % per annum and has reached the level of 150,000 tonnes per year. The domestic rice production is around 1000 tonnes per year which accounts for 1 % of the imports.

The Food and Agriculture Organization (FAO) sent a Mission in 1985 to evaluate the options for meeting future rice production in PNG and their findings includes:

- Commercial rice production in PNG is not viable
- Domestic rice production needs heavy subsidy
- No foreign exchange savings due to domestic production
- Rice import is cheaper than domestic rice.

Most of these findings of the FAO Mission were found to be not valid, as the financial analysis of various rice production models, which was the basis for most of the recommendations, is to be revised. Further it is necessary to carryout economic analysis to justify any rice policy.

Revised and updated analysis indicates that commercial rice production is financially and economically viable without any subsidies, domestic rice production is having competitive and comparative advantages, domestic rice production will be cheaper than import and will result in savings in foreign exchange.

The following key issues are to be evaluated:

- Long-term food security at national and household level
- Growing demand for rice consumption
- Increasing trend in rice imports bill
- Capacity to pay for the rice import bills in the long-run
- Declining trade balance under primary sector
- Debt-service obligations of the country
- The value of non-food imports and import substitution
- Terms of trade vis-a-vis the capacity to import
- Technical feasibility of rice cultivation in PNG
- Cheaper domestic rice than import
- Surplus Land and labour and employment creation
- Other socio-economic desirability

Based on careful evaluation of all these issues the following policy options may be appropriate:

- The way to improve agricultural growth is to look beyond prices and price elasticities. The best starting point is to invest in areas with favourable agro-climatic potential.
- Domestic rice production is the right option for a sustainable future and for a broad based economic development. Necessary resources should be allocated to facilitate technological improvements under subsistence rice farming and to steadily develop commercial rice production.
- Appropriate design and technology should be adopted to increase the productivity to 3-5 mt/ha and to cultivate double crop per year to ensure commercial as well as economic viability.
- Subsidies, if any, provided on economic justification may have to be phased out once the economy of scales and imperfections in the production and marketing systems are reduced considerably.
- Structural adjustment efforts do not increase aggregate agricultural supply for several years, any possible stagnation or decline in food production must be compensated for with targeted food subsidies and nutrition programmes.
- Structural adjustment programmes should do more than ease the balance of payments. Adjustment packages must be designed to spur food production and all agricultural growth, supporting investments in human capital, infrastructure, markets, research and extension and allowing for the long lag time before investments show results.

INTRODUCTION

Food security is access by all people at all times to enough food for an active and healthy life. International conferences on hunger and development have time and again emphasised the need for national food strategies that push broad-based agricultural development, foster food security and protect and renew the natural resource base.

Food security implies that food is available, accessible, and affordable when and where needed in sufficient quantity and quality. Food security exists when adequate food is available to all people on a regular basis.

In 1993 FAO defined the goal for World Food Security: "To ensure that all people at all times have both physical and economic access to the basic food they need" (FAO, 1993). Food security at Global, National and Household level are the three dimensions of food security.

Adequacy of food at global level and an effective distribution system are required for ensuring global food security. Given the global security, national food security depends on domestic production and the ability to import food commercially. Household level food security is determined by both physical access to food and adequate purchasing power. While food security ensure availability of food, nutrition security depends on factors like social practices, health and hygiene conditions. Food security, therefore, is one but not the only necessary condition for achieving the nutrition security.

Most of the developing countries recognised food self sufficiency under their food security policy regimes. The first task is to maximise food production from resources already committed within the sector. New technologies can raise yield potentials; improved management can bring yields nearer to their potentials; better marketing practices can reduce post harvest losses and increase food availability (Ti,P.C., 1991).

Economists should not deny to the developing world the tools which the developed countries have used for decades - minimum price supports, management of grain stock, and protection from low priced imports. The GAAT participants must examine the relationship between trade and agricultural development and be prepared to endorse agreements that will foster food self-reliance in lower income countries (Don Reeves et al. 1991).

Food self sufficiency is feasible as demonstrated by Indonesia, Korea, Philippines and Vietnam. In PNG domestic rice production at smallholders and subsistence level will ensure food security in rural areas and commercial level shall ensure food security at urban areas.

In this paper the author evaluates the rice policy with empirical analysis and by applying broader socio-economic criteria.

CURRENT SCENARIO

According to FAO estimate (FAO,1993), during the year 1993 the global level import demand for rice is expected to decline to about 13.2 million tons and the export supply is expected to be around 14.6 million tons. The supply is expected to exceed import demand by about 1.4 million tons. It is predicted that the international market for rice in 1993 would weaken and that the prices could fall well below the 1992 levels.

The rice importing developing countries which have technical potentiality to produce rice can either produce rice domestically if the domestic rice is cheaper than imports or alternatively import rice if their foreign exchange reserves permit them to do so.

The terms of trade between rice and their export crops can also guide to some extent to trade off between rice and export crop production depending on the optimization of resource use. Considering the long-term household and national food security, the exchange reserves, employment potentiality and other socio-economic obligations, it may be appropriate to promote domestic rice productions.

Domestic rice self sufficiency may be the most appropriate policy for the developing countries where there are surplus land and labour, technical feasibility, declining foreign reserves, increasing trend in imports than exports and so on.

In PNG, the domestic rice production is around 1000 tonnes per year as against the rice imports of 150,000 tonnes per year. The domestic rice production is almost negligible and is less than 1 % of rice imports.

In the Asia-Pacific region PNG is the only country where the roots and tubers supply more than 45 % of the food energy for the people. In the recent past rice is replacing the traditional staples and therefore the demand for rice is steadily increasing.

There are farmers in some pockets of the country cultivating rice on subsistence level. Government of Papua New Guinea promoted two rice projects at Berina in Central Province and Maprik in East Sepik Province and the impact of these project is yet to be evaluated.

The rural economy in PNG is characterised by declining per capita real income; declining share of agriculture sector under the GDP; rural sector is a net importer due to declining export earning versus increasing imports, growing unemployment, growing demand for rice and declining economic access to rice. The planners are expected to address to these key issues while planning for food security and rice self sufficiency in PNG.

FAO MISSION REPORT

The Food and Agriculture Organisation (FAO), in 1985 sent a Mission under Technical Cooperation Programme to evaluate the options for meeting future rice production in PNG. The FAO Mission report is the main source of reference for most of the economists to advocate that rice production is not commercially viable and it would be, therefore, cheaper to import than produce domestically.

The FAO Missions recommendations includes:

- Commercial rice production in PNG is not viable
- Domestic rice production needs heavy subsidy(60-100 %)
- No foreign exchange savings due to domestic production
- Import is cheaper than domestic rice

A careful evaluation of the FAO report, particularly the financial cost-benefit analysis, which was the basis for most of the recommendations, indicates that the financial analysis and estimation of financial internal rate of return (IRR/FIRR) by the FAO Mission should be revised as there is double counting of return of capital (Loan servicing). The report also ignored the need for capital replacements and the importance of irrigation.

Revised evaluation of the rice production indicates that the rate of return has been underestimated. Based on the underestimated Internal Rate of Return, the Mission judged that rice cultivation is not commercially profitable and concluded that commercial rice industry may not be viable without heavy subsidy.

The FIRR as estimated by FAO mission and the corrected FIRR (Table: 1-3) are furnished below:

Farm	Model	FIRR-FAO estimate	FIRR Corrected*
1.	200 Ha Rain-fed-single crop Commercial Rice	0 %	19 %
2.	200 Ha Rain-fed-Double crop Commercial Rice	11.93 %	56 %
3.	500 Ha Rain-fed-single crop Commercial Rice	0 %	24 %

* There was double counting of return of capital in the FAO report, which was corrected and IRR estimated.

Note: 1. Yield 3 mt/ha in both cases (As furnished by FAO)
2. Price K 153/mt in both cases (As estimated by FAO)

Any project with Financial IRR (FIRR) more than 12-15 % can be treated as commercially viable and accordingly all the three commercial models discussed in the FAO report are viable without any subsidy. Further it may be noted that the commercial viability is at the farm gate price level of K 153/mt (1985). Assuming that a bank loan of 90 % of the investment cost is provided at 11 % interest, they can repay the bank loan out of the income within year 11.

The FAO Mission's conclusions are not valid and there are also other aspects in the Mission Report which need revisions like (FAO informed that they would like to revise and update the report):

- Computation of loan repayment
- Replacement of capital assets
- Accounting of management cost

The FAO Mission used the 1985 constant prices and there is negligible relative price changes of rice project input and output, though the present (1993) nominal farm gate price is K 200/mt. Even though the conclusions based on the corrected version of the analysis is still valid for 1993, a revised financial analysis was also carried out to assess the current situation.

FAO Mission's Report continued to influence the Food Policy Analysts, including the various aid donors and funding agencies and most of them concluded that commercial rice production in PNG may not be viable without subsidy. While designing rural development projects it is the responsibility of the planners to identify various models and options, to the extent possible, to achieve the cost effective way of attaining the project goals and objectives.

REVISED FINANCIAL ANALYSIS

The 1985 costs and prices were inflated at 20 % to account for relative price changes during 1985 to 1993 under rice project inputs and outputs. Provisions were made for capital replacement during 8 and 15 years (Table: 4-6). The debt-servicing was estimated to assess the loan servicing capacity. With these revisions the financial farm budgets for all the three models were prepared for 1993 costs and prices.

The results indicate the FIRR of all the three models as furnished below:

- 200 Ha Single crop model - 17 %
- 200 Ha double crop model - 73 %
- 500 Ha single crop model - 24 %

The rate of returns are well above 12 % and therefore all the three commercial rice production models are viable. There is no need to subsidise the production as the price required to reach 12 % FIRR is well below the current price of K 200/mt. and at comparable import price of rice.

Assuming that 90 % of investment cost is provided as bank loan at 11 % interest, the cash-flow from all the three models leaves enough surplus to easily repay the bank loan within seven years.

The capacity to pay for additional management and administrative cost and tolerable additional investment cost (in the case of eventuality to increase these costs) while maintaining a rate of return of 12 % for the investment, were also estimated and results furnished below:

Farm Model	Addl. Capacity to pay for Management at 12 %	Addl. tolerable investment cost at 12 %
1. 200 Ha Single crop	K 5,500	K 28,000
2. 200 Ha Double crop	K 63,000	K 320,000
3. 500 Ha Single crop	K 24,000	K 110,000

The above results indicate that 200 ha single crop model cannot contribute to additional management cost more than K 5,500 whereas the 200 ha double crop and 500 ha models can contribute to K 63,000 and K 24,000 respectively while retaining the rate of return of 12 %.

The results also indicate that the additional tolerable investment costs are K 28,000, K 320,000 and K 110,000 for 200 Ha single and double crop and 500 Ha single crop models respectively. It can be concluded that 200 ha double crop model will be viable even if the management costs and investment costs are increased by K 63,000 and K 320,000.

ECONOMIC ANALYSIS

The FIRR is the indicator of private profit and the basis for private sector to invest on commercial projects. Economic policy analysis on rice, however, should evaluate the cost and benefit to the economy and that should be the basis to advise the government on policy issues. Economists should convert the financial cost and benefit by carefully treating transfer payments, distortions under traded items and shadow prices of non-traded items of costs and benefits and then estimate the Economic IRR/EIRR.

The details of the economic conversion factor for 1985 relating to the rice project was not estimated by the FAO Mission. Based on earlier agriculture projects, the financial costs and benefits were converted into economic values. The investment cost being mainly traded items was converted after elimination of taxes and duties (on vehicle, equipments, housing etc.), and the domestic resource cost (non-traded) after deflation at 90 % (SCF 0.9) to equate with border prices and so on.

The EIRR is estimated for 200 ha commercial farm for double and single crop using cost and benefits of the FAO financial farm budgets with correction for double counting of return of capital and for capital replacements. The the EIRR is 25 % and 116 % respectively for single and double crop at yield level of 3 mt/ha and price level of K 153/mt (Table: 7-9).

Economic Farm Budget: 200 ha Commercial Farm - Double cropping

Price K/mt	Double Cropping EIRR %	Single Cropping EIRR %
100	3	-26
125	46	1
150	106	22
175	above 106	44
200	above 106	69

Note:

1. Yield 3 mt/ha and price K 153/mt
2. Capital Replacement on 7 and 14 years.
3. Capital cost converted into economic value using conversion factor of 0.75 to eliminate taxes etc.
4. Variable cost converted using 0.9 to eliminate taxes etc. on traded items and non-traded item conversion.
5. Fixed cost being non-traded SCF of 0.9 used.

Based on these estimates it can be concluded that the domestic commercial rice production is financially and economically viable.

FAO Mission had not carried out economic analysis to evaluate policy options based on economic justification. The FAO Mission Report without the EIRR and other related economic analysis may not be appropriate to advise the government on rice policy.

COMPETITIVE AND COMPARATIVE ADVANTAGES

Competitive and comparative advantages were estimated using the 200 ha single and double crop rice models. The cost and price as of 1993 was the basis for the estimates (Tables:10-14).

The constant price of rice which equates the discounted value of the cost streams and physical yields at 12 % discount rate was considered as the cost of production of rice. This estimate fairly takes care of "Return of Capital and Return on Capital". At 12 % discount rate, the cost includes a 12 % return on capital. This is also the most convenient way to allocate the capital cost.

The domestic resource cost (DRC) and the foreign cost (FC) were estimated by decomposing all tradables into domestic and foreign costs and treating all non-tradables as domestic resource cost. The ratio between the discounted domestic resource cost at market price per US dollar and the official exchange rate indicates the competitive advantage and the ratio between the discounted domestic resource costs at shadow price per US dollar and the shadow exchange rate indicates the comparative advantage. The ratio less than unity (one), in both cases, indicates competitive and comparative advantages.

COMPETITIVE AND COMPARATIVE ADVANTAGES

200 Ha Farm model:		Single crop	Double crop
Competitive advantage	=	1.0	0.68
Comparative advantage	=	0.51	0.39
1. Market price DRC per US \$	=	0.98	0.67
2. Shadow price DRC per US \$	=	0.50	0.38
3. Official/Shadow Exchange rate	=	K 0.98 / US \$	
4. FOB price of rice	=	K 600/mt = US \$ 612/mt	

The competitive advantage is 1.0 for 200 ha single crop model and this indicates just break-even private profitability of domestic rice production at 12 % discount rate. The comparative advantage is 0.51 and this indicates the economic or social profitability at comfortable level. The DRC of 0.50 for rice at shadow price per unit of US \$ is an indication of its own exchange rate at which domestic resources can be converted into foreign exchange.

The results for 200 ha double crop models indicate competitive advantage of 0.68 and comparative advantage of 0.39. It is clear that when appropriate models are designed there will be competitive and comparative advantages to produce domestic rice.

The difference between the competitive and comparative advantages will indicate that the commercial viability of domestic rice production is adversely affected by distortion in wages, exchange rates, processing cost, transport and other infrastructure. All these imperfections are eliminated through shadow pricing under comparative advantages.

SUBSIDIES

The FAO Mission indicated that commercial rice production would require subsidies up to 40-90 % of the prevailing market rice price to achieve 12 % FIRR. This conclusion is also not valid, if the analysis is carried out after correcting the cash-flow as discussed earlier.

The revised financial analysis relating to cost-benefits of 1993 may also prove that the FAO mission conclusions are not appropriate.

The corrected and revised rice price to reach FIRR of 12 % is furnished below:

Farm Model	Rice Price(K/mt) to achieve 12 % FIRR		
	FAO estimate	Corrected*	Revised**
1. 200 Ha Single crop Commercial Rice	225.66	135	192
2. 200 Ha Double crop Commercial Rice	153.08	108	147
3. 500 Ha single crop Commercial Rice	290.23	133	184

* There was double counting of return of capital in the FAO report, which was corrected and IRR estimated.

** Revised Financial analysis using 1993 cost and benefits and after making provision for assets replacements in years 8 & 15.

Note: 1. Yield 3 mt/ha in both cases (As furnished by FAO)
2. Price K 153/mt in both cases (As estimated by FAO)
3. Price K 200/mt under revised financial analysis.

In all the three models the corrected estimates indicates that FIRR of 12 % can be achieved at the price level of K 135/mt as against the farm gate price of K 153/mt. This indicates that the commercial rice production will be financially viable without any subsidy.

The revised analysis relating to 1993 indicates that the price to be paid to reach FIRR of 12 % is well below the market price of K 200/mt. This again confirm that commercial rice production shall be viable without subsidy.

Some projects may be economically viable with EIRR more than 12 % but financially not viable, then it indicates that the project benefits are generated elsewhere and not fully to the investor. The benefits generated in the economy should be transferred to the investors through appropriate policies to subsidise the investor. Then there will be a justification to provide subsidies to private investors.

The appropriate policy is to provide capital subsidy rather than price subsidy. The capital subsidy may be in the form of development of infrastructure and support services. Once these costs are met by the government the project will be automatically financially/commercially viable. However since all the three models are financially and economically viable there is no need for any subsidy.

DOMESTIC RICE PRICE

In terms of economic efficiency, not only domestic rice production, but all the primary, secondary and tertiary sectors are all facing the same problems like high cost of labour, transport, technology, support services etc. In a perfect and full employment situation the economic efficiency may be the best judgment to decide the option to produce or to import. When some of the factors are under-employed or unemployed, pure economic efficiency may not be appropriate for judgment.

It may be noted here that when economists say that imported rice is cheaper than domestic production, they completely ignore one aspect of rice price and costs of production estimate. In other rice producing countries there are well established infrastructure and support services and these cost never enter into the cost of production of rice as these facilities are public utility services for various sectors of the economy. Therefore the imported rice appears to be cheaper.

Food Policy Analyst should evaluate the reasons for the higher cost and identify the alternate least cost and cost effective production models and technologies. Probably the most appropriate least cost technology should be identified.

When cost of rice production is estimated in PNG, invariably, all economists include the total cost of infrastructure and support services and therefore domestic rice appears to be costly. Investment on infrastructure and support services are not exclusively used by the project but it will be utilised for all other socio-economic activities. It would be wise on the part of economists to design an appropriate costing of all services and allocate cost to the various users rather than one project.

The low capacity utilisation of capital intensive farm machineries and rice processing further increase the cost of rice production and this is a clear case of economics of scale.

There are evidences to indicate that rice production at smallholder level and subsistence level are cheaper than imports. The current prices at Maprik Rice Project area in East Sepik Province are furnished below :

Imported rice Landed cost K 600/mt

Price at Wewak Town K 750/mt

Price at Maprik K 850/mt

Price at near by villages K 900/mt

Price at remote areas K 1000/mt

Domestic rice cost at Maprik K 580/mt

Price at Maprik K 600/mt

Source: D.Kwamillon, Manager, Maprik Rice Project.

It can be seen from the above data that the domestic rice is cheaper than imported rice. In view of the rugged terrain and the poor access the domestic rice will be cheaper if it is produced in the rural areas which will minimise the transport cost.

The domestic rice is being sold at K 600/mt as against imported rice at K 850/mt in Maprik area and K 1000 and above per mt in remote areas. In Bereina domestic rice is being sold at K 480/mt whereas the imported trukai rice at K 760/mt. In Maprik imported rice was sold at K 800/mt (N. Feredy, 1993). Efforts should be made to improve the quality of rice and to improve the milling to minimise the percentage of broken grain.

It may be of interest to note that even if there is an element of hidden subsidy, it is not the producers but the consumers are the beneficiaries. This price differential indicates the potential to increase the farm gate price up to K 360/mt without increasing the domestic price above the imported rice.

FAO Mission estimated that the landed price of imported rice bagged as K 278/mt for imports from Bangkok (1985). The Mission also estimated the domestic production, milling, polishing and bagging cost as K 243/mt. This includes paddy rice cost of K 130/mt, which was paid to the farmers in PNG (1985), and the domestic milling, polishing and bagging cost of K 113/mt (1985 - Under small mills option with capacity of 500 tonnes). This indicates that the domestic production will be cheaper than import if appropriate technology is adopted..

The resources utilisation indicates that the land, labour and water are available in plenty and the capital alone is the limiting factor. By proper resource allocation the domestic production can be increased.

SUBSISTENCE RICE FARMING

Smallholders are cultivating rice at subsistence level. Subsistence rice production mainly makes use of the unemployed labour and the cash input is at very low level. Evaluation of smallholders rice production should consider the opportunity cost of labour as well as the opportunity cost of rice for consumption. The estimation of return per man day, as normally practised, may not be appropriate.

As there will not be any cash input and as they practice mostly shifting cultivation, the entire gross margin remains as net margin. This income indicates the financial return and there is a shadow income which is normally not accounted. Normally without rice production the farm family either has no means to purchase rice or has to divert their cash income from other sources to purchase rice from the market.

The viability of smallholders rice at subsistence level is furnished below:

Without Rice cultivation:

(Assumption -Family consumption of rice = 1.8mt/year)
 Market price of rice purchased for consumption = K 1188
 (1.8 mt x .66 x K 1000)

With rice cultivation(B):

Production/ha	= 1.8 mt/ha
Gross income at K 200/mt	= K 360/ha
Total man days required	= 180
Financial Return per man day	= K 2/md
Opportunity cost of rice consumed	= K 1188
Less milling cost	= K 188/1.8mt
Net opportunity cost	= K 1000

Economic/shadow return per man day = K 5.5/md

A comparison of with and without rice project farm budget may indicate that farmers save considerable amount of cash by cultivating rice. The rural minimum wages is K 4.5/md. Considering the unemployment level the shadow wages or the opportunity cost of labour shall be in the range of K 2/md.

The shadow return of K 5.5 per man day as well as the financial return of K 2 per man day are well above the shadow wages and market wages, indicating the smallholders are better off by cultivating rice than without rice cultivation. Without rice cultivation, the farm families may not get adequate food and or income and employment. This also indicates the income and employment generating capacity of rice production and the contribution to household food security.

TECHNICAL ASPECTS

We can produce rice only when we can grow it. In terms of agro-climatic conditions, and soil PNG is having technically comparative advantage. There are thousands of Indica, Japonica and Javanica varieties of rice which are suitable for a wide range of situation -low chemical inputs, water logged rices, saline/alkaline resistant, non-season-bound, low technology varieties, resistant to pest, diseases and to adverse climatic conditions and so on.

Even though the corrected FAO estimates indicate that domestic commercial production will be cheaper, it would be always preferable to technically design the project to ensure the productivity level of 3-5 mt/ha as achieved in other developing countries and to cultivate double crop in a year followed by a leguminous cover crop wherever possible to maintain soil fertility and productivity.

Rice being a hydrophytic plant, irrigation is a critical aspect of rice production and it is therefore essential to include irrigation facilities, surface or sub-surface source, under the rice project. There should be provision to replace the machineries, equipments etc. once in seven years.

FOREIGN EXCHANGE EARNING

Referring to the FAO report it is argued that the foreign exchange component of rice production per metric tonne (mt) may be equivalent to the import price /mt of rice and therefore there is no foreign exchange savings.

The FAO estimate for cost of production of rice was K 180/mt (K 542/ha divided by 3 mt as per FAO estimates and after making correction for double counting of cost it should be K 120/mt). Adding the investment cost of K 0.225 million for total production of 12,000 mt (FAO estimate), the investment cost will be about K 20/mt. The total cost of production will be K 200/mt.

Out of the investment cost about 30-40 % may relate to domestic resource cost (DRC) including the taxes, marketing, sales margin etc. When the FAO cost of production estimate is K 200/mt, it is not clear how they estimated the foreign exchange cost as equivalent to K 254/mt.

Considering other agricultural projects it can be reasonably assumed that the foreign exchange component may not exceed 60 % of the production cost. The empirical analysis of comparative advantages indicates that rice import worth US \$ 1.0 can be domestically produced with imported input component of less than US \$ 0.5. It is, therefore, evident that domestic production will ensure savings in foreign exchange. This may be the case with rice production in other developing countries which involves import components in the form of agro-chemicals, farm machineries etc.

The other aspect is the impact on rural employment creation and income generation due to the domestic production rather than imports and therefore it is advisable to promote domestic rice production.

With population growing at around 2.5 % annually, the per capita output in the agricultural sector declined appreciably over the past decade with serious consequences especially for incomes and employment in rural areas. The main burden of development and employment creation will have to be borne by the part of the economy in which agriculture is the predominant activity; that is, the rural sector.

TRADE POLICY

Trade Policy is one aspect, especially the terms of trade, which is used to judge domestic production vis-a-vis import by most of the advocates of "Import Rice." Economic policy analysis should go beyond trade policy and evaluate a matrix of policies including food security, employment, income, balance of payments, exchange rates and so on.

It is not a simple solution that it is cheaper to import; so don't produce. If cheaper price is the only criterion, then economists should advise developed countries to hire cheap labour from Asian markets rather than their citizens. Asian economies are having comparative advantages in labour market. Further most of the goods and services are cheaper in Asian market and the developed economies will be better off by imports than producing them.

Some economists believe that devaluation of kina will have favourable impacts on rural sector. Rural sector will gain as well as lose as a producer of export crop and as a consumer of imported goods and the net result may be negative in an import dominated sector.

The currency value may, perhaps, depreciate after the mineral boom. Depreciated / devalued currency will increase the cost of imports and perhaps the rice import will become costly overnight; but we cannot produce cheaper domestic rice overnight because it is not a function of economic variables but agronomic variables.

Favourable or adverse TOT for tree crop or rice is not the only criterion to decide production and exports; the viability and profitability to recover the cost of production at that price level for each crop shall decide the option.

Again it is neither the TOT (relative price change) nor the absolute price change of tree or rice crops shall be the deciding factor for resource allocation. Ultimately the net margin, rate of return, cost of cultivation, technical feasibility, economic viability and socio-cultural factors jointly influences the resources allocation decision.

Technically rice and tree crops are not perfectly interchangeable cropping pattern and therefore switching over from crop to crop based on TOT is practically impossible due to technical reasons. There are limitations to increase the tree crop areas and production due to technical reasons. It is doubtful whether the growing import bill for food can be met out of the tree crop export earnings. Moreover the above terms of trade comparison limits the scope of external trade.

Evidences are there to indicate that domestic rice will be cheaper than import at smallholder system and there are possibility to produce cheaper rice at commercial level with appropriate technology and design. Further any possible devaluation of currency after the mineral boom may increase the cost of imported rice.

The country is not only importing food but also other industrial and manufactured goods and services. Some of these goods and services cannot be produced in the country and therefore to keep the import bills within the export earning capacity, it is necessary to substitute imports of some of the items which could be domestically produced at reasonable cost. Domestic rice production is one option available to the country. Further most of the rice producing Asian countries are industrialising in fast manner and their rice production may not leave any surplus for exports.

Planners should evaluate various facts and situations and try to solve the problems instead of advocating adhoc solutions in isolation. Terms of trade argument may not hold water for long and may be misleading in an imperfect market.

BALANCE OF TRADE

The balance of trade in agriculture as estimated by DAL is furnished here:

(Million Kina)

YEAR	EXPORTS	IMPORTS	BALANCE
1986	414.5	170.0	244.5
1987	390.8	179.1	211.7
1988	360.2	190.8	169.4
1989	374.4	195.1	179.3
1990	268.0	214.2	53.8
1991	215.1	240.0	-24.9

Source: DAL Publication - Statistics at a glance 1993.

There are clear indications that the agriculture exports are declining at 8 % per annum whereas the imports increase by 7 % per annum since 1986 and the balance of agricultural trade resulted in a deficit of K 25 million in 1991.

The export price indices (QEB, Bank of Papua New Guinea) indicate that the export crop prices are declining at an average of 8 % per annum since 1985 and continues to remain depressed. However during the same period the food prices increased by 1 % per annum (Economist Commodity Price Indices). The import bill on rice is about K 39 million and other food items K 100 million. The total food imports are increasing steadily over the years and other imports are also increasing.

Possibly in the near future, certainly after the mineral boom, there will be problems of balance of payments and at that time another set of economist will advise the stabilization plans to cut expenditure including imports, currency devaluation etc. which may be seriously affecting the low income and rural sector as experienced in other developing countries.

Keeping all these eventualities in mind planners should carefully evaluate all the variables and try to solve the problems rather than making hasty conclusions.

PNG cannot be complacent that export earning from tree crops, leave alone the windfall gain under mineral sector, can be better utilised to import rice rather than devoting resources for rice production and we can ensure food security by imports.

The World Bank report March 25, 1993 and the AIDAB report (1992) indicate that PNG's economy suffers from the phenomenon known as the "Dutch Disease" - a situation whereby a sudden surge in an enclave sector (Oils, Minerals etc.) depresses output, profitability and employment in other sectors by misallocation of factors. After the mineral boom, intersectoral resource flows would have to be reversed which could be a costly exercise and painful too.

Indonesian Government under similar situation successfully managed the oil windfalls by adopting a set of economic policies which includes development strategies to raising rural incomes, strengthening agriculture and infrastructure.

NUTRITION

As incomes rise consumers buy higher priced sources of calories and the typical movements might be from tubers to rice to wheat. In developed economies these cereals are fed to animals and the meat is consumed to improve protein intake. Most of the Papua New Guineans obtain their energy mainly from tubers and other starchy food which are the traditional staples.

Papua New Guinea is the only country in the Asia-Pacific region where the people get more than 46 % of the total kilocalories from starchy sources like sago, tubers, roots, bananas etc. and perhaps because of this reason PNG scores lowest under dietary 'Q' score in comparison with desirable dietary pattern (DDP) in the pacific region.

The Indian medicines texts written some thousand years ago, discuss about the adverse effects of tubers and starchy food like sweet potato, tapioca, taro, bananas and so on and even now the traditional villagers in India try to minimise these items under their food intake. These foods supply energy but always not good for healthy life. The modern nutritionists are also of the same view.

It is therefore necessary to encourage change in the food habits of the people. Change is necessary to improve the nutritional aspects. Rice is now a favoured food for increasing number of Papua New Guineans and wheat, normally cannot replace rice in tropics. Rice production is the only option available.

CONCLUSION

Mr. Hans Binswanger of the World Bank, who delivered his talk at the Bank's Conference on Development Economics:

- The way to improve agricultural growth is to look beyond prices and price elasticities. The best starting point is to invest in areas with favourable agro-climatic potential.
- Structural adjustment efforts do not increase aggregate agricultural supply for several years, any possible stagnation or decline in food production must be compensated for with targeted food subsidies and nutrition programmes.
- Structural adjustment programmes should do more than ease the balance of payments. Adjustment packages must be designed to spur food production and all agricultural growth, supporting investments in human capital, infrastructure, markets, research and extension and allowing for the long lag time before investments show results.

Based on the empirical evidences and the above discussions it can be concluded that:

- Domestic rice production is the right option for a sustainable future and for a broad based economic development. Necessary resources should be allocated to facilitate technological improvements under subsistence rice farming and to steadily develop commercial rice production.
- Appropriate design and technology should be adopted to increase the productivity to 3-5 mt/ha and to cultivate double crop per year to ensure commercial as well as economic viability.
- Subsidies, if any, provided on economic justification may have to be phased out once the economy of scales and imperfections in the production and marketing systems are reduced considerably.

REFERENCES

- AIDAB. 1992. The Papua New Guinean Economy - Prospects for recovery. Australian International Development Assistance Bureau.
- Asian Development Bank -RETA(5382). 1991. " Competitive and Comparative Advantage in Palm Oil: Report by PRAGMA Corporation VA 22046, USA.
- Don Reeves et al, 1991. Farm Subsidies: Choices, American Agricultural Economic Association. United Lithographic Services Inc. USA (Fourth Quarter).
- Food and Agriculture Organization of the United Nations (FAO). 1986. TCP/PNG/4504(I) FAO Mission report on Rice Development Policy - an analysis of the options for meeting future rice consumption requirements.
-
- _____. 1991. Selected Indicators of Food and Agriculture Development in Asia-Pacific Region, 1980-90, RAPA. Bangkok.
- Feredy, Nicholas. 1993. Rice Production in Papua New Guinea: The experiences of the Bereina and Maprik Rice Projects. Policy Working Paper No 5. Department of Agriculture and Livestock, Konedobu - NCD Papua New Guinea.
- Ti, P.C. 1991. Paper on " Improving Food Security in Selected Asian and Pacific Countries ". Presented in the Seminar organised by ADB and Department of Agriculture and Livestock-PNG.

ANNEX

FINANCIAL AND ECONOMIC ANALYSIS

AND

COMPETITIVE AND COMPARATIVE ADVANTAGES

FAO Mission: Table D-8a: Rate of Return: Rainfed Commercial rice - 200 hectare single crop
(Model 4a) (1985 Constant Kina '000)

Year	Costs				Gross Returns	Net Benefits	Tonnage (m.t)
	Investment	Variable	Fixed	Total			
1	225.00	48.30	60.20	333.50	91.80	(241.70)	600.00
2		48.30	60.20	108.50	91.80	(16.70)	600.00
3		48.30	60.20	108.50	91.80	(16.70)	600.00
4		48.30	60.20	108.50	91.80	(16.70)	600.00
5		48.30	60.20	108.50	91.80	(16.70)	600.00
6		48.30	60.20	108.50	91.80	(16.70)	600.00
7		48.30	60.20	108.50	91.80	(16.70)	600.00
8		48.30	60.20	108.50	91.80	(16.70)	600.00
9		48.30	60.20	108.50	91.80	(16.70)	600.00
10		48.30	60.20	108.50	91.80	(16.70)	600.00
11		48.30	60.20	108.50	91.80	(16.70)	600.00
12		48.30	60.20	108.50	91.80	(16.70)	600.00
13		48.30	60.20	108.50	91.80	(16.70)	600.00
14		48.30	60.20	108.50	91.80	(16.70)	600.00
15		48.30	60.20	108.50	91.80	(16.70)	600.00
16		48.30	60.20	108.50	91.80	(16.70)	600.00
17		48.30	60.20	108.50	91.80	(16.70)	600.00
18		48.30	60.20	108.50	91.80	(16.70)	600.00
19		48.30	60.20	108.50	91.80	(16.70)	600.00
20		48.30	60.20	108.50	91.80	(16.70)	600.00

Internal Rate of return: None

Rice price to achieve IRR % :	% IRR	K / m.t.
	4 %	207.37
	6 %	211.68
	8 %	216.20
	10 %	220.88
	12 %	225.66
	14 %	230.50

Table 1. FINANCIAL FARM BUDGET: Rainfed commercial rice - 200 hectare single crop
Corrected Budget: Refer FAO Table:D-80 (Model 4a) (Constant Kina '000 1995)

Year	Costs				Gross Returns	Net Benefits	Tonnage (m.t)
	Investment	Variable	Fixed	Total			
1	225.00	48.30	6.20	279.50	91.80	(187.70)	600.00
2		48.30	6.20	54.50	91.80	37.30	600.00
3		48.30	6.20	54.50	91.80	37.30	600.00
4		48.30	6.20	54.50	91.80	37.30	600.00
5		48.30	6.20	54.50	91.80	37.30	600.00
6		48.30	6.20	54.50	91.80	37.30	600.00
7		48.30	6.20	54.50	91.80	37.30	600.00
8		48.30	6.20	54.50	91.80	37.30	600.00
9		48.30	6.20	54.50	91.80	37.30	600.00
10		48.30	6.20	54.50	91.80	37.30	600.00
11		48.30	6.20	54.50	91.80	37.30	600.00
12		48.30	6.20	54.50	91.80	37.30	600.00
13		48.30	6.20	54.50	91.80	37.30	600.00
14		48.30	6.20	54.50	91.80	37.30	600.00
15		48.30	6.20	54.50	91.80	37.30	600.00
16		48.30	6.20	54.50	91.80	37.30	600.00
17		48.30	6.20	54.50	91.80	37.30	600.00
18		48.30	6.20	54.50	91.80	37.30	600.00
19		48.30	6.20	54.50	91.80	37.30	600.00
20		48.30	6.20	54.50	91.80	37.30	600.00

FIRR when yield is 3 tonnes/ha and price K 153/tonne =
Price to be paid to reach a FIRR of 12 % = K 135/mt

19 % Viable

Sensitivity of FIRR at different yield and price of rice:

Price(K/Mt)	Yield(Mt/ha)			
	2.00	3.00	4.00	5.00
100.00	0.00	(7.00)	11.00	25.00
125.00	0.00	7.00	25.00	46.00
150.00	(7.00)	18.00	41.00	74.00
175.00	4.00	29.00	61.00	115.00
200.00	11.00	41.00	88.00	183.00

Note: FIRR less than 12 % is not viable.

Debt Servicing: Loan of K 200,000 was granted at 11 % repayable within 11 years.

Debt Servicing	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Opening Balance	0.00	190.00	179.00	167.00	154.00	139.00	122.00	102.00	80.00	55.00	29.00
Loan Drawal	200.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest 11 %	22.00	20.90	19.69	18.37	16.94	15.29	13.42	11.22	8.80	6.05	3.19
Repayment-Principal	10.00	11.00	12.00	13.00	15.00	17.00	20.00	22.00	25.00	26.00	29.00
- Interest	22.00	20.90	19.69	18.37	16.94	15.29	13.42	11.22	8.80	6.05	3.19
Closing balance	190.00	179.00	167.00	154.00	139.00	122.00	102.00	80.00	55.00	29.00	0.00

FAO Mission: Table D-8c: Rate of return: Rainfed Commercial rice, 200 ha double crop
(Model 4c) (1985 Constant Kina '000)

Year	Costs				Gross Returns	Net Benefits	Tonnage (m.t)
	Investment	Variable	Fixed	Total			
1	225.00	96.60	60.20	381.80	183.60	(198.20)	1,200.00
2		96.60	60.20	156.80	183.60	26.80	1,200.00
3		96.60	60.20	156.80	183.60	26.80	1,200.00
4		96.60	60.20	156.80	183.60	26.80	1,200.00
5		96.60	60.20	156.80	183.60	26.80	1,200.00
6		96.60	60.20	156.80	183.60	26.80	1,200.00
7		96.60	60.20	156.80	183.60	26.80	1,200.00
8		96.60	60.20	156.80	183.60	26.80	1,200.00
9		96.60	60.20	156.80	183.60	26.80	1,200.00
10		96.60	60.20	156.80	183.60	26.80	1,200.00
11		96.60	60.20	156.80	183.60	26.80	1,200.00
12		96.60	60.20	156.80	183.60	26.80	1,200.00
13		96.60	60.20	156.80	183.60	26.80	1,200.00
14		96.60	60.20	156.80	183.60	26.80	1,200.00
15		96.60	60.20	156.80	183.60	26.80	1,200.00
16		96.60	60.20	156.80	183.60	26.80	1,200.00
17		96.60	60.20	156.80	183.60	26.80	1,200.00
18		96.60	60.20	156.80	183.60	26.80	1,200.00
19		96.60	60.20	156.80	183.60	26.80	1,200.00
20		96.60	60.20	156.80	183.60	26.80	1,200.00

Internal Rate of return: 11.93 %

Rice price to achieve IRR % :	% IRR	K / m.t.
	4 %	143.93
	6 %	146.09
	8 %	148.35
	10 %	150.69
	12 %	153.08
	14 %	155.50

Table 2. FINANCIAL FARM BUDGET: Rainfed commercial rice - 200 hectare double crop
(Corrected: Refer FAO Table: D-8c) Constant K '000 - 1985

Year	Costs				Gross Returns	Net Benefits	Tonnage (m.t)
	Investment	Variable	Fixed	Total			
1	223.00	96.60	6.20	327.80	183.60	(144.20)	1,200.00
2		96.60	6.20	102.80	183.60	80.80	1,200.00
3		96.60	6.20	102.80	183.60	80.80	1,200.00
4		96.60	6.20	102.80	183.60	80.80	1,200.00
5		96.60	6.20	102.80	183.60	80.80	1,200.00
6		96.60	6.20	102.80	183.60	80.80	1,200.00
7		96.60	6.20	102.80	183.60	80.80	1,200.00
8		96.60	6.20	102.80	183.60	80.80	1,200.00
9		96.60	6.20	102.80	183.60	80.80	1,200.00
10		96.60	6.20	102.80	183.60	80.80	1,200.00
11		96.60	6.20	102.80	183.60	80.80	1,200.00
12		96.60	6.20	102.80	183.60	80.80	1,200.00
13		96.60	6.20	102.80	183.60	80.80	1,200.00
14		96.60	6.20	102.80	183.60	80.80	1,200.00
15		96.60	6.20	102.80	183.60	80.80	1,200.00
16		96.60	6.20	102.80	183.60	80.80	1,200.00
17		96.60	6.20	102.80	183.60	80.80	1,200.00
18		96.60	6.20	102.80	183.60	80.80	1,200.00
19		96.60	6.20	102.80	183.60	80.80	1,200.00
20		96.60	6.20	102.80	183.60	80.80	1,200.00

FIRR when yield is 3 tonnes/ha and price K 153/tonne = 56 % Viable
Price to be paid to reach FIRR of 12 % = K 108/mt

Sensitivity of FIRR at different yield and price of rice:

Price(K/Mt)	Yield(Mt/ha)			
	2.00	3.00	4.00	5.00
100.00	0.00	5.00	34.00	76.00
125.00	0.00	26.00	76.00	*
150.00	(1.70)	52.00	*	*
175.00	19.00	91.00	*	*
200.00	34.00	155.00	*	*

Note: FIRR above 12 % viable
* Denotes above 76 %

Debt Servicing: Loan of K 200,000 granted at 11 % repayable in 7 years.

Details	Year 1	Year 2	Year 3	Year 4	Year 5
Opening Balance	0.00	170.00	135.00	95.00	50.00
Loan Drawal	200.00	0.00	0.00	0.00	0.00
Interest 11 %	22.00	18.70	14.85	10.45	5.50
Repayment-Principal	30.00	35.00	40.00	45.00	50.00
- Interest	22.00	18.70	14.85	10.45	5.50
Closing balance	170.00	135.00	95.00	50.00	0.00

FAO Mission: Table D--8b: Rate of Return: Rainfed commercial rice, 500 ha single
(Model 4b) (1985 Constant Kina '000)

Year	Investment	Variable	Fixed	Total	Gross Returns	Net Benefits	Tonnage (m.t)
1	394.00	120.75	267.50	782.25	229.50	(552.75)	1,500.00
2		120.75	267.50	388.25	229.50	(158.75)	1,500.00
3		120.75	267.50	388.25	229.50	(158.75)	1,500.00
4		120.75	267.50	388.25	229.50	(158.75)	1,500.00
5		120.75	267.50	388.25	229.50	(158.75)	1,500.00
6		120.75	267.50	388.25	229.50	(158.75)	1,500.00
7		120.75	267.50	388.25	229.50	(158.75)	1,500.00
8		120.75	267.50	388.25	229.50	(158.75)	1,500.00
9		120.75	267.50	388.25	229.50	(158.75)	1,500.00
10		120.75	267.50	388.25	229.50	(158.75)	1,500.00
11		120.75	267.50	388.25	229.50	(158.75)	1,500.00
12		120.75	267.50	388.25	229.50	(158.75)	1,500.00
13		120.75	267.50	388.25	229.50	(158.75)	1,500.00
14		120.75	267.50	388.25	229.50	(158.75)	1,500.00
15		120.75	267.50	388.25	229.50	(158.75)	1,500.00
16		120.75	267.50	388.25	229.50	(158.75)	1,500.00
17		120.75	267.50	388.25	229.50	(158.75)	1,500.00
18		120.75	267.50	388.25	229.50	(158.75)	1,500.00
19		120.75	267.50	388.25	229.50	(158.75)	1,500.00
20		120.75	267.50	388.25	229.50	(158.75)	1,500.00

Internal Rate of Return: None

Rice price to achieve IRR % :	% IRR	K / m.t.
	4 %	277.42
	6 %	280.44
	8 %	283.60
	10 %	286.88
	12 %	290.23
	14 %	293.62

Table 3. FINANCIAL FARM BUDGET: Rainfed commercial rice, 500 Ha single crop (1985 Constant Kina '000)
(Corrected: FAO Table:D-8b) Constant K '000

(Revised FAO Table:D-8b)

Year	Investment	Variable	Fixed	Total	Gross Returns	Net Benefits	Tonnage (m.t)
1	394.00	120.75	31.00	545.75	229.50	(316.25)	1,500.00
2		120.75	31.00	151.75	229.50	77.75	1,500.00
3		120.75	31.00	151.75	229.50	77.75	1,500.00
4		120.75	31.00	151.75	229.50	77.75	1,500.00
5		120.75	31.00	151.75	229.50	77.75	1,500.00
6		120.75	31.00	151.75	229.50	77.75	1,500.00
7		120.75	31.00	151.75	229.50	77.75	1,500.00
8		120.75	31.00	151.75	229.50	77.75	1,500.00
9		120.75	31.00	151.75	229.50	77.75	1,500.00
10		120.75	31.00	151.75	229.50	77.75	1,500.00
11		120.75	31.00	151.75	229.50	77.75	1,500.00
12		120.75	31.00	151.75	229.50	77.75	1,500.00
13		120.75	31.00	151.75	229.50	77.75	1,500.00
14		120.75	31.00	151.75	229.50	77.75	1,500.00
15		120.75	31.00	151.75	229.50	77.75	1,500.00
16		120.75	31.00	151.75	229.50	77.75	1,500.00
17		120.75	31.00	151.75	229.50	77.75	1,500.00
18		120.75	31.00	151.75	229.50	77.75	1,500.00
19		120.75	31.00	151.75	229.50	77.75	1,500.00
20		120.75	31.00	151.75	229.50	77.75	1,500.00

FIRR when yield is 3 tonnes/ha and price K 153/tonne =

24 % Viable

Price to be paid to reach FIRR of 12 % =

K 133/mt

Sensitivity of FIRR at different yield and price of rice:

Price(K/Mt)	Yield(Mt/ha)			
	2.00	3.00	4.00	5.00
100.00	0.00	(1.73)	12.00	33.00
125.00	0.00	7.00	33.00	*
150.00	(7.00)	22.00	*	*
175.00	2.00	39.00	*	*
200.00	12.00	60.00	*	*

Note: FIRR less than 12 % is not viable.

* Denotes more than 33 % and viable

Debt Servicing: Bank loan of K 370,000 was granted at 11 % interest repayable within 11 years.

Details	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Opening Balance	0.00	355.00	332.00	305.00	273.00	236.00	194.00	147.00	95.00	38.00
Loan Drawal	370.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest 11 %	40.70	39.05	36.52	33.55	30.03	25.96	21.34	16.17	10.45	4.18
Repayment - Principal	15.00	23.00	27.00	32.00	37.00	42.00	47.00	52.00	57.00	38.00
- Interest	40.70	39.05	36.52	33.55	30.03	25.96	21.34	16.17	10.45	4.18
Closing balance	355.00	332.00	305.00	273.00	236.00	194.00	147.00	95.00	38.00	0.00

Table 4. Revised Financial Farm Budget: 200 ha single crop (Constant K '000 - 1993)

Year	Costs				Gross Returns	Net Benefits	Tonnage (m.t)
	Investment	Variable	Fixed	Total			
1	250.00	57.98	7.44	315.40	120.00	(195.40)	600.00
2		57.98	7.44	65.40	120.00	54.60	600.00
3		57.98	7.44	65.40	120.00	54.60	600.00
4		57.98	7.44	65.40	120.00	54.60	600.00
5		57.98	7.44	65.40	120.00	54.60	600.00
6		57.98	7.44	65.40	120.00	54.60	600.00
7		57.98	7.44	65.40	120.00	54.60	600.00
8	250.00	57.98	7.44	315.40	120.00	(195.40)	600.00
9		57.98	7.44	65.40	120.00	54.60	600.00
10		57.98	7.44	65.40	120.00	54.60	600.00
11		57.98	7.44	65.40	120.00	54.60	600.00
12		57.98	7.44	65.40	120.00	54.60	600.00
13		57.98	7.44	65.40	120.00	54.60	600.00
14		57.98	7.44	65.40	120.00	54.60	600.00
15	250.00	57.98	7.44	315.40	120.00	(195.40)	600.00
16		57.98	7.44	65.40	120.00	54.60	600.00
17		57.98	7.44	65.40	120.00	54.60	600.00
18		57.98	7.44	65.40	120.00	54.60	600.00
19		57.98	7.44	65.40	120.00	54.60	600.00
20		57.98	7.44	65.40	120.00	54.60	600.00

NOTE:

1. All costs increased by 20 % from 1985 level to make them equivalent to 1993.
2. The machineries, equipments, vehicle etc. shall be replaced in seven year cycle.
3. It is therefore the replacement cost included on years 8 and 15.
4. Salvage value for machineries etc. not accounted as it may not be realistic.
5. Current price of K 200/mt of rice is considered.

FIRR when yield is 3 tonnes/ha and price K 200/tonne =
 Price to be paid to reach the FIRR of 12 % =
 Additional tolerable investment cost at 12 % return =
 Additional capacity to pay for management at 12 % return =

17 % Viable
 K 192/mt
 K 26,000
 K 5,500/year

Sensitivity of FIRR at different yield and price of rice:

Price(K/MT)	Yield(Mt/ha)			
	2.00	3.00	4.00	5.00
150.00	**	(17.00)	17.00	39.00
175.00	**	(1.00)	36.00	65.00
200.00	**	17.00	49.00	*
225.00	**	31.00	*	*
250.00	(5.00)	39.00	*	*

Note: FIRR above 12 % viable

* Denotes above 49 % & ** Denotes below -5 %

Debt Servicing: Bank loan of K 250 was granted at 11 % interest repayable within 7 years.

Details	Years						
	1	2	3	4	5	6	7
Opening Balance	0.00	225.00	197.00	165.00	130.00	91.00	48.00
Loan Drawal	250.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest 11 %	27.50	24.75	21.67	18.15	14.30	10.01	5.28
Repayment-Principal	25.00	26.00	32.00	35.00	39.00	43.00	46.00
- Interest	27.50	24.75	21.67	18.15	14.30	10.01	5.28
Closing balance	225.00	197.00	165.00	130.00	91.00	48.00	0.00

Table 5. Revised Financial Farm Budget: Rainfed commercial rice, 200 hectare double crop
(Constant K '000 - 1993)

Year	Costs				Gross Returns	Net Benefits	Tonnage s (mt)
	Investment	Variable	Fixed	Total			
1	270.00	115.92	7.44	393.36	240.00	(153.36)	1,200.00
2		115.92	7.44	123.36	240.00	116.64	1,200.00
3		115.92	7.44	123.36	240.00	116.64	1,200.00
4		115.92	7.44	123.36	240.00	116.64	1,200.00
5		115.92	7.44	123.36	240.00	116.64	1,200.00
6		115.92	7.44	123.36	240.00	116.64	1,200.00
7		115.92	7.44	123.36	240.00	116.64	1,200.00
8	270.00	115.92	7.44	393.36	240.00	(153.36)	1,200.00
9		115.92	7.44	123.36	240.00	116.64	1,200.00
10		115.92	7.44	123.36	240.00	116.64	1,200.00
11		115.92	7.44	123.36	240.00	116.64	1,200.00
12		115.92	7.44	123.36	240.00	116.64	1,200.00
13		115.92	7.44	123.36	240.00	116.64	1,200.00
14		115.92	7.44	123.36	240.00	116.64	1,200.00
15	270.00	115.92	7.44	393.36	240.00	(153.36)	1,200.00
16		115.92	7.44	123.36	240.00	116.64	1,200.00
17		115.92	7.44	123.36	240.00	116.64	1,200.00
18		115.92	7.44	123.36	240.00	116.64	1,200.00
19		115.92	7.44	123.36	240.00	116.64	1,200.00
20		115.92	7.44	123.36	240.00	116.64	1,200.00

NOTE:

1. All costs increased by 20 % from 1965 level to make it equivalent to 1993.
2. The machineries, equipments, vehicle etc. shall be replaced in seven year cycle.
3. It is therefore the replacement cost included on years 8 and 15.
4. Salvage value for machineries etc. not accounted as it may not be realistic.
5. Current price of K 200/mt of rice is considered.

FIRR when yield is 3 tonnes/ha and price K 200/tonne = 73 % Viable
Price to be paid to reach the FIRR of 12 % = K 147/mt
Additional tolerable investment cost at 12 % return = K 320,000
Additional capacity to pay for management at 12 % return = K 63,000/year

Sensitivity of FIRR at different yield and price of rice:

Price(K/mt)	Yield(Mt/ha)			
	2.00	3.00	4.00	5.00
150.00	**	15.00	73.00	189.00
175.00	**	41.00	*	*
200.00	(4.00)	73.00	*	*
225.00	15.00	118.00	*	*
250.00	52.00	189.00	*	*

Note: FIRR above 12 % viable

* Denotes above 73 % and ** denotes less than -4 %.

Debt Servicing: Bank loan of K 250,000 was granted at 11 % interest repayable in 7 years.

Details	Years						
	1	2	3	4	5	6	7
Opening Balance	0.00	220.00	165.00	145.00	100.00	50.00	0.00
Loan Drawal	250.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest 11 %	27.50	24.20	20.35	15.95	11.00	5.50	0.00
Repayment-Principal	30.00	35.00	40.00	45.00	50.00	50.00	0.00
-Interest	27.50	24.20	20.35	15.95	11.00	5.50	0.00
Closing balance	220.00	165.00	145.00	100.00	50.00	0.00	0.00

Table 6. REVISED FINANCIAL FARM BUDGET: Rainfed commercial rice, 500 Ha single crop
(Constant Kina 1993)

Year	Investment	Variable	Fixed	Total	Gross Returns	Net Benefits	Tonnage t (m.t)
1	472.00	144.90	37.20	654.10	300.00	(354.10)	1,500.00
2		144.90	37.20	182.10	300.00	117.90	1,500.00
3		144.90	37.20	182.10	300.00	117.90	1,500.00
4		144.90	37.20	182.10	300.00	117.90	1,500.00
5		144.90	37.20	182.10	300.00	117.90	1,500.00
6		144.90	37.20	182.10	300.00	117.90	1,500.00
7		144.90	37.20	182.10	300.00	117.90	1,500.00
8	472.00	144.90	37.20	654.10	300.00	(354.10)	1,500.00
9		144.90	37.20	182.10	300.00	117.90	1,500.00
10		144.90	37.20	182.10	300.00	117.90	1,500.00
11		144.90	37.20	182.10	300.00	117.90	1,500.00
12		144.90	37.20	182.10	300.00	117.90	1,500.00
13		144.90	37.20	182.10	300.00	117.90	1,500.00
14		144.90	37.20	182.10	300.00	117.90	1,500.00
15	472.00	144.90	37.20	654.10	300.00	(354.10)	1,500.00
16		144.90	37.20	182.10	300.00	117.90	1,500.00
17		144.90	37.20	182.10	300.00	117.90	1,500.00
18		144.90	37.20	182.10	300.00	117.90	1,500.00
19		144.90	37.20	182.10	300.00	117.90	1,500.00
20		144.90	37.20	182.10	300.00	117.90	1,500.00

NOTE:

1. All costs increased by 20 % from 1985 level to make it equivalent to 1993.
2. The machineries, equipments, vehicle etc. shall be replaced in seven year cycle.
3. It is therefore the replacement cost included on years 8 and 15.
4. Salvage value for machineries etc. not accounted as it may not be realistic.
5. Current price of K 200/mt of rice is considered.

FIRR when yield is 3 tonnes/ha and price K 200/tonne = 24 % Viable
Price to be paid to reach the FIRR of 12 % = K 184/mt
Additional tolerable investment cost at 12 % return = K 110,000
Additional capacity to pay for management at 12 % return = K 24,000/year

Sensitivity of FIRR at different yield and price of rice:

Price(K/mt)	Yield(Mt/ha)			
	2.00	3.00	4.00	5.00
150.00	**	(17.00)	24.00	56.00
175.00	**	5.00	50.00	.
200.00	**	24.00	.	.
225.00	**	43.00	.	.
250.00	(2.00)	66.00	.	.

Note: FIRR less than 12 % is not viable.
* Denotes more than 50 % and ** Denotes less than -2 %.

Debt Servicing: Bank loan of K 470,000 was granted at 11 % repayable within 7 years.

Details	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Opening Balance	0.00	420.00	365.00	305.00	240.00	170.00	90.00
Loan Drawal	470.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest 11 %	51.70	46.20	40.15	33.55	26.40	18.70	9.90
Repayment-Principal	50.00	55.00	60.00	65.00	70.00	60.00	90.00
- Interest	51.70	46.20	40.15	33.55	26.40	18.70	9.90
Closing balance	420.00	365.00	305.00	240.00	170.00	90.00	0.00

Table 7. ECONOMIC FARM BUDGET: Rainfed commercial rice, 200 hectare single crop
(Constant K '000 - 1985)

Year	Investment	Variable	Fixed	Total	Gross Returns	Net Benefits	Tonnage s (m.t)
1	166.75	43.47	5.56	217.80	91.80	(126.00)	600.00
2		43.47	5.56	49.06	91.80	42.75	600.00
3		43.47	5.56	49.06	91.80	42.75	600.00
4		43.47	5.56	49.06	91.80	42.75	600.00
5		43.47	5.56	49.06	91.80	42.75	600.00
6		43.47	5.56	49.06	91.80	42.75	600.00
7		43.47	5.56	49.06	91.80	42.75	600.00
8	166.75	43.47	5.56	217.80	91.80	(126.00)	600.00
9		43.47	5.56	49.06	91.80	42.75	600.00
10		43.47	5.56	49.06	91.80	42.75	600.00
11		43.47	5.56	49.06	91.80	42.75	600.00
12		43.47	5.56	49.06	91.80	42.75	600.00
13		43.47	5.56	49.06	91.80	42.75	600.00
14		43.47	5.56	49.06	91.80	42.75	600.00
15	166.75	43.47	5.56	217.80	91.80	(126.00)	600.00
16		43.47	5.56	49.06	91.80	42.75	600.00
17		43.47	5.56	49.06	91.80	42.75	600.00
18		43.47	5.56	49.06	91.80	42.75	600.00
19		43.47	5.56	49.06	91.80	42.75	600.00
20		43.47	5.56	49.06	91.80	42.75	600.00

- Note: 1. Machinery, equipment etc, replaced once in 7 years and therefore replacement cost included under years 8 and 15.
2. Conversion factor of 0.75 used to eliminate taxes etc, from capital cost.
3. Conversion factor of 0.9 used to convert nontraded items and traded items to equate to border prices and eliminate taxes respectively.

ERR when yield is 3 tonnes/ha and price K 153/tonne = 25 % Viable 0.25

RRSensitivity of ERR at different yield and price of rice:

Price(K/Mt)	Yield(Mt/ha)		4.00	5.00
	2.00	3.00		
100.00	**	(26.00)	8.00	37.00
125.00	**	1.00	37.00	*
150.00	**	22.00	*	*
175.00	(7.00)	44.00	*	*
200.00	8.00	66.00	*	*

Note: ERR above 12 % viable
* Denotes above 37 % & ** Denotes less than - 7 %

Table: 6, ECONOMIC FARM BUDGET: Rainfed commercial rice, 200 hectare double crop
(Constant K '000 - 1985)

Year	Costs				Gross Returns	Net Benefits	Tonnage t (m.t)
	Investment	Variable	Fixed	Total			
1	108.75	88.94	5.58	261.27	183.60	(77.67)	1,200.00
2		88.94	5.58	92.52	183.60	91.08	1,200.00
3		88.94	5.58	92.52	183.60	91.08	1,200.00
4		88.94	5.58	92.52	183.60	91.08	1,200.00
5		88.94	5.58	92.52	183.60	91.08	1,200.00
6		88.94	5.58	92.52	183.60	91.08	1,200.00
7		88.94	5.58	92.52	183.60	91.08	1,200.00
8	108.75	88.94	5.58	261.27	183.60	(77.67)	1,200.00
9		88.94	5.58	92.52	183.60	91.08	1,200.00
10		88.94	5.58	92.52	183.60	91.08	1,200.00
11		88.94	5.58	92.52	183.60	91.08	1,200.00
12		88.94	5.58	92.52	183.60	91.08	1,200.00
13		88.94	5.58	92.52	183.60	91.08	1,200.00
14		88.94	5.58	92.52	183.60	91.08	1,200.00
15	108.75	88.94	5.58	261.27	183.60	(77.67)	1,200.00
16		88.94	5.58	92.52	183.60	91.08	1,200.00
17		88.94	5.58	92.52	183.60	91.08	1,200.00
18		88.94	5.58	92.52	183.60	91.08	1,200.00
19		88.94	5.58	92.52	183.60	91.08	1,200.00
20		88.94	5.58	92.52	183.60	91.08	1,200.00

Note: 1. Machineryes, equipment etc. replaced once in 7 years and therefore replacement cost included under years 8 and 15.

2. Conversion factor of 0.75 used to eliminate taxes etc. from capital cost.

3. Conversion factor of 0.9 used to convert nontraded items and traded items to equate to border prices and eliminate taxes respectively.

ERR when yield is 3 tonnes/ha and price K 153/tonne

= 116 % Viable

1.16

RF Sensitivity of ERR at different yield and price of rice:

Price(K/MT)	Yield(Mt/ha)			
	2.00	3.00	4.00	5.00
100.00	**	3.00	63.00	175.00
125.00	**	45.00	71.00	.
150.00	5.00	106.00	.	.
175.00	32.00	.	.	.
200.00	63.00	.	.	.

Note: ERR above 12 % viable

* Denotes above 71 % & ** Less than 3 %

Table 3. ECONOMIC FARM BUDGET: Rainfed commercial rice, 500 Ha single crop
(Constant K '000 - 1988)

Year	Investment	Variable	Fixed	Total	Gross Returns	Net Benefits	Tonnage t (m.t)
1	295.50	108.66	27.90	432.06	229.50	(202.56)	1,500.00
2		108.66	27.90	136.56	229.50	92.94	1,500.00
3		108.66	27.90	136.56	229.50	92.94	1,500.00
4		108.66	27.90	136.56	229.50	92.94	1,500.00
5		108.66	27.90	136.56	229.50	92.94	1,500.00
6		108.66	27.90	136.56	229.50	92.94	1,500.00
7		108.66	27.90	136.56	229.50	92.94	1,500.00
8	295.50	108.66	27.90	432.06	229.50	(202.56)	1,500.00
9		108.66	27.90	136.56	229.50	92.94	1,500.00
10		108.66	27.90	136.56	229.50	92.94	1,500.00
11		108.66	27.90	136.56	229.50	92.94	1,500.00
12		108.66	27.90	136.56	229.50	92.94	1,500.00
13		108.66	27.90	136.56	229.50	92.94	1,500.00
14		108.66	27.90	136.56	229.50	92.94	1,500.00
15	295.50	108.66	27.90	432.06	229.50	(202.56)	1,500.00
16		108.66	27.90	136.56	229.50	92.94	1,500.00
17		108.66	27.90	136.56	229.50	92.94	1,500.00
18		108.66	27.90	136.56	229.50	92.94	1,500.00
19		108.66	27.90	136.56	229.50	92.94	1,500.00
20		108.66	27.90	136.56	229.50	92.94	1,500.00

Note: 1. Machineries, equipment etc. replaced once in 7 years and therefore replacement cost included under years 8 and 15.

2. Conversion factor of 0.75 used to eliminate taxes etc. from capital cost.

3. Conversion factor of 0.8 used to convert nontraded items and traded items to equate to border prices and eliminate taxes respectively.

EBR when yield is 3 tonnes/ha and price K 133/tonne

= 40 % Viable

0.40

Sensitivity Analysis:

Price (K/Mt)	Yield (Mt/ha)			
	2.00	3.00	4.00	5.00
100.00	**	(1.00)	27.00	62.00
125.00	**	20.00	62.00	*
150.00	(1.00)	36.00	*	*
175.00	14.00	74.00	*	*
200.00	27.00	124.00	*	*

Table:10. Cost of Production; rainfed commercial rice model, 200 hectare
(Model 4a) Constant Kina '000 1993

Yield (mt/ha):	3.00		
Price (K/mt): 1/	200.00		
Gross returns (K/ha):	600.00		
Variable costs (K/ha):	COST	FX COST	DR COST
- field operations (machinery & equipment)2/	35.00	20.00	15.00
- seed: 100 kg @ t20	20.00	0.00	20.00
- fertilizer 3/	85.00	70.00	15.00
- plant protection and weed control	70.00	50.00	20.00
- grain drying, @ K12/mt	40.00	10.00	30.00
- on-farm transport & storage	2.00	0.00	2.00
- transport to mill; 50km @ K0.12/ton/km	18.00	10.00	8.00
- miscellaneous labour; 5md/ha @ K4.0	20.00	0.00	20.00
Total variable costs:	290.00	160.00	130.00
Fixed costs:			
- land lease rent; K20/ha/yr	24.00	0.00	24.00
- insurance 5/	12.00	0.00	12.00
- utilities	1.00	0.00	1.00
Total fixed costs:	37.00	0.00	37.00
Processing and marketing cost	450.00	150.00	300.00
Total costs per hectare:	777.00	310.00	467.00
Cost / mt of rice -milled	388.50	155.00	233.50
Capital cost durable for 7 years	270000	220000	50000
Capital for Processing mill	150000	125000	25000

FX cost - Foreign Cost: DR cost - Domestic Resource cost.

- 1/ Indicator price.
- 2/ Direct operating costs of tractor and field equipment including harvest, not including operators wage.
- 3/ Fertilizer: 250 kg/ha sulfate of ammonia @ K165/mt plus K35/ha for ZnSO₄.
- 4/ Assumes K200,000 of investment financed at 11 % rate loan;
- 5/ Insurance on K200,000 of assets at 1 percent annual premium.

Table: 11.A. COST OF PRODCUTION ESTIMATE OF RICE IN MARKET PRICE – CONSTANT K '000 1993

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
420.00	58.00	7.40	90.00	575.40	237.60	(337.80)	600.00
	58.00	7.40	90.00	155.40	237.60	82.20	600.00
	58.00	7.40	90.00	155.40	237.60	82.20	600.00
	58.00	7.40	90.00	155.40	237.60	82.20	600.00
	58.00	7.40	90.00	155.40	237.60	82.20	600.00
	58.00	7.40	90.00	155.40	237.60	82.20	600.00
	58.00	7.40	90.00	155.40	237.60	82.20	600.00

Cost of production at 12 % discount rate = K 600/mt 0.12

Table: 11.B. Domestic resource cost – market price– at 12 % discount rate: K '000

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
75.00	26.00	7.40	60.00	168.40	108.11	(60.29)	600.00
	26.00	7.40	60.00	93.40	108.11	14.71	600.00
	26.00	7.40	60.00	93.40	108.11	14.71	600.00
	26.00	7.40	60.00	93.40	108.11	14.71	600.00
	26.00	7.40	60.00	93.40	108.11	14.71	600.00
	26.00	7.40	60.00	93.40	108.11	14.71	600.00
	26.00	7.40	60.00	93.40	108.11	14.71	600.00

Domestic resource cost at 12 % discount = K 273/m 0.12

Table: 11.C. Foreign cost – market price at 12 % discount rate: K '000

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
345.00	32.00	0.00	30.00	407.00	129.49	(277.51)	600.00
	32.00	0.00	30.00	62.00	129.49	67.49	600.00
	32.00	0.00	30.00	62.00	129.49	67.49	600.00
	32.00	0.00	30.00	62.00	129.49	67.49	600.00
	32.00	0.00	30.00	62.00	129.49	67.49	600.00
	32.00	0.00	30.00	62.00	129.49	67.49	600.00
	32.00	0.00	30.00	62.00	129.49	67.49	600.00

Foreign cost at 12 % discount = K 327/mt 0.12

Table: 12.A. COST OF PRODCUTION ESTIMATE OF RICE IN SHADOW PRICE – CONSTANT K '000 1993

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
296.25	44.40	6.66	66.00	413.31	174.64	(238.67)	600.00
	44.40	6.66	66.00	117.06	174.64	57.58	600.00
	44.40	6.66	66.00	117.06	174.64	57.58	600.00
	44.40	6.66	66.00	117.06	174.64	57.58	600.00
	44.40	6.66	66.00	117.06	174.64	57.58	600.00
	44.40	6.66	66.00	117.06	174.64	57.58	600.00
	44.40	6.66	66.00	117.06	174.64	57.58	600.00
Cost of production at 12 % discount rate =				K 441/mt		0.12	

Table: 12.B. Domestic resource cost – shadow price – at 12 % discount rate: K '000

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
37.50	15.60	6.66	36.00	95.76	65.54	(30.22)	600.00
	15.60	6.66	36.00	58.26	65.54	7.28	600.00
	15.60	6.66	36.00	58.26	65.54	7.28	600.00
	15.60	6.66	36.00	58.26	65.54	7.28	600.00
	15.60	6.66	36.00	58.26	65.54	7.28	600.00
	15.60	6.66	36.00	58.26	65.54	7.28	600.00
	15.60	6.66	36.00	58.26	65.54	7.28	600.00
Domestic resource cst – shadw price at 12 % discunt =				K 166/mt		0.12	

Notes: (Domestic resource cost at market price is converted)

1. Investment cost converted at 50 % to eliminate taxes etc.
2. Variable cost being wages shadow wage rate of 60 % used.
3. Fixed cost converted at SCF of 0.9.
4. Processing cost mostly wages so shadow wage rate of 60 % used.

Table: 12.C. Foreign cost – shadow price at 12 % discount rate: K '000

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
258.75	28.80	0.00	30.00	317.55	108.90	(208.65)	600.00
	28.80	0.00	30.00	58.80	108.90	50.10	600.00
	28.80	0.00	30.00	58.80	108.90	50.10	600.00
	28.80	0.00	30.00	58.80	108.90	50.10	600.00
	28.80	0.00	30.00	58.80	108.90	50.10	600.00
	28.80	0.00	30.00	58.80	108.90	50.10	600.00
	28.80	0.00	30.00	58.80	108.90	50.10	600.00
Foreign cost at 12 % discount				= K 275/mt		0.12	

1. Conversion factor of .75 used to eliminate taxes etc under investment.
2. Conversion factor of .9 used to eliminate taxes under variable cost.

Table:13. Comparative and Competitive Advantage: Single Crop model K '000
Discount Rate 12 %

1. Market prices DRC/US \$	=	$(273/(612 - (327/0.98)))$	=	0.98
2. Shadow prices DRC/US \$	=	$(166/(612 - (275/0.98)))$	=	0.50
3. Competitive advantage(*)	=	$(0.98/0.98)$		1.00
4. Comparative advantage(*)	=	$(0.5/0.98)$		0.51

* A value less than 1.0 indicates advantage.

1. Official exchange rate K 0.98 per US \$
2. Shadow exchange rate K 0.98 per US \$
3. FOB Price of rice K 600/mt = US \$ 612

Table: 14.A. COST OF PRODCUTION ESTIMATE OF RICE IN MARKET PRICE CONSTANT K '000 1993
200 Ha Double crop

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
420.00	116.00	7.40	180.00	723.40	385.70	(337.70)	1,200.00
	116.00	7.40	180.00	303.40	385.70	82.30	1,200.00
	116.00	7.40	180.00	303.40	385.70	82.30	1,200.00
	116.00	7.40	180.00	303.40	385.70	82.30	1,200.00
	116.00	7.40	180.00	303.40	385.70	82.30	1,200.00
	116.00	7.40	180.00	303.40	385.70	82.30	1,200.00
	116.00	7.40	180.00	303.40	385.70	82.30	1,200.00

Cost of production at 12 % discount rate = K 487/mt 0.12

Table:14.B. Domestic resource cost – market price– at 12 % discount rate: K '000

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
75.00	52.00	7.40	120.00	254.40	194.04	(60.36)	1,200.00
	52.00	7.40	120.00	179.40	194.04	14.64	1,200.00
	52.00	7.40	120.00	179.40	194.04	14.64	1,200.00
	52.00	7.40	120.00	179.40	194.04	14.64	1,200.00
	52.00	7.40	120.00	179.40	194.04	14.64	1,200.00
	52.00	7.40	120.00	179.40	194.04	14.64	1,200.00
	52.00	7.40	120.00	179.40	194.04	14.64	1,200.00

Domestic resource cost – at 12 % discount rate = K 245/mt 0.12

Table: 14.C. Foreign cost – market price at 12 % discount rate: K '000

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
345.00	64.00	0.00	60.00	469.00	191.66	(277.34)	1,200.00
	64.00	0.00	60.00	124.00	191.66	67.66	1,200.00
	64.00	0.00	60.00	124.00	191.66	67.66	1,200.00
	64.00	0.00	60.00	124.00	191.66	67.66	1,200.00
	64.00	0.00	60.00	124.00	191.66	67.66	1,200.00
	64.00	0.00	60.00	124.00	191.66	67.66	1,200.00
	64.00	0.00	60.00	124.00	191.66	67.66	1,200.00

Foreign cost at 12 % discount = K 242/mt 0.12

Table: 15.A. Domestic resource cost – shadow price – at 12 % discount rate: K '000

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
37.50	31.20	6.66	72.00	147.36	117.22	(30.14)	1,200.00
	31.20	6.66	72.00	109.86	117.22	7.36	1,200.00
	31.20	6.66	72.00	109.86	117.22	7.36	1,200.00
	31.20	6.66	72.00	109.86	117.22	7.36	1,200.00
	31.20	6.66	72.00	109.86	117.22	7.36	1,200.00
	31.20	6.66	72.00	109.86	117.22	7.36	1,200.00
	31.20	6.66	72.00	109.86	117.22	7.36	1,200.00

Domestic resource cost – shadow price at 12 % discount = K 148/mt 0.12

Notes: (Domestic resource cost at market price is converted)

1. Investment cost converted at 50 % to eliminate taxes etc.

2. Variable cost being wages shadow wage rate of 60 % used.

3. Fixed cost converted at SCF of 0.9 %.

4. Processing cost mostly wages so shadow wage rate of 60 % used.

Table: 15.B. Foreign cost – shadow price at 12 % discount rate: K '000

Investment Cost	Variable Cost	Fixed Cost	Milling & selling	Total	Gross Returns	Net Benefits	Tonnage (m.t)
258.75	57.60	0.00	60.00	376.35	168.70	(207.65)	1,200.00
	57.60	0.00	60.00	117.60	168.70	51.10	1,200.00
	57.60	0.00	60.00	117.60	168.70	51.10	1,200.00
	57.60	0.00	60.00	117.60	168.70	51.10	1,200.00
	57.60	0.00	60.00	117.60	168.70	51.10	1,200.00
	57.60	0.00	60.00	117.60	168.70	51.10	1,200.00
	57.60	0.00	60.00	117.60	168.70	51.10	1,200.00

Foreign cost at 12 % discount = K 213/mt 0.12

1. Conversion factor of .75 used to eliminate taxes etc under investment.

2. Conversion factor of .9 used to eliminate taxes under variable cost.

Table: 15.C. Comparative and Competitive Advantage: 200 Ha double crop K '000
Discount Rate 12 %

1. Market prices DRC/US \$ =	(245/(612-(242/0.98)) =	0.67
2. Shadow prices DRC/US \$ =	(148/(612-(213/0.98))) =	0.38
3. Competitive advantage(*) =	(0.67/0.98)	0.68
4. Comparative advantage(*) =	(0.38/0.98)	0.39

* A value less than 1.0 indicates advantage.

1. Official exchange rate K 0.98 per US \$

2. Shadow exchange rate K 0.98 per US \$

3. FOB Price of rice K 600/mt = US \$ 612/mt