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LIBERIA

# Liberian Rice Policy:
# Rice Self-Sufficiency Versus Rice Security

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OVERVIEW

# Liberian Rice Policy: Rice Self-Sufficiency Versus Rice Security

by
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Rice is the focal point of Liberian agriculture. It is the major crop of traditional agricultural producers and is the main staple of the Liberian diet. Despite rice being the major product of traditional Liberian agriculture, the country is not currently self-sufficient in rice. Approximately one-third of all rice consumed in the country in 1983 and 1984 was imported. Liberia's agricultural sector in total, however, is self-sufficient in the sense that it has a positive net balance of trade. Major agricultural exports include rubber, forest products, palm products, coffee, and cocoa.

The achievement of rice self-sufficiency in Liberia must be viewed as a long-term effort. Its achievement in the next few years is not possible without drastic policy actions. The policy alternatives considered in this paper for short-term achievement of rice self-sufficiency all proved to either be extremely costly or result in large food cost escalations, or both. Until Liberia achieves rice self-sufficiency there exists a strong need for "rice security." Rice shortages and rice price instability can generate considerable social and political hardships for the country of Liberia given the importance of rice in the Liberian diet and economy. This paper has examined policies which can be immediately undertaken by Liberia to achieve

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"rice security" within a year. Rice security, as defined here, means that adequate rice reserves would be held by the government to guarantee that demand for rice could be filled in any foreseeable future production and price situation. In the rice security program described within this paper a rice reserve stock program is presented which would guarantee adequate rice supplies in 99 out of 100 years. Even in the year when reserves were not adequate, the shortfall amounts to less than 10 percent of normal consumption.

The rice reserve stock/security program proposed and analyzed in this paper is envisioned to be conducted by the Liberian Produce and Marketing Corporation (LPMC) as an added responsibility to its current coffee, cocoa and rice price support operations. The program in essence relies on the world market to serve as the main form of rice reserves, but gives Liberia the guaranteed financial security to always be able to buy the rice it needs on the world market. The program is envisioned to operate as follows. LPMC would maintain a specified level of rice stocks. The stocks would be purchased with surplus revenue during years of positive cash flows. Rice import tax levels and coffee and cocoa processing profit margins required to finance these purchases are estimated in the analysis. The estimates made indicate that current profit margins on coffee and cocoa plus a rice import tax of three to five cents per pound would be adequate to finance the program. As long as c.i.f. rice import prices plus any import taxes remained below Monrovian wholesale rice prices, no reserve stocks would need to be used. Under such circumstances adequate profit incentives would exist to cause commercial rice importers to import adequate rice supplies. However, when world rice prices rise to the extent that c.i.f. prices plus taxes exceed Monrovia wholesale rice prices, commercial imports will cease and rice shortages will occur. Under such circumstances and with the rice security

program, stored rice stocks would be used to subsidize rice imports. The objective of the subsidy is to make rice importation profitable and hence create the incentive for commercial importers to import sufficient rice to fulfill the existing demand. For example, if the c.i.f. price plus any import tax was 10 percent above the Monrovia wholesale rice price, importers would be given one pound of reserve rice for each ten pounds of rice imported, thus effectively reducing the import cost per pound by 10 percent and generating a normal profit situation for importers. In subsequent years when world rice prices declined, subsidies would not be needed and reserve stocks could be rebuilt.

The same type of reserve/import subsidy program could also be conducted using a cash reserve rather than a rice reserve. Such a program has the advantage of being cheaper since no storage cost exists; in fact, interest can be earned on the reserve fund. However, a cash reserve has the disadvantage of being more subject to political intervention to use the cash reserve fund to meet other governmental financial obligations in times of budget crises.

Analysis of the above reserve stock rice security program leads to the conclusion that Liberia can obtain rice security with approximately $20 to $25 million of cash reserves or 45 to 50 thousand tons of rice reserves, depending on the rice import tax rate assessed and the rice support price maintained. Excluding administrative cost and initial funding of $20 to $25 million, the annual average cost of a cash reserve security system would be roughly $50 thousand per year. Annual net costs for a rice stock security system would be higher, at about $3.7 million per year. Both the cash and stock security programs were estimated to be capable of being more than self-supporting. In fact the cash reserve security program, given the LPMC policies assumed, would have a profit or excess cash flow of about $10 million per year which could be

returned to the government. The rice stock reserves form of the program would return an average of about $5 million per year to the government.

The magnitude of the cash or rice reserves required to operate the security program can be reduced in several ways. First, the higher the import tax the lower the reserve needed. Higher import taxes generate more year to year liquidity in the LPMC budget and hence increase its ability to deal with shortfalls out of current operating capital. In addition, larger annual net revenue flows allow reserves to be built back faster, thus leaving reserves at vulnerable low levels for less time. Secondly, lowering the paddy rice support price reduces the amount of reserves needed. The current paddy rice support and milling activities of LPMC operate at a net loss. Reducing the support price cuts losses in this program by reducing the price paid for marketed surplus rice and by reducing the typical amount of marketed surplus to be purchased. Reducing the support price for rice increases LPMC's net income and reduces the volatility of LPMC's net income. Both of these effects help reduce the amount of cash or stock reserves necessary to provide rice security.

Over the past several years Liberia has annually received 40 to 50 thousand tons of United States P.L. 480 rice imports. The rice security programs discussed to this point have not considered the use of P.L. 480 stocks or funds to assist the rice security fund, with the exception that import taxes are assumed to be collected on P.L. 480 rice imports. However, the magnitude of P.L. 480 rice imports to Liberia are strikingly similar in size to the magnitude of rice reserve stocks estimated to be needed for a rice security program. If P.L. 480 imports and/or the funds raised from their sale were to be given first priority for use in the rice security program, the size of rice stock or cash reserves needed for the security program would be

reduced to nearly zero. Assuming 45 thousand tons of P.L. 480 rice was given first priority for use in the rice security program, estimates made in this study indicated only two to three thousand tons of rice stock reserves or about $1 million of cash reserves would be needed. Net annual costs of the rice security program under such a system would be less than $50 thousand per year for a cash reserve and about $400 thousand for a stock reserve program. Hence, nearly all funds from the P.L. 480 program would over time continue to be passed on to other activities, but in a rather volatile manner. LPMC's average net income, including income from the sale of P.L. 480 rice, would be about $21 million per year, but with a standard deviation of approximately $8 million per year. Hence, P.L. 480 funds could be expected to be passed on to the government with about the same volatility.

The alternatives presented in this paper for achieving rice security appear to be obtainable by the government of Liberia within one to two years. Furthermore, their costs are reasonable and much less than those associated with obtaining rice self-sufficiency. While rice security may not be as socially and politically attractive as rice self-sufficiency, it appears to be a good low-cost, short-run substitute for rice self-sufficiency.

# Liberian Rice Policy: Rice Self-Sufficiency Versus Rice Security

## Introduction

Rice is the food staple of Liberian agriculture. It is the major crop of [illegible] agricultural producers and is the main staple of the Liberian [illegible] Despite rice being the major product of traditional Liberian [illegible] the country is not currently self-sufficient in rice. [illegible] one-third of all rice consumed in the country in 1983 and 1984 [illegible] Liberia's agricultural sector in total, however, is [illegible] in the sense that it has a positive net balance of trade. [illegible] agricultural exports include rubber, forest products, palm products, [illegible]

[illegible] the world market to provide one-third of the major staple [illegible] of the Liberian diet has troubled the Liberian government. For [illegible] the Liberian government has had the stated objective of making [illegible] self-sufficient in rice. To this end several policy actions have been [illegible] swamp rice production has been subsidized; retail prices have [illegible] generally set at a level above the world market; rice [illegible] agricultural research and extension efforts have been [illegible] and provide high yielding rice varieties to producers; [illegible] programs have helped facilitate expanded swamp rice production [illegible] marketing of rice has been facilitated with the construction of [illegible] supported rice collection centers and mills in the rice producing [illegible]

[illegible] policies and programs have also had an influence on Liberia's rice [illegible] approximately one-half of Liberia's rice imports in 1983 were through [illegible] food aid program.

## Purpose

The purpose of this paper is to analyze selected policy alternatives for coping with the problem of non-self-sufficiency in rice production in Liberia. To do this two analytical models will be employed together with Liberian agricultural data for the past thirty years. The models used include the Liberian Agricultural Policy Analysis Model (LAPA), and a Monte Carlo Trade Simulator (MCTS). Both of these models are operable on microcomputers and can be operated without the aid of a programmer.

The LAPA model is an econometric model of the Liberian Agricultural Sector. It consists of supply and demand equations for nine categories of agricultural commodities including rice, cassava, palm oil, vegetables, spices, coffee, cocoa, meat and other crops. The model also considers imports and exports for these commodities. Consumption of the commodities modeled is broken into rural and urban categories. The core of the model is a set of three elasticity matrices, one each for rural demand, urban demand, and supply. These matrices, when coupled with a base set of prices and quantities, can be used to estimate the impact of any price or quantity change upon the supply and demand of all other commodities represented in the model. The model is particularly designed to estimate the impact of changes in rice prices at the farm level and retail level.

The MCTS model is a simulation model designed to estimate the amount of variation in the net trade balance for rice, coffee, and cocoa. These three commodities comprise the major portion of agricultural product trade for Liberia's traditional agricultural sector. Furthermore, trade in these commodities is conducted by the Liberian Produce and Marketing Corporation (LPMC). Therefore, trade of these commodities should be readily controllable through government policy. The TCTS model is capable of determining the net

trade balance and expected variation in the trade balance under alternative price conditions and production levels for the three commodities. The major use of the MCTS model here will be to explore the level of financial or stock reserves required to assure adequate rice supplies under alternative world market conditions and Liberian agricultural policies.

The approach taken in this paper will be to first explore selected alternative rice support prices and taxation policies that could lead to self-sufficiency in rice production. Secondly the trade stability implications of these policies will be explored. As an alternative to rice self-sufficiency and/or as a contingency plan until rice self-sufficiency is achieved, the requirements for obtaining assured adequate rice supplies through trade and stock or financial reserves will be explored. Such a plan would in essence achieve "rice security" rather than rice self-sufficiency.

## The Impact of Alternative Crop Taxes and Subsidies

The government policy of Liberia is currently to tax the export of tree crops and subsidize the production of rice. The ultimate objective of these and other policies is to make Liberia self-sufficient in rice. In 1983 Liberia consumed an estimated 253.6 thousand metric tons of rice. Imports made up 86.5 thousand metric tons of this consumption, or approximately 34 percent of all rice consumed. Commercial imports of rice amounted to only 34 thousand tons, or about 13 percent of total consumption. United States AID imports totaled to approximately 40 thousand metric tons. The remaining 12.5 thousand tons of rice imports were by concessions.

### Policies to Achieve Rice Self-Sufficiency

Perhaps the first question to be asked is how much subsidization of rice production would be required to achieve self-sufficiency. Raising rice

prices in general has a two-edged effect, it encourages production and discourages consumption. In 1983 paddy rice prices received by producers were set at 18 cents per pound when delivered to LPMC delivery sites by licensed buyers, while retail prices for cleaned rice were set at 24 cents per pound. In contrast the world price for comparable quality cleaned rice was approximately 17 cents per pound.

Increased subsidization of rice production does not in itself appear to be a feasible way to achieve self-sufficiency in rice production. Although the LAPA model is not specifically designed to estimate the impact of large, long-run policy changes, it is capable of giving an approximate estimate of the producer response to changes in the price they receive for rice. The model indicates that doubling the rice price received by farmers to 36 cents per pound paddy would only bring about 20 thousand metric tons of additional rice production. This increase would be at the expense of reduced cassava, vegetable, coffee, and cocoa production. Additional problems associated with raising producer prices would be the development of dependency upon neighboring country rice imports. Without strict control of the borders, rice would be imported from neighboring countries and sold by producers in Liberia as Liberian rice. Indeed, this likely already is the case to some degree with the current price support program and free trade policy.

Raising the retail price of rice and thus economically rationing rice is another alternative to assist in obtaining self-sufficiency. However, this alternative has obvious serious political and humanitarian problems. Rice is the dominate food in most Liberian diets. Raising its price would create substantial financial pressures for many consumers. For investigative sake the LAPA model can be used to estimate the approximate magnitude of increase in retail prices that would result in rice comsumption begin rationed back

to self-sufficiency levels. The estimate obtained is that rice prices would have to increase to about 28 or 29 cents per pound to eliminate commercial rice imports, i.e. to reduce consumption by approximately 34 thousand metric tons. Rationing rice consumption enough also to eliminate AID rice imports would require raising the retail price of rice to approximately 38 cents per pound.

Neither of the preceding price policy alternatives (producer price subsidies or consumer price escalation) appear feasible. A third alternative for achieving rice self-sufficiency is to improve rice yields. To achieve rice self-sufficiency through improved yields would require a percentage increase in yield roughly equal to the percentage of rice consumption that is imported, i.e. 13 percent to eliminate commercial imports, and 34 percent to eliminate all imports. This assumes constant rice acreage. Most likely rice acreage would decrease as yields rose if economic incentives were not offered to motivate production beyond rural self-sufficiency. Current tests being conducted with improved varieties of rice appear to be capable of generating a 13 percent yield increase, but not a 34 percent increase.

All of the above analysis have not factored in the need to increase rice supplies by at least the population growth rate in order to maintain the current level of self-sufficiency in rice production. As the need for rice increases with population growth, rice acreage must expand if yields do not increase. Expansion of rice acreage will likely reduce rice yield due to poorer quality of land being used and/or the fallow period for land being shortened. The above analysis also does not address the need for at least some reserves of rice to protect against variations in production due to weather, disease, and insect problems.

Taken individually it appears impossible to rely upon producer subsidies, retail price rationing, or yield improvement to achieve rice self-sufficiency. Combined together these three elements may provide a workable method of achieving rice self-sufficiency. First assume that improvements in rice yields will exceed the population growth rate by 5 percent per year. Secondly assume retail prices can be raised by no more than 2 cents. In this case the LAPA model indicates producer price incentives would have to be raised to 24 cents per pound to eliminate the need for commercial imports. To eliminate the need for AID imports, producer prices would have to more than double. Such an increase in producer prices appears impossible to undertake.

An alternative combination policy approach to take may be to start by setting paddy rice prices at twice the current official LPMC price for paddy rice, i.e. at 36 cents per pound. Again assume rice yield improvement exceeds population growth by 5 percent. The LAPA model estimates that in this case a retail price of 25 cents would eliminate the need for commercial imports, and a retail price of 32 cents would eliminate the need for AID imports also.

None of the above alternatives for achieving rice self-sufficiency appear particularly desirable. Raising producer prices through subsidies would be extremely costly and would jeopardize the production of other crops. It also would likely lead to imports from neighboring countries which enjoy free trade relations with Liberia. Raising the retail price of rice effectively rations rice, but basically defeats the fundamental purpose of having a self-sufficiency program. Rice supplies would not be ample to fulfill dietary needs without extreme financial difficulty for many Liberians. The alternative of improving yields by more than 5 percent a year is attractive, but likely not realistic. Yield improvement is a slow and unpredictable process which is not without its limits.

## Alternatives to Rice Self-Sufficiency

Undoubtedly there are more creative ways to work toward achieving rice self-sufficiency than those discussed in the previous section. The LAPA model could also be used to consider numerous other combinations of the type reviewed above. However, the task of achieving rice self-sufficiency under any approach will likely not be easy. The alternative to self-sufficiency in rice is reliance on the world market for imports of rice and the development of a "rice security" program. Relying on the world market for a major portion of one's staple food supply has some undesirable traits. Foremost may be the insecurity such reliance creates if international instability and political relations should shut-off normal world trade channels. Secondly, the need arises to have adequate export flows to maintain foreign exchange balances with which to purchase imports. Thirdly, normal variation in the world price of rice is substantial and could create wide variations in the export revenue or financial reserves needed to finance required rice imports.

There are likely other adverse affects to be alleviated by self-sufficiency, but the focus of this analysis is upon the export revenue requirements and trade instability generated by reliance upon rice imports. The elimination of these factors as a problem with trade reliance would likely reduce the need for self-sufficiency. The question to be raised here is can the objective of making rice import reliance socially and politically tolerable be achieved at a lower cost than rice self-sufficiency? Additionally, what steps, if any, can be taken immediately to provide rice security to the citizens of Liberia while the objective of rice self-sufficiency is being sought?

The focus of the analysis will be upon trade in rice, coffee, and cocoa. The trade of all three of these commodities is currently under the control of

LPMC. Hence, government policy for these three commodities can readily be administered through this agency to deal with the problem of rice trade instability.

To begin with, this analysis will attempt to quantify the past and expected future volatility of export revenue for coffee and cocoa, and import costs for rice. Of prime importance here is the volatility of the net balance of trade for these products. Can LPMC be operated in a manner such that the export revenue from coffee and cocoa can be reliably expected to cover the import costs of rice under any foreseeable world market conditions and Liberian production conditions? This question will be addressed in the remaining portions of this paper.

## Estimation of the Sources of Variation in the Net Trade Balance

Variation in the net trade balance for rice, coffee, and cocoa is derived primarily from variation in export/import prices for these three commodities and variation in the quantities of the commodities traded. To accurately estimate the sources of variation in the trade balance for these three commodities, estimates must first be made of the expected variance in each commodity's price and traded quantity. In addition, any correlation in the variation of the prices or traded quantities of rice, coffee, and cocoa should be considered. For example, it is logical to expect that the variation in quantities of coffee and cocoa available for export might be correlated. Both crops are tree crops and are produced in close proximity to each other. Hence, growing conditions would likely be similar for both crops.

The variances and covariances used in this study were estimated from Liberian export/import data and price data available in the "Liberian Statistical Handbook" for the years 1954 to 1976. To determine the variance

and covariance of quantities of rice, coffee, and cocoa traded, the export/import quantities for these commodities were first regressed against time and their own price. This removed variation due to price response and trend growth. The variation that remains is largely due to unexpected year to year changes in factors such as weather, disease, etc. The equations obtained are as follows where the values in parenthesis below the parameters are t-values.

$$\text{(1) Coffee Exports} = -36{,}838 - \underset{(-.37)}{42.211*Pcf} + \underset{(5.14)}{711.214*T} \qquad R^2 = .59$$

$$\text{(2) Cocoa Exports} = -15{,}025 + \underset{(1.95)}{36.419*Pco} + \underset{(9.42)}{269.205*T} \qquad R^2 = .85$$

$$\text{(3) Rice Imports} = -285{,}256 - \underset{(-2.88)}{387.61*Pr} + \underset{(8.36)}{5{,}984.64*T} \qquad R^2 = .83$$

where

Pcf = price of coffee (cents/lb.)
Pco = price of cocoa (cents/lb.)
Pr = price of rice (cents/lb.)
T = a time trend variable 1958=58

All export and import quantities are in thousands of pounds. The price variable parameter in the coffee equation was not statistically significant, nor did it have the expected sign. Because of this the above coffee export equation was not used. Instead, a simple time trend equation for coffee exports was used. The estimated coffee time trend equation appears as follows:

$$\text{(4) Coffee Exports} = -37{,}242 + \underset{(5.34)}{697.785*T} \qquad R^2 = .59$$

The variance/covariance matrix for the residuals of equations (3), (4), and (5) appears below. A quick examination of the matrix in Table 1 indicates that coffee export quantities are much more volatile than cocoa exports and rice imports. This does not appear to be due to a different equation form

being used for coffee, but is due to actual greater volatility in the coffee export data series. The standard deviations of coffee exports, cocoa exports, and rice imports as a percent of their mean values (i.e. coefficients of variation) are 52.5, 25.5, and 20.7 percent respectively. Observation of the variance/covariance matrix also shows that all three quantity series have positive covariances.

Table 1. Export/Import Quantity Variance/Covariance Matrix 1954-1976 (Variance due to trend and price removed).

| | Coffee | Cocoa | Rice |
|---|---|---|---|
| | ----------thousands of pounds---------- | | |
| Coffee | 13,760,055 | 398,099 | 24,663,521 |
| Cocoa | | 583,608 | 647,018 |
| Rice | | | 180,829,962 |

A variance/covariance matrix similar to that reported in Table 1 was also estimated for rice, coffee, and cocoa prices. The price series used were also from the "Liberian Statistical Handbook" for the years 1954 to 1976. Before calculating the variance/covariance relationships between the price series, each series was "detrended" with a time trend equation. This removed all variation due to general inflation and other trended variation. The variance/covariance matrix obtained from the detrended price data is reported below.

Table 2. Export/Import Price Variance/ Covariance Matrix 1956-1976 (Variance due to trend removed).

| | Coffee | Cocoa | Rice |
|---|---|---|---|
| | -------cents per pound-------- | | |
| Coffee | 55.477 | 48.219 | 10.114 |
| Cocoa | | 88.432 | 16.152 |
| Rice | | | 5.254 |

The price volatility of all three commodities is approximately the same in terms of the standard deviation as a percent of the average price. The standard deviations of coffee, cocoa, and rice prices as a percent of their mean values (i.e. coefficients of variation) are 25.01, 36.68, and 30.42 percent respectively. All covariances between the price series are positive implying all three price series tend to randomly vary above or below their long-run trends together.

## Simulation of the Variation of the Net Trade Balance

Given estimates of the variance/covariance matrices for price and quantity variation in rice, coffee, and cocoa trade, the variation of the net balance of trade for these three commodities can be simulated. In addition, the simulation procedure can be used to examine the effect of changing trade levels or price volatility for any of the three commodities, thus allowing analysis of the impact of policies designed to change any of these factors.

Simulation of the variation in the balance of trade is achieved by using a random number generator and procedure for correlating random events. The random event correlation procedure is used to simulate the covariances present between the price and quantity series. The procedure used is described by Clements, et al., and Naylor et al. Nearly all computers have the capability of generating a series of uniformly distributed random numbers between zero and one. This series can then be transformed into any distribution desire by using either the density function or cumulative distribution for the desired distribution (see Naylor, et al.). It was assumed here that the distributions in question followed a normal distribution with means and variances equal to those estimated from the data series available from 1954 to 1976.

To estimate the variation in the net trade balance for Liberian rice, coffee, and cocoa, a procedure known as Monte Carlo Simulation was used. This procedure consists of repeatedly generating sets of random import/export prices and quantities and then calculating the trade balance implied by them and saving the results. After a large number of such calculations have been made the mean, variance, and minimum and maximum value of the simulated net trade balance values are calculated. The calculated values represent estimates of the expected volatility of the net trade balance.

The advantage of this approach is that complex interactions between the data series generating the variable in question can be separated and considered. Such interactions would be nearly impossible to quantify and solve for mathematically.

The sequence of steps employed in the Monte Carlo Simulation used here is as follows:

(a) Random, but correlated prices for rice, coffee, and cocoa are generated.

(b) The prices generated are used in conjunction with equations (2), (3), and (4) to generate expected import/export quantities of rice, coffee, and cocoa.

(c) Random, but correlated, variations in the expected quantities of rice, coffee, and cocoa are calculated and added to the expected export values for rice, coffee, and cocoa.

(d) The net trade balance implied by the price and quantities simulated is calculated.

(e) Steps (a) through (d) are repeated for one hundred or more times with the results of each simulation saved. The mean, variances, minimum, and maximum values of the data series generated are then calculated and summarized.

The procedures for steps (a) through (c) are further explained in Clements, et al., and Naylor, et al.

## Simulation Results and Assumptions for 1983 Conditions

The first simulation to be considered was that of the current (1983) situations. The assumed 1983 situation is summarized in Table 3. Reviewing Table 3 the quantities and prices assumed are relatively self explanatory with the exception perhaps of the Marketed Surplus figure. Marketed Surplus is assumed to be the difference between production and rural consumption. All rice falling in the Marketed Surplus category is assumed to be purchased by LPMC for 18 cents per pound of paddy or approximately 29.5 cents per pound cleaned, assuming a conversion rate of .61 (.61 is the average of the reported range of conversion rates from .55 to .67).

Table 3. Summary of 1983 Market and LPMC Policies for Rice, Coffee, and Cocoa.

| | Quantities and Prices | | |
|---|---|---|---|
| | Cleaned Rice (1000 tons) | Price (cents/lb.) | Expected Value (million $) |
| Coffee Exports | 10.0 | 1.060 | 23.36 |
| Cocoa Exports | 10.0 | .780 | 17.19 |
| Rice Imports | 86.5 | .167 | 31.84 |
| Expected Rice Production | 167.3 | --- | --- |
| Expected Rice Consumption | 253.8 | .240 | 134.25 |
| Expected Rural Rice Consumption | 154.7 | .240 | 81.83 |
| Expected Rice Marketed Surplus | 12.6 | .295 | 8.18 |

Taxes and LPMC Costs and Policies

LPMC Profit Margin on Coffee and Cocoa of 10 Percent
Rice Import Tax - One Cent Per Pound
LPMC Rice Processing and Storage Cost - 9 to 12 cents/lb.
LPMC Cleaned/Paddy Conversion Rate - .55 to .67 percent
LPMC Sells All Cleaned Rice at Wholesale for 22 cents/lb.

| | Expected Value (million $) |
|---|---|
| Expected LPMC Net Revenue from Coffee | 2.33 |
| Expected LPMC Net Revenue from Cocoa | 1.72 |
| Expected LPMC Rice Tax Collection | 1.88 |
| Expected LPMC Rice Processing and Storage Cost | 2.96 |
| Expected LPMC Rice Purchase Costs | 8.19 |
| Expected LPMC Rice Sales (22 cents/lb.) | 6.11 |
| Expected LPMC Net Revenue | .89 |

The assumption made concerning LPMC's operating cost and policies are listed in the second part of Table 3. LPMC is assumed to price its purchases of coffee and cocoa such that a 10 percent profit can be made. It was assumed that the tax collection rate on rice was one cent per pound for all rice imported. Processing and storage costs for rice purchased by LPMC are difficult to determine and have not been reported in any literature reviewed.

Hence, an estimated cost of 9 to 12 cents per pound was assumed and the average of that range, 10.5 cents, was generally used. Likewise, the milling efficiency for LPMC milling of rice was also assumed to be the average of the range of conversion rates reported, i.e. .61, which is the average of .55 and .67. LPMC was assumed to sell all cleaned rice at a wholesale price of 22 cents per pound.

Given the listed assumptions about costs and prices, LPMC's revenues and costs from its coffee, cocoa, and rice activities can be estimated. This has been done in the lower portion of Table 3. With these assumed values and conditions, LPMC is expected to have an average net revenue of $890 thousand on its coffee, cocoa, and rice activities.

Table 3 reflects the expected values for 1983. These expected values can be used in conjunction with the Monte Carlo Trade Simulation model to determine the variance of the trade balance and the variance of LPMC's net revenue balance. In doing this the Monte Carlo Trade model is used to generate random values for world coffee, cocoa, and rice prices as well as random values for the quantities of Liberian coffee and cocoa exported and rice imported to Liberia. Domestic prices are assumed to be controlled and non-random. Domestic consumption is also assumed to be known and non-random. Because consumption is assumed to be known, Liberian rice production can be defined by identity as consumption minus imports. Since imports are random, use of this identity results in random production values. This in turn yields random values for marketed surplus which is defined as production minus rural consumption. In some cases the values generated for marketed surplus may become negative because of the smallness of the production value generated, i.e. in about one out of ten cases. In such cases the model assumes marketed surplus to be equal to zero. This implies that some of the rice imports are used to fulfill rural consumption.

The results of the Monte Carlo Trade Simulation for 1983 conditions are presented in Tables 4 and 5. Table 4 presents the Trade Balance estimates. Coffee and cocoa export revenues were expected to be $40,301 thousand. The simulated average export revenue of $40,028 thousand was calculated from 500 simulation runs. The closeness of the simulated average to the expected value verifies the correctness of the simulation process. The standard deviation of the simulated average export revenue was $117,239 thousand, or 43 percent of the average value. The maximum export revenue earned was nearly three times the average export revenue while the minimum export revenue value was about 12 percent of the average. Hence, considerable export revenue volatility is indicated to exist.

Table 4. Simulated 1983 Rice, Coffee, and Cocoa Trade Balance and Variation.

| | |
|---|---|
| Exports (Coffee and Cocoa - $1,000) | |
| Expected Revenue | 40,301 |
| Simulated Average Revenue | 40,028 |
| Standard Deviation of Revenue | 17,239 |
| Maximum Revenue | 114,705 |
| Minimum Revenue | 4,859 |
| Imports (Rice - $1,000) | |
| Expected Cost | 31,467 |
| Simulated Average Cost | 31,004 |
| Standard Deviation of Cost | 12,335 |
| Maximum Cost | 84,404 |
| Minimum Cost | 3,887 |
| Trade Balance ($1,000) | |
| Expected Balance | 8,834 |
| Simulated Average Balance | 9,024 |
| Standard Deviation of Balance | 13,755 |
| Maximum Balance | 49,401 |
| Minimum Balance | -38,689 |

Import cost volatility was slightly less than export revenue volatility. The standard deviation of rice import cost was only 40 percent of the average simulated value. The maximum rice import cost was also about triple the average value.

Given the volatility of both imports and exports, it is logical to expect considerable volatility in the trade balance itself. This is the case. The standard deviation of the trade balance is 150 percent of the simulated average trade balance. The maximum trade balance in the 500 simulations made was five times greater than the average trade balance. Likewise, the minimum trade balance was a deficit balance of $38,689 thousand.

Table 5 presents the expected and estimated variance results for LPMC's net income. The expected net income is the same as that reported in the bottom line of Table 3 and reflects the fact that the conditions assumed in Table 3 are correctly modeled. The result for the simulated average net revenue for the assumed 1983 conditions indicates that in an average year LPMC will have a negative net revenue flow of $-1,167 thousand with a rather large standard deviation of $7,462 thousand. In 49 out of a hundred cases LPMC will have negative net revenue flows.

Table 5. Simulated 1983 LPMC Net Revenue

| | Value ($1,000) |
|---|---|
| Expected Net Revenue | 890 |
| Simulated Average Net Revenue | -1,167 |
| Standard Deviation of Net Revenue | 7,462 |
| Largest Single Deficit | 77,499 |
| Number of Deficits Per 100 Years | 49 |

The simulated average LPMC net revenue is considerably lower than the expected net revenue. This deserves some explanation. The discrepancy comes from the procedure for dealing with simulated negative marketed surpluses of rice and the fact that LPMC loses approximately 18 cents per pound of market surplus rice purchased. This loss in essence amounts to a subsidy for Liberian rice producers. This loss or subsidy is calculated as follows. LPMC purchases paddy rice for 18 cents per pound. This converts to a cleaned rice price of 29.5 cents per pound assuming a 61 percent conversion rate from paddy to cleaned rice. When a 10.5 cent per pound milling and storage charge is added, the cost of cleaned Liberian rice to the LPMC is approximately 40 cents per pound. This rice is assumed to be sold at a wholesale price of 22 cents per pound. This is a loss of 18 cents per pound. The expected volume of market surplus rice purchased by LPMC is 12.6 tons. However, the distribution for the expected volume of marketed surpluses is skewed such that the simulated average is greater than the expected or most frequent value. The skewedness of the distribution results because negative marketed surplus values are not allowed. They are converted to zero values. Thus, the average loss encountered by LPMC in purchasing and processing marketed surplus rice is larger than the expected value reported in Table 3. This in turn causes LPMC's net revenues to be less than expected.

## Policy Adjustments and Buffer Stock Requirements for Rice Security Through Trade

While the 1983 situation yielded a favorable trade balance, it did not yield a favorable LPMC net revenue situation. The financial hardships of LPMC during 1984 reflect and confirm the conditions simulated here. In this section policy adjustments will be considered which would make LPMC self supporting. In addition, LPMC will also be charged with the additional responsibility of assuring rice supplies are adequate to meet demand under all

foreseeable market conditions. Buffer stocks in the form of cash reserves or rice stocks that insure LPMC's financial independence in maintaining its current programs and the rice security program, even in unfavorable years, will be estimated.

Two alternative buffer or reserve options will be considered as methods of obtaining rice security. One option will consider holding rice stock reserves, while the other will consider holding cash reserves. The physical holding of rice reserves has the advantage of holding one's reserves as "in-kind reserves." Such reserves are not as vulnerable to political pressure to be used elsewhere, regardless of their purpose, in times of budgetary pressure. The cash reserve system on the other hand has the advantage of being considerably cheaper to operate since no storage costs are encountered.

Specifically, a cash buffer reserve system would operate as follows. A specified cash reserve level would be maintained by LPMC at all times to the best of LPMC's financial ability. This reserve fund is assumed to earn 10 percent interest income per year. Any earnings by LPMC from interest, rice import taxes, and coffee and cocoa processing in excess of those needed to maintain the specified cash reserve and carry on their other activities would be paid to the government. When LPMC experienced shortfalls in the cash flows needed to carry on any of its programs, including the rice security program, the shortfalls would be covered by the cash reserve fund.

The rice security import program is envisioned to work as follows. As long as Monrovian c.i.f. rice import prices, plus any taxes charged, are below Monrovian wholesale rice prices, it is assumed that commercial rice imports will flow in and fill the gap between domestic production and demand. Should world rice prices rise and cause the c.i.f. rice price plus any taxes to exceed the Monrovia wholesale price, no profits would remain for importers,

hence, rice importation would cease and a rice shortage would occur. In such a case, LPMC would intervene and pay a subsidy to commercial importers equal to the difference between the c.i.f. price plus any taxes and the wholesale price, thus maintaining a normal profit incentive to import rice.

A rice stock reserve program would operate in a similar manner to the cash reserve program, except subsidy payments would be made in terms of rice, not cash. For example, if c.i.f. prices plus taxes were 10 percent above the wholesale price, importers would be given one pound of LPMC reserve rice for each ten pounds of rice imported, thus effectively reducing their import cost by 10 percent. Likewise, if additional funds were needed to carry out any other LPMC functions, rice reserves could be sold at the wholesale price to generate the required funds. It is assumed in this analysis that a rice stock program would encounter storage costs equal to 20 percent of the value of rice in storage.

The objective of the two alternative rice reserve programs outlined above is to achieve rice security through trade. If adequate cash or rice reserves are held, LPMC should never experience any financial liquidity problems. Hence, LPMC should always be able to adequately subsidize commercial imports to a degree that they will import rice to fill the existing demand. The following sections of this paper will report the results of analyses conducted to determine the level of cash or rice reserves needed to maintain LPMC's financial liquidity and the alternative import tax rates and paddy rice support prices needed to guarantee this liquidity.

"Full" Rice Tax Collection

The first policy alternative to be considered is that of "full" rice tax collection. In principle the government of Liberia should be able to charge a

tax equal to the difference between the c.i.f. Monrovia rice import price and the Monrovia wholesale price for rice. Such a tax should continue to generate imports because of the profits which can be generated by wholesaling rice. In practice collecting this tax has been difficult to achieve due to the problem of determining the Monrovia c.i.f. rice import price. As a result only a one cent per pound fixed tax has been effectively collected. Several alternative taxation policies and methods appear worthy of consideration. These are as follows:

(1) Use a formula based variable levy tax. Monrovia c.i.f. rice import prices would be estimated using either Houston, Texas, USA rice prices plus shipping costs, or Bangkok, Thailand rice prices plus shipping costs, whichever is lower. The tax would then be based on the difference between this calculated price and the Monrovia wholesale price, less any margin desired to be given the importer above the profit from wholesaling of rice. The tax could be adjusted continuously as prices changed in Houston or Bangkok, or more practically seasonally or monthly. In the event that Monrovia c.i.f. rice import prices ever exceeded the Monrovia wholesale price, a subsidy would be paid with this system to maintain an incentive to import rice and to prevent the wholesale price from rising.

(2) LPMC could act as a monopoly agent for rice importation. Thus, LPMC would obtain profits (or losses) equal to the difference between the import price and the Monrovia wholesale price for rice.

(3) Import licenses for specified quantities of rice imported within a specified time period could be auctioned to the highest bidder. If a competitive import marketing system exists this should generate nearly as much revenue as a tax equal to the difference between the import price and the Monrovia wholesale price. Again, with this system, if the wholesale price of rice ever rose above the import price, licenses would have to be auctioned for the lowest subsidy to import a specified quantity of rice within a specified time period.

(4) Establish a flat tax equal to approximately 70 percent of the expected long-term difference between the import price for rice and the Monrovia wholesale price for rice. Since the standard deviation in world rice prices is about 30 percent of the detrended rice price, this should result in a profit margin for importers about 84 percent of the time. Under the 1983 price conditions this procedure would have established about a 3.5 to 4 cent tax. This would have more than tripled the rice import tax actually collected in 1983 if imports remained at the same level.

Assuming that the "full" difference between the Monrovia wholesale price for rice and the import price for rice can be collected using a variable levy, the Monte Carlo Trade Simulator was again used to ascertain LPMC's net revenue position. In addition to estimating the expected LPMC net revenue and the variance of this revenue, the Monte Carlo model was expanded to estimate the degree of financial "self-sufficiency" given to LPMC by alternative levels of buffer stocks or cash reserves. The model was also expanded to consider the costs encountered in conducting the rice security program. Price policies and buffer stock programs that would make LPMC relatively self-supporting in this effort are considered. For this analysis all rice imports into Liberia were assumed to be commercial imports. P.L. 480 imports were no longer relied upon. The first policy set to be considered was a continuation of the 1983 and 1984 policies except that it is now assumed that a tax system will be developed that will allow the full difference between the rice import price and Monrovia wholesale price to be collected. Table 6 reports the results of the simulations for alternative stock levels.

Table 6 presents results for holding either cash reserves or rice buffer stocks. The rice buffer stock levels considered are those stock levels that could have been purchased with the cash reserves reported in each column, i.e. $5 million would purchase 13.58 thousand tons of rice at a price of .167 cents per pound. All values in the rice buffer stock portion of Table 6 are reported in terms of rice quantities, except excess cash flows. The revenues and costs reported in terms of rice quantities are determined by converting the reported dollar values into the quantity of rice with an equivalent value at the rice price simulated that year. Since the rice price is random the conversion rate of dollars to rice is not the same from year to year.

Table 6. LPMC Net Revenue Conditions With Alternative Stock Levels and Maximum Import Taxes.

| Alternative Cash Reserves (Million $) | | | | | |
|---|---|---|---|---|---|
| Cash Reserves | 5.000 | 10.000 | 15.000 | 20.000 | 25.000 |
| Simulated Rev. from Coffee, Cocoa, Rice Taxes and Interest on Reserves | 14.051 | 14.454 | 14.898 | 15.383 | 15.885 |
| Domestic Rice Program Costs | 6.230 | 6.230 | 6.230 | 6.230 | 6.230 |
| Interest Income | .343 | .754 | 1.190 | 1.675 | 2.177 |
| Simulated Average LPMC Net Revenue | 7.821 | 8.224 | 8.668 | 9.153 | 9.655 |
| Standard Deviation of Net Revenue | 12.025 | 12.137 | 12.219 | 12.258 | 12.272 |
| Average Excess Cash Flow | 6.538 | 7.449 | 8.278 | 8.916 | 9.559 |
| Largest Cumulative Deficit | 41.857 | 36.357 | 30.857 | 24.913 | 19.431 |
| Number of Deficits Per 100 Years | 26 | 16 | 9 | 3 | 1 |
| **Alternative Rice Stock Reserves (1,000 tons) (All values except excess funds are in terms of rice quantities.)** | | | | | |
| Stock Reserves | 13.58 | 27.17 | 40.75 | 54.34 | 67.92 |
| Revenue from Coffee, Cocoa, and Rice Taxes | 46.91 | 46.91 | 46.91 | 46.91 | 46.91 |
| Domestic Rice Program Costs | 18.47 | 18.47 | 18.47 | 18.47 | 18.47 |
| Storage Cost | 2.02 | 4.45 | 7.03 | 9.77 | 12.46 |
| Simulated Average LPMC Net Stocks | 26.42 | 2[illegible].43 | 21.41 | 18.67 | 15.98 |
| Standard Deviation of Net Stocks | 42.06 | 41.67 | 41.48 | 41.36 | 41.16 |
| Average Excess Cash Flow | 6.538 | 7.449 | 5.491 | 4.784 | 4.056 |
| Largest Cumulative Stock Deficit | 119.3 | 111.7 | 100.8 | 95.3 | 90.7 |
| Number of Stock Deficits Per 100 Years | 20 | 12 | 7 | 3 | 2 |

A quick review of the figures in Table 6 indicates that charging a "full" tax equal to the difference between the rice import price and the Monrovia wholesale rice price results in a net overall profit to LPMC of approximately $8 to $10 million per year with a standard deviation of about $12 million per

year. This compares favorably to the negative net revenue flow reported in Table 5 when only a one cent per pound tax was simulated.

While some of the figures in Table 6 are self explanatory, others deserve some definition and discussion. Excess cash flows are assumed to occur in any year when LPMC has a positive net revenue, has no outstanding debts, and holds the specified level of cash or stock reserves. The first priority of LPMC profits is assumed to be that of rebuilding any cash reserve or buffer stock reserves that may have been depleted in previous years. Once this is achieved any debts to the government or other institutions must be paid. Cash remaining after this is termed "excess cash." Excess cash would likely be turned over to the government. Hence, excess cash flow is a cumulative concept and takes into account the payment of any deficits temporarily covered by the government or other institutions. The values under "Largest Cumulative Deficit" and "Number of Deficits Per 100 Years" give some idea of the frequency and magnitude of revenue shortfalls by LPMC and hence, a measure of LPMC's potential reliability as an institutional method for achieving rice self-sufficiency through trade.

Reviewing the alternative cash/stock reserve levels in Table 5 reveals that a reserve level in excess of $20 million or 55 thousand tons of rice are needed to provide a reasonable degree of stability to LPMC's financial independence. This is true despite the relative high average profitability level of LPMC. Of course, if LPMC were allowed to retain all excess cash funds it would soon become quite independent under conditions assumed for developing Table 6. But the purpose of LPMC, or any other government agency formed to conduct the tasks assumed here, is not to be profitable, but to provide a set of services to the people of Liberia at a reasonable cost.

Full Rice Tax and Low Producer Support Prices

An alternative policy to follow in achieving self-sufficiency in rice through trade is to reduce the subsidy given to domestic rice producers and use these funds, if necessary, to help insure the ability to import adequate supplies of rice. Such a policy would increase rather than decrease Liberia's dependence upon the world market. Additional rice imports would be needed. Also the resources no longer drawn to rice production would likely be diverted in part to coffee and cocoa production. In turn, exports of coffee and cocoa would increase. The question to be answered here is, however, would savings rendered from the reduction in subsidization cost more than offset the negative effects of the increased reliance on trade? The Liberian Agricultural Policy Analysis model and Monte Carlo Trade Simulator were used to address this question.

The subsidy reduction considered here was to reduce the rice price paid by LPMC at its collection points from 18 cents to 15 cents per pound. This would reduce LPMC's cost of producing cleaned Liberian rice to approximately 35 cents per pound and cut the loss on each pound of excess market rice from 18 cents to 13 cents, i.e. 35 cents minus the wholesale price of 22 cents. Lowering the producer price for paddy rice would also reduce the expected production and the expected amount of excess market rice. This, of course, would raise the need for imports. Table 7 shows the new expected quantities and LPMC costs and revenues with a 15 cent paddy rice price.

With a 15 cent producer rice price versus an 18 cent producer rice price, rice production is expected to drop from 167.3 thousand tons to 164.5 thousand tons. Total consumption and rural consumption are assumed to remain unchanged since consumer prices have not been altered. Hence, marketed surplus will drop by the same amount as production from 12.6 thousand tons to 9.8 thousand

tons. Rice imports rose to 89.3 thousand tons from 86.5 thousand tons to cover this drop in production and marketed surplus. Coffee exports increased from 10 thousand tons to 10.1 thousand tons. Cocoa exports rose from 10 thousand tons to 10.3 thousand tons.

Table 7. Expected Market and LPMC Conditions With a 15 Cent Paddy Rice Price and Full Rice Import Tax.

| | Quantities and Prices | | |
|---|---|---|---|
| | Cleaned Rice (1,000 tons) | Price (cents/lb.) | Expected Value (million $) |
| Coffee Exports | 10.1 | 1.060 | 23.64 |
| Cocoa Exports | 10.3 | .780 | 17.88 |
| Rice Imports | 86.5 | .167 | 31.84 |
| Expected Rice Production | 164.5 | --- | --- |
| Expected Rice Consumption | 253.8 | .240 | 134.25 |
| Expected Rural Rice Consumption | 154.7 | .240 | 81.83 |
| Expected Rice Marketed Surplus | 9.8 | .246 | 5.31 |

LPMC Costs and Revenues

| | Expected Value |
|---|---|
| Expected LPMC Net Revenue from Coffee | 2.36 |
| Expected LPMC Net Revenue from Cocoa | 1.79 |
| Expected LPMC Rice Tax Collection | 10.10 |
| Expected LPMC Rice Processing and Storage Cost | 2.27 |
| Expected LPMC Rice Purchase Costs | 5.31 |
| Expected LPMC Rice Sales (22 cents/lb.) | 4.75 |
| Expected LPMC Net Revenue | 11.42 |

The above change in production subsidy costs greatly improves LPMC's net revenue situation compared to the 1983 situation, and moderately improves it compared to the full tax/high subsidy case considered in the preceding

section. Coffee and cocoa revenues increase slightly. Rice tax collections increase to $10.1 million, due to an increase in rice imports of 2.8 thousand tons. Expected LPMC rice processing costs and storage cost are cut by nearly a fourth due to a 22 percent drop in expected rice market surpluses. LPMC rice purchase costs are cut by 35 percent, or $1.54 million due to 22 percent less rice being bought at a 17 percent lower price. Hence, overall expected net revenue increases to $11.42 million versus the 1983 expected net revenue of $.89 million and the high subsidy policy expected net revenue of $9.11 million. As previously pointed out, however, the simulated average LPMC net revenues will not be as high as the expected net revenues due to the manner in which negative marketed surpluses are treated. The simulation results for the "low subsidy/full tax" case are presented in Table 8.

The results presented in Table 8 indicate that reducing the subsidy paid to rice producers will reduce the cash or stock reserve LPMC must hold and increase the average excess revenue flow returned to the government. With the assumed reduction in the rice production subsidy level, only two-thirds as much reserve cash or rice stocks have to be held to achieve the same approximate assurance of financial soundness of LPMC, i.e. only about $15-20 million of cash reserves are needed with reduced subsidies, versus $25 million without reduced subsidies.

Table 8. LPMC Net Revenue Conditions With Alternative Stock Levels, Maximum Import Taxes, and 15 Cent Paddy Rice Price

| Alternative Cash Reserves (Million $) | | | | |
|---|---|---|---|---|
| Cash Reserves | 5.000 | 10.000 | 15.000 | 20.000 |
| Simulated Revenue from Coffee, Cocoa, Rice Taxes and Interest on Reserves | 14.773 | 15.236 | 15.725 | 16.223 |
| Domestic Rice Program Costs | 3.810 | 3.810 | 3.810 | 3.810 |
| Interest Income | .420 | .882 | 1.371 | 1.870 |
| Simulated Avg. LPMC Net Revenue | 10.963 | 11.426 | 11.915 | 12.413 |
| Standard Deviation on Net Revenue | 11.034 | 11.102 | 11.128 | 11.137 |
| Average Excess Cash Flow | 10.498 | 11.250 | 11.856 | 12.400 |
| Largest Cumulative Deficit | 21.007 | 16.077 | 10.618 | 5.118 |
| Number of Stock Deficits Per 100 Years | 11 | 5 | 2 | 1 |
| **Alternative Rice Stock Reserves (1,000 tons) (All values except excess funds are in terms of rice quantities.)** | | | | |
| Stock Reserves | 13.58 | 27.17 | 40.75 | 54.34 |
| Simulated Revenue from Coffee, Cocoa, and Rice Taxes | 49.08 | 49.08 | 49.08 | 49.08 |
| Domestic Rice Program Costs | 11.30 | 11.30 | 11.30 | 11.30 |
| Storage Cost | 2.40 | 2.40 | 2.40 | 2.40 |
| Simulated Avg. LPMC Net Stocks | 35.39 | 32.64 | 29.73 | 26.64 |
| Standard Deviation of Net Stocks | 42.69 | 42.62 | 42.72 | 42.93 |
| Average Excess Cash Flow | 9.678 | 9.015 | 8.142 | 7.183 |
| Largest Cumulative Deficit | 61.87 | 49.79 | 38.92 | 28.05 |
| Number of Stock Deficits Per 100 Years | 10 | 3 | 1 | 1 |

First Priority Use of P.L. 480 Rice Stocks

The previous cash/rice reserve analyses ignored the presence of P.L. 480 rice imports. It was assumed that funds from the P.L. 480 program were used elsewhere. Import taxes were assumed, however, to be collected on P.L. 480 imports. This analysis will assume that funds earned from P.L. 480 rice imports will be given first priority for use in the rice security program. If not needed for the program, they will be passed on as has normally been done.

Basing part of the funding for the rice security program on P.L. 480 program revenue may be questionable in that P.L. 480 rice imports are subject to change as U.S. policy changes. Use of the P.L. 480 imports to initially fund the program does, however, seem reasonable. In the event that P.L. 480 import levels change in the future the program could be quickly phased into the self-supporting mode described in the previous sections. As will be seen in this analysis, the use of P.L. 480 funds virtually eliminates the need for any sizeable cash or rice reserve.

The analysis conducted here assumes that 45 thousand tons of P.L. 480 rice will be received annually. Observation of Tables 6 and 8 indicates that this is roughly enough rice to fill the rice reserve requirements, if a 15 cent paddy support price is paid, but not enough if an 18 cent paddy rice support price is paid. However, these analyses do not permit the use of P.L. 480 funds to immediately fill any shortages in reserves. Allowing LPMC to claim P.L. 480 funds as income and pass them on to the government as excess cash flows when possible gives LPMC much more liquidity. This in turn would be hypothesized to reduce the reserves needed. Table 9 presents analyses where all P.L. 480 funds are assumed to be given first priority for use by LPMC. The table also assumes one other policy change from the previous analyses. Rice import taxes are now considered to be only 66 percent of the

Table 9. LPMC Net Revenue Conditions and Rice Security Conditions When P.L. 480 Imports Have First Priority Use in the Rice Security Program.

| Alternative Cash Reserves (Million $) | | | |
|---|---|---|---|
| Cash Reserve | 0.000 | 1.000 | 5.000 |
| Simulated Revenue from Coffee, Cocoa, Rice Taxes, P.L. 480 Imports and Interest on Reserves | 27.254 | 27.353 | 27.750 |
| Domestic Rice Program Costs | 6.230 | 6.230 | 6.230 |
| Interest Income | 0.000 | .099 | .496 |
| Simulated Avg. LPMC Net Revenue | 21.024 | 21.123 | 21.520 |
| Standard Deviation of Net Revenue | 8.149 | 8.153 | 8.162 |
| Average Excess Cash Flow | 21.024 | 21.072 | 21.494 |
| Largest Cumulative Deficit | 12.316 | 11.316 | 7.316 |
| Number of Cash Deficits Per 100 Years | 2 | 1 | 0 |
| **Alternative Rice Stock Reserves (1,000 tons)** (All values except excess funds are in terms of rice quantities.) | | | |
| Stock Reserves | 0.00 | 2.72 | 13.58 |
| Simulated Revenue from Coffee, Cocoa, Rice Import Taxes, and P.L. 480 Imports | 80.06 | 80.06 | 80.06 |
| Domestic Rice Program Cost | 18.47 | 18.47 | 18.47 |
| Storage Cost | 0.00 | 0.54 | 2.69 |
| Simulated Average LPMC Net Stocks | 61.59 | 61.06 | 58.90 |
| Standard Deviation of Net Stocks | 32.47 | 32.45 | 32.40 |
| Average Excess Cash Flow | 20.971 | 20.718 | 19.930 |
| Largest Cumulative Stock Deficit | 45.05 | 42.33 | 31.46 |
| Number of Stock Shortages Per 100 Years | 2 | 1 | 1 |

spread between c.i.f. prices and Monrovia wholesale prices. It is believed such a tax would allow more than adequate incentive to remain for importers to import rice. It also may be more reflective of the "effective" tax rate that could be collected with a 100 percent import tax rate, given administrative cost and "slippage." A paddy rice support price of 18 cents per pound is assumed in Table 9.

In observing Table 9, we see that including P.L. 480 revenues as part of LPMC's revenues nearly doubles LPMC's gross revenues per year compared to those reported in Tables 6 and 8, i.e. from $14 to $16 million to about $28 million per year. Gross income from P.L. 480 rice imports valued at world prices runs approximately $16 million per year. LPMC's net revenue is also approximately doubled, thus giving them greater liquidity to deal with any short-term cash flow problems. Tables 6 and 8 indicated that combined cash reserves and net incomes of $27 to $37 million provided adequate funds for rice security. Table 9 indicates that with annual net revenues of approximately $27 million, only about $1 million of cash reserves are needed for fulfilling rice demand in 99 out of 100 years. A cash reserve of $5 million coupled with an average annual net income of $27.75 million would result in no rice shortages at all in 100 years.

Annual costs for a $1 million cash reserve fund, as reflected by the difference between average net income and average excess cash flow, is estimated to be $51 thousand. Cost for an equivalent rice stock reserve would be about $405 thousand. Hence, nearly all $16 million of income typically derived from P.L. 480 import sales would, on the average, be passed on to the government for other uses. However, its transfer would likely be very erratic. The standard deviation of LPMC's net income is approximately $8

million per year. The standard deviation of excess cash flows can be expected to be almost equally volatile.

## Conclusion

Liberia is currently not self-sufficient in rice. Alternatives for achieving rice self-sufficiency appear costly and/or require a long period to achieve. In light of this, this paper has considered the feasibility of the alternative of achieving assured adequate rice supplies through trade. Pricing, taxation, and buffer stock policies for operating a marketing organization that would assure ample rice supplies and have the financial stability to reliably achieve this objective were hypothesized and tested. It is concluded that Liberia can achieve a high degree of confidence of having adequate and stable rice supplies through trade with only minor changes in its current agricultural policies. The program devised could either incorporate the use of P.L. 480 rice imports or stand on its own.

The analysis found that insured adequate rice supplies through trade is aided by higher rice import taxes and lower producer rice support prices, if the savings from lower producer support prices are used in the rice import program. Further analysis to determine the exact level of import tax and producer price level to achieve the goal of insured rice supplies through trade is needed. At this point it appears that reducing the rice price paid to farmers by 3 to 6 cents while collecting a rice import tax of 2 to 3 cents per pound would allow financial stability of a marketing organization designed to assure adequate rice supplies. It is even feasible that the above subsidy and tax policy would permit some reduction in consumer rice prices in Liberia.

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