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The use of the policy analysis matrix

In agricultural policy analysis:

A case study of crop rotations in Egypt

by

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**THE USE OF THE POLICY ANALYSIS MATRIX
IN AGRICULTURAL POLICY ANALYSIS:
A CASE STUDY OF CROP ROTATIONS IN EGYPT**

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1. INTRODUCTION

The increase in interest in policy analysis in recent years has arisen from the serious economic problems that faced Egypt over the past decade. These problems include severe indebtedness, acute balance of payments deficits, inflation, economic stagnation, and related problems that have in some cases reached crises proportions. The economic difficulties confronting in the late 1980s necessitated major economic policy reforms.

In response to the deterioration in the Egyptian economy, the government initiated the economic reform and structural adjustment programme (ERSAP) in March of 1990. Economic reform is generally defined as "stabilization policies" and "structural adjustment policies".

The major difference between these policies is that the International Monetary Fund (IMF) stabilization policies aim at restoring current account deficits in the short run, while the structural adjustment programmes of the World Bank (WB) have a wider development role in establishing better conditions for economic efficiency and growth.

A typical *stabilization policy* recommends a devaluation of the national currency, coupled with measures to reduce public sector expenditure and restrain any inflationary tendencies which could invalidate any increase of the nominal exchange rate. Ceilings are placed on government borrowing and on money expansion. Food and other subsidies are discouraged. Wage increases, especially in the public sector, are contained. More detailed recommendations, however, are refrained from. The government in question decides on the incidence of cuts, etc., provided ceilings and macro targets are observed.

On the other hand, a typical *structural adjustment programme* works on the premise that any distortions in the economy should be dismantled in order to restore efficiency. The timing, extent, and priorities of adjustments in eliminating distortions and prioritizing the role of markets signals has become the subject of detailed discussions and recommendations.

The rationale behind these policies is based on the causes of excess consumption. There exists an unfinished debate as to the relative importance of external and domestic factors. The choice of policies considered is based on the analysis of the root causes of the problems and the factors aggravating and perpetuating these problems. The effective implementation of policy reforms requires that policy measures be identified and their effects anticipated. In this macroeconomic context the role of policy analysis has come to the forefront.

As for agricultural sector, control over prices of farm products and inputs has been an important part of Egypt's development strategy during the sixties and seventies. These

controls belong to a broader system of intervention that regulates agricultural production and the distribution of benefits.

The aim of this study is to demonstrate the use of the Policy Analysis Matrix (PAM) in analyzing the impact of agricultural policies and to assess the degree to which domestic input and output prices, of agricultural commodities, differ from their equivalents in international markets, thereby determining the extent of protection. Also, to perform a similar procedure with respect to comparative advantage.

The methodology used here is the standard calculation of protection coefficients and of domestic resource costs. Price distortions are defined as the divergence between the price of a good at the border and at the farm-gate adjusted for equivalent location and stage of processing. The distortions are expressed through the standard indicators of nominal and effective protection by commodities. Comparative advantage is examined in terms of value-added, at border prices, per unit of domestic resource with costs measured as marginal opportunity costs.

The study consists of four parts. The first part is an introduction to the economic reform and structural adjustment programme and the role of International Monetary Fund (IMF) and the World Bank (WB).

The second part presents an economic framework for agricultural policy analysis. It discusses the policy objectives, policy instruments, evaluation of the policy, implications for agricultural performance, economic policy reform, agriculture role under economic reform and structural adjustment programme and finally, agricultural strategy in the 1990s.

The third part, the core of the study, concentrates on the policy analysis matrix (PAM)- that can be used to assess the costs and benefits of different policies, in order that choices can be made between alternatives. It begins by devoting considerable attention to the structure of the PAM and measures of economic protection. Then, the discussion shifts to the social valuation of tradable and non-tradable goods. Finally, the use of the PAM for agricultural planning and the limitation of its use.

The fourth and last part considers a case study to be analyzed using the PAM. Seven single crops and six crop rotations were analyzed.

2. ECONOMIC FRAMEWORK FOR AGRICULTURAL POLICY ANALYSIS

2.1 POLICY OBJECTIVES

Agricultural policy in Egypt has two broad objectives: *first*, to provide adequate food to all groups of population, including poorest; and *second*, to make the nation self-sufficient in food commodities, except wheat. The broad goals of Egyptian agricultural policy should be seen in historical context: the planning period and the liberalization period¹.

- i) *During the planning period (1960-1973)*, agriculture was mainly subordinated to the objective of industrialization. Such policies discriminating against the agricultural sector resulted in distributing the income in a way against the interest of the agricultural sector. Preferential pricing policies resulted in low prices for the farmers, and reduced their real incomes in favour of other sectors as well as the urban population.
- ii) *During the liberalization period*, the objective of food self-sufficiency was subsumed within price stability and consumer welfare. The designed policies of that period aimed at redressing the distribution of income in the rural sector in order to narrow the internal gap between the rural and urban communities.

2.2 POLICY INSTRUMENTS

Prices of major commodities, rather than being determined by market forces only, are influenced by several policy instruments. Markets for major crops combine intervention on the demand side with intervention on the supply side. The main types of sector-specific intervention influencing prices are:

- (1) Delivery quotas for certain crops:

The Ministry of Agriculture divided crops into four pricing groups:

- i) *In the first group*, prices are set and farmers are obliged to deliver all their product to the government. This applies to cotton and sugarcane.

¹ FAO, The State of Food and Agriculture 1993. FAO Agriculture Series No. 26, Rome, 1993.

- ii) In the second group, prices are set for a certain quota of production that farmers are obliged to deliver to the pooling centers while the balance of the crop is marketed freely. Examples are rice, sesame, and groundnut.
 - iii) The third group includes crops the price of which the government indirectly determines since it controls imports and, consequently, affects domestic prices. Wheat and maize are examples.
 - iv) The fourth group includes commodities whose price is determined in general by forces of supply and demand. Examples are vegetables, fruits, meat, dairy products, eggs, fish, and berseem.
- (2) Fixed producer prices for food and export crops that are procured.
 - (3) Subsidization of agricultural inputs, either through explicit subsidies or through pricing of some inputs (water and fuel) below marginal cost.
 - i) *Direct Subsidy*: The government pays direct subsidies on best control, fertilizer, improved seeds, gypsum for soil improvement, fuel oil, diesel, concentrate feed mix, and other items.
 - ii) *Indirect Subsidy*: In addition, agricultural credit is subsidized through preferential rates.

In addition to sector-specific intervention, prices of agricultural commodities were also indirectly affected by economy-wide intervention such as exchange rate policy and trade policy.

2.3 EVALUATION OF THE POLICY

After 20 years of policy implementation the characteristics of Egypt's economy remain the same, being, rural poverty, technological inefficiency, an agrarian dominated economy and reliance on foreign support. The agricultural growth rates indicate that Egypt's farm sector is performing poorly over time. A comparison with food production growth rates show that Egypt is putting progressively more of its total farm output into a losing battle of trying to feed itself. Following are some impacts of the adopted policy:

- i) In 1974 farmers had received 15%, 16% and 30% of the actual export prices the State had received for their onions, rice and cotton respectively. Cotton growers, for example, were found to be consistently defaulting on quota obligations choosing instead to pay the resultant fines and grow alternate

crops. Inputs, such as fertilizer, destined for use on specified crops were freely sold on the black market for use on other crops. The cost of the subsidy programme had multiplied 11 times in four years.

- ii) Maintaining the objective of low and stable cost of production had been reasonably simple until 1972 when world wide coincidences of commodity shortfalls began to appear. Prices for imports escalated to unprecedented heights. Wheat prices tripled and urea fertilizer prices quintupled within two years. During the same period the consumer price and the farm gate price of wheat were kept constant. As a result of such policy, the consumer subsidies rose from US\$ 69 million in 1972 to peak at US\$ 1.054 billion in 1975 then began to fall as import prices decline. Producer subsidies at US\$ 32 million in 1972 rose to US\$ 261 million in 1975 then fall to US\$ 146 million in 1976.
- iii) The differentials between foreign and domestic prices brought windfall gains to the state. The weighted average export f.o.b. price of cotton lint rose by 118% from 1972 to 1974, meanwhile, farm gate price for seed cotton rose by 20% during the same period. As for rice, world prices increased by 268% from 1972 to 1974, while farm-gate prices had risen only by 3% in total over the whole period since 1968¹.

2.4 ECONOMIC POLICY REFORM

The economic difficulties confronting Egypt in the late 1980s necessitated major economic policy reforms. In the 1970s and early 1980s, the country had achieved impressive GDP growth rates, based on high petroleum prices, worker remittances and foreign assistance and borrowing. Economic growth slowed in the second half of 1980s when oil prices and export earnings fell, but Egyptian policies did not adjust to the decline in resources. Continued large government expenditures on food and energy subsidies as well as on support of public sector enterprises helped generate massive fiscal deficits which exceeded 20% of GNP annually.

Egypt financed its fiscal and current deficits partly through foreign borrowing, but capital inflows slowed as Egypt's credit worthiness deteriorated and foreign arrears began to accumulate. By 1990, Egypt's total foreign debt had reached \$51 billion, equivalent to 144% of GDP, with repayment obligations equal to one-half of its export earnings². As expansionary monetary policy was also used to help fund the fiscal deficits and consequently contributed to high inflation.

¹ IBRD, Agricultural Price Management in Egypt. Report No. 388, Washington D.C., 1980.

² FAO, The State of Food and Agriculture 1993, Ibid.

In response to the deterioration in the Egyptian economy, the government initiated the economic reform and structural adjustment programme (ERSAP) in march of 1990 which aimed at:

- rapid achievement of sustainable macroeconomic environment;
- economic restructuring to lay the foundation for medium- and long-term growth;
- improvements in social policies to minimize the negative effects of economic reforms on the poor.

The measures implemented during the first stage of Egypt's ERSAP included:

- a reduction in the current account and fiscal deficits;
- the liberalization of foreign exchange and interest rates;
- the privatization and restructuring of public enterprises;
- a reduction in trade barriers;
- establishing a social fund to cushion the effects of market reforms on vulnerable populations.

The ERSAP is being implemented with support from the international community. The IMF is supporting the macroeconomic stabilization component of the programme. The World Bank is supporting structural adjustment to improve efficiency as the country shifts towards an export-led growth strategy based on the private sector. Other donors are supporting a review of social policies to minimize the effects of economic reforms on the poor. Egypt made significant progress during the first three years of the ERSAP and, in some areas, moved ahead of schedule in implementing policy reform including:

- it reduced its fiscal deficit to 7% of GDP by 1992 while growth in money supply slowed, causing inflation to decline from 27% in 1989 to 14% in 1992¹;
- exchange rate restrictions were removed and the exchange rate system unified ahead of in November 1991;
- balance of payments was improved and a current account surplus was achieved in 1991 and 1992.
- prices were liberalized in the energy, industrial and agricultural sectors.

¹ FAO, The State of Food and Agriculture 1993, Ibid.

It is worth to notice that the surplus of the current account was due to the effects of foreign debt reduction and a recovery in earnings from tourism, worker remittances and Suez Canal revenues, combined with declining imports.

2.5 ROLE OF AGRICULTURE UNDER ERSAP

Egypt has targeted agriculture, along with tourism and industry, as a sector with strong potential for supporting economy-wide growth under the ERSAP adopted in March 1990. This is a comprehensive policy reform effort designed to correct structural weaknesses of the economy and achieve macroeconomic stability under the economic reform and structural adjustment programme, Egypt's objective is to restructure economic activity to achieve a decentralized, market-based and outward-oriented economy. This marks a complete break with the completely planned, inward-oriented economic policies that the country has pursued for more than four decades. Several factors account for the expectation that agriculture can help support economy-wide reform and stabilization:

- *First*, the share of agriculture in the Egyptian, while declining, continues to be important. In 1990, agriculture accounted for 17% of Egypt's GDP, 41% of employment and 20% of export earnings;
- *Second*, the farm sector has potential for additional gains in productivity. Egyptian farmers are already among the most productive in the world, aided by good soils and a mild climatic that permits three crops per year. Further productivity gains are expected to come from increased yields in some crops, efficiency gains from crop substitution as remaining price distortions are removed and better management of limited water resources;
- *Third*, the agricultural sector has already achieved considerable progress in implementing market liberalization. Major policy initiatives undertaken since 1986 have removed most sectoral price distortions in agriculture, exposed Egyptian farmers to decision making in a competitive market and achieved a role for the private sector.

2.6 AGRICULTURAL STRATEGY IN THE 1990S

Until the mid-1980s, Egyptian agricultural policy was characterized by extensive government intervention and an inward orientation. Egypt's objectives were:

- to attain self-sufficiency in basic food products;
- provide food to consumers at low prices;

- generate sufficient rural employment to absorb a rapidly growing labour force;
- tax agriculture to support industrial growth and generate government revenue.

To achieve above mentioned objectives, the government applied following policies:

- controlled producer prices;
- controlled area and marketing quotas;
- controlled agricultural trade;
- government monopolies in trade and marketing.

Under this policy regime, agricultural GDP growth slowed, increasing by an average 2.5% annually in the 1980s¹. The main reasons for slow growth in agriculture were the disincentives that price distortions created for farmers and declining government investment in the sector. Slow growth in agriculture helped induce urban migration. During the period 1980-1990, Egypt's urban population grew by an average of 3.1% annually, compared with 2.4% average annual growth in the national population.

As agriculture production failed to keep pace with population growth, Egypt suffered from:

- cereal self-sufficiency declined from an average of 65% in 1978-80, to 52% in 1986, when ERSAP was initiated.
- food imports increased by more than 10% annually during that period, reaching \$ 2.6 billion in 1986.

In response to these trends, in 1986 Egypt introduced agricultural policy reforms which included:

- the removal of crop area allotments with delivery quotas at fixed procurement prices, except cotton and sugar cane;
- the liberalization of producer prices for all crops except cotton and sugar, with the cotton price raised to 66% of the border price equivalent in 1992;
- a reduction of subsidies on fertilizers and pesticides;
- encouragement of the privatization of processing and marketing of agricultural products and inputs;

¹ Ministry of Agriculture, Agriculture Strategy in the 1990s.

- the implementation of a programme for divesting land held by public enterprises; and
- lower trade barriers and a shift of agricultural trade to a free foreign exchange market.

2.7 IMPLICATIONS FOR AGRICULTURAL PERFORMANCE UNDER ERSAP

Egypt's main crops are wheat, maize, rice, berseem clover and cotton which, combined, account for more than 80% of cultivated land area. Other important crops are broad beans, sugar cane, fruits and vegetables. Since 1986, Egyptian agriculture has undergone a sustainable modification in crop mix in response to changing price signals and the removal of planting and procurement requirements.

Wheat area expanded by about 75% between 1985 and 1986 while output increased by 150% as a result of both increased area and rising yields. In 1992, Egypt harvested its six consecutive record wheat crop, causing wheat imports to decline by 14% to 6 million tonnes during the period 1985-1992¹. Wheat flour imports were liberalized in 1992 to allow importation by the private sector, and flour prices were to be determined by the market. The area planted to coarse grains and rice rose by 11% and 16%, respectively, while the area planted to cotton and beans declined by 17% and 13%, respectively.

Poultry and livestock became less profitable under market liberalization. The government reduced maize imports in 1986 and removed feed subsidies in 1988. Poultry production in particular began to decline as input prices rose. Output had grown at an average annual rate of 16% between 1980 and 1988, mainly because of government subsidies on feed grains and equipment. Between 1988 and 1992, poultry meat production fell by 21% as nearly one-half of the producers were forced out of the industry. Currently, chicken imports are banned to protect the remaining producers, with plans to replace the bans with tariffs in 1993. Beef imports were banned in 1989 but liberalized again in 1992. In the long term, livestock and poultry output is expected to recover as efficiency gains in production restore profitability.

Agricultural policy reforms to be implemented in the short term include the removal of fertilizer and pesticide subsidies, except for cotton, by November 1993. Price and area controls on cotton are planned to be removed in 1994. A floor price for cotton will be set, with the market price to be determined in a planned cotton exchange. Wheat imports were liberalized in mid-1993 and land rental rates are to be market-determined by 1997.

¹ FAO, The State of Food and Agriculture 1993, Ibid.

3. THE POLICY ANALYSIS MATRIX (PAM)

The Policy Analysis Matrix (PAM) approach to policy analysis is a simple powerful tool for analyzing the impact of current policies on costs and returns of agricultural production. The results can be used to identify which crops are competitive under current policies affecting both output and input prices and how profit changes as policies are altered. Through the use of an accounting matrix, the sources of all policy distortions affecting profitability become easily identifiable. Finally, a PAM can also address the issue of economic efficiency (or comparative advantage) thus providing important information on how best to allocate funds for investment and research.

The main purpose of PAM analysis is to measure the impact of government policy on the private profitability of agricultural systems and on the efficiency of resource use.

PAM methodology allows the comparison of actual private profitability of a given commodity with the economic profitability as it would be in free trade environment. The coefficients calculated on the basis of the PAM data permit the ranking of commodity systems according to the degree of protection that they receive and the efficiency with which they receive. The indicators can be calculated for the commodity system as a whole or for each single stage so that more specific measures can be identified and recommended.

3.1 The Structure of a PAM

The matrix consists of three rows and four columns. The PAM is a product of two accounting identities, one defining profitability (first two rows) and the other measuring the effects of divergences (third row). Profitability is measured horizontally, across the columns of the matrix. Profits shown in the fourth column are found by subtracting of costs, given in the second and third columns, from revenues indicated in the first column. The two cost columns contained in the PAM represent costs of tradable inputs and costs of domestic factors.

$$\text{Profit} = \text{Revenue} - \text{Cost}$$

The equation can be written in terms of private prices or social prices¹. The Policy Analysis Matrix presents the results of such comparisons.

¹ Private prices are sometimes called "financial prices", "market prices" or "actual prices". Social prices are sometimes called "economic prices", "efficiency prices" or "shadow prices"

Table 1. Policy Analysis Matrix (PAM)

	Revenue	Cost		Profit
		Tradable inputs	Domestic factors	
Private prices	A	B	C	D
Social prices	E	F	G	H
Transfers	I	J	K	L

Comparisons of private and social costs and returns provide three essential pieces of information for the policy maker. The calculation of private profitability provides information on the incentives and competitiveness of domestic commodity and factors markets. The same computations using social prices provide information on profitability of commodities and factors when these are priced at their social or opportunity cost. Divergences provide insights into the extent of policy interventions in the form of taxes, subsidies and trade restrictions. The comparison also points to imperfections in the functioning of factor markets.

3.1.1 Private Profits

The data entered in the first row of the matrix provide a measure of private profitability. Private profits express the returns of an activity when products and factors have been valued at market price. Private profits show the competitiveness of the agricultural system, given current technologies, output values, input costs, and policy transfers.

In the PAM private profitability is defined as the difference between the revenues (A) and costs (B+C). Private profitability is calculated at actual market prices and is defined as (D).

Private profits: $D = A - B - C$

If $D < 0$ (private profits are negative), operators are earning a subnormal rate of return and thus can be expected to exit from this activity, unless something changes to increase profits to at least a normal level i.e. $D=0$.

If $D > 0$ (private profits are positive), operators are earning supernormal returns and should lead to future expansion of the system, unless some constraints are existing.

3.1.2 Social Profits

The data entered in the second row of the matrix provide a measure of social profitability. Social profits express returns to the economy when products and factors have been valued at their opportunity cost. Social profitability measures the comparative advantage or efficiency in the agricultural commodity system.

In the PAM social profitability is defined as the difference between the revenues (E) and costs (F+G). Social profitability is calculated at prices that reflect social opportunity cost and is defined in the PAM as (H).

Social profits: $H = E - F - G$

If $H < 0$ (social profitability is negative), the production system is using resources inefficiently and gives a negative contribution to the national income.

If $H > 0$ (social profitability is positive), the production system is using resources efficiently and gives a positive contribution to the national income.

3.1.3 Transfers (Effect of Divergences)

Transfers express the effects of policy interventions and market failures, which are reflected in the difference between private and social costs and returns. In the PAM transfers are defined as the differences between private and social valuations of revenues, costs, and profits i.e. $I = A - E$, $J = B - F$, $K = C - G$, and $L = D - H$.

Output transfers: $I = A - E$

If $A < E$ (output transfers are negative), this is the case when the private output price is less than the social output price.

If $A > E$ (output transfers are positive), this is the case when producers can fix a market price higher than the international price for similar items.

Input transfers: $J = B - F$

If $B < F$ (tradable inputs transfers are negative), this happens when producers are paying tradable inputs a price lower than the corresponding world price, e.g. a subsidized price.

If $B > F$ (tradable inputs transfers are positive), this happens when the market price of tradable inputs is higher than the world price.

Factor transfers: $K = C - G$

If $C < G$ (domestic factors transfers are negative), this is the case when producers pay for domestic factors a price less than its opportunity cost.

If $C > G$ (domestic factors transfers is positive), this is the case when producers pay for domestic factors a price higher than its opportunity cost.

The sum of the first three elements on the transfer line gives the total value of the incentive/disincentive effect of government policies and market failure on private profitability and is defined as (L).

Net transfers: $L = D - H$ $= I - J - K$

If $L > 0$ (profits effect is positive), the commodity activity is generating profits at a level higher than what would occur without government intervention situation.

3.2 Measures of Economic Protection

Economic protection is defined as the degree to which domestic prices are sustained above world market prices. At least some agricultural prices deviate from international levels in all countries, developed and developing alike.

Economic protection could be positive and also could be negative. As an example of positive economic protection, the Japanese price of rice at the farm gate has been three to four times higher than the international price. As an example of negative protection, the Egyptian price of cotton at the farm gate amounted to only eighty percent of its international price.

Economic protection distorts the allocation of resources away from a more efficient pattern that could be achieved through greater reliance on mechanism of international trade, and it diminishes economic welfare in other countries through reducing their opportunities to participate in international trade. Protection coefficients are important analytical tools for monitoring the performance of the sector over the time.

The optimal or desirable rate of protection is not always immediately obvious, but it is clear that protection that is excessively high, or strongly negative, or sharply uneven over products has negative net economic effects.

The information behind such coefficients is central to developing production and trade strategies for the sector. Protection can be measured using two different but closely related concepts, nominal protection and effective protection.

3.2.1 Nominal Protection Coefficient (NPC)

The nominal protection coefficient involves a comparison of domestic price of an output with its international price, after converting to common currency units via the exchange rate.

The NPC is a summary indicator of all protection or taxation measures that prevent equality between domestic and border prices, and can be used to show whether the price structure works as an incentive or disincentive to local producers.

According to PAM elements, the NPC is the ratio between revenues measured at private prices (A) and revenues measured at social prices (E).

$$\text{NPC} = \frac{\text{Revenues measured at private prices } A}{\text{Revenues measured at social prices } E}$$

If $\text{NPC} > 1$, this means that the private price is higher than the border price and implies an implicit subsidy to producers.

If $\text{NPC} < 1$, this means that the private price is lower than the international price, reflecting an implicit tax on producers. In other words those involved in the commodity system are earning less than they would if the commodity was freely traded.

If $\text{NPC} = 1$, this means the absence of any price intervention. In other words, the absence of any protection.

3.2.3 Nominal Protection on Inputs (NPI)

NPI is the ratio between tradable inputs measured at market prices (B) and tradable inputs measured at social prices (F).

$$\text{NPI} = \frac{\text{Tradable inputs measured at private prices } B}{\text{Tradable inputs measured at social prices } F}$$

If $NPI < 1$, it means that the government is subsidizing the use of inputs by farmers.

If $NPI > 1$, it means that the government is taxing the use of inputs by farmers.

3.2.3 Effective Protection Coefficient (EPC)

Effective protection is a natural extension of the nominal protection concept in that it makes allowance for distortions in the output as well as the input markets. It is conceptually easy to find a case where output prices are higher than world prices, but where the disincentives in the input market are so large that net incentives are negative. EPC takes this phenomenon of balancing implicit taxes on production with subsidies on input, or vice-versa, into consideration as it measures the net effect of domestic economic policy in both the output and input markets.

Generally, the effective protection coefficient is the ratio of value added (in producing the given output), computed at prevailing domestic prices, to that same value added computed at international prices.

In PAM, the EPC is the ratio between value added measured at market prices (A-B) to the value added measured at social prices (E-F). EPC takes into account the values of both outputs and inputs.

$$EPC = \frac{\text{Value added measured at market prices}}{\text{Value added measured at social prices}} = \frac{A-B}{E-F}$$

or

$$EPC = \frac{\text{Market price of output} - \text{Market price of traded inputs}}{\text{Social price of output} - \text{Social price of traded inputs}}$$

If $EPC > 1$, it implies protection of the commodity i.e, the commodity activity is receiving positive incentives. In other words the combined effect of transfers on revenues and tradable inputs is increasing private profits above socially optimal levels.

If $EPC < 1$, it implies a net disincentive to the commodity activity.

Notes on Protection Coefficients

- The NPC and NPI are useful tools that can be used to obtain a preliminary assessment of the incentive structure facing a commodity, EPC is a more accurate measure of price incentives.
- Sometimes, we prefer using rates of protection rather than protection coefficients. The rate of protection is expressed in percentage and is calculated as follows:
Rate of protection = $100 * (\text{Protection coefficient} - 1)$,
Accordingly:
 - The Nominal Rate of Protection on Outputs = $100 * (\text{NPC} - 1)$;
 - The Nominal Rate of Protection on Inputs = $100 * (\text{NPI} - 1)$;
 - The Nominal Rate of Effective Protection = $100 * (\text{EPC} - 1)$.
- Protection rates can vary substantially in short periods of time, mainly because they are measured against international prices, which vary considerably from year to year. The sources of instability are:
 - variations in the real domestic price;
 - variations in the world market price;
 - variations in the degree of disequilibrium in the exchange rate.

Therefore it is preferable to calculate the protection coefficients for several years, or at least three years, before attempting to draw conclusions about protection policies.

- Protection rates can vary substantially by technology and region.
- Protection rates do not say much about the comparative advantage of domestic producers in the international market, but a high rate of protection is incompatible with competing against imports or entering export markets.

3.2.4 Domestic Resource Cost (DRC)

The DRC coefficient is a cost/benefit ratio. In the PAM the DRC coefficient measures the social cost of using domestic resources (G) to produce one unit of foreign exchange (E-F).

$$\text{DRC} = \frac{G}{E - F}$$

The domestic resources (G) as well as the net output (E - F) are valued at social prices; border prices for tradables and opportunity costs for domestic resources.

The DRC concept is essentially a measure of the efficiency of domestic production relative to the international market. It indicates whether there are social costs or social benefits in producing the commodity rather than importing it. Consequently, the DRC coefficient can be used as a measure of the comparative advantage of a commodity system. A commodity system has a comparative advantage when its DRC is $<$ or $=$ the equilibrium exchange rate.

If $\text{DRC} < 1$, it means that it is needed less than one unit of domestic resources to generate one unit of foreign exchange. In this case the country enjoys a comparative advantage in producing the commodity as the costs associated with importing the commodity are greater than the costs of producing it domestically.

If $\text{DRC} > 1$, it means that more than one unit of domestic resources is needed to generate one unit of foreign exchange. This means that the country is not internationally competitive in the production of the commodity or the country is better-off importing the commodity than producing it. In other words the opportunity cost of using domestic resources exceeds the value added (at world prices); this is socially unprofitable activity.

Notes on Comparative Advantage

- The DRC provides a measure of the static comparative advantage. However, there is also a dynamic comparative advantage, which changes with exogenous fluctuations in the world prices and with technological improvements.
- Border prices at the relevant marketing level, which play an important role in DRC analysis, are affected by marketing efficiency in the domestic market.
- Changes in marketing factors such as port charges and domestic transport will affect the border prices for inputs as well as outputs. Such changes in these elements will alter comparative advantage without there being any structural or technological changes in production activity.

- If a country does not have comparative advantage in the production of a particular commodity, it should produce other commodities for which comparative advantage exists.
- Comparative advantage and competitiveness in the export market are two closely related but separate concepts. Comparative advantage simply shows if a country is better-off producing a commodity than importing it, but does not provide a proof that the country can effectively compete in the international market. If a number of policies distort negatively the market prices, no private trader may be interested in exporting a commodity with a low DRC, which indicates a higher comparative advantage.

Summary of Protection and Comparative Advantage Measures

I. Nominal Protection Coefficient (NPC)

$NPC = 1$ implies no distortion on output price.
 $NPC > 1$ implies an implicit subsidy to producers.
 $NPC < 1$ Implies an implicit tax on producers.

II. Nominal Protection on Inputs (NPI)

$NPI = 1$ implies no distortion on input price.
 $NPI > 1$ implies an implicit subsidy to inputs.
 $NPI < 1$ implies an implicit tax on inputs.

III. Effective Protection Coefficient (EPC)

$EPC = 1$ implies no distortion.
 $EPC > 1$ implies effective protection or a net incentive to producers.
 $EPC < 1$ implies effective taxation or discrimination against producers.

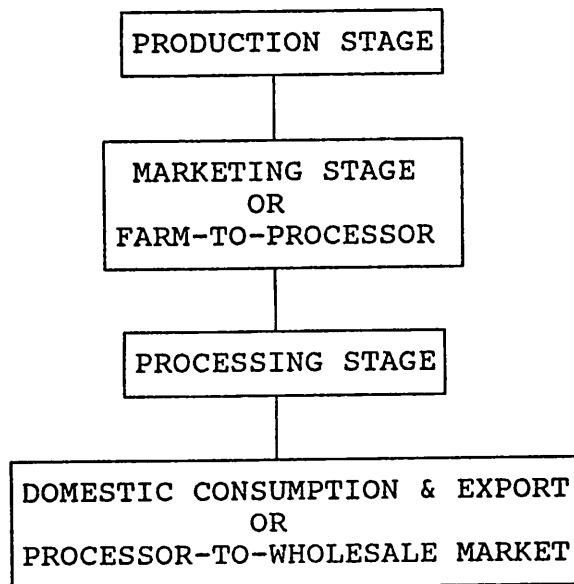
IV. Domestic Resource Coefficient (DRC)

$DRC = 1$ indicates an inclusive test.
 $DRC > 1$ indicaces comparative disadvantage or that the activity is inefficient.
 $DRC < 1$ indicates comparative advantage or that the activity makes efficient use of domestic resources to save or earn a unit of foreign exchange.

3.3 The Stages of the Commodity System

The most efficient supply of agricultural product to the consumers is not necessarily from the most efficient producers; it is rather the result of the combination of the costs of production, marketing and processing the commodity. For example, inefficiencies in transport, marketing and processing may generate negative value added; e.g. the value added at the production stage will be reduced by the activity downstream.

Including transport, marketing and processing stages in the commodity system analysis is critically important in order to identify exactly where are the main bottlenecks to the full exploitation of the commodity and the overall comparative advantage of the country in producing a given commodity. The following figure illustrates the structure of the commodity system.



Following are short notes about activities contained in each stage and level of analysis:

Production Stage:

Inputs and outputs for production of raw materials. Evaluation stops at farm gate.

Marketing Stage or Farm-to-Processor Stage:

Commodity moved from farm gate to processing site. It may include storage and handling as well as transportation costs.

Processing Stage:

Commodity processed into consumer-acceptable form. It may involve physical transformation or just packing, handling, and quality control.

Domestic Consumption or Processor-to-Wholesale Market:

Commodity moved from processing site to market where domestic activity is comparable to tradable product. It may include inputs and outputs for farm-to-wholesale market if processing activity is irrelevant.

Table 2. Example of Hypothetical DRCs for Different Stages of Two Commodities¹

	STAGE 1 (production)	STAGE 2 (marketing)	STAGE 3 (processing)	TOTAL
COMMODITY 1				
system 1.1 (traditional)	1.2	0.8	1.0	0.9
system 1.2 (innovation)	1.5	0.5	0.4	0.7
COMMODITY 2				
system 2.1 (traditional)	0.8	1.2	1.9	1.2
system 2.2 (innovation)	0.7	1.8	1.7	1.4

Looking first at the column labeled total, commodity 2 is inefficient under the two systems, while commodity 1 is always efficient. According to such results, government policies should promote commodity 1 and discourage commodity 2.

Both commodity 1 systems have comparative advantage with total DRCs less than one. In the case of commodity 1, system 1.1 is more efficient at stage 2 (marketing) while system 1.2 is more efficient in stages 3 and 2 (processing and marketing). Commodity 2 is quite efficient in stage 1 (production) while not efficient in stages 2 and 3 (marketing and processing).

¹ FAO, The Policy Analysis Matrix for the Agricultural Sector. Training Paper No. 6. Rome, 1989.

3.4 Social Valuation in the PAM

Commodities are usually defined as tradable and non-tradable goods. For tradable inputs and outputs, social valuation entails calculation of world price equivalents for the domestic product. For domestic factors, the social valuation process begins with observed market prices and then adjusts those prices for the effects of factor market divergences.

The production of any good or service, whether it be tradable or non-tradable, is the result of a transformation of some combination of traded and non-traded goods and services. Therefore the contents of a non-tradable can be broken down into tradable and original factors. Original factors basically refers only to labour and land, the essential domestic resources.

3.4.1 The Foreign Exchange Rate

Before meaningful comparison between domestic and border prices can be made, it is essential to choose the appropriate world price and then to convert that price at an appropriate exchange rate into domestic currency units. An exchange rate that either undervalues or overvalues domestic currency will correspondingly overprice or underprice the commodity to the domestic economy.

The foreign exchange rate is the price of a unit of foreign currency in terms of local currency. In many developing countries the foreign exchange rate is overvalued. This means that the cost of foreign exchange is artificially cheap. This would make the price of tradable outputs and inputs lower than that measured at social price.

When the exchange rate is overvalued, farmer and market system allocation of resources, which are response to actual prices, will not result in either efficiency or foreign exchange maximization measured at sectoral or national level. This is because the price of tradables is artificially depressed, leading to over production of non-tradables and over consumption of tradables.

Since the agricultural sector usually has a larger share of tradable production potential relative to other sectors, this exchange rate situation draws resources out of the agricultural sector and causes an inefficient allocation of resources within the agricultural sector.

From the perspective of input use and choice of technology, overvalued exchange rates, by making imported capital artificially cheap, encourage the use of inappropriate capital intensive technologies. This causes serious long-term distortions and

limitations to the agricultural sector's capacity for employment absorption and real economic growth.

Once the appropriate price for the exchange rate is determined, analysts apply it in valuing the prices of imports and exports so that domestic prices for various commodities can be compared to their equivalents in the world market. Interest then centers on what exchange rate to use to convert world prices into domestic currency for social valuation.

3.4.2 The Shadow Exchange Rate

It is defined as the equilibrium rate in a situation of no distortion in trade policy and international capital markets. The shadow exchange rate is a summary of the trade-related distortions, and it is used to adjust for distortions in the official rate. The terms shadow exchange rate and equilibrium exchange rate are used interchangeably. Calculating the equilibrium exchange rate envisages calculating the real exchange rate (RER) and the real effective exchange rate (REER).

3.4.2.1 The Real Exchange Rate (RER)

In a world of floating exchange rates, the real rate is not entirely under the control of the domestic government. The real rate depends both on domestic policy and on international factors outside the control of the domestic government. In computing the real from the nominal, one needs a base year against which monetary changes are to be assessed. According to the Purchasing Power Parity theory (PPP), the real exchange rate (RER) is obtained by eliminating the effect of the changes in the purchasing power of the two currencies. The measure of inflation could be provided by the Consumer Price Index (CPI) or Wholesale Price Index (WPI). These indices are also called deflator¹.

- Step 1: Deflate the nominal exchange rate to get the cost of one foreign currency at constant prices of the domestic currency.
- Step 2: Compute the real exchange rate by adjusting for the foreign country inflation. In fact, also the foreign currency may loose some purchasing power during the same period, therefore, its cost has to be adjusted accordingly. Consider CPI as a measure of deflation.

¹ FAO, Agricultural Policy Analysis Exercises. Policy Analysis Division, Training Service (ESPT), Rome, 1992.

$$RER(t) = OER(t) * \frac{CPIW(t)}{CPID(t)}$$

where:

RER = Real Exchange Rate
 OER = Official Exchange Rate
 CPIW = Consumer Price Index of World (Foreign Countries)
 CPID = Domestic Consumer Price Index
 (t) = Year t

The previous formula gives the real cost of a unit of foreign exchange, after having taken into account domestic and external inflation.

3.4.2.2 The Real Effective Exchange Rate (REER)

Almost in every country, foreign trade is taxed and, in many countries, import and export taxes are among the important sources of revenue for the government budget. Sometimes, imports and exports are subject also to quantitative restrictions which give origin to the smuggling black markets.

It is important to note that the import tax has the role to make more expensive the imports, that is, to increase the exchange rate for the imports. Similarly, subsidies designed to make the exports more attractive have the function to increase the exchange rate for the exporters. The foreign trade taxation is an instrument in the hands of Government for adjusting the exchange rate.

The overall taxation policy of the foreign trade gives origin to an effective exchange rate which is different from the nominal and real exchange rate. This difference, which can be considered as a premium attached by the Government to the foreign currencies, can be estimated through the following formula:

$$PRIM = (CIF + TARIM + FOB + SUB) / (CIF + FOB)$$

and then

$$REER = RER * PRIM$$

where:

PRIM = percentage of premium on the exchange rate
 CIF = value of imports
 TARIM = total taxes on imports
 FOB = value of exports
 SUB = subsidies or taxes on exports
 REER = real effective exchange rate

The REER can be used as an equilibrium exchange rate only in the case the current accounts balance of the country is sustainable. In the other cases, other methods are to be used for calculating the equilibrium exchange rate.

3.4.2.3 The Equilibrium Exchange Rate (EER)

The Equilibrium exchange rate is the exchange rate that keeps in equilibrium the balance of payment of a country and does not require any policy intervention by the Government. This is the theoretical definition of EER. In Practice we talk about an equilibrium exchange rate in relation to a certain level of trade deficit.

In Egypt, the real effective exchange rate has almost halved in the last decade, which means that the effective cost of a dollar in 1988 was 50% of its cost ten years ago. At the same time the balance of payment has worsened and a debt problem has arisen. The fall in the effective price of the foreign exchange and the balance of payment problem are related. The imports are becoming cheaper and cheaper and the exports less and less attractive, with the immediate consequence of an increasing gap in the foreign trade. Following are the steps of calculating the equilibrium exchange rate¹:

- Step 1: Estimate the elasticities of imports and exports with respect to the effective exchange rate.
- Step 2: Project imports and exports using the estimated elasticities.
- Step 3: On the basis of results of the previous two steps we can now estimate the exchange rate that equilibrates the trade imbalances.

¹ FAO, Agricultural Policy Analysis Exercises, Ibid.

3.4.3 Import and Export Parity Prices

The social price for an agricultural commodity is a border price. The border price is the price at which foreign suppliers would deliver the commodity to the domestic market or the price that the foreign consumers would pay domestic suppliers to deliver the commodity to their markets. In the absence of actual imports or exports of the domestically produced commodity, world price equivalents must be estimated.

For correctly comparing two different prices the following conditions should be met:

- the commodities are exactly comparable in physical terms;
- the commodities are compared at the same location.

If the first condition is not achievable, adequate allowance is to be given to compensate for differences in quality. The second condition requires a precise accounting of transport, handling, and marketing costs. The equivalent international price for the same commodity at the same location is also defined as "import/export parity price".

The f.o.b (free on board) and c.i.f (cost, insurance, and freight) prices for a given economy serve as reference prices because they represent what the commodity can earn as an export or what it costs the economy as a import. When the international, or world, price is translated into domestic currency at a given exchange rate, the resulting price is called the border price.

The following two schemes illustrate the steps of calculating import and export parity price respectively. The schemes are followed by two examples for calculating import and export parity price. The first table presents an example for import parity price for Egyptian wheat in 1990, while the second table presents another example for export parity price of Egyptian cotton in 1990.

Figure 1: Scheme of Calculating Import Parity Price

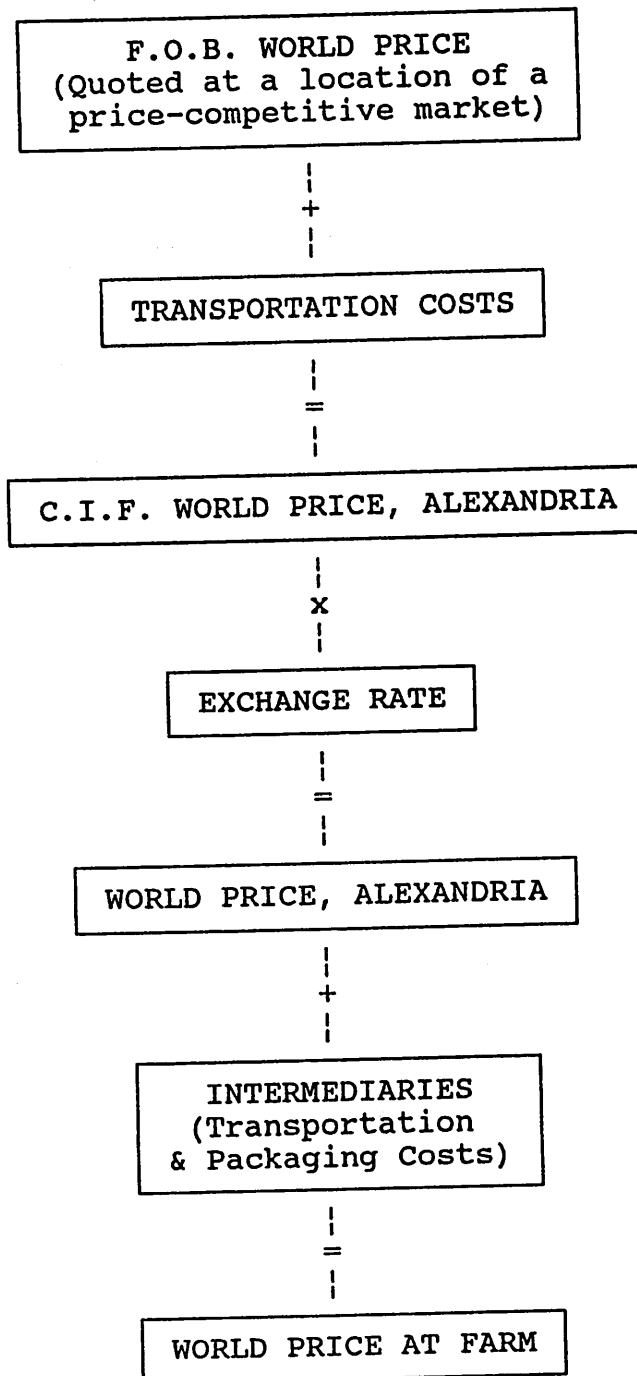


Figure 2: Scheme of Calculating Export Parity Price

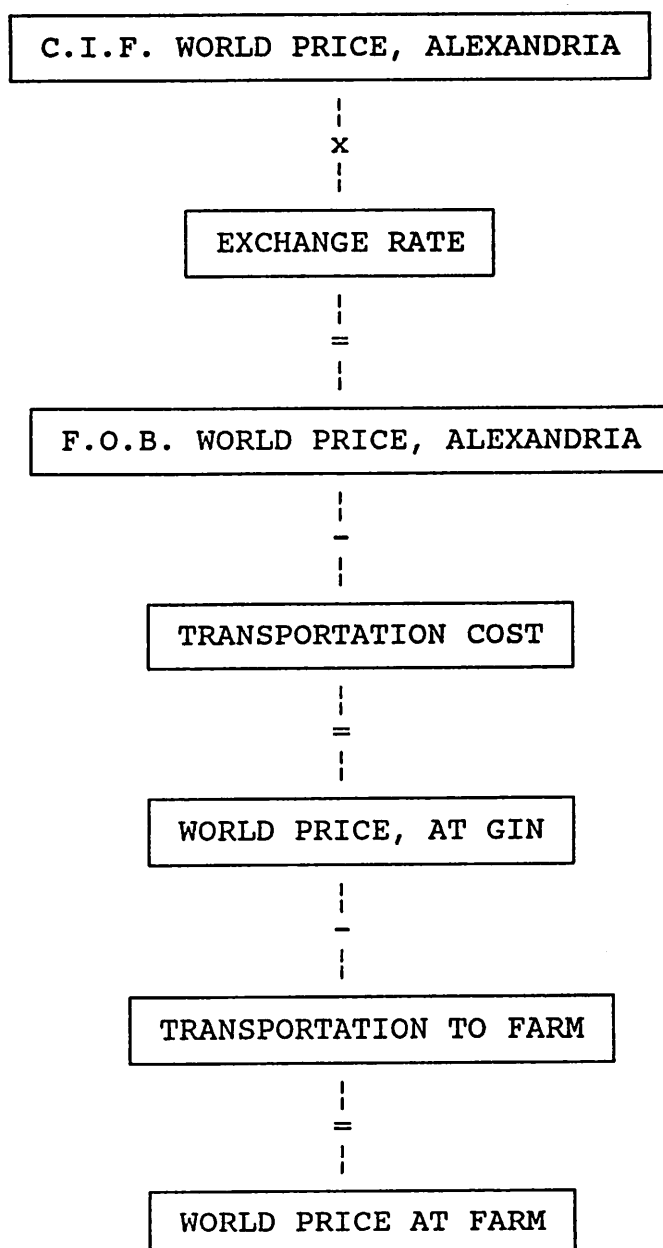


Table 3. Example of Import Parity Price of Wheat, 1990

Item	Unit	Price
World price (FOB), U.S Gulf	\$/Ton	138.00
Add Freight and insurance cost U.S Gulf to Alex	\$/Ton	32.00
Get World price (CIF), Alexandria	\$/Ton	170.00
Multiply Shadow exchange rate	LE/\$	2.70
Get Border price at Alexandria	LE/Ton	459.00
Add Transport and Marketing costs	LE/Ton	26.00
Get Border price at mills	LE/Ton	485.00
Add Value of by-product	LE/Ton	0.00
Deduct Processing margin and transport cost	LE/Ton	6.00
Get Border price before milling	LE/Ton	479.00
Consider Conversion allowance	%	100.00
Get Border price at farm-gate	LE/Ton	4.9.00

Table 4. Example of Export Parity Price of Raw Cotton, 1990

Item	Unit	Price
World price (CIF), Liverpool	\$/Ton	3059.00
Deduct Freight and insurance cost Liverpool to Alex	\$/Ton	32.00
Get World price (FOB), Alexandria	\$/Ton	3027.00
Multiply Shadow exchange rate	LE/\$	2.70
Get Border price at Alexandria	LE/Ton	8172.90
Deduct Transport and Marketing costs	LE/Ton	12.30
Get Border price at mills	LE/Ton	8160.60
Add Value of by-product	LE/Ton	45.00
Deduct Processing margin and transport cost	LE/Ton	82.00
Get Border price before milling	LE/Ton	8132.60
Consider Conversion allowance	%	2.67
Get Border price at farmgate	LE/Ton	3045.92

3.4.4 Social Prices of Tradables

Tradable goods, by definition, have border prices. Tradable goods may be divided into four categories as shown in the following table.

Table 5. Social Prices for Tradable Goods¹

Category	Price
Exported output	The price is the FOB value of commodities actually exported. If the country is a major exporter of the good and its sales can affect the international price, the shadow price is the marginal export price.
Diverted export	The price is the FOB value of commodities that would be exported if they were not used as inputs by the domestic economy.
Import substitutes	The price is the CIF value of commodities that would be imported if there were no domestic production by the commodity system.
Imported inputs	The price is the CIF value of imported goods used by the commodity system to produce outputs.

3.4.5 Social Prices of Non-Tradables

Non-tradable goods and services have no readily available border price by which to measure social value. All analysis begin by asking a basic question: what does the economy forgo because input X is used in the production of Y. This is referred to as its contribution to the next best alternative use².

There are two polar cases. First, no alternative is forgone if input X is not used in production of Y. Second an alternative is forgone if the contribution of X in the alternative output Z would have been as valuable as in the current production of Y. The task is to identify and price this next best alternative.

¹ FAO, Economic Analysis of Agricultural Policies. A Basic Training Manual with Special Reference to Price Analysis. Rome, 1991.

² Isabelle Tsakok, Agricultural Price Policy. A Practitioner's Guide to Partial Equilibrium Analysis. Cornell University Press, New York, 1990.

3.4.5.1 Shadow Price of Land

If there is a competitive market in renting or leasing land, it can be assumed that land rentals and prices reflect the marginal productivity of the land, then there is no real problem in determining its social value as the rental value indicates the net value of production of the land. If there is no land or rental market exists, the production foregone in its best alternative use for a crop that compete directly for land. The foregone production, in this case, is the profit of the activity at social values, excluding land costs.

3.4.5.2 Shadow Price of Labour

The market wage of labour sometimes does not reflect the opportunity cost of the marginal worker to the economy. In many countries government fixes minimum wage rate for unskilled labour.

The valuation of labour in shadow terms is of importance, specially, in production systems where labour forms a large part of the total cost structure. Generally speaking, the opportunity cost of labour in production of Y is its contribution to Z, or its marginal product in the next best alternative. However, if the labour markets are competitive, an average of market wage rates is indicative of the marginal product of labour.

3.4.5.3 Shadow Price of Irrigation Water

Assessing the economic value of water can be a difficult task because its value is dependent on the particulars of the delivery system: quality, time, and location. If the public provision of irrigation water is a major component of public investment, as in Egypt, water's shadow price is equal to the cost of operating and maintaining the delivery system. The best source of information would be a detailed cost-benefit appraisal of the investment in the irrigation system.

Table 6 below illustrates the sources of social prices for tradable and non tradable goods and domestic factors.

Table 6. Sources of Social Prices for Tradable and Non-Tradable Goods and Domestic Factors

Item	Source of Social Price
Revenue (Tradable Output)	
• exported	border price
• exportable (diverted export)	border price similar goods
• import substitutes	border price of competing goods
Tradable Input	
• imported	border price
• importable	border price of similar goods
Domestic Resources	shadow prices
Non Tradable Input	break-down in terms of tradable inputs and domestic resources. Domestic resources are then valued at shadow prices.

3.5 Sensitivity Analysis

Sensitivity analysis provides a way of assessing the impact of changed assumptions and errors in estimating profitability. It can be applied to both private and social estimations. In principle, all social parameters can be subjected to sensitivity analysis. However, the social estimates of long-run world prices for output, the cost of labour, and the cost of capital are usually the most uncertain and receive the most attention in sensitivity analysis.

3.6 Farm-Level Budgets and Analysis

The PAM analyst is concerned with the price and quantity used of each input in order to measure the effects of price distortions or to assess the potential impacts of input substitution.

The farm budget is the most basic source of information for any analysis concerned with costs of agricultural production or the role of inputs. A farm budget is a list of the costs of production. Preferably it displays both the quantity and the unit price of each input. All prices should be standardized to a common time period.

The more detail the list of inputs, the more useful the farm budget. To be useful, the budget must identify the locality of the farm and the yield of crop(s). It is even more useful if the local farm gate price of the output is given, so that regional-average or national-average prices do not have to be applied.

The major item that varies in its treatment is land costs. Some budgets exclude them, on the ground that the farmer owns his land. If the budget is to be used in studies of economic protection rates, then the implicit land rent must be added.

In some kinds of analysis it is necessary to know how crops are combined and rotated. In other words, a description of prevailing farming system is needed.

3.6.1 Selection of Representative Farm Activities

Choice of farm activities are determined by the scope of agricultural issues identified by the government. If the research focuses on the impact of government policies of tax/subsidy on the agricultural sector, one or two representative budgets for each crop should be sufficient.

If the research focuses on a single crop or technology, a more detailed specification of commodity production is needed and a

large number of representative farms should be used. If the research focuses on sectoral income distribution, the farm scale becomes an important issue. If the focuses on regional growth the region-specific commodity systems become essential.

3.6.2 Multiple Commodities

Sometimes two or more crops are grown simultaneously on a particular parcel because of some mutually beneficial relationship. Sometimes, also, agronomic considerations require crop rotations on a particular parcel of land. For example if cotton cultivation is limited by agronomic constraints to two every three years.

The sustainable unit area approach can be used in the case of multiple commodities. According to this approach a representative land unit (for example one hectare) includes all agricultural practices required by the representative system. In case of cotton rotation a representative hectare includes two-thirds of a hectare of cotton and one-third of a hectare of an alternative crop. Similarly, inter-crop systems will be based on shares of area occupied by the various crops.

3.6.3 Permanent Crops

Permanent crops, such as tree crops, present another group of problems for budget estimates. A sustainable unit area can be built, so that the representative area included different stages of the crop life cycle. Each year one a three-year crop cycle (sugarcane for example) is represented in one-third of a unit of area in the representative crop budget.

The problem with the sustainable unit area calculations for permanent crops is the omission of the time related costs and revenue. For example, it calculates profits as if they were available every year. To avoid such difficulty, revenue and costs for each year are then discounted to a present value of the use of land over the project cycle.

3.7 The Policy Analysis Matrix and Agricultural Planning

The PAM analyses can form an integral part of three types of agricultural policy analysis¹:

- agricultural prices;
- public investment projects; and
- public agricultural research allocations.

Policy makers typically want to know how agricultural policies affect farm incomes, where new public investments in agriculture should be made, or why public funds should be spent on one line of agricultural research instead of another. If a planning agency were assigned responsibility for all three policy areas, the PAM could assist that agency in setting its research agenda.

3.7.1 The PAM and Price Policy Analysis

For price policy analysis, the PAM shows the extent to which policies and market failures have influenced the levels of revenues and costs facing producers in some recent base year. The PAM demonstrates empirically the relationships among different policies and market failures that cause private prices to diverge from their social values. The accounting framework is a consistent means of tabulating information required for price policy analysis.

3.7.2 The PAM and Investment Policy Analysis

A critical element in deciding on a strategy for a sequence of public investments is to know the social profitabilities of the existing agricultural systems. Hence it is critical for planners to know how socially profitable or not systems before the investment.

If the planning agency has constructed PAMs for the country's major agricultural systems, these matrices can provide results that aid in the process of determining the allocation of public investment in agriculture. Calculation of domestic resource cost ratios (DRCs) allows the comparison of efficiency among systems that produce unlike outputs. These DRCs offer useful information to investment planners.

¹ Eric A. Monke and Scott R. Pearson, The Policy Analysis Matrix for Agricultural Development. Cornell University Press, New York, 1989.

It is worth to notice that the efficiency results given by PAMs must be complemented with complete social benefit-cost analyses of the most promising projects, selected on the basis of the baseline social profits and expected improvements from the investments. Evaluation of alternative projects, therefore, can use the PAM baseline results to discover which systems are currently socially profitable.

3.7.3 The PAM and Agricultural Research Policy Analysis

Almost all public expenditure for agricultural research intend to improve crop yields or to reduce input needs, thereby raising profits in existing agricultural systems. Since the new technologies would be used in the future under differing economic environments, complementary analyses should include projections of changes in world prices and factor prices along with technological changes arising from agricultural research.

The baseline PAMs show how well current systems are operating. The technological changes (yield increases or cost reductions) needed to arrive at improved private or social profits can then be determined.

3.8 Strengths and Weaknesses of the PAM

The major strength of the PAM is that its results, in the form of a simple accounting matrix, are easily understood by policy makers. Consequently, PAM output is more likely to receive consideration than the output of less transparent models. However, there are some difficulties and limitations to this form of partial analysis. Following are the most important limitations and weaknesses of the PAM¹:

- The analysis is static as it is carried out at one point in time only, and the choice of time period can have an important effects on the results of the analysis;
- The PAM does not link different crop activities endogenously as it implies that a change in the profitability of one farm activity will not change the input-output relationship in another activity or even the level of inputs into another activity;

¹ FAO, The Policy Analysis Matrix for Wheat and Cotton in Egypt: a case study. Workshop on Prices and Marketing Policies in Agriculture, 17 Nov.-, Dec. 1991, INP, Cairo, Egypt.

- The analysis assumes a fixed input-output relationship. This implies that the same quantities of inputs are used under differing price scenarios. In other words, it ignores the impact of relative prices on the level of physical inputs. This is because the PAM does not include any elasticity estimates;
- The PAM approach, as with any social cost-benefit analysis, makes many assumptions with respect to the nature of free markets and their prices.

4. THE CASE STUDY

The PAM methodology was used to analyze the important crops in Egypt, namely: bean, rice, wheat, cotton, corn, sugarcane, and short berseem. The harvested area of these seven crops amounts approximately 80% of the total harvested area.

Since farmers are following cropping patterns rather than single crops, PAM was, also, used to analyze the most important cropping patterns in Egypt. The analyzed cropping patterns are six, namely: wheat & corn, wheat & rice, bean & corn, sugarcane, and short berseem & cotton.

All mentioned crops have a border price except short berseem. Wheat, corn, and sugarcane are importable, while cotton, rice, and bean are exportable. Import parity prices were calculated for importable goods and export parity prices were, also, calculated for exportable goods. Social price for short berseem was derived on the basis of equivalent goods (concentrates).

As the commodity system includes different activities (or stages), PAM was used, in this case study, to analyze only the production stage. To run such analysis the following data have been collected for 1990, for the seven crops, and tabulated as follows:

- Table 7: Farm-Level input-output data;
- Table 8: Farm-Level private or market prices.

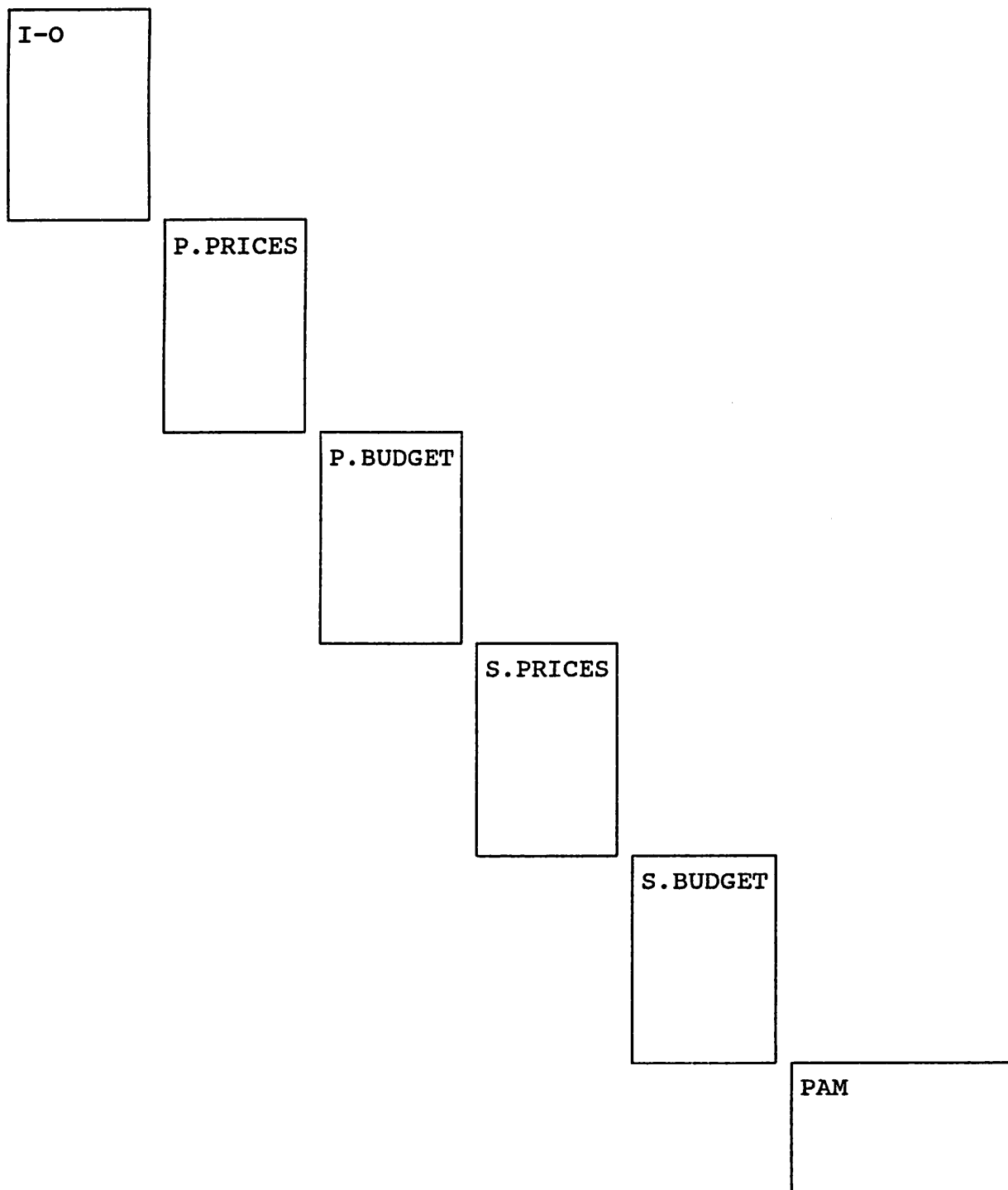
Such data are just enough to calculate farm-level private budget. Social prices are needed in order to calculate farm budget at social prices. Additional data related to social prices were collected and assumed. Mentioned data and assumptions were tabulated in the following tables:

- Table 19: Assumptions for social prices calculations;
- Table 20: Indicative data for import/export parity prices calculations;
- Table 21: Assumptions for sensitivity analysis.

Other tables are working tables to be used for calculations. It is worth to mention that all tables are laid out in the spreadsheet (LOTUS 123), and organized in a "diamondback" format (see diagram in next page).

4.1 Organization of the Spreadsheet

The working tables are located on the diagonal of the spreadsheet as follows:



4.2 Calculating Cots and Revenue at Private Prices

Data to be used for the calculations of the private budget are contained in the I-O table and private prices table. Private budget table is obtained by multiplying quantities from I-O table by prices from private prices table.

The results of private profitability calculations are shown in the table 9 for single crops and in table 12 for crop rotations.

4.3 Calculating Cots and Revenue at Social Prices

Data to be used for the calculations of the social budget are contained in the I-O table and social prices table. Social budget table is obtained by multiplying quantities from I-O table by prices from social prices table.

The most difficult part of calculations is the estimate of social prices. To get such estimates data contained in tables 19 (assumptions for social prices calculations) and table 20 (indicative data for import/export parity prices) were used. Table 10 presents estimated social prices. The results of the social profitability calculations are shown in table 11 for single crops and in table 13 for crop rotations.

4.4 Entering Data Into the PAM

Data for the PAMs are contained in the private and social budgets. Tables 14a, b, c, d, e, f, and g present PAMs for single crops bean, rice, wheat, cotton, maize, sugarcane, and short berseem respectively. Tables 15a, b, c, d, and e present PAMs for crop rotations wheat and maize, wheat and rice, bean and maize, bean and rice, and cotton and short berseem. The sugarcane PAM contained in table 14f is considered as single crop and crop rotation meanwhile as sugarcane is a perennial crop.

4.5 Computing Coefficients

The results from the previous PAMs will be used to calculate the Nominal Protection Coefficient (NPC) on tradable outputs, Nominal Protection Coefficient on tradable inputs (NPI), Effective Protection Coefficient (EPC), and the Domestic Resource Cost Coefficient (DRC). Results are contained in above mentioned tables.

Table 16 presents a summary of protection and efficiency coefficients (NPCs, NPIs, EPCs, and DRCs) for single crops and crop rotations (cropping patterns).

4.6 Interpretation of Results

The interpretation of results will focus on the results of single crops. Similar interpretation could be derived for crop rotations.

4.6.1 Output Transfers

The results of the analysis show that the private value of bean, rice, wheat, cotton, and sugarcane currently less than the social value. On the other hand, the private value of corn and short berseem currently exceeds the social value.

Because the domestic price of corn and short berseem are held above the world market price, farmers producing these commodities are receiving a transfer from the rest of the economy of 42.12 and 41.72 LE per feddan respectively. The picture for the other crops is completely different as farmers are taxed since they are receiving less than the world market price by 364.92, 29.87, 12.45, 1129.89, and 1709.50 for bean, rice, wheat, cotton, and sugarcane respectively.

The NPCs for corn and short berseem are 1.04 and 1.10 respectively. This means that private revenue are 4% and 10% above what they could be if there were no intervention. The NPCs for other crops are less than one which means that they are taxed. The picture is more clear for cotton and sugarcane as the production is completely purchased by the government at a low price. As the NPCs for cotton and sugarcane are 0.56 and 0.58 respectively, it means that the prices received by farmers growing cotton and sugarcane are less by 44% and 42% respectively than they would be if the delivery system was not existing.

4.6.2 Input Transfers

All input transfers are negative except for short berseem which means that farmers are paying, for tradable inputs, less than it should be if there is no intervention. In other words, farmers are subsidized in tradable inputs except for berseem.

The NPIs for all crops are less than one except for berseem. The least NPI is 0.24 for cotton which means that the prices paid by farmers growing cotton are less by 76% than they would be if there is no subsidy on the tradable inputs.

NPIs for other subsidized crops are 0.61, 0.67, 0.62, 0.56, 0.52 for bean, rice, wheat, corn, and sugarcane. Such figures mean that farmers are paying for their tradable inputs less than it should be by 39%, 33%, 38%, 44%, and 48% respectively.

4.6.3 Effective Protection Coefficients

The effective protection coefficient (EPC) displays the effect of policy on the value added. The results of the analysis show that the EPCs for rice, wheat, corn and short berseem were 1.01, 1.05, 1.15, and 1.03 respectively implying that value added was 1%, 5%, 15%, and 3% respectively higher than it would be in the absence of policies.

On the other hand, the EPCs for bean, cotton, and sugarcane were 0.74, 0.61, and 0.59 respectively implying that value added was 26%, 39%, and 41% respectively lower than it would be in the absence of policies

4.6.4 Domestic Resource Coefficients

The Domestic Resource Coefficient (DRC) displays the comparative advantage. The results of the analysis show that the DRCs for bean, cotton, and sugarcane are less than one implying that there is a comparative advantage in the production of these crops. As an example, the DRC for cotton is 0.75 which means efficient use of domestic resources to earn a unit of foreign exchange.

TABLE 7: FARM-LEVEL INPUT/OUTPUT DATA, 1990

I-O (1990)	UNITS	BEAN	RICE	WHEAT	COTTON	MAIZE	SUG. CANE	SHORT BERSEEM

TRADABLE INPUTS								
FERTILIZER								
UREA N. 15.5%	KG/FED	100.000	266.000	500.000	400.000	600.000	1000.000	0.000
SUPER PHOSPHATE	"	200.000	100.000	100.000	100.000	100.000	100.000	0.000
POTASIMUM SULPHATE	"	0.000	0.000	0.000	0.000	0.000	100.000	0.000
INCETICIDES	UNIT	1.000	1.000	1.000	1.000	1.000	1.000	0.000
SEED								
DELIVERED	KG/FED	28.000	45.000	47.500	70.000	0.000	0.000	0.000
PURCHASED	"	50.000	15.000	27.500	0.000	35.000	1000.000	25.000
DOMESTIC FACTORS								
LABOUR								
LAND PREPARATION	MANDAY/FED	4.000	4.000	4.750	9.000	4.000	6.000	3.250
PLANTING	"	1.500	1.000	0.250	3.500	1.000	5.000	1.000
IRRIGATION	"	1.000	10.500	4.500	8.000	5.000	17.000	2.000
FERTILIZER	"	1.500	1.000	2.000	2.000	2.000	2.000	0.000
WEEDING & PLOWING	"	4.000	17.750	0.000	38.000	7.000	18.000	0.000
HARVES. & THRESHING	"	10.500	13.000	17.500	19.000	10.000	25.500	14.000
TRANSPORTATION	"	1.000	2.500	1.000	1.000	2.000	20.000	1.000
MACHINERY								
LAND PREPARATION	HRS/FED	4.000	8.000	4.000	4.000	5.900	6.000	3.000
IRRIGATION	HRS/FED	12.000	30.000	10.000	21.000	25.000	48.000	15.000
PEST CONTROL	UNIT	1.000	1.000	1.000	1.000	1.000	1.000	1.000
HARVES. & THRESHING	HRS/FED	4.000	4.000	4.000	5.000	4.000	0.000	0.000
TRANSPORTATION	UNIT	1.000	1.000	1.000	1.000	1.000	1.000	1.000
WATER	1000 M3	3.000	3.500	2.500	4.500	2.500	12.000	1.500
YIELD								
MAIN PRODUCT	TON/FED	1.236	3.050	2.180	0.820	2.340	40.680	9.756
BY PRODUCT	TON/FED	1.613	1.700	2.900	1.788	2.175	0.000	0.000
LAND	FEDDAN	1.000	1.000	1.000	1.000	1.000	1.000	1.000
=====								

TABLE 8: FARM-LEVEL PRIVATE PRICES, 1990

PRIVATE PRICES (1990)	UNITS	BEAN	RICE	WHEAT	COTTON	MAIZE	SUG. CANE	SHORT BERSEEM

TRADABLE INPUTS								
FERTILIZER								
UREA/N.15.5%	LE/KG	0.132	0.132	0.132	0.132	0.132	0.132	0.132
SUPER PHOSPHATE	"	0.129	0.129	0.129	0.129	0.129	0.129	0.129
POTASIAM SULPHATE	"	0.000	0.000	0.000	0.000	0.000	0.305	0.305
INCETICIDES	LE	5.630	3.800	1.690	14.700	0.400	2.160	0.000
SEED								
DELIVERED	LE/KG	0.039	0.550	0.533	0.084	0.000	0.000	0.000
PURCHASED	"	0.690	0.367	0.473	0.000	0.427	0.058	1.234
DOMESTIC FACTORS								
LABOUR								
LAND PREPARATION	LE/MANDAY	5.410	5.560	5.410	5.470	5.560	5.470	5.490
PLANTATION	"	5.410	5.560	5.410	5.470	5.560	5.470	5.490
IRRIGATION	"	5.410	5.560	5.410	5.470	5.560	5.470	5.490
FERTILIZER	"	5.410	5.560	5.410	5.470	5.560	5.470	5.490
WEEDING & PLOWING	"	5.410	5.560	5.410	5.470	5.560	5.470	5.490
HARVES. & THRESHING	"	5.410	5.560	5.410	5.470	5.560	5.470	5.490
TRANSPORTATION	"	5.410	5.560	5.410	5.470	5.560	5.470	5.490
MACHINERY								
LAND PREPARATION	LE/HR	7.000	7.000	7.000	7.000	7.000	7.000	7.000
IRRIGATION	LE/HR	2.500	2.500	2.500	2.500	2.500	2.500	2.500
PEST CONTROL	LE	3.700	1.600	1.490	5.300	0.300	0.300	0.000
HARVES. & THRESHING	LE/HR	9.000	9.000	9.000	9.000	9.000	0.000	0.000
TRANSPORTATION	LE	17.500	24.000	20.000	10.800	15.300	86.500	7.000
WATER	LE/1000M3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YIELD								
MAIN PRODUCT	LE/TON	690.360	367.000	473.290	1668.000	426.600	58.000	48.400
BY PRODUCT	LE/TON	54.040	24.480	90.240	31.080	32.480	0.000	0.000
LAND	LE	86.180	72.000	81.950	122.600	66.500	160.400	38.130
=====								

TABLE 9: PRODUCTION FARM BUDGET AT PRIVATE PRICES

REVENUES AND COSTS AT PRIVATE PRICES	BEAN	RICE	WHEAT	COTTON	MAIZE	SUG. CANE	SHORT BERSEEM
TRADABLE INPUTS							
FERTILIZER							
UREA, N. 15.5%	13.200	35.112	66.000	52.800	79.200	132.000	0.000
SUPER PHOSPHATE	25.800	12.900	12.900	12.900	12.900	12.900	0.000
POTASIAM SULPHATE	0.000	0.000	0.000	0.000	0.000	30.500	0.000
INCECTICIDES	5.630	3.800	1.690	14.700	0.400	2.160	0.000
SEED							
DELIVERED	23.492	24.750	25.318	5.880	0.000	0.000	0.000
PURCHASED	34.500	5.505	13.008	0.000	14.945	58.000	30.850
DOMESTIC FACTORS							
LABOUR							
LAND PREPARATION	21.640	22.240	25.698	49.230	22.240	32.820	17.843
PLANTATION	8.115	5.560	1.353	19.145	5.560	27.350	5.490
IRRIGATION	5.410	58.380	24.345	43.760	27.800	92.990	10.980
FERTILIZER	8.115	5.560	10.820	10.940	11.120	10.940	0.000
WEEDING & PLOWING	21.640	98.690	0.000	207.860	38.920	98.460	0.000
HARVES. & THRESHING	56.805	72.280	94.675	103.930	55.600	139.485	76.860
TRANSPORTATION	5.410	13.900	5.410	5.470	11.120	109.400	5.490
MACHINERY							
LAND PREPARATION	28.000	56.000	28.000	28.000	41.300	42.000	21.000
IRRIGATION	30.000	75.000	25.000	52.500	62.500	120.000	37.500
PEST CONTROL	3.700	1.600	1.490	5.300	0.300	0.300	0.000
HARVES. & THRESHING	36.000	36.000	36.000	45.000	36.000	0.000	0.000
TRANSPORTATION	17.500	24.000	20.000	10.800	15.300	86.500	7.000
WATER	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL REVENUE	940.424	1160.966	1293.468	1423.316	1069.356	2359.440	472.190
MAIN PRODUCT	853.285	1119.350	1031.772	1367.760	998.712	2359.440	472.190
BY PRODUCT	87.140	41.616	261.696	55.556	70.644	0.000	0.000
TOTAL COST(execl. land cost)	344.957	551.277	391.705	668.215	435.205	995.805	213.013
LAND COST	86.180	72.000	81.950	122.600	66.500	160.400	38.130
PROFIT (execl. land cost)	595.467	609.689	901.763	755.101	634.151	1363.635	259.178
NET PROFIT(incl. land cost)	509.287	537.689	819.813	632.500	567.651	1203.235	221.048

TABLE 10: ESTIMATED FARM-LEVEL SOCIAL PRICES

SOCIAL PRICES (1990)	UNITS	BEAN	RICE	WHEAT	COTTON	MAIZE	SUG.CANE	SHORT BERSEEM

TRADABLE INPUTS								
FERTILIZER								
UREA,N15.5%	LE/KG	0.248	0.248	0.248	0.248	0.248	0.248	0.248
SUPER PHOSPHATE	"	0.291	0.291	0.291	0.291	0.291	0.291	0.291
POTASIMUM SULPHATE	"	0.738	0.738	0.738	0.738	0.738	0.738	0.738
INCETICIDES	LE	7.525	5.079	2.259	19.649	0.535	2.887	0.000
SEED								
DELIVERED	LE/KG	0.986	0.377	0.479	3.046	0.409	0.100	0.044
PURCHASED	"	0.986	0.377	0.479	3.046	0.409	0.100	0.662
DOMESTIC FACTORS								
LABOUR								
LAND PREPARATION	LE/MANDAY	8.500	8.500	8.500	8.500	8.500	8.500	8.500
PLANTATION	"	8.500	8.500	8.500	8.500	8.500	8.500	8.500
IRRIGATION	"	8.500	8.500	8.500	8.500	8.500	8.500	8.500
FERTILIZER	"	8.500	8.500	8.500	8.500	8.500	8.500	8.500
WEEDING & PLOWING	"	8.500	8.500	8.500	8.500	8.500	8.500	8.500
HARVES. & THRESHING	"	8.500	8.500	8.500	8.500	8.500	8.500	8.500
TRANSPORTATION	"	8.500	8.500	8.500	8.500	8.500	8.500	8.500
MACHINARY								
LAND PREPARATION	LE/HR	10.500	10.500	10.500	10.500	10.500	10.500	10.500
IRRIGATION	LE/HR	3.750	3.750	3.750	3.750	3.750	3.750	3.750
PEST CONTROL	LE	5.550	2.400	2.235	7.950	0.450	0.450	0.000
HARVES. & THRESHING	LE/HR	13.500	13.500	13.500	13.500	13.500	0.000	0.000
TRANSPORTATION	LE	26.250	36.000	30.000	16.200	22.950	129.750	10.500
WATER	LE/'000M3	20.000	20.000	20.000	20.000	20.000	20.000	20.000
YIELD								
MAIN PRODUCT	LE/TON	985.600	376.794	479.000	3045.918	408.800	100.023	44.123
BY PRODUCT	LE/HEML	54.040	24.480	90.240	31.080	32.480	0.000	0.000
LAND	LE							

TABLE 11: PRODUCTION BUDGET AT SOCIAL PRICES

REVENUES AND COSTS AT SOCIAL PRICES	BEAN	RICE	WHEAT	COTTON	MAIZE	SUG.CANE	SHORT BERSEEM

TRADABLE INPUTS							
FERTILIZER							
UREA,N.15.5%	24.800	65.968	124.000	99.200	148.800	248.000	0.000
SUPER PHOSPHATE	58.200	29.100	29.100	29.100	29.100	29.100	0.000
POTASIAM SULPHATE	0.000	0.000	0.000	0.000	0.000	73.800	0.000
INCETICIDES	7.525	5.079	2.259	19.649	0.535	2.887	0.000
SEED							
DELIVERED	27.597	16.956	22.753	213.214	0.000	0.000	0.000
PURCHASED	49.280	5.652	13.173	0.000	14.308	100.023	16.546
DOMESTIC FACTORS							
LABOUR							
LAND PREPARATION	34.000	34.000	40.375	76.500	34.000	51.000	27.625
PLANTATION	12.750	8.500	2.125	29.750	8.500	42.500	8.500
IRRIGATION	8.500	89.250	38.250	68.000	42.500	144.500	17.000
FERTILIZER	12.750	8.500	17.000	17.000	17.000	17.000	0.000
WEEDING & PLOWING	34.000	150.875	0.000	323.000	59.500	153.000	0.000
HARVES. & THRESHING	89.250	110.500	148.750	161.500	85.000	216.750	119.000
TRANSPORTATION	8.500	21.250	8.500	8.500	17.000	170.000	8.500
MACHINARY							
LAND PREPARATION	42.000	84.000	42.000	42.000	61.950	63.000	31.500
IRRIGATION	45.000	112.500	37.500	78.750	93.750	180.000	56.250
PEST CONTROL	5.550	2.400	2.235	7.950	0.450	0.450	0.000
HARVES. & THRESHING	54.000	54.000	54.000	67.500	54.000	0.000	0.000
TRANSPORTATION	26.250	36.000	30.000	16.200	22.950	129.750	10.500
WATER	60.000	70.000	50.000	90.000	50.000	240.000	30.000
TOTAL REVENUE	1305.341	1190.838	1305.916	2553.208	1027.236	4068.936	430.466
MAIN PRODUCT	1218.202	1149.222	1044.220	2497.652	956.592	4068.936	430.466
BY PRODUCT	87.140	41.616	261.696	55.556	70.644	0.000	0.000
TOTAL COST(execl. land cost)	599.952	904.530	662.019	1347.813	739.343	1861.760	325.421
LAND COST							
PROFIT (execl. land cost)	705.389	286.308	643.897	1205.395	287.893	2207.176	105.045
NET PROFIT(incl. land cost)	705.389	286.308	643.897	1205.395	287.893	2207.176	105.045
=====							

TABLE 12: PRODUCTION BUDGET AT PRIVATE PRICES FOR CROP ROTATIONS

REVENUES AND COSTS AT PRIVATE PRICES (CROP ROTATIONS)	WHEAT & MAIZE	WHEAT & RICE	BEAN & MAIZE	BEAN & RICE	SUGAR CANE	S.BERSEEM & COTTON

TRADABLE INPUTS						
FERTILIZER						
UREA,N.15.5%	145.200	101.112	92.400	48.312	132.000	52.800
SUPER PHOSPHATE	25.800	25.800	38.700	38.700	12.900	12.900
POTASIUH SULPHATE					30.500	0.000
INCETICIDES	2.090	5.490	6.030	9.430	2.160	14.700
SEED						
DELIVERED	25.318	50.068	23.492	48.242	0.000	5.880
PURCHASED	27.953	18.513	49.445	40.005	58.000	30.850
DOMESTIC FACTORS						
LABOUR						
LAND PREPARATION	47.938	47.938	43.880	43.880	32.820	67.073
PLANTATION	6.913	6.913	13.675	13.675	27.350	24.635
IRRIGATION	52.145	82.725	33.210	63.790	92.990	54.740
FERTILIZER	21.940	16.380	19.235	13.675	10.940	10.940
WEEDING & PLOWING	38.920	98.690	60.560	120.330	98.460	207.860
HARVES. & THRESHING	150.275	166.955	112.405	129.085	139.485	180.790
TRANSPORTATION	16.530	19.310	16.530	19.310	109.400	10.960
MACHINARY						
LAND PREPARATION	69.300	84.000	69.300	84.000	42.000	49.000
IRRIGATION	87.500	100.000	92.500	105.000	120.000	90.000
PEST CONTROL	1.790	3.090	4.000	5.300	0.300	5.300
HARVES. & THRESHING	72.000	72.000	72.000	72.000	0.000	45.000
TRANSPORTATION	35.300	44.000	32.800	41.500	86.500	17.800
WATER	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL REVENUE	2362.824	2454.434	2009.780	2101.390	2359.440	1895.506
MAIN PRODUCT	2030.484	2151.122	1851.997	1972.635	2359.440	1839.950
BY PRODUCT	332.340	303.312	157.784	128.756	0.000	55.556
TOTAL COST(execl. land cost)	826.910	942.982	780.162	896.234	995.805	881.228
LAND COST	148.450	153.950	152.680	158.180	160.400	160.730
PROFIT (execl. land cost)	1535.914	1511.452	1229.618	1205.156	1363.635	1014.278
NET PROFIT(incl. land cost)	1387.464	1357.502	1076.938	1046.976	1203.235	853.548
=====						

TABLE 13: PRODUCTION BUDGET AT SOCIAL PRICES FOR CROP ROTATIONS

REVENUES AND COSTS AT SOCIAL PRICES (CROPPING ROTATIONS)	WHEAT & MAIZE	WHEAT & RICE	BEAN & MAIZE	BEAN & RICE	SUGAR CANE	S.BERSEEM & COTTON

TRADABLE INPUTS						
FERTILIZER						
UREA,N.15.5%	272.800	189.968	173.600	90.768	248.000	99.200
SUPER PHOSPHATE	58.200	58.200	87.300	87.300	29.100	29.100
POTASIU M SULPHATE	0.000	0.000	0.000	0.000	73.800	0.000
						0.000
INCE TICIDES	2.794	7.338	8.060	12.604	2.887	19.649
SEED						
DELIVERED	22.753	39.708	27.597	44.553	0.000	213.214
PURCHASED	27.481	18.824	63.588	54.932	100.023	16.546
DOMESTIC FACTORS						
LABOUR						
LAND PREPARATION	74.375	74.375	68.000	68.000	51.000	104.125
PLANTATION	10.625	10.625	21.250	21.250	42.500	38.250
IRRIGATION	80.750	127.500	51.000	97.750	144.500	85.000
FERTILIZER	34.000	25.500	29.750	21.250	17.000	17.000
WEEDING & PLOWING	59.500	150.875	93.500	184.875	153.000	323.000
HARVES. & THRESHING	233.750	259.250	174.250	199.750	216.750	280.500
TRANSPORTATION	25.500	29.750	25.500	29.750	170.000	17.000
MACHINERY						
LAND PREPARATION	103.950	126.000	103.950	126.000	63.000	73.500
IRRIGATION	131.250	150.000	138.750	157.500	180.000	135.000
PEST CONTROL	2.685	4.635	6.000	7.950	0.450	7.950
HARVES. & THRESHING	108.000	108.000	108.000	108.000	0.000	67.500
TRANSPORTATION	52.950	66.000	49.200	62.250	129.750	26.700
WATER						
	100.000	120.000	110.000	130.000	240.000	120.000
TOTAL REVENUE						
	2333.152	2496.754	2332.577	2496.179	4068.936	2983.674
MAIN PRODUCT						
BY PRODUCT	2000.812	2193.442	2174.794	2367.423	4068.936	2928.118
	332.340	303.312	157.784	128.756	0.000	55.556
TOTAL COST(execl. land cost)						
	1401.362	1566.549	1339.295	1504.482	1861.760	1673.234
LAND COST						
PROFIT (execl. land cost)	931.790	930.205	993.282	991.697	2207.176	1310.440
NET PROFIT(incl. land cost)	931.790	930.205	993.282	991.697	2207.176	1310.440
=====						

TABLE 14a: PRODUCTION POLICY ANALYSIS MATRIX FOR BEAN

POLICY ANALYSIS MATRIX FOR BEAN (ALL PER FEDDAN)

	TRADABLE		DOMESTIC FACTORS					
	REVENUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	940.424	102.622	242.335	0.000	86.180	509.287	NPC	0.720
SOCIAL PRICES	1305.341	167.402	372.550	60.000	643.897	61.492	NPI	0.613
EFFECTS OF							EPC	0.736
DISTORTIONS	-364.917	-64.780	-130.215	-60.000	-557.717	447.795	DRC	0.946

TABLE 14b: PRODUCTION POLICY ANALYSIS MATRIX FOR RICE

POLICY ANALYSIS MATRIX FOR RICE (ALL PER FEDDAN)

	TRADABLE		DOMESTIC FACTORS					
	REVENUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	1160.966	82.067	469.210	0.000	72.000	537.689	NPC	0.975
SOCIAL PRICES	1190.838	122.755	711.775	70.000	535.731	-249.423	NPI	0.669
EFFECTS OF							EPC	1.010
DISTORTIONS	-29.872	-40.688	-242.565	-70.000	-463.731	787.112	DRC	1.234

TABLE 14c: PRODUCTION POLICY ANALYSIS MATRIX FOR WHEAT

POLICY ANALYSIS MATRIX FOR WHEAT (ALL PER FEDDAN)

	TRADABLE		DOMESTIC FACTORS					
	REVENUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	1293.468	118.915	272.790	0.000	81.950	819.813	NPC	0.990
SOCIAL PRICES	1305.916	191.284	420.735	50.000	705.389	-61.492	NPI	0.622
EFFECTS OF							EPC	1.054
DISTORTIONS	-12.448	-72.369	-147.945	-50.000	-623.439	881.305	DRC	1.055

TABLE 14d: PRODUCTION POLICY ANALYSIS MATRIX FOR COTTON

POLICY ANALYSIS MATRIX FOR COTTON (ALL PER FEDDAN)

	TRADABLE		DOMESTIC FACTORS					
	REVENUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	1423.316	86.280	581.935	0.000	122.600	632.501	NPC	0.557
SOCIAL PRICES	2553.208	361.163	896.650	90.000	647.760	557.635	NPI	0.239
EFFECTS OF DISTORTIONS	-1129.892	-274.883	-314.715	-90.000	-525.160	74.865	EPC	0.610
							DRC	0.746

TABLE 14e: PRODUCTION POLICY ANALYSIS MATRIX FOR MAIZE

POLICY ANALYSIS MATRIX FOR MAIZE (ALL PER FEDDAN)

	TRADABLE		DOMESTIC FACTORS					
	REVENUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	1069.356	107.445	327.760	0.000	66.500	567.651	NPC	1.041
SOCIAL PRICES	1027.236	192.743	496.600	50.000	535.731	-247.838	NPI	0.557
EFFECTS OF DISTORTIONS	42.120	-85.298	-168.840	-50.000	-469.231	815.489	EPC	1.153
							DRC	1.297

TABLE 14f: PRODUCTION POLICY ANALYSIS MATRIX FOR SUGARCANE

POLICY ANALYSIS MATRIX FOR SUG. CANE (ALL PER FEDDAN)

	TRADABLE		DOMESTIC FACTORS					
	REVENUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	2359.440	235.560	760.245	0.000	160.400	1203.235	NPC	0.580
SOCIAL PRICES	4068.936	453.810	1167.950	240.000	1607.194	599.982	NPI	0.519
EFFECTS OF DISTORTIONS	-1709.496	-218.250	-407.705	-240.000	-1446.794	603.253	EPC	0.587
							DRC	0.834

TABLE 14g: PRODUCTION POLICY ANALYSIS MATRIX FOR SHORT BERSEEM

POLICY ANALYSIS MATRIX FOR SHORT BERSEEM (ALL PER FEDDAN)

	TRADABLE		DOMESTIC FACTORS					
	REVENUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	472.190	30.850	182.163	0.000	38.130	221.048	NPC	1.097
SOCIAL PRICES	430.466	16.546	278.875	30.000	302.310	-197.265	NPI	1.864
EFFECTS OF							EPC	1.066
DISTORTIONS	41.724	14.304	-96.713	-30.000	-264.180	418.313	DRC	1.477

TABLE 15a: PRODUCTION POLICY ANALYSIS MATRIX FOR WHEAT AND MAIZE

POLICY ANALYSIS MATRIX FOR WHEAT & MAIZE ROTATION (ALL PER FEDDAN)

	TRADABLE		DOMESTIC FACTORS					
	REVENUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	2362.824	226.360	600.550	0.000	148.450	1387.464	NPC	1.013
SOCIAL PRICES	2333.152	384.027	917.335	100.000	2207.176	*****	NPI	0.589
EFFECTS OF							EPC	1.096
DISTORTIONS	29.672	-157.667	-316.785	-100.000	-2058.726	2662.849	DRC	1.654

TABLE 15b: PRODUCTION POLICY ANALYSIS MATRIX FOR WHEAT AND RICE

POLICY ANALYSIS MATRIX FOR WHEAT & RICE ROTATION (ALL PER FEDDAN)

	TRADABLE		DOMESTIC FACTORS					
	REVENUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	2454.434	200.982	742.000	0.000	891.813	619.639	NPC	0.983
SOCIAL PRICES	2496.754	314.039	1132.510	120.000	1310.440	-380.235	NPI	0.640
EFFECTS OF							EPC	1.032
DISTORTIONS	-42.320	-113.057	-390.510	-120.000	-418.627	999.874	DRC	1.174

TABLE 15c: PRODUCTION POLICY ANALYSIS MATRIX FOR BEAN AND MAIZE

POLICY ANALYSIS MATRIX FOR WHBEAN & MAIZE ROTATION

(ALL PER FEDDAN)

	TRADABBLE		DOMESTIC FACTORS					
	REVANUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	2009.780	210.067	570.095	0.000	152.680	1076.938	NPC	0.862
SOCIAL PRICES	2332.577	360.145	869.150	110.000	2207.176	*****	NPI	0.583
EFFECTS OF							EPC	0.912
DISTORTIONS	-322.797	-150.078	-299.055	-110.000	-2054.496	2290.832	DRC	1.615

TABLE 15d: PRODUCTION POLICY ANALYSIS MATRIX FOR BEAN AND RICE

POLICY ANALYSIS MATRIX FOR WHBEAN & RICE ROTATION

(ALL PER FEDDAN)

	TRADABBLE		DOMESTIC FACTORS					
	REVANUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	2101.390	96.442	711.545	0.000	158.180	1135.223	NPC	0.842
SOCIAL PRICES	2496.179	290.157	1084.325	130.000	1310.440	-318.743	NPI	0.332
EFFECTS OF							EPC	0.909
DISTORTIONS	-394.788	-193.715	-372.780	-130.000	-1152.260	1453.966	DRC	1.144

TABLE 15e: PRODUCTION POLICY ANALYSIS MATRIX FOR COTTON AND SHORT BERSEEM

POLICY ANALYSIS MATR COTTON & SHORT BERSEEM ROTATION

(ALL PER FEDDAN)

	TRADABBLE		DOMESTIC FACTORS					
	REVANUES	INPUTS	LABOUR	WATER	LAND	PROFITS		
PRIVATE PRICES	1895.506	117.130	764.098	0.000	160.730	853.548	NPC	0.635
SOCIAL PRICES	2983.674	377.709	1175.525	120.000	993.282	317.158	NPI	0.310
EFFECTS OF							EPC	0.682
DISTORTIONS	-1088.168	-260.579	-411.428	-120.000	-832.552	536.391	DRC	0.878

TABLE 16: PROTECTION AND EFFICIENCY COEFFICIENTS

SUMMARY OF PROTECTION AND EFFICIENCY COEFFICIENTS

	NPC	NPI	EPC	DRC
BEAN	0.720	0.613	0.736	0.946
RICE	0.975	0.669	1.010	1.234
WHEAT	0.990	0.622	1.054	1.055
COTTON	0.557	0.239	0.610	0.746
MAIZE	1.041	0.557	1.153	1.297
SUG. CANE	0.580	0.519	0.587	0.834
S.BERSEEM	1.097	1.864	1.066	1.477
WHEAT & MAIZE	1.013	0.589	1.096	1.654
WHEAT & RICE	0.983	0.640	1.032	1.174
BEAN & MAIZE	0.862	0.583	0.912	1.615
BEAN & RICE	0.842	0.332	0.909	1.144
COTTON & S.BERSEEM	0.635	0.310	0.682	0.878

TABLE 17: IMPORT PARITY PRICE CALCULATIONS

IMPORT PARITY PRICE CALCULATIONS	UNIT	WHEAT	MAIZE	SUG. CANE
WORLD PRICE (FOB)	\$/TON	138.000	112.000	518.000
ADD FREIGHT & INSURANCE	\$/TON	32.000	32.000	32.000
WORLD PRICE AT ALEX.	\$/TON	170.000	144.000	550.000
MARKET EXCH.RATE	LE/\$	2.700	2.700	2.700
BORDER PRICE AT ALEX.	LE/TON	459.000	388.800	1485.000
ADD TRANSPORT & MARKETING COSTS	LE/TON	26.000	26.000	14.300
BORDER PRICE AT MILLS	LE/TON	485.000	414.800	1499.300
ADD VALUE OF BY-PRODUCT	LE/TON	0.000	0.000	0.000
DEDUCT PROCESSING MARGIN & TRANSPORT COST	LE/TON	6.000	6.000	590.000
BORDER PRICE BEFORE MILL.	LE/TON	479.000	408.800	909.300
CONVERSION ALLOWANCE	%	100.000	100.000	11.000
BORDER PRICE AT FARMGATE	LE/TON	479.000	408.800	100.023

TABLE 18: EXPORT PARITY PRICE CALCULATIONS

EXPORT PARITY PRICE CALCULATIONS	UNIT	COTTON	RICE	BEAN
WORLD PRICE (CIF)	\$/TON	3059.000	278.000	409.000
DEDUCT FREIGHT & INSURANCE	\$/TON	32.000	32.000	32.000
WORLD PRICE AT ALEX.	\$/TON	3027.000	246.000	377.000
MARKT EXCH.RATE	LE/\$	2.700	2.700	2.700
BORDER PRICE AT ALEX.	LE/TON	8172.900	664.200	1017.900
DEDUCT TRANSPORT & MARKETING COSTS	LE/TON	12.300	12.300	12.300
BORDER PRICE AT MILLS	LE/TON	8160.600	651.900	1005.600
ADD VALUE OF BY-PRODUCT	LE/TON	54.000	6.000	0.000
DEDUCT PROCESSING MARGIN & TRANSPORT COST	LE/TON	82.000	87.000	20.000
BORDER PRICE BEFORE MILL.	LE/TON	8132.600	570.900	985.600
CONVERSION ALLOWANCE	%	2.670	66.000	100.000
BORDER PRICE AT FARMGATE	LE/TON	3045.918	376.794	985.600

TABLE 19: ASSUMPTIONS FOR SOCIAL PRICES CALCULATIONS

I. SOCIAL PRICES FOR TRADABLE INPUTS

1. OFFICIAL EXCHANGE RATE	=	2.020	LE/US\$			
2. SHADOW EXCHANGE RATE	=	2.700	LE/US\$			
3. BORDER PRICE AT FARMGATE OF N.15.5%	=	248.000	LE/TON			
4. BODER PRICE AT FARMGATE OF SUPER PHOSPHATE	=	291.000	LE/TON			
5. BORDER PRICE AT FARMGATE OF POTAS.SULPHATE	=	738.000	LE/TON			
6. SHADOW PRICE FOR INSECTICIDES = PRIVATE PRICE * SHADOW EX.RATE/ OFFICIAL EX.RATE						
7. SOCIAL PRICE FOR SEED IS THE SAME AS FOR MAIN PRODUCT	= S.PRICE*	1.000				
8. SHADOW PRICE FOR LABOR = THE BEST WAGE PREVAILED IN THE SECTOR	=	8.500	LE/M.DAY			
9. SHADOW PRICE FOR MACHINARY PRIVATE PRICE OF MACHINARY RENT * 150% (50% INCREASE OF OIL COST)	= P.PRICE*	1.500				
10. SHADOW PRICE FOR WATER	=	20.000	LE/'000M3			
11. SOCIAL PRICES OF MAIN PRODUCTS = IMPORT/EXPORT PARITY PRICES						
12. SOCIAL PRICES OF BY-PRODUCTS	= P.PRICE*	1.000				
13. OPPORTIUNITY COST OF LAND = PROFIT EXCLUDING LAND COSTS OF THE SECOND BEST CROP THAT COMPETE DIRECTLY FOR AGRICULTURAL RESOURCES WITH THE CROP						
14. FOLLOWING ARE CROPS' DURATION IN MONTHS:						
BEAN	RICE	WHEAT	COTTON	MAIZ	S.CANE	S.BERSEEM
7	4	7	9	4	12	3

II. SOCIAL PRICE FOR SHORT BERSEEM

GIVEN:

- ONE TON OF CONCENTRATE + 10 TONS OF WHEAT STRAW ARE SUBSTITUTABLE FOR 10 TONS OF BERSEEM
- ONE TON OF BERSEEM ADDS 0.4 KG. OF NITROGEN TO THE SOIL

FOLLOWING ARE SOCIAL PRICE CALCULATIONS FOR SHORT BERSEEM:

SOCIAL PRICE OF CONCENTRATE	350.000	LE/TON
SOCIAL PRICE OF WHEAT STRAW	90.240	LE/TON
SOCIAL PRICE OF BERSEEM	44.024	LE/TON
N.15.5% OF ONE TON BERSEEM	0.400	KG.
SOCIAL PRICE OF N.15.5%	0.248	LE/KG
VALUE OF NITROGEN ADDED	0.099	LE/TON
NET SOCIAL PRICE OF BERSEEM	44.123	LE/TON

TABLE 20: INDICATIVE DATA FOR IMPORT/EXPORT PARITY PRICES

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DATA FOR IMPORT/EXPORT PARITY PRICES

I. DATA FOR IMPORTABLE GOODS

	UNIT	WHEAT	MAIZE	S.CANE
WORLD PRICE FOB	\$/TON	138.000	112.000	518.000
FREIGHT & INSURANCE	\$/TON	32.000	32.000	32.000
TRANS. & MARKETING	LE/TON	26.000	26.000	14.300
VALUE OF BY-PRODUCT	LE/TON	0.000	0.000	0.000
PROCESS. MARGIN & TRANS.	LE/TON	6.000	6.000	590.000
CONVERSION ALLOWANCE	%	100.000	100.000	11.000

II. DATA FOR EXPORTABLE GOODS

	UNIT	COTTON	RICE	BEAN
WORLD PRICE CIF	\$/TON	3059.000	278.000	409.000
FREIGHT & INSURANCE	\$/TON	32.000	32.000	32.000
TRANS. & MARKETING	LE/TON	12.300	12.300	12.300
VALUE OF BY-PRODUCT	LE/TON	54.000	6.000	0.000
PROCESS. MARGIN & TRANS.	LE/TON	82.000	87.000	20.000
CONVERSION ALLOWANCE	%	2.670	66.000	100.000

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TABLE 21: SENSITIVITY ANALYSIS

SENSITIVITY ANALYSIS

EGYPTIAN GOVERNMENT IS TARGETING TO PHASE OUT INPUTS SUBSIDIES THROUGH A PACKAGE OF POLICY REFORM PROGRAMS. SOME OF THESE PROGRAMS ARE:

I. ELEMINATION OF INPUTS SUBSIDY

- PRIVATE PRICES OF N.15.5% INCREASED FROM LE	0.132	TO	0.248
- PRIVATE PRICES OF SUPER PHOSPHATE INCREASED FROM LE	0.129	TO	0.291
- PRIVATE PRICES OF POTASium SULPHATE INCREASED FROM LE	0.305	TO	0.460
- PRIVATE VALUE OF PESTCIDES INCREASED BY 20%	= P.PRICE	*	1.200

II. INCREASING CROPS FARMGATE PRICES TO THE WORLD PRICES

INCREASE FARMGATE PRICES OF COTTON TO BE 60 % OF ITS WORLD PRICES

= P.PRICE * 1.600

REFERENCES

Gittinger, J.P., "Economic Analysis of Agricultural prices", EDI Series in Economic Development, 2nd edition, 1982.

Pearson, S.R. and Monke, E.A., "The Policy Analysis Matrix: A Guide for Practitioners", Washington, 1987.

Pearson, S.R. and Monke, E.A., "The Policy Analysis Matrix for Agricultural Development", Cornell University Press, 1989.

Timmer, C.P., Falcon, W.P. and Pearson, Scott R., "Food Policy Analysis", International Bank for Reconstruction and Development, 1983.

Tsakok, I., "Agricultural Price Policy: A Practitioner's Guide to Partial-Equilibrium Analysis", Cornell University Press, 1990.

Winter-Nelson, A., (Editor), "Application of the Policy Analysis Matrix (PAM)", EDI Working Papers, Economic Development Institute of The World Bank, Washington, 1991.

FAO, "Economic Analysis of Agricultural Policies: A Basic Training Manual with Special Reference to Price analysis", ESPT, Rome, 1991

FAO, "Agricultural Policy Analysis Exercises", ESPT, Rome, 1991.

FAO, "Structural Adjustment and Agriculture. Report on In-Service Training Seminar for FAO Staff", ESPT, Rome 1991

Lotus, "Lotus 123 Reference Manual", Cambridge MA, 1985.

IBRD, "Agricultural Price Management in Egypt", Report No. 388, Washington, D.C., 1980