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RATIONALIZING PEASANT DECISIONS IN A RESTRUCTURING ECONOMY

Abstract.

A Neo-Malthusian optimization model with efficient consumption is used to represent the economics of the peasantry. The household model includes both the costs of living and production, maximizes the family's net income, and is connected to the rest of the economy through product and labor markets. The critical decision of whether or not peasants will continue as farm producers depends on off-farm employment possibilities, crop diversification and the relationship of farm costs to market prices. In all simulations, a production subsidy proved superior to a direct income transfer both for family income and in providing the peasantry incentives to remain as farm producers and not to migrate to urban centers.

Key words: Mexico, migration, peasantry, restructuring, subsidies

Classification code: C61; D13; O18; Q18

1.-Introducción

The restructuring of markets from semi-closed to more open conditions requires rapid and substantial adjustments in behavior by all economic agents in effected societies. Because of their disadvantaged positions both as producers and consumers, and because they typically represent a much larger fraction of the national population than their participation in the national product, considerable concern is directed toward the consequences of open economies on the peasant sector. In this study we direct our attention on the least advantaged segment of the Mexican peasantry, although the style of analyisis and probably the results as well should have much wider currency.

Questions related to the economic behavior of marginalized subsistence peasant corn producers in Mexico although addressed, have been only partially answered by recent research. In fact, there is no explanation of why peasants continue growing corn when, according to official data, its market price is lower than their production costs. Why haven't they all migrated to urban areas leaving the countryside abandoned? Do they behave irrationally? If not, what are the economic relations which determine their behavioral patterns? Will corn market trade liberalization under the North American Free Trade Agreement (NAFTA) push them to migrate, or won't they be affected? Does the substitution of the guarantee price policy and input subsidies by a lump sum subsidy either in the form of an income transfer or a direct production subsidy accelerate or retard out-migration of the peasantry, or does it have no effect on migration? If peasants are forced out, in what year? For all of these questions, how is the marginalized peasant to be economically characterized both for production and consumption using the household as the unit of analysis? The work which is here being reported addresses these questions.

A good deal of recent research on Mexican agriculture has focused on estimating NAFTA's effects on these issues, using two basic approaches and aggregation levels: i) partial equilibrium models directed toward specific questions or specific agricultural goods or commodities, as for example in estimations of producer and consumer subsidy equivalents (Engels and Segarra, 1990; Perez, 1990; Reyes, 1991; Webbs et al,.1990); ii) as a sector within computable general equilibrium models (CGEM), which have varying degrees of emphasis on the agricultural sector (Levy and Wijnberger, 1992 and 1994; Taylor, 1993; Joslin, 1993; Kejhoe, 1992; Hinojosa and Robinson, 1992 and 1993; Robinson et al., 1992; Yunez, 1991). Within this group two works stand out as closely related to the questions addressed in this paper.

The work by Levy and Wijnberger (1992), under the assumptions of trade liberalization and within a CGEM environment, analyzes the whole corn subsector dividing the plantings into two areas: irrigated and rainfed. They assume that subsistence producers are located on rainfed soils, grow only corn and have farms not bigger than 5 hectares. These are limiting assumptions, because as will be shown, marginalized peasants own at most two hectares, corn has byproducts, and corn and beans are commonly grown together. Levy and Wijnberger's main conclusion is that an immediate liberalization of corn from product and input subsidies and import controls would produce the highest gain (0.6% per year) in gross domestic product (GDP), but it would induce a large rural out-migration (700,000 workers). If liberalization were to be gradual, gains would be 0.4% in GDP, and out-migration would be distributed over a period of 5 years. In this analysis, gainers are consumers, taxpayers and government, while losers are those corn growers who are net corn sellers.

At an alternative level of aggregation, there is the work by Taylor, which uses a village CGEM with the following assumptions: production is composed of staples, livestock, and non-agricultural products; subsistence farm households own less than two hectares of land, a middle group owns two to eight hectares of land, and larger households have more than eight hectares of land. Within this analysis the guarantee price of corn is reduced by 40 %, while at the same time an equivalent income transfer is made to corn producing households. If direct subsidies to both producers and consumers of maize are set at zero, and if transaction costs are included, a number of his findings are relevant to this study. Taylor shows that under these conditions and compared to pre-intervention conditions household production is reduced by no more than 1.6 percent, while income is increased by 2.8 percent for the subsistence households. Migration is reduced by 2.5 percent, in contrast to Levy's estimations of massive out-migration, and leisure time for the peasant family increases by 3.6 percent.

The differences in the conclusions of these two studies in part derive from their differences in basic assumptions the nature of the product mix, the use of direct income transfers, and the size of the land resource base. Our own analysis, which is reported later in this study indicates that when the marginalized peasant produces only corn, receives an income transfer as a sole subsidy, and operates under corn market liberalization starting in 1994 and in accordance with NAFTA provisions, he will cease to produce in the year 1997; this corresponds approximately with Levy's conclusion when he provides for a gradual opening-up of Mexican domestic corn markets.

However, under the same conditions but assuming that the only subsidy is a lump sum one in the form of a direct production subsidy -- as has been the case under the Direct Subsidy Program (PROCAMPO) in its transitory phase -- the results indicate that peasant producers will continue to stay in agriculture through the last year modeled in the analysis (2003). This suggests the superiority of a lump sum production subsidy over an income transfer in retarding and controlling rural migration, thus lessening urban problems associated with the lack of infrastructure for urban services demanded by the incoming population as well as social unrest and insecurity. In this respect, the general equilibrium models mentioned above do not include government expenditure requirements to build additional urban infrastructure when dealing with migration (just as Robinson and Hinojosa,1992, do not include it when allowing for repatriation of Mexican out-migration from the US), so that implicitly the studies are based on the assumption of permanent urban poverty belts populated by rural families. In a later extension of his work, Levy (1994) proposes to invest in rural infrastructure for the rain-fed areas to store water during the rainy season. The construction phase would create jobs retarding rural out-migration and at the same time increase the rain-fed land's productive capacity tending to equalize it with that of irrigated land. Although a good proposition, unfortunately it has not been subjected to an adequate analysis of precipitation distributions; it would not be promising to implement in areas where it hardly rains. This study does, however, support the proposition that goverment expenditures for productive activities are more efficient than income transfers in enhancing economic development (Çassini, Martellato and Raffaelli, 1995).

Additional insights into the economic behavior of peasant producers derive from our analysis by incorporating the more commonly observed conditions of production, that is to say, jointly producing corn and beans. Under this traditional system of cultivation, the subsistence farmers remain producing until the last year analyzed (2003). This more realistic crop combination gives results distinct from Levy's and approximates Taylor's; the greater the variety of products being produced, the lesser the effect of corn prices on the viability of the marginalized peasant as a participant in the farm economy.

There are two further considerations which can be noted here. Our results indicate that when only corn is being produced, the smallest peasant producers can be expected to cease cultivation in the same year with or without a program of direct income transfers. The results also show that the peasant farmers, when they grow both corn and beans, continue to maintain about the same allocation of household resources to these crops, in part because of resource restraints which limit production possibilities. This result is apparently in contrast to Taylor's, with his analysis showing a drop in corn production when relative corn prices fall even though the producer is compensated by an income transfer. However, his results are for all producers as a group not just the peasantry, and where there is the opportunity to produce a variety of agricultural and non-agricultural products. A significant limitation to this assumption is that it cannot really apply to the marginalized peasantry; if they had these alternatives, they would not be marginalized.

Not related to corn market trade liberalization, but relevant to understanding the economic behavior of the marginalized peasantry is an important case study of a small village (Garcia et al.,1991). The questions of why these farmers cultivate corn even at high costs relative to market prices, and why their production is more or less stable, are answered culturally and anthropologically, thus contributing certain insights but making comparison with the present paper rather difficult.

2. Tasks and objectives.

The main purposes of this paper are to characterize the nature of corn and bean production for the producers who are marginalized both from economic and technological points of view, as well as to rationalize family consumption patterns in terms of the nutritional value of their foods. In section 3, we analyze the relationship between technological packages, both actual and potential, with derived corn yields as a function of the marginalized producer's land acreage. In order to dimension the size of the targeted population group, there is an estimation of the number of farmers and households that should be considered marginalized. The production side is rounded out by reporting the most common inputs and factors used in production and why these are selected. The analysis specifies the peasantry's production mode.
Section 3 also includes the characterization of household consumption in terms of calorie, vitamin, protein and mineral intakes and how these compare to those recommended by the Mexican National Institute of Nutrition. The analysis offers a priori answers to why these peasant household food baskets are composed of corn, beans, and chili and other vegetables.

A second task is the building of a behavioral model (section 4) of the marginalized peasant household economy developed from the discussion in section 3. It is a Neo-Malthusian one, combined with a Lancaster-type activity analysis of consumption. Assumptions and properties of the model are specified. It is appropriate to note that the household is the unit of analysis, both as producer and consumer.

A third element of this study is the calibration of the model using relevant data, and generating simulations for several scenarios, including those under NAFTA. Here, most of the questions introduced at the beginning of the paper are addressed. In fact, the answers generated by the model constitute the basic objective of this work. They are presented under the heading of results in section 5. Section 6 specifies the conclusions and gives the policy interpretation of the main findings.

3. Economic and technological patterns of corn production.

3.1 Technology and potential yields.

The National Forestry, Agricultural and Livestock Research Institute (INIFAP) (1991) has graded cultivable land into five classes according to moisture regimes: (1) gravity irrigated, (2) pump irrigated; and rainfed in three categories, (3) good natural rainfall, (4) inadequate rainfall, and (5) relatively poor rainfall. Marginalized peasant lands fall into the fourth and fifth classes.

Using 31 explanatory variables and a statistical model, the Secretariat of Agriculture and Water Resources of Mexico (SARH), INIFAP, and the Colegio de Postgraduados (CP, Postgraduate School) (1993) have shown that the fourth and fifth land class areas: i) have a low potential to produce agricultural products other than corn, or corn and beans in association, either because there is no available improved technology, or yields even including those for maize and beans are extremely low making the planting of alternative crops infeasible. Among the variables considered one can mention: moisture, transevaporation, soil types, rainfall, irrigation, temperatures, and land slope; ii) show no significant differences in the corn yields derived from alternative technological packages, even those especially designed for the agro-ecologic regional and soil conditions. It follows that changes in seed quality, input mix, use of machinery, etc. do not significantly modify corn and bean yields, but do effect production costs. Under these circumstances, traditional farming presents the relatively lowest mean cost among all relevant technologies, and is barely challenged by any of the alternative technological packages. One can expect corn to continue to be produced utilizing traditional technology as long as the mean cost of producing grain -- net of byproduct value, because it is recovered as animal feed -- does not exceed its market price, recognizing that production costs respond to the market prices of inputs.

3.2 Land acreage and observed yields.

According to a recent sample survey of corn farmers by the SARH (1992), 67 percent of corn producers (1.6 million peasants) own less than two hectares of land. Of these, 70 percent (1.12 million producers) are located in inadequate and poor natural rainfall areas according to work by the SARH, INIFAP and CP. The other 500 thousand could improve their yields and lower their mean production costs by applying known technological packages. Observed corn yields for those 1.12 million less advantaged peasants are in the range of from 0.48 tons/hectare to 1.2 tons/hectare, with a mean of 0.8 tons/hectare. This compares to the better-off smallest farmer group's mean yield of 1.4 tons/hectare, and to the national yield of 2 tons/hectare. The approximately two-thirds of those farmers with less than two hectares of corn lands and for whom there is no presently known improved production technology is the group that we refer to as the marginalized peasantry. It is the population segment targeted in this essay. Other characteristics of this group will be specified.

3.3 Productive inputs and factors.

Data developed by the SARH, INIFAP and CP, using Mexican sub-state level Rural Development Districts (DDR), show for the marginalized producers that the dominant actual and/or potential technologies depend principally upon the two traditional factors, land and labor, with only minimal capital goods, and two direct inputs -- seed and fertilizer. Physical technological coefficients per ton are shown in Table 1. These data define the technological possibilities, yields, productive inputs and factor mixes and provide estimates of these peasant producers' production function over time using a classical formulation with a constant land yield (0.8 tons/hectare), a la Malthus, as explored by Baumol (1970).

3.4 Income and consumption patterns.

A recent household income expenditure survey by the National Institute of Statistics, Geography and Information (INEGI) (1989) shows that expenditure on corn relative to total food expenditure by the lowest first and second rural income deciles is twice that of rural households as a whole. Of course, as income rises the share of expenditure on corn decreases. Data also show the importance of corn related expenditure by most rural households -- from the i^{st} to the vi^{th} deciles (Table 2).

According to Mexico's National Institute of Nutrition (1989): i) the actual consumption of rural low-income classes is far from the standardized nutritional requirements of calories and vitamins, 30 percent and 80 percent below the minimum requirements, respectively (Table 3); ii) the current diet of this segment of the population is based principally on four products: corn and its derivatives, beans, chili, and sugar. Their nutritional contents (Munoz et al., 1992; Avila and Gutierrez, 1992) are shown in Table 4.

This basket composition and the pattern of corn consumption concentration leads one to suspect that feasible substitutes within the goods basket are of little relevance.

Reasons for this may be that:

i) Marginal rates of substitution utility derived from the substitutes and goods actually consumed are quite small, meaning a rather considerable decrease in the relative prices of substitutes would have to occur for the group to reduce traditional consumption goods. Or,

ii) This segment of the peasantry has little knowledge of how to cook and prepare substitutes, such as bread from wheat, or that changes would require equipment whose acquisition costs require accumulated savings which are rarely available to them. Both possibilities mean that even if substitute prices are lower than that of corn (assuming that in the utility function tastes are equal for corn and noncorn), the costs to peasants of preparing substitutes, --or of buying them in the market-- might more than compensate for price differences between traditional goods and the substitutes. It also implies that the relevant prices for the peasant families are those of the whole meal and not just of the grain component. Or,

iii) These marginalized families are actually aware of the substitutes' nutritional properties, which happen to be lower in calories, calcium, and vitamins, and equivalent only in proteins (see Table 3). One can hypothesize, using an activity analysis of consumption along the lines used by Lancaster (1966a, 1966b and 1970), and Deaton and Muellbauer (1980), that family consumption is a) objectively efficient in satisfying nutritional requirements if relative prices in terms of corn were higher than for wheat-based meals; and b) peasant households are subjectively efficient in choosing their traditional goods if relative prices are close to one, given their tastes and cultural background.

4. A behavioral model and its properties.

The smallest peasant farms principally produce corn and its secondary products and usually beans. For these farmers the following model is proposed to represent the economics of the marginalized peasantry.

4.1 Assumptions.

The Model assumes the population growth rate to be an endogenous variable relating actual and past population in a first difference equation as in recent Neo-Malthusian dynamic models (Nerlove, 1992). Technology, for the marginalized peasant as discussed above, is unique with fixed technological coefficients of production as in Ricardian production functions. Given that one wants to analyze what could happen if peasant farmers grow corn and beans (as is frequently the case), it is considered that the products are produced jointly. Because of the soil and agro-ecologic conditions already discussed, yields for both products are quite low (those observed). Following the argument by Schultz (1964), peasant production is efficient; and we propose that consumption is as well, assuming that the utility function of the peasant family is separable into subutilities, with the one corresponding to food being linearly explained by the technological properties or nutritional characteristics of alternative goods. Following Malthus (Blaug, 1967), food costs, and by extension housing costs, enter as costs of reproducing the labor force (the unit of analysis). The smallest farm producers are assumed to be price takers both as sellers and buyers of inputs, factors, and goods they produce and consume; however, they have a reservation expected wage for the cultivation of their own land that lies between 0 - 100 percent of the market rural wage. Corn and bean market prices are exogenous to the subsistence farmers and have been estimated independently of the model.

4.2 Model for the marginalized peasantry.

Under the above assumptions the model is specified as:

$$\text{Max } Y = \text{Max } \{P_m Q + PP_m q + P_f F + PP_f f + P_z Z - CA - CPROD\} \qquad (1)$$

Maximum net income = maximum income from selling corn and beans in the market and to themselves (at producer price), and from either labor or other products' net value; less food costs and the out-of-pocket production costs of corn and beans. Where Y = net income, P_m = corn market price, Q = amount of corn sold in the market, PP_m = corn producer's price, q= amount of household consumed corn, P_f = bean market price, F = amount of beans sold in the market, PP_f = bean production price, f = amount of household consumed beans, P_z = market price (or wages) of other goods (labor) sold by the peasant family, Z = amount of goods (labor) sold in the market, CA = food and housing costs, CPROD = purchased input costs.

Subject to:

$CA = PP_m\, q + PP_f\, f + \Sigma_i X_i P_i + HC$ (2)

Food costs = consumption of corn and beans produced by the peasant family valued at producer's price plus other food costs, including corn and beans bought in the market. Housing costs complete the principal peasant household requirements.

Where X_i = amount of consumer goods bought by the peasant family in the market, P_i = consumer good prices, and HC = housing costs.

$CPROD = PP_m\, M + PP_f\, B$ (3)

Direct production costs of corn and beans valued at producer's prices. Where M = corn production, and B = bean production.

Because of joint production, it is assumed that costs of inputs and factors, except for those of seed and corn byproducts, are common to both. Therefore, mean costs for each one are:

$PP_m = \Sigma_i v_i d_{1i} + w\, d_2 + R\, d_3 + P_{seedm}\, d_{4m} - k_1 P_{rm}$ (4)

$PP_f = \Sigma_i v_i d_{1i} + w\, d_2 + R\, d_3 + P_{seedf}\, d_{4f}$ (5)

where $1/d_{1i} = (M+B)/I_i$, $1/d_2 = (M+B)/J_1$, $1/d_3 = (M+B)/T$, $1/d_{4f} = M/Seed_f$, $1/d_{4m} = M/Seed_m$, $1/d_{3m} = M/T$, $1/d_{3f} = B/T$.

Where d_{1i}=inverse physical yields or technical coefficients of inputs expressed in tons of input per ton of production (corn and beans). d_2, d_3, d_{4m}, d_{4f} = technical coefficient of labor, land, corn seed, bean seed, respectively. Seed prices, P_{seedm} and P_{seedf}, are either market or producer prices of corn and beans, whichever is lower. T is utilized land in hectares, I_i amount of inputs, J_1 labor work-days, w = wages, R = land rent, v_i = price of inputs, k_1 P_{rm} is the unit value of recuperations (corn byproducts), k_1 being the proportion of byproducts per ton of corn, and P_{rm} the market price or opportunity cost.

$M = q + Q$ (6)

which represents corn production and its allocation for household consumption and sale in the market.

$B = f + F$ (7)

which represents bean production and its allocation for household consumption and sale in the market.

$$X^*_m = X_m + q \qquad (8)$$

which states that the total corn consumption (X^*_m) equals corn bought in the market plus farm produced consumption.

$$X^*_f = X_f + f \qquad (9)$$

which states that the total bean consumption (X^*_f) equals beans bought in the market plus farm produced consumption.

$$J = J_1 + J_2 \qquad (10)$$

which states that the total labor supply is allocated to the production of corn and other goods (work-days/household).

$$RM = k_1 M \qquad (11)$$

which is the quantity of corn byproducts.

$$Z P_z = k_2 J_2 P_z \qquad (12)$$

which is the production of other goods or income from selling family labor in the market, including transportation cost: for example if $k_2 = 1$, transport costs are null, while if $k_2 = 0.5$, transport absorbs 50% of wages ($P_z = w$), J_2 are non agricultural work-days.

$$J = m\,POB, \qquad (13)$$

which states labor supply as a proportion of household members in work-days per family.

$$POB = (1 + r)POB_{-1} \qquad (14)$$

which is the household size expressed in terms of itself lagged one period, and its net growth rate, r.

$$T \leq T^* \qquad (15)$$

which states that cultivated land may not exceed that available.

$$M = 1/d_{3m}\,T\,,\ B = 1/d_{3f}\,T \qquad (16)$$

which is the quantity of corn and beans produced as specified by the Ricardian production functions.

4.3 Nutritional relations.

The traditional basket of a typical marginalized family includes corn (X_m), chili and other vegetables (X_{ch}), beans (X_f), potatoes (X_{po}), and sugar (X_s). Bread and cooking oil might be added. Calories per kilogram of goods are represented by the Cs, where subindices stand for specific goods. Here, W_c represents the calorific value of the traditional goods basket per capita, and is expressed as:

$$W_c = C_m X^*_m + C_{ch} X_{ch} + C_f X^*_f + C_{po} X_{po} + C_s X_s. \tag{17}$$

Similarly, E stands for the protein content per kilogram of a specific consumer good (subindex), while W_e equals the protein value of the traditional goods basket percapita, which is expressed as:

$$W_e = E_m X^*_m + E_{ch} X_{ch} + E_f X^*_f + E_{po} X_{po} + E_s X_s. \tag{18}$$

The vitamin value of the traditional goods basket percapita W_h is expressed as:

$$W_h = H_m X^*_m + H_{ch} X_{ch} + H_f X^*_f + H_{po} X_{po} + H_s X_s. \tag{19}$$

The H stands for the vitamin content per kilogram of consumer good. As before, the subindex corresponds to the specific good.

The mineral value of the traditional goods basket percapita is:

$$W_{mi} = L_m X^*_m + L_{ch} X_{ch} + L_f X^*_f + L_{po} X_{po} + L_s X_s. \tag{20}$$

Where, W_{mi} is the mineral value of the traditional goods basket percapita, and L is the mineral content per kilogram of consumer good. The subindex corresponds to a specific good.

The minimal nutrient requirements for the family, represented by an asterisk (*) are:

$$POB\ W_c(.) \geq POB\ W^*_c \tag{21}$$

or household minimum calorific requirements.

$$POB\ W_e(.) \geq POB\ W^*_e \tag{22}$$

or household minimum protein requirements

$$POB\ W_h(.) \geq POB\ W^*_h \tag{23}$$

or household minimum vitamin requirements.

$$POB\ W_{mi}(.) \geq POB\ W^{*}_{mi} \qquad (24)$$

or household minimum mineral requirements.

*4.4 Properties at the optimum (*derivations are shown in Appendix 1*).*

4.4.1 The shadow land rent equals the farmers' profits on corn and beans, each weighted by its yield. Or, land is not utilized when its shadow rent is lower than the peasant's corn and beans profits, each weighted by its yields.

4.4.2 Marginalized households' corn (beans) production is consumed by the household if its producer price equals its nutritional characteristics per household, valued at their shadow prices. Or, corn (beans) is not consumed by the household if its producer price is not lower than its nutritional characteristics per household, valued at their shadow prices.

4.4.3 Corn (beans) is bought in the market if its market price equals its nutritional characteristics per household, valued at their shadow prices. Or, corn (beans) is not bought in the market if its market price is not lower than the optimal nutritional corn characteristics per household, valued at its (their) shadow price.

4.4.4 For corn (beans) to be produced, producer and market prices, at optimal resource allocation are equal to each other. Or, corn (beans) is produced if its (their) producer price is not lower than its market price.

4.4.5 For the peasant family to remain in the countryside and to provide for its basic needs, the labor supply parameter (m) should equal the sum of weighted relative shadow prices of nutritional basket components per unit of labor shadow price. Given that the relationship is homogeneous of zero degree, any relative rise (fall) in the labor shadow price is compensated by an equal relative rise (fall) in the other shadow prices (the objective substitution effect). Or, for the family to remain stable on its land, the labor supply parameter (m) should not be greater than the sum of weighted relative shadow prices of nutritional basket components by unit of the labor shadow price. Weights in the formulation are excess nutritional requirements (section "e", Appendix 1).

If the net growth rate is negative and not lower than minus one, the peasant family eventually abandons the land.

4.4.6 For the i^{th} good of the peasant's food basket to be consumed, at the optimum, its market price must equal the household's value of its nutritional properties priced at their shadow prices. Or, for the i^{th} good of the peasant's food basket not to be consumed, at the optimum, its market price must not be lower than the household's value of its nutritional properties priced at their shadow prices.

5. Results.

Due to the very nature of the Kuhn-Tucker conditions, the properties already discussed do not offer numerical answers. So, several model simulations were run aimed at answering the questions posed in the introduction, force des motifs of this paper, basically why the marginalized producer continues to grow maize, and when if ever he would abandon such activity, each under several scenarios. Other answers offered by the optimization model which enrich the topic are reported also, such as the peasant's net real income and the household's food basket composition, as well as the shadow prices for nutritional contents and labor.

5.1 Model simulations, settings and scenarios.

5.1.1 Model simulations.

They were grouped in two sets: the first is based on the assumption that corn and its byproducts is the sole enterprise; the second introduces corn and beans to be jointly produced. For each simulation the following settings were considered:

5.1.2 Settings.

a) Two alternatives of corn and bean price vectors are used in the analysis.

The first alternative considers corn and bean real market prices, both taken from SARH, INIFAP and CP (op.cit.) --estimated in accordance with NAFTA (Secretaria de Comercio y Fomento Industrial, 1994), including transaction costs such as transportation, and financial services among the main ones, as well as being adjusted for the transitory tariff provisions of NAFTA. These are identified as Vector Prices I in the Appendix Table 1.

For the second alternative (Price Vector II, also specified in Appendix Table 1) the real market prices for corn and beans during the period 1991-1995 are the guarantee ones. For the years 1996-2003 the corn ones are assumed to equal mean long-run international prices adjusted upward for the possible shift in world demand demonstrated during 1995-96; transaction costs are the ones already mentioned, and we further assumed a Mexican undervalued currency in relation to the US dollar of about 20% -- assuming that the Mexican government will try to mantain an undervalued currency to help obtain a positive trade balance, to stabilize the economy, and to increase savings to promote growth. This corn price scenario, which exempts corn pricing from the transitory quota and tariff provisions of NAFTA, is used as an alternative because other national policy imperatives (control of basic food costs) may well be determinant in corn and beans pricing. That is to say, all corn domestic protections would be dismantled. The bean market prices during the period 1991-95 are the guarantee ones, while for the period 1996-2003 they are assumed to remain constant in real terms.

b) Two per-ton costs of corn and bean production vectors are specified, differentiated by whether there is a lump sum production subsidy or none. Vector components vary according to the chosen peasant producer's reservation on-farm wage, which is taken as a proportion of the market wage (Appendix Table 2). These price and cost vectors are directly incorporated in the analytical models, and have their expression in the contents of tables 5 and 6.

c) Constant values are assumed for the population growth rate as well as for the labor force share in the total population; two categories of labor -- the one associated with the skill requirements for the use of machinery does not include members of the households under analysis while the other, the non-skilled, does incorporate members of the peasant households; five members integrate the peasant family: the two parents, one teenager and two children.

The higher corn and bean prices for vector I during early years of analysis as compared to those for alternative price vector II, result in the simulations being more sensitive in the early years for the alternative I when evaluating the likelihood of farm abandonment against variations in both reservation wages for on-farm work and transport costs (which is also a wage under-cut) for the peasant to work off-farm. Under both price alternative vectors, however, lower production costs derived from a lump sum production subsidy have greater influence on continuation in production decisions than would a direct income transfer; because the production subsidy operates as a reduction in out-of-pocket costs, simulations for early years of alternative II are more sensitive than those of alternative I.

Data used in the models have been given in tables 1, 3, 4 and appendix tables 1 and 2. The base year being used for the simulations is 1991.

5.1.3 Scenarios.

a) Varying only the marginalized farmer's reservation wage for on-farm work, considering three levels of reservation wages: 0, 50 and 100 percent of the rural market wage (results are reported for 50 and 100%).

b) Giving the peasant unit either a zero subsidy, a non-zero direct income transfer, or a non-zero lump sum production subsidy, ceteris paribus. This allows the simulation of Mexico's program of Direct Transfers (PROCAMPO) (SARH, 1993) in either its income transfer or production subsidy approach. Here, we assume that the household unit is given an income transfer of 1992 n$ 360, that is close to what they got during 1995. The direct transfer corresponding to the final phase of PROCAMPO has not been as yet officially determined.

c) Offering the marginalized farmer two labor market locations, one reachable by foot with transportation costs set at zero, the other located within a 50 mile radius with transportation costs by bus set to 1992 n$ 6.

5.2 Results when corn and its byproducts are the only peasant enterprise (Table 5).

5.2.1 The producer unit is given either a zero subsidy, a non-zero direct income transfer, or a lump sum production subsidy.

a) Alternative I of corn price vector.
Model optimization shows that a direct income transfer has no effect in delaying or bringing forward these farmers' decision to continue or to stop cultivating corn, as shown in Table 5. For instance, Table 5 shows that the last year for corn cultivation is 1997 when transport costs are zero, regardless of the income transfer. Accordingly, direct income transfers do not change the poorest peasants' decisions as to when to stop growing corn.

When marginalized farmers are given a production subsidy, they remain cultivating corn in the year 2003 (with non zero transport costs), which may delay their decisions to migrate as compared to the income transfer simulation.

b) Alternative II of corn price vector.
Model results confirm that an income transfer has no effect on farmers' decisions to stop or continue producing corn; although, due to lower corn prices, the last year for corn cultivation is 1995. On the other hand, when the subsistence producer is given a production subsidy he continues to grow corn beyond 2003, the last year analyzed. Again, this kinf of subsidy may help retard peasant farmers from migrating.

5.2.2 The peasant household's reservation wage varies.

a) Alternative I of corn price vector.
Results provided by the model are that the lower the reservation wage the longer the peasant unit will continue cultivating corn, other things being held constant. In fact, at a 100 percent reservation wage, the poorest peasants stop producing corn by the year 1998; if the reservation wage is 0% of the market one, they stop production in the year 1999.

b) Alternative II of corn price vector.
As expected, due to the lower price as compared to the alternative price vector I during early years, results are not sensitive to reservation wage variations.

5.2.3 The marginalized farmer is offered two labor market locations.

a) Alternative I of corn price vector.
Given that transportation costs are equivalent to a wage under-cut, it has the same effect as wage variations. Thus, the optimization analysis shows that the greater the transportation cost for traveling to their work place, other things held constant, the longer marginalized peasants continue to cultivate corn. Table 5 shows that there is a one year difference in the critical year for abandoning corn production when transport costs go from zero to 1992 n$ 6.0/day (from 1998 to 1999) and when the reservation wage for on-farm work is either 1.0 or 0.5 of the market wage.

b) Alternative II of corn price vector.
As expected, due to the lower price as compared to alternative I, results are not sensitive to transportation costs variations.

5.1.4 Comparison between the two price vector alternatives.

Commonalties:

a) Corn and chili and other vegetables predominate in the peasant household diet with consumption exactly at the same amount each year (1.17 and 1.27 tons, respectively); these amounts just cover the minimum subsistence requirements. Below these levels there is malnutrition. Workdays dedicated to corn are 1.8 percent of all disposable labor. Corn which is not consumed within the peasant household is sold on the market.

b) The labor shadow price equals the market wage net of transport cost, as is to be expected.

c) Real shadow prices of minimum nutritional requirements are highest for vitamins at 1992 n$ between 1.92 and 2.00 per gram, with protein costing 1992 n$ 0.002 to 0.006 per gram. Calories and minerals are valued as free goods, showing zero shadow prices, which is understandable due to their relative abundance in maize compared to the other nutritional requirements. In other words, in buying vitamins and proteins, calories and minerals are obtained free.

Differences:

d) Net income is highest when there is a production subsidy; the second best is the income transfer scenario. These transfer payments when combined with zero transport costs and zero reservation wages offer all together the highest net income; while the lowest net income occurs with non-zero transport cost, 0% percent reservation wage, and a zero subsidy. A liberalization of corn markets in the absence of a subsidy leaves the marginalized peasantry worse off than otherwise.

e) Land shadow prices are higher whenever transport costs obtain, when the reservation wage is low and when a production subsidy exists. When land acreage is not fully cultivated its shadow price drops to zero, as is to be expected.

f) Cessation of farming. Under an income transfer and a non-zero transport cost the first alternative of corn and bean price vectors offers the latest cessation date (1999), the year following the last year of production, while the use of price vector II results in the earliest one (1996). Under a production subsidy and a non-zero transport cost for both price alternatives these peasant producers keep on farming at a minimum through the last year simulated (2003).

g) Due to the settings of costs and prices in the alternatives being evaluated, wage reservation levels and transportation costs make differences in farm cessation dates for the first corn price alternative, but neither factor influences the abandonment of farming under the second price vector alternative.

5.3 Corn and beans produced jointly (table 6).

5.3.1 The same alternatives which were modeled for the case of moncultural corn were repeated for the case where corn and beans are being produced jointly. The results for the two production years, 1996 and 2003, are given in table 6. For 1996 peasants optimize household resources allocation by producing both corn and beans under all of the simulated conditions. By the year 2003, some variations in household economic behavior is demonstrated. Under the assumptions of price vector I (that is, pricing protection consistent with provisions of NAFTA) by the last year for the simulation excercise full corn and bean production levels are maintained only when there is a production subsidy, this continuation in farming notwithstanding that off-farm employment may be available nearby without having to pay a daily transportation cost. For all other modeled conditions with prices consistent with the provisions of NAFTA farmers have ceased production or reduced it to minimal levels, as is the case when there are neither production subsidies or income transfers and even when there is a negative incentive transportation cost for getting to an off-farm job.

By constrast, when the model was evaluated for alternative II of the price vector (more competitive price conditions and with a structural change in world grain demand) peasant households continued farm production beyond the last year modeled (2003) under all simulated conditions. Price vector II provides for higher grain prices in the later years of the analysis than is the case for the alternative set of price assumptions. Higher net household incomes result both from the combinations of corn and beans in the production system and from the higher prices under the competitive price scenario. The simulation is consistent with the widely-held position that peasant households are effective economic agents. Two related factors are at play in this part of the analysis; on the one hand the higher final product prices under price vector II encourage peasant producers to continue their farming activities, and in related manner where under the assumptions of price vector I there are lower production prices the simulated introduction of a production subsidy has the effect of reducing production costs and results in comparable production incentives to those of higher prices.

5.3.2 Comparison between the two pricing alternatives.

Commonalties:

a) Corn, chili and other vegetables and beans (whenever grown by the farmer) predominate in the peasant household diet with consumption exactly at the same level each year: 1.17 tons of corn and 1.27 tons of vegetables, except when beans are produced; if they are, family consumption shifts to 0.93 ton of corn, 1.27 tons of vegetables and 0.10 tons of beans. These amounts just cover the minimum subsistence requirements. Below these levels there is malnutrition. Workdays dedicated to corn are 1.8 percent of all disposable labor. Corn which is not consumed within the peasant houschold is sold on the market.

b) Family corn consumption is from farm production when a production subsidy applies; family net income is greater when the costs of corn consumption are valued at the subsidized production cost rather than at the market price. On the other hand, whenever corn market prices are lower than per-ton production costs and bean prices are not, peasant producers continue production as long as the net additional income from selling that proportion of bean production which is not consumed more than compensates the incremental loss incurred in producing corn at market prices lower than per-ton production costs. Under these conditions the total net income (after food and housing costs) derived from producing corn and beans jointly is greater than would be the net income of working off-farm. The analysis provides that all corn produced is sold and consumption requirements are bought in the market. This case, ilustrated in table 6, occurs when there is either a zero subsidy or an income transfer, and where production costs are calculated with a reservation wage for on-farm work equal to the market rate.

c) The labor shadow price equals the market wage net of transport cost, as is to be expected.

d) Real shadow prices of minimum nutritional requirements are highest for vitamins at 1992 n$ 2.00 per gram, with protein costing 1992 n$ 0.001 to 0.003 per gram. Calorie shadow prices show very small figures. Minerals are valued as free goods, which is understandable due to their relative abundance in maize compared to the other nutritional requirements. In other words, in buying vitamins and proteins, calories and minerals are practically obtained free.

Differences:

e) Net income is highest when there is a production subsidy; the second best is the income transfer scenario. The lowest net income occurs with non-zero transport cost, and a zero subsidy. It follows that a liberalization of corn and bean markets not compensated by a subsidy leaves the marginalized peasantry worse off than otherwise.

f) Land shadow prices are higher whenever corn and bean prices are higher, as can be seen by noting the earliest year (1996) and latest year (2003) data in Table 6--

prices are higher in alternative I during earlier years as compared to alternative II, and viceversa during the latter year.When land acreage is not fully cultivated, its shadow price drops to zero, as is to be expected.

g) Cessation of farming. Only when a zero subsidy or an income transfer applies do the poorest farmers cease to cultivate corn and beans and this occurs in the last year simulated (2203). If a production subsidy or a wage under-cut applies as a non zero transport cost, the farmer keeps on growing the two grains, the subsidy offering a higher net income as compared to the negative effects of the transportation cost. As we demonstrated earlier, the production subsidy also tends to delay the peasant family's decision to migrate, even when corn cultivation is the sole enterprise.

6. Conclusions

There is little room for modifying the yields of the poorest peasant cultivators given known technological packages anytime within the next five to eight years. This means that the most efficient form of subsistence agriculture is traditional farming. Government investment in productive infrastructure has negligible possibilities for increasing corn yields on the poorest peasant lands; the only alternative is to bring water from far away places, which would mean having to pump it up to 6000 feet above sea level, or even having to desalinize it. Of course, these actions would be impossibly costly. There might be some opportunity to invest in creating very efficient crop varieties which in the long run could improve corn and bean yields.

If policy calls for marginalized peasants to stay on their land for the next decade or more, they have to be offered a lump sum production subsidy or encouraged to jointly cultivate corn and beans, even at very low yields (800 kilograms and 360 kilograms per hectare, respectively). This action would also result in peasants being better off in that they would receive a higher net real income. By extension, they might also be encouraged to produce their own chili and vegetables. Government programs to slow down migration should rely on the joint production of corn and beans and emphasize vegetable production, especially if urban employment is constrained by labor market failure due to barriers to entry by unions, or because job skill requirements are not matched to the abilities of the new entrants. The necessary training would also take time to accomplish.

If peasant households only grow corn, the effects of liberalizing and gradually eliminating import tariffs (as under NAFTA) on the corn market will result in eliminating corn production by the marginalized peasantry at the earliest in 1998 or at the latest in 2000 depending on whether or not they are given an income subsidy and perceive their on farm reservation wage as zero. Abandonment of farming will not happen if the lump sum subsidy is to production. A production subsidy shows superiority over an equal amount of income transfer in retarding rural out-migration.

If mono-cultural corn growers can find jobs where transport costs are less than 40 percent of wages and where they can commute daily, they will continue growing corn until 1999. Otherwise they will migrate mainly to the cities. This means that highway construction and other public works should tend to facilitate local employment, for then the displaced peasant could temporarily delay migration.

Assuming that the subutility function for foodstuffs of the marginalized peasant household is characterized by the nutritional properties of the goods, the basic diet of peasant families consists mainly of corn, chili and other vegetables, and beans. Other products which happen to be consumed by them, including wheat products -bread and pasta-, potatoes, sugar, and cooking oil do not enter into the consumption basket because they have higher relative prices and comparatively lower nutritional contents. These results have been objectively determined, independent of tastes or cultural and social values.

A Neo-Malthusian optimization model with efficient consumption resulted in a good representation of the economics of the marginalized peasantry, incorporating the peasant household as the unit of analysis as producer and consumer. In the model, land per household has been fixed, and migration is included. The peasant's land is utilized as a productive factor, as is his house. The model includes both the costs of living and production, and maximizes the family's net income. It is connected to the rest of the economy through market prices for all grains, as well as through labor markets.

The most advantaged of those peasants with extremely limited land resources will be the ones who can find a job close to their land, who cultivate corn and beans jointly, and who receive a production subsidy. On the other hand, within the analysis nothing can be concluded as to whether this group of the peasantry will be better or worse off with NAFTA. It depends on whether or not they can find a job, and what their wages will be.

Appendix 1. Derivation of model's properties at the optimum.

Utilizing equations 1 thru 24, the Lagrangian function can be written as:

$LL = (P_m - PP_m)\, d_{3m}\, T + (P_f - PP_f)\, d_{3f}\, T - P_m\, q - P_f\, f + k_2\, w\, J_2 - HC - [P_m\, X_m + P_{ch}\, X_{ch} + P_f\, X_f + P_{po}\, X_{po} + P_s\, X_s] - \{(1+r)\, POB_{-1}\}\{G_1[W^*{}_c - W_c(.)] + G_2[W^*{}_e - W_e(.)] + G_3[W^*{}_h - W_h(.)] + G_4[W^*{}_{mi} - W_{mi}(.)\} - G_5[T - T^*] - G_6\,[J_1 + J_2 - m\,(1+r)\, POB_{-1}]$

where $G_1,...,G_6$ stand for the shadow prices -- Lagrange multipliers -- of calories, proteins, vitamins, minerals, land, and labor, respectively.

Applying the Kuhn - Tucker (1968) conditions one gets, at the optimum:

a) For $T > 0$, $LL'_T = 0$: $G_5 = (P_m - PP_m)\, d_{3m} + (P_f - PP_f)\, d_{3f}$.
The shadow land rent equals, at the optimum, the farmers' profits of corn and beans, each weighted by its yield.
For $T = 0$, $LL'_T \leq 0$: $G_5 \geq (P_m - PP_m)\, d_{3m} + (P_f - PP_f)\, d_{3f}$.

Land is not utilized when its shadow rent is lower than the peasant's corn and beans profits, each weighted by its yields.

b) For $q > 0$, $LL'_q = 0$: $PP_m = (1+r)\, POB_{-1}\, [G_1\, C_m + G_2\, E_m + G_3\, H_m + G_4 L_m]$.
At the optimum, marginalized households' corn (beans) production is consumed by the household if its producer price equals its nutritional characteristics per household, valued at their shadow prices.

For $q = 0$, $LL'_q \leq 0$: $PP_m \geq (1+r) POB_{-1}\, [G_1\, C_m + G_2\, E_m + G_3\, H_m + G_4 L_m]$.

On-farm produced corn (beans) is not consumed by the household if its (their) producer price is not lower than its (their) nutritional characteristics per household, valued at their shadow prices.

c) For $X_m > 0$, $LL'_{Xm} = 0$: $P_m = (1+r) POB_{-1}\, [G_1\, C_m + G_2\, E_m + G_3\, H_m + G_4 L_m]$.

At the optimum, corn (beans) is bought in the market if its market price equals its nutritional characteristics per household, valued at their shadow prices.
For $X_m = 0$, $LL'_{Xm} \leq 0$: $P_m \geq (1+r) POB_{-1}\, [G_1\, C_m + G_2\, E_m + G_3\, H_m + G_4 L_m]$.

Corn (beans) is not bought in the market if its market price is not lower than the optimal nutritional corn characteristics per household, valued at their shadow prices.

d) For $M > 0$, $LL'_M = 0$: $P_m = PP_m$.

For corn (beans) to be produced, producer and market prices, at the optimum, are equal to each other.

For $M = 0$, $LL'_M \leq 0$, or $PP_m \geq P_m$

No corn (beans) is produced if its producer price is not lower than its market price.

e) For $r > 0$, $LL'_r = 0$:

$m\ G_6 = G_1\ [W^*_c - W_c(.)] + G_2\ [W^*_e - W_e(.)] + G_3\ [W^*_h - W_h(.)] + G_4\ [W^*_{mi} - W_{mi}(.)]$, or :

$m = (G_1/G_6)\ [W^*_c - W_c(.)] + (G_2/G_6)\ [W^*_e - W_e(.)] + (G_3/G_6)\ [W^*_h - W_h(.)] + (G_4/G_6)\ [W^*_{mi} - W_{mi}(.)]$.

For the peasant family to remain in the countryside and to provide for its basic needs, the labor supply parameter (m) should equal the sum of weighted relative shadow prices of nutritional basket components per unit of labor shadow price. Weights within the equation are excess nutritional requirements. Given that the relationship is homogeneous of zero degree, any relative rise (fall) in the labor shadow price is compensated by an equal relative rise (fall) in the other shadow prices (the objective substitution effect).

For $r = 0$, $LL'_r \leq 0$:

$m \geq (G_1/G_6)\ [W^*_c - W_c(.)] + (G_2/G_6)\ [W^*_e - W_e(.)] + (G_3/G_6)\ [W^*_h - W_h(.)] + (G_4/G_6)\ [W^*_{mi} - W_{mi}(.)]$.

Or, for the family to remain stable on its land, the labor supply parameter (m) should not be greater than the sum of weighted relative shadow prices of nutritional basket components by unit of the labor shadow price. Weights are excess nutritional requirements.

If $-1 < r < 0$, the inequality strictly holds, and the peasant family eventually abandons the land.

f) For $X_i > 0$, $LL'_{Xi} = 0$: $P_{Xi} = POB\ [\ G_1\ C_i + G_2\ E_i + G_3\ H_i + G_4\ L_i]$.

For the i^{th} good of the peasant's food basket to be consumed, at the optimum, its market price must equal the household's value of its nutritional properties priced at their shadow prices.

For $X_i = 0$, $LL'_{Xi} \leq 0$: $P_i \geq POB\ [\ G_1\ C_i + G_2\ E_i + G_3\ H_i + G_4\ L_i\ ]$.

For the i^{th} good of the peasant's food basket not to be consumed, at the optimum, its market price must not be lower than the household's value of its nutritional properties priced at their shadow prices.

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Table 1

Technical Coefficients.
Corn and Bean Production by Peasant Producers.

Components	Technical coefficients	
	maize alone	maize and beans
	per ton	
Labor (work-day):		
Non-skilled	8.75	6.03
Skilled	5.00	3.45
Fertilizers (ton)	0.31	0.22
Tractor (work-day)	5.00	3.45
Land (hectare)	1.25	0.86
Seed (ton)		
maize	0.02	
maize jointly w/beans		0.02
beans		0.05
Maize byproducts (tons of stover)	4.00	3.00

Source: Secretaria de Agricultura y Recursos Hidraulicos, Instituto Nacional de Investigaciones Forestales, Agricolas y Pecuarias y Colegio de Postgraduados, 1993, Programa de modernizacion de la agricultura (SARH, Mexico).

Table 2

Rural Household's Relative Shares of Food Expediture in Total Expediture (rf), and of Corn Expediture in Food Expediture (cf), by Income Deciles
(in percentages)

	total	i	ii	iii	iv	v	vi	vii	vii	ix	x
rf	39.7	56.1	51.7	53.1	53.3	47.7	47.5	45.5	40.4	37.2	27.3
cf	5.8	11.4	11.6	9.6	7.5	7.6	6.1	5.5	5.2	4.3	2.2

Source.- Instituto Nacional de Estadistica, Geografia e Informacion (INEGI), 1989, Encuesta nacional de ingreso-gasto de los hogares (INEGI, Mexico).

Table 3

Observed Nutrient Contents of the Peasant Family Diet

Family Members	Age	Calories (calories/day)	Proteins (grams /day)	Minerals (miligrams /day)	Vitamins
Family		7214.0	251.0	3520.0	522.0
		63.6	**75.4**	**130.4**	**12.0**
Father	35-54	2251.0	50.2	1005.0	163.0
		90.1	**60.5**	**201.0**	**15.2**
Mother	35-54	1534.0	74.7	644.0	98.0
		82.9	**105.2**	**128.8**	**9.2**
Son	14-18	1251.0	50.1	1005.0	163.0
		41.7	**66.8**	**143.6**	**15.1**
Son	0-10	1134.0	38.0	460.0	54.0
		56.7	**73.1**	**92.0**	**9.6**
Daughter	0-10	1044.0	38.0	406.0	44.0
		52.2	**73.1**	**81.2**	**7.8**

Bold numbers represent percentage of recommended levels.

Source.- Instituto Nacional de Nutricion, Comision Nacional de Alimentacion, 1989, Encuesta nacional de nutricion del sector rural (Instituto Nacional de Nutricion, Mexico). Interviews with Dr. Abelardo Avila Curiel, coordinator general of the National Survey of Nutrition, and Guillermina Gutierrez, researcher at the Instituto Nacional de Nutricion, Mexico 1992.

Table 4

Nutritional Contents of the Typical Peasant's Foods

Product (100 grams)	Calories (calories)	Proteins (grams)	Vitamins	Calcium (miligrams)	Potassium
White corn	362.0	7.9	3.3	159.0	0.0
Tortilla	224.0	5.9	20.0	108.0	1406.0
Beans	332.0	19.2	0.0	228.0	0.0
Vegetables and chili	35.0	2.3	122.5	35.0	340.0
Refined sugar	384.0	0.0	0.0	0.0	0.0
Pasta	340.0	9.4	1.3	26.0	197.0
White bread (70 grams)	292.0	8.4	1.3	39.0	94.0
Cooking oil	884.0	0.0	0.0	0.0	0.0

Source: Muñoz, M., M. Hernandez and A. Roldan, 1992, Tablas de valores nutricionales de los alimentos consumidos en Mexico (Instituto Nacional de Nutricion, Mexico). Other minerals reported by the source are magnesium and sodium. Both are contained in tortillas, vegetables and chili and white bread. The first with 140, 25 and 22 miligrams; while the second with 24, 7 and 1564 miligrams, respectively.

Table 5

Model Results for Corn Price Alternatives I and II. Monocultivation of Corn

(1992 N$, tons, hectares and workdays)

	Transport cost				
	zero			N$ 6	
Subsidy					
income	0	360	0	360	0
production	0	0	360	0	360
Net income (I)	5190	5549	5800 (5862)	1949 (1974)	2634 (2325)
(II)	5259	5617	5730 (5792)	2018 (2034)	2193 (2255)
Land utilized (I, II)	0	0	1.5	0 (1.42 alt I)	1.5
Land shadow price (I)	0	0	154 (175)	0	196 (217)
(II)	0	0	107 (128)	0	149 (170)
Labor allocated to					
farm (I, II)	0	0	10.5	0 (10.2 alt I)	10.5
non-farm (I, II)	600	600	589.5	600 (589.8 alt I)	589.5
Labor shadow price (I, II)	15	15	15	9	9
Corn					
production (I, II)	0	0	1.2	0 (1.17 alt I)	1.2
last year of production (I)	1997	1997	2001	1998	continuing
(II)	1995	1995	continuing	1995	continuing
home consumption (I, II)	0	0	1.17	0 (1.17 alt I)	1.17
bought in market (I II)	1.17	1.17	0	1.17 (0 alt I)	0
Vegetable consumption (I, II)	1.27	1.27	1.27	1.27	1.27
Nutrient shadow prices					
protein (per kg) (I)	6.26 (5.99)	6.26	2.13 (1.79)	6.26 (5.99)	2.13 (1.80)
(II)	5.51	5.51	2.13 (1.80)	5.51	2.13 (1.80)
vitamin (per gram) (I, II)	1.92	1.94	2.00	1.94	2.00

Note 1: Model simulations were obtained for each year of the period 1991-2003. Results presented in this table are for the years 1998 and 1996 for alternative price vectors I and II, respectively.

Note 2: Results are for on-farm reservation wages equaling 1.0 and 0.5 market wage; whenever different, parenthesis figures refer to the latter.

Note 3: Model results show zero calorie and mineral shadow prices.

Note 4: For alternative I with a zero transport cost and a on farm reservation wage equaling zero market wage, the producers cease corn production in 1999.

Note 5: In 1992 the exchange rate was US$ 1.00 = N$ 2.9.

Table 6

Model Results for years 1996 and 2003, and Grain Price Alternatives I and II.
Corn and Beans Jointly Produced.

(1992 N$, tons, hectares and workdays)

	1996				2003			
Transport cost	0	6	0	0	0	6	0	0
Income transfer	0	0	360	0	0	0	360	0
Production subsidy	0	0	0	360	0	0	0	360
Net income (I)	6167	2630	6526	6939	5469	1869	5828	6299
(II)	**5655**	**2118**	**5954**	**6394**	**5634**	**2097**	**5993**	**6324**
Land utilization (I)	1.5	1.5	1.5	1.5	0	0.3	0	1.5
(II)	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Land shadow price (I)	596	638	596	911	0	0	0	262
(II)	**234**	**276**	**234**	**560**	**170**	**212**	**170**	**485**
Labor allocated to								
farm (I)	10.5	10.5	10.5	10.5	0	1.9	0	10.5
(II)	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**
non-farm (I)	589.5	589.5	589.5	589.5	600	598.5	600	589.5
(II)	**589.5**	**589.5**	**589.5**	**589.5**	**589.5**	**589.5**	**589.5**	**589.5**
Labor shadow price (I, II)	15	9	15	15	15	9	15	15
Corn								
production(I)	1.2	1.2	1.2	1.2	0	0.22	0	1.2
(II)	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
home consumption (I, II)	0	0	0	0.93	0	0	0	0.93
bought in market (I)	0.93	0.93	0.93	0	1.17	0.93	1.17	0
(II)	**0.93**	**0.93**	**0.93**	**0**	**0.93**	**0.93**	**0.93**	**0**
Vegetable Consumption (I, II)	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
Beans								
production (I)	0.56	0.56	0.56	0.56	0	0.10	0	0.56
(II)	**0.56**	**0.56**	**0.56**	**0.56**	**0.56**	**0.56**	**0.56**	**0.56**
home consumption (I)	0.10	0.10	0.10	0.10	0.0	0.10	0.0	0.10
(II)	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**
Nutrient shadow prices								
protein (per kilogram) (I)	1.27	1.27	1.27	1.85	3.22	3.18	3.22	1.85
(II)	**1.55**	**1.55**	**1.55**	**1.85**	**2.15**	**2.15**	**2.15**	**1.85**
vitamin (per gram) (I, II)	1.99	1.99	1.99	2.00	1.99	1.99	1.99	2.00
calorie (per kilocal.) (I)	0.10	0.10	0.10	0.01	0.00	0.00	0.00	0.01
(II)	**0.09**	**0.09**	**0.09**	**0.01**	**0.05**	**0.05**	**0.05**	**0.01**

Note 1: Results are for the two alternatives of grain price vectors. For both alternatives farm reservation wage equals 1.0 market wage. (In 1992 US$ 1.00 = N$ 2.9).

Note 2: Model results show zero mineral shadow prices, and zero beans bought in the market.

Appendix Table 1

Corn and Bean Price Alternatives.

(in 1992 N$ per ton)

	Price Vector I		Price Vector II	
Years	Corn	Beans	Corn	Beans
1991	782	2298	782	2298
1992	750	2100	750	2100
1993	694	1800	694	1759
1994	776	2000	540	1599
1995	752	2100	496	1600
1996	683	2200	500	1600
1997	619	2400	487	1600
1998	558	2161	475	1600
1999	504	1942	464	1600
2000	452	1738	453	1600
2001	405	1548	442	1600
2002	360	1372	431	1600
2003	320	1204	420	1600

Note 1: For the first scenario maize and bean prices for the years 1991- were taken from SARH, INIFAP and CP (1993).

Note 2: For the second scenario maize and bean prices for the years 1991-95 are the guarantee levels. For 1996-2003 maize prices are estimated following trends of the Chicago Board of Trade futures markets and adjusted for an assumed shift upward in the world demand for grains; they include transportation costs from US Gulf ports ports to Veracruz, financial services, and warehousing charges. Bean prices are assumed not to change in real terms.

Appendix Table 2

Per ton Costs for Corn and Bean Production by Peasant Producers

	Maize								Beans			
Years	(alone)				(jointly w/beans)				(jointly w/maize)			
	(a)	(a and c)	(b)	(b and c)	(a)	(a and c)	(b)	(b and c)	(a)	(a and c)	(b)	(b and c)
1991	534	534	508	508	351	351	298	298	582	582	535	535
1992	534	534	508	508	351	351	298	298	582	582	535	535
1993	152	152	126	126	88	88	34	34	319	319	271	271
1994	157	157	131	131	90	90	37	37	321	321	274	274
1995	216	216	189	189	131	131	78	78	362	362	315	315
1996	534	234	508	208	351	144	298	91	582	375	535	328
1997	534	234	508	208	351	144	298	91	582	375	535	328
1998	534	234	508	208	351	144	298	91	582	375	535	328
1999	534	234	508	208	351	144	298	91	582	375	535	328
2000	534	234	508	208	351	144	298	91	582	375	535	328
2001	534	234	508	208	351	144	298	91	582	375	535	328
2002	534	234	508	208	351	144	298	91	582	375	535	328
2003	534	234	508	208	351	144	298	91	582	375	535	328

Note 1: (a) and (b) refer to cost calculations using reservation wages 1,0 and 0.5, respectively; while (c) incorporates a lump sum production subsidy that equals real 1992 N$ 300/ton when maize is the only enterprise, and N$ 207/ton for maiz and beans jointly produced.