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A FARM MODEL OF PRODUCTION AND CONSUMPTION FOR THE EASTERN REGION OF HONDURAS.

by

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A FARM MODEL OF PRODUCTION AND CONSUMPTION

FOR THE EASTERN REGION OF HONDURAS

SUMMARY

The model developed in this study examines both the production and consumption behaviour for a representative cooperative group of farmers in the Eastern Region of Honduras. The model, based on the linear programming techniques, allocates farm resources among different production alternatives, so that net income is maximized and at the same time farm members' nutritional requirements are satisfied.

The L.P. matrix has the following components: crop production techniques, family and hired labor use, family labor sales, purchase of production inputs, storage, own consumption, food purchases, and incorporates risk: this last measured in terms of net income deviations during a 6-year period prior to the base year 1978.

The constraints or restriction on available resources in the model include: land availability, family and hired labor supply, non-negativity of cash flows, minimum nutrient intakes and diet preferences.

The basic assumptions of the model are that family labor would be fully employed, different energy requirements for family and hired labor, that initial stocks of corn and beans exist, and that an initial amount of cash is available to sufficiently satisfy both the nutritional requirements and the production costs during the months prior to crop harvests.

The results of the model show that with an optimum allocation of resources in agricultural production an additional net income results, after discounting costs of production, satisfying nutritional requirements (based on a diversified diet), and restoring both initial capital and stocks of corn and beans. This net income includes farm family salaries from on and off farm activities.

Own consumption of corn and beans (farm production consumed by members) would take place only when market prices for these products are higher than the endogenous prices (or those prices generated by the supply and demand conditions in the model).

The consumption of available food products would result in an excessive intake of calories and proteins when the minimum levels of iron and vitamin A are satisfied. If these constraints are relaxed, the consumption of starchy food products are significantly reduced, increasing farm net income by a factor of five.

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I. INTRODUCTION

The Government of Honduras in collaboration with AID carried out in 1967 a nutritional assessment which, among other things, concluded that the quantity and the quality of food consumption in Honduras depend primarily on three factors: education, purchasing capacity and food availability. While education modifies the consumption pattern and the distribution of family expenditures, income affects heavily the consumption and production of food which in turn determines the purchasing pattern. Food availability depends basically on production, which is influenced by rural administration, agricultural credit, technical assistance and market accessibility.

The factors influencing agricultural production can be analyzed simultaneously by using a quantitative model that simulates farmers' behaviour, which also constitutes a consumption and marketing unit. Henceforth, the objective of this study is to formulate a model that would provide both the optimal production and consumption patterns for a farm group in the Eastern Region of Honduras.

II. NUTRITIONAL STATUS IN HONDURAS

The cyclical variation in food production, due mainly to climatic aspects and marketing conditions, affects the availability of and demand for food products. In recent years, basic food production has been insufficient to satisfy domestic requirements, resulting in an increasing deficit of calories-protein intake. This means, according to the 1967 survey, that 43% of the population had a moderate deficit, 32% a severe deficit, and 6% a most acute deficit.

The basic food products, as the consumption patterns show, are corn and beans, except in the Northern Region where rice and other products substitute for corn. Among other regularly consumed food products with the average quantities consumed expressed in grams per day paer catipa, are: milk (200 for 64% of the population), eggs (less than 12), meat (45), fish (31 in the islands and 11 in the Puerto Cortez Region), plantains and bananas (less than 20), potatoes (less than 10), cassava (between 66 and 322 in the Northern Region), fats and oils (20), sugar (between 30 and 39 for 50% of the population), molasses (more than 20 for 32% of the population), fruits (mainly oranges, less than 30), and vegetables (basically "patasta", cabbage and onions, less than 30).

Calories and other nutrients are in deficit. While calories intake represent 89% of the required level, Vitamin A, riboflavin and niacin intakes are 34, 64, and 75% respectively of the minimum required levels. Iron, though present in most of the vegetables, is lacking seriuosly because of its limited assimilation.

III. THE MODEL

Linear Programming Models have been used extensively for farm planning. The common objective function for these models is to maximize farm income through the optimum allocation of available resources among a given set of production activities. During recent years the risk factor has been added to these models in an attempt to incorporate farmers' expectations to changes in net incomes.

On the other hand, in consumption studies, the L.P. technique has been directed mainly to less costly diets with the incorporation of tastes and nutritional content of food products.

Even though production and consumption are important for farms, few models have been developed to integrate the two into a single methodological framework. (Suttor, R. etal. 1973; and Andrews, M. 1976 among others).

The model used in this study determines the optimum production and consumption pattern of a representative grain farm given a set of available resources and nutritional constraints. The model is formulated for a one-year period with two production cycles reflecting farmers' decisions in production planning. While production and consumption activities are the basic model components, the L.P. matrix includes labor use, differentiated into family and hired. The first labor use is devoted to more intensive activities and longer working hours then the second. In addition, family labor is paid a "reservation wage" lower then the market wage which applies to the hired labor. Furthermore, family labor is specified as fully employed. When family labor is not engaged in farm activities, it is employed elsewhere.

Other activities included in the model are inputs purchases, cash flow, product sales, own consumption, storage, food products purchases, and risk.

In order to satisfy cash requirements for both purchase of food products and production costs, a given amount of cash is assigned at the beginning of the first production cycle together with stocks of corn and beans. The supply of labor is approximated by a two-step function: family labor at a "reservation wage" constitutes the first step, and hired labor at a market wage the second. The risk component is presented by the variance of net incomes derived from price and yield variations during the 6-year period prior to the base year. The risk factor becomes thus an additional cost for farm products, greater for the non-traditional than for the basic food crops.

Among the restrictions, land is assigned an upper limit of 50 Mz. (1 Mz = 1.4 acres) reflecting a perfectly inelastic supply curve in the short run. The availability of family labor is estimated at 375 days per month (15 farm members working 25 days a month), and of hired labor

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at 200 monthly days. The additional calorie requirements are 168 kcal per working hour for family labor and 82 for hired labor. Additional protein need is calculated at a constant rate of 2 grams per working hour for both family and hired labor. The nutritional constraints are for calories, proteins, iron and vitamin A. These would be satisfied through consumption of farm products and purchases of food products. The farm member's tastes are specified in terms of proportions of traditional food products, corn-beans 3:1 and corn-soybean 6:1. Lower and upper consumption levels are also incorporated for basic foods.

IV. The Results

The results of the basic model are given in tables 1 and 6, and figures 2 and 3. Land became restrictive during two months, with"shadow" prices[1] per "manzana" (Mz) Lps. 131.60 and 221.70, respectively (1 Lp=$0.5) Labor is restrictive in May and November with"shadow" prices for hired labor of Lps. 4.61 in May and 1.00 in November (table 1). This would imply that labor is more restrictive at the beginning of the crop season.

The total corn available both from production and initial stocks are sold in February when market prices are the highest during the harvest period. Beans, on the other hand, are stored the whole year. (table 2)

Family labor is used in farm activities during 6 months and elsewhere during the whole year except May and November. (figure 2) In addition, farm activities require hired labor during 8 months of the year. The total value of used inputs for farm production is Lps. 25,303, from which Lps. 15,318 is required in August, Lps. 9,184 in February and the difference in January and October.

The own consumption of corn and beans occurs during the months when market prices are relatively higher than the endogenous farm level prices. Henceforth, own consumption of corn is given in January, March, October and November, while beans own consumption occurs in June and October.

The optimum production plan is given in table 3 and figure 3. Corn is the most significant product in terms of area, castorbeans the second, and soybean the third. Cabbage is restricted to 1 Mz. per cycle and beans are produced to satisfy the final stock.

Table 4 shows that in order to fulfill the nutritional requirements, the diet must include at least 15 food products.

The farm net income after taking into account costs of production, restoring initial capital as well as corns and beans stocks, and satisfying nutritional requirements, is Lps. 8,650. Farm labor salaries are included in this residual income.

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[1] Shadow prices are endogenous prices determined by the model reflecting the opportunity cost of restrictive resources.

The constraints imposed on iron and vitamin A result in excessive caloric and protein intake with iron the most restrictive. (Table 5) When these constraints are relaxed, the consumption of starchy foods (plantains and cassava) and carrots decreases considerably and the net income increases to Lps. 44,635. The optimum plan deviates slightly from the basic solution: the castorbean area increases in 0.39 Mz, while the area with beans reduces in 0.29 Mz and of soybean in 0.09 Mz. (Table 6).

If these constraints are relaxed, the optimum farm plan does not change significantly but net income increases. This points to the need for finding cheap sources of Vitamin A and iron.

V CONCLUSIONS

The L. P. model developed for a representative group farm in the Eastern Region of Honduras, examines the possibility of reducing nutritional deficiencies in rural areas, based on the efficient use of farm resources in agricultural production.

The model determines optimum patterns of production, consumption, storage, and marketing. The results apply to a static condition and they are normative in the sense that they suggest desirable production and consumption patterns. The imposed restrictions on production and consumption reflect not only market and resources constraints, but also consumption habits in the rural sector.

The policy implications of the model can be related with nutritional planning and extension. The lack of storage capacity with a price control policy would seriously affect programs directed to farm storage for basic food products. In addition, credit traditionally given for production purposes could be extended to consumption, especially for new farms, and during periods of serious shortfalls in agricultural production.

Eventhough the model could be considerably refined, it has relevance because of the attempt to incorporate both production and nutritional targets. In this sense it is a tool that the agricultural extension agent as well as the nutritional officer, could use to work in close coordination.

The model would be more suitable for new colonized areas during the first phases when production is basically for own consumption. By taking into account nutritional requirements as well as colonists' tastes, production alternatives, and available resources, farm planning could be more realistic.

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CUADRO N° 1

MODELO NUTRICIONAL: Solución base: Utilización y precios sombra de los recursos tierra y mano de obra.

	TIERRA		M. O. F.[1/]		M. O. A.[2/]	
MESES	Mz.	Precio	Jornales	Precio	Jornales	Precio
Enero	24.2	-	-	-	106.5	-
Febrero	50.0	131.60	364.7	-	-	-
Marzo	44.2	-	189.1	-	200.0	-
Abril	37.4	-	-	-	97.0	-
Mayo	37.4	-	375.0	7.61	200.0	4.61
Junio	23.3	-	-	-	160.9	-
Julio	-	-	-	-	-	-
Agosto	49.0	-	-	-	39.9	-
Septiembre	49.0	-	297.4	-	-	-
Octubre	50.0	221.70	158.0	-	-	-
Noviembre	50.0	-	375.0	4.00	200.0	1.00
Diciembre	30.0	-	-	-	78.1	-

1/ Mano de Obra utilizada en labores propias de la finca.

2/ Mano de Obra Asalariada.

CUADRO N°2

MODELO NUTRICIONAL: Precios "sombra" y observados, cantidades autoconsumidas, almacenadas y adquiridas de maíz y frijol.

Meses	M A I Z					F R I J O L				
	P.O	P.S.	C.A	C.Adq.	C.Alm.	P.O	P.S	C.A.	C.Adq.	C.Alm.
Enero	.35	302	.432		8164	.46	.662	-	108	320
Febrero	.37	310	.432		-	.52	.675	-	108	313
Marzo	.37	290	.432	--	3365	.50	.689	-	108	307
Abril	.31	297	.	432	3281	.50	.703	-	108	301
Mayo	.31	305	.	432	3199	.71	.718	-	108	295
Junio	.31	313	.	432	3119	.75	.732	108	-	478
Julio	.33	321	.	432	3041	.73	.747	-	108	468
Agosto	.33	329	.	432	2965	.73	.762	-	108	459
Septiembre	.35	338	.	432	2891	.66	.778	-	108	450
Octubre	.38	346	.272	160	2547	.81	.794	108	-	333
Noviembre	.40	355	.432	-	2051	.75	.810	-	108	326
Diciembre	.38	364	.	432	2000	.61	.826	-	108	320

Simbología:

P.O = Precio observado (Lps./Kg)

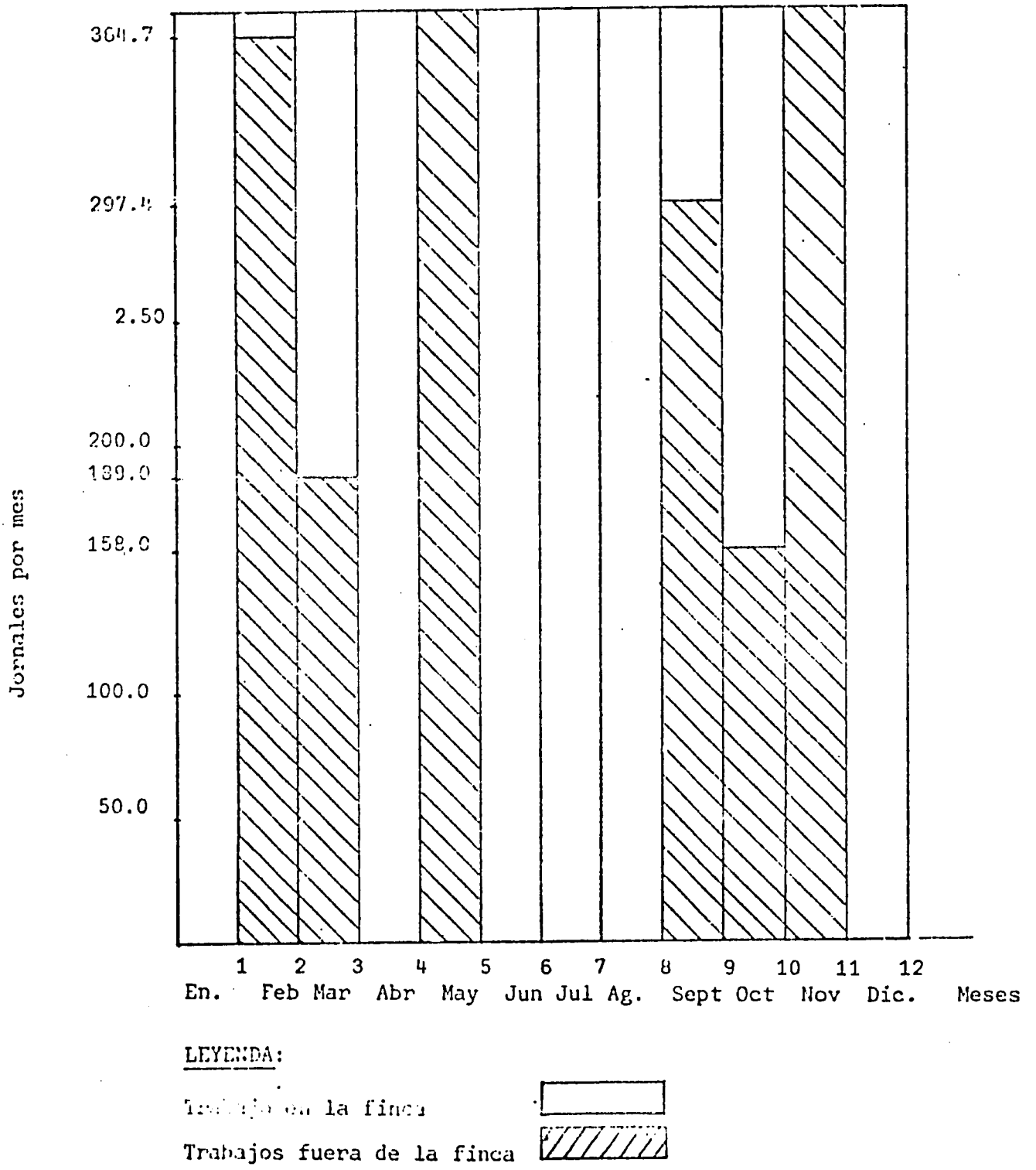
P.S = Precio sombra (" ")

C.A. = Cantidad Autoconsumida (Kgs.)

C.Adq.= Cantidad Comprada (Kgs.)

C.Alm. Cantidad Almacenada (Kgs.)

FIGURA No. 2 SOLUCION BASE: UTILIZACION DE LA MANO DE OBRA FAMILIAR.

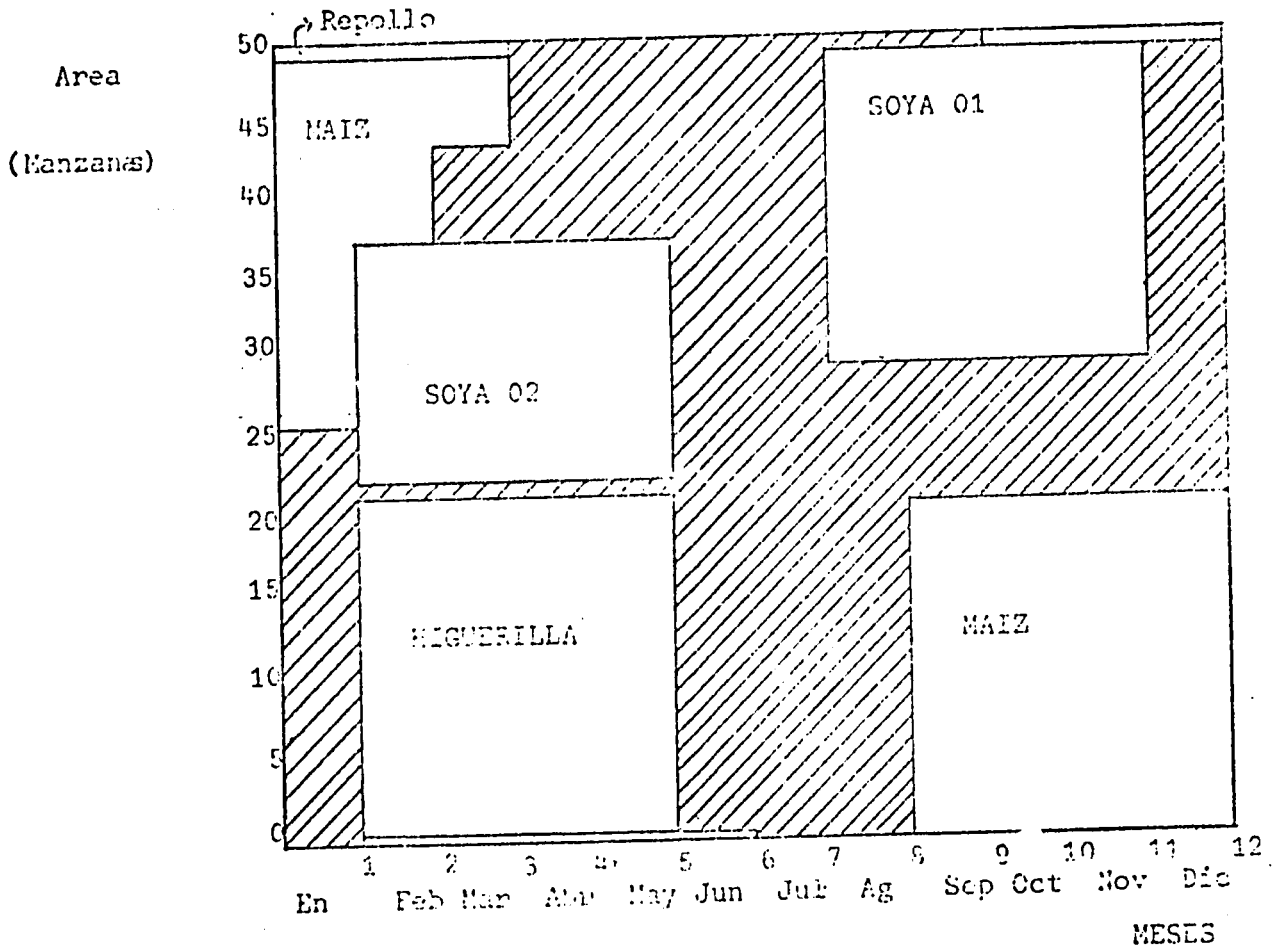


CUADRO N°3

MODELO NUTRICIONAL: SOLUCION BASE: Plan de producción y Distribución de las cosechas.

Cultivo	Area (Mz.)	Ventas (T.M.)	Autoconsumo (T.M.)	Almacenamiento (T.M)
Higuerilla	21.75	20.050	-	-
Repollo Oct.	1.00	9.201	-	-
Repollo Enero	1.00	9.201	-	-
Maíz	29.06	63.186	2.000	0.867
Frijol	0.54	-	.216	.078
Soya Agosto	19.94	22.931	-	-
Soya Febrero	15.08	17.384	-	-

FIGURA No.3 : SOLUCION BASE: PLAN DE CULTIVOS



LEYENDA:

TIERRA NO UTILIZADA

CUADRO N°4

MODELO NUTRICIONAL: Consumo de productos alimenticios con y sin restricciones en hierro y retinol.

(kilogramos/año)

PRODUCTOS	Con Restricciones	Sin Restricciones
Maíz	5,184	4,097
Frijol	1,296	583
Plátano	48,732	-
Queso	720	720
Huevos	180	180
Chicharrones	180	180
Carne de res	360	360
Carne de cerdo	-	-
Arroz	-	-
Salchichas	720	720
Zanahorias	2,162	-
Naranjas	-	-
Mangos	-	-
Galletas	300	300
Azúcar	480	6,446
Manteca Vegetal	300	300
Tomate	-	-
Yuca	41,088	-
Repollo	-	-
Soya	881	695

CUADRO N° 5

MODELO NUTRICIONAL: Ingreso neto de la finca y consumos de calorías y proteínas, con y sin restricciones en niacina y retinol.

(Unidades/año).

	Con Restricciones		Sin Restricciones	
MESES	Calorías (10^6 K-Cal)	Proteínas (10^3 gm.)	Calorías (10^6 K-Cal)	Proteínas (10^3 gm.)
Enero	12.45	94.8	3.55	64.3
Febrero	12.20	88.6	"	"
Marzo	12.27	87.0	"	"
Abril	12.10	144.7	"	"
Mayo	12.11	92.2	"	"
Junio	12.03	143.9	"	"
Julio	12.50	90.1	"	"
Agosto	12.12	145.3	"	"
Septiembre	11.90	144.6	"	"
Octubre	12.01	145.2	"	"
Noviembre	11.76	141.9	"	"
Diciembre	12.47	89.2	"	"
Ingreso Neto: (Lps.)	25,145.		44,635.	

CUADRO N° 6

MODELO NUTRICIONAL: Planes de Cultivos, con y sin restricciones en hierro y retinol.

PRODUCTO	Con Restricciones	Sin Restricciones
Higuerilla	21.75	22.13
Repollo - Octubre	1.0	1.0
Repollo - Enero	1.0	1.0
Maíz	29.06	29.06
Frijol	0.54	0.25
Soya - Agosto	19.94	19.94
Soya - Febrero	15.08	14.99

A N E X O I I

M O D E L O N U T R I C I O N A L

MATRIZ DE MODELO DE PROGRAMACION LINEAL

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