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15715-E

Distr.
LIMITED
UNIDO/IS.643
8 September 1986
ENGLISH
Original: SPANISH

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

METHODOLOGY FOR THE ASSESSMENT, PROGRAMMING AND MANAGEMENT OF PRODUCTION AND CONSUMPTION SYSTEMS

Abridged version

Sectoral Studies Series
No.27

SECTORAL STUDIES BRANCH
STUDIES AND RESEARCH DIVISION

Main results of the study work on industrial sectors are presented in the Sectoral Studies Series. In addition a series of Sectoral Working Papers is issued.

This document presents major results of work under the element Food Processing Industries in UNIDO's programme of Industrial Studies 1986/87.

Preface

This document contains a concise description of a methodological tool originally developed by the Technology Policy Group of the Junta del Acuerdo de Cartagena (JUNAC) aimed at the assessment, programming and techno-economic management of national and subregional production and consumption systems. This methodology was later further developed by JUNAC in co-operation with UNIDO.

The methodology combines the analysis of micro and macro economic aspects and facilitates the decision making by a quantitative comparison of explicit technical and/or economic development options. It further allows to measure the effects that policies have on the system and measures their sectoral interdependence.

The present document describes the main stages of the methodology and the description is illustrated by the results obtained from its application to the programming of integrated development of the production and consumption system of oils and fats in Peru. This work was performed jointly by UNIDO and JUNAC.

This methodology can be obtained from UNIDO and its transfer to other developing countries is envisaged through specific case studies which will be carried out with the co-operation of officials and industrial associations of the country concerned.

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1. INTRODUCTION

This study contains the abridged version of the Methodology for Assessing and Programming Production and Consumption Systems (MEPS) originally prepared by the Junta del Acuerdo de Cartagena (JUNAC). JUNAC in co-operation with the United Nations Industrial Development Organization (UNIDO) has further developed this methodology which permits the practical assessment and programming of industrial production and consumption systems. It considers all economic, technological and policy variables that affect a given system, the linkages between its components and the interdependence between micro and macro aspects as well as the relationship between economic policy instruments and the system and its components.

The principal tool of the methodology is an accounting and engineering simulation model, containing a great number of equations, in which the parameters relating to production, inputs, investments, manpower, imports, etc. are estimated for each component and for the system as a whole. Exogenous data are fed into the model. These data are obtained from the analysis of the system at the stages of disaggregation and identification.

The model has been transferred to a microcomputer in order to be applicable to a large number of countries. This model contains relations of functional behaviour, however, the relations do not reflect preconceived theories, on the contrary, the inputs are co-efficients which are strictly technical and controllable. Simulation of economic policies can be introduced into the model and using the equations of the model, the effect that the simulated policies can have on the system itself and on the remainder of the economy can be measured.

The model is different from econometric projection models which are based on an analysis of historical data and it is also different from models of optimization which imply the aggregation of results in a unique objective function. It is not a predictive model but an instrument to facilitate the comparison of hypotheses based on alternative policies through successive approximations.

The advantages of this methodology over conventional methods of techno-economic assessment and programming of the development of industrial sectors are the following:

(a) Development programmes are generally formulated with a macro-economic focus with reference to national economic policies and with a micro-economic focus when a specific project is formulated and assessed. This methodology combines the macro and micro analysis and makes it possible to assess the development programme on both levels and at the same time, determining the necessary policy measures to make it viable;

(b) The use of this methodology allows an immediate comparison between different technical and/or economic operations facilitating the decision making;

(c) It links the methodology directly to the components of the production and consumption system and allows the assessment of the interaction effects between supply and demand;

(d) The methodology measures the sectoral interdependence of a given system, thereby facilitating the analysis of the integrated development of industrial systems and also allows a quantitative assessment of the different interactions of options, vertically as well as horizontally;

(e) The integrated development of an industrial sector, e.g. it is understood as the linked development of production/consumption systems in which the feasibility of a project in a given component of a system, meets a high degree of interdependence with the feasibility of the project in other components of the system. In this way it is necessary to develop studies and actions together to promote the linked development of all components and this can be achieved by applying this methodology.

In a joint effort of JUNAC and UNIDO this methodology was applied to elaborate a proposal of a programme for the integrated development of oils and fats production/consumption systems in Peru. This study has been published as Sectoral Study No. 19, entitled "A programme for the integrated development of the Peruvian oils and fats system" (UNIDO/IS.569).

The proposal derived from this study which covers a period of 21 years details the projects, investments, financing and the distribution over this period to achieve the integrated development strategy selected through the application of this methodology. The proposed strategy of development is supported by the adoption of specific economic policies identified in the study and its feasibility is verified by simulating different alternatives. These alternatives are assessed against the projected development of the present system of the Peruvian oils and fats system.

Other applications of the methodology have generated technical and socio-economic components of the national food programme in Bolivia. This programme was directed specially to improve the milk production sector and the evaluation of milk extenders within the sector. The model has allowed to set the basis on which the proposals of development of national programmes for wheat and composite flours in the 5 countries of the Andean Group, should be formulated. Included in this are investment programmes, technical assistance, policy related to production, prices and subsidies, tariff measures, trade measures, investment and credit, technological policies and basis for agreement at national and subregional levels.

The present methodology can be easily applied to the programming and planning of the development of industrial lines, not only in the agro-industrial field but in other industrial sectors. The results of its application are of interest to government planning institutions, industrial associations and promoting agencies for industrial development in the countries concerned.

The present document describes the main stages of the methodology and the description is illustrated with the results obtained by applying this methodology to the integrated development of the production/consumption systems of oils and fats in Peru.

The chapters of the document correspond to the principal stages of the methodology, i.e. disaggregation (simple, structural, spatial), assessment (simple, structural, spatial) and programming. The final section describes briefly the accounting model mentioned.

This methodology can be obtained from UNIDO and its transfer to other developing countries is envisaged through specific case studies which will be carried out with the co-operation of officials and industrial associations of the countries concerned.

2. THE SYSTEMS APPROACH

The systems approach is a problem-solving technique which takes into account relationships between different components using a combination of disciplines.

"Knowledge of the parts is used to study the behaviour of a whole complex of interacting parts of sub-systems. The behaviour of a complete complex of components is determined both by the characteristics of the parts and by their interrelatedness."1/

When this concept is applied to specific production and consumption processes and if the problem defined is to satisfy a particular need for a good or service, the system will cover:

(a) Final consumption/demand structure; population and income shown in figure 1 as two superimposed opposite triangles;

(b) The final consumer goods industry. For example domestic appliances, processed foods, motorcars, etc.;

(c) The sectors producing the goods and services needed for production in the final goods industry. These productive and service sectors are: agricultural intermediate and final goods, intermediate goods industry, productive services and the capital goods industry;

(d) Storage, transport and distribution activities, required for the exchange of goods and services between the agricultural, intermediate goods, capital goods and productive service sectors, and the final goods industry, together with activities needed to distribute final consumer goods. The activities are shown in figure 1 as the symbols W, T and D (W = warehousing and storage, T = transport and D = distribution);

(e) The import of final goods, intermediate goods and services destined for final consumption by both the population and all productive activities. Imports are designated by the letter M in figure 1;

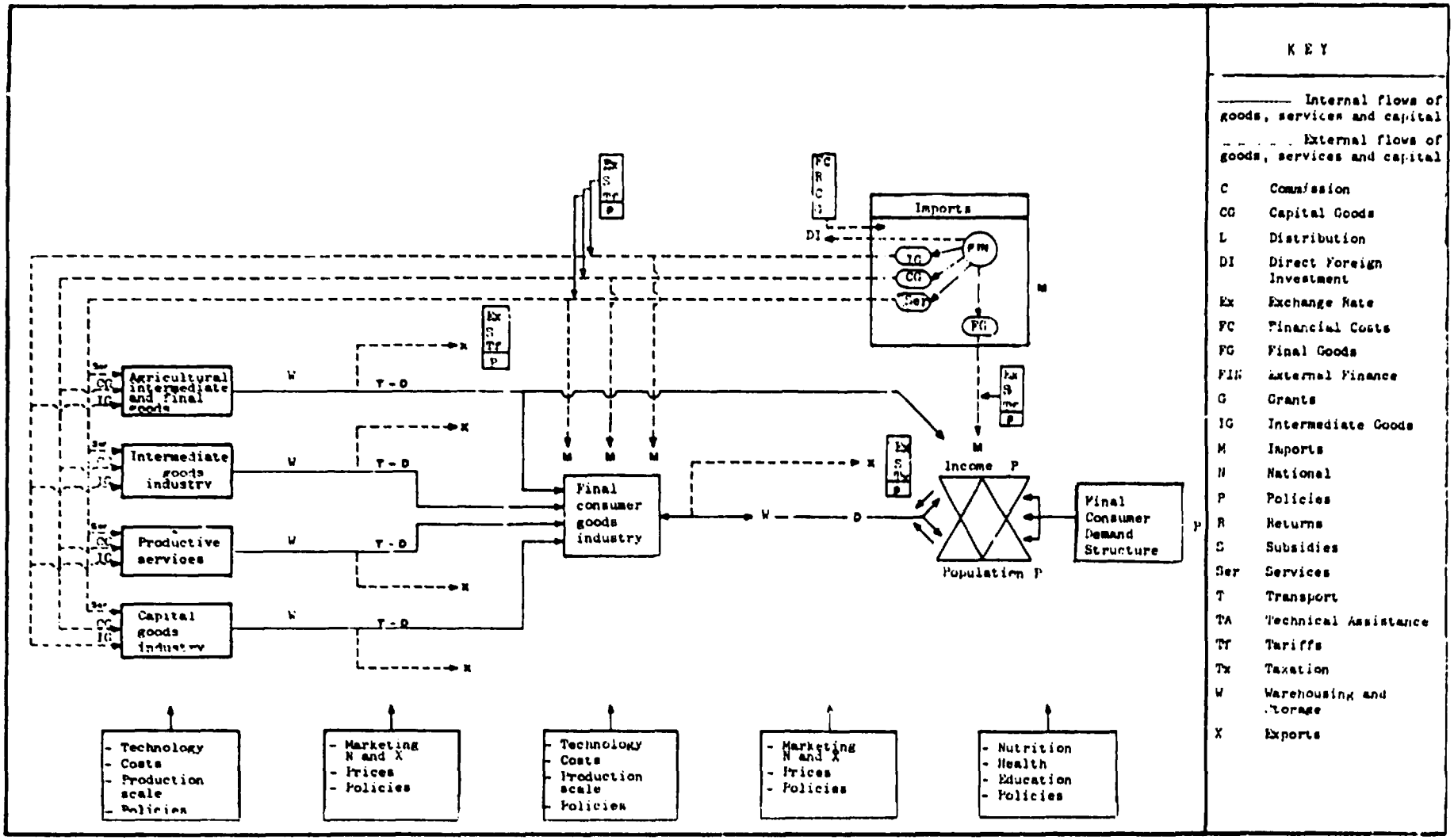
(f) The export of goods and services provided by the productive sectors involved. Exports are shown by the letter X in figure 1;

(g) The policies expressly regulating the functioning and behaviour of the system as well as policies concerned with relationships between the systems components. These policies are:

(i) Policies concerned with the consumer: income, population, nutrition, health, etc.;

1/ "El Enfoque de Sistemas", Dr. Victor Gerez M. en C. Manual Grijalva, 1978.

Figure 1. Production and consumption system: base scheme



(ii) Policies relating to productive activities: wages, taxation, finance, ownership, etc.;

(iii) Policies concerning relationships between the components of the system:

- Relationships between national components: policies with regard to prices, subsidies, finance, taxation, etc.;

- Relationships between national and international components: policies concerned with export promotion, tariffs, taxation, foreign exchange, etc.

The representation of this production and consumption system (figure 1) is called the base scheme.

The relationship between the complete set of components making up the system is not a simple one consisting only of the exchange of goods and services, but rather a structural one with a consequently high degree of interdependence. This interdependence is interactive in character, so that any change occurring in one of the components tends to modify the whole, in a variety of ways and to a varying extent. For example, an increase in the cost of foreign exchange (caused by fluctuations in the exchange rate) changes the prices of imported inputs, thus altering the cost structure and affecting the final value of a good and/or service produced anywhere in the system.

The system shown in the base scheme implies a sequential chain of inputs and products. It is a system in which the components may be situated in a variety of geographical locations, both within the country and internationally. Consequently sectoral interdependence may be linked with geographical location.

The idea of a production and consumption system can be applied to a variety of consumer goods or services, both at the aggregated or sectoral level and to groups of products or individual goods. The degree of disaggregation will depend on the desired objectives.

A specific example is the agro-food industrial economy which can be separated into individual production and consumption systems. The division will be on the basis of goods produced according to type and characteristics. Classification by systems satisfies the need to treat each type of good produced differently.

A system takes the name of the final consumer goods industry.

The following systems are considered here:

- Industrial system for the production and consumption of fish products;

- Agro-industrial system for the production and consumption of dairy products;

- Agro-industrial system for the production and consumption of fruit;

- Agro-industrial system for the production and consumption of cereals;

- Agro-industrial system for the production and consumption of root crops;

- Agro-industrial system for the production and consumption of other products.

Figure 2 shows the agro-food industrial economy disaggregated into the specific systems listed above. As can be seen, it includes all internal and external flows of goods, services and capital between national and international productive sectors involved in the various food industries.

As an example, the system for the production and consumption of oils shows the following:

- The quantity and value of oil products consumed overall, in turn divided into specific goods (vegetable oil, compound oil, butter, margarine, etc.);

- Each final consumer good is produced by a corresponding base industry (AIFG); e.g. in this case, the oil industry collectively produces the above-mentioned goods;

- The production of the oils requires agricultural inputs (AIG) which are produced by a specific activity in the corresponding sector (cultivation of soya bean, sesame, cotton, etc.);

- The oils industry also requires inputs from intermediate industries (IGI) in order to produce the corresponding final goods. In this example, the inputs are: palm oil, fish oil, packaging, etc., which are produced by specific intermediate industries;

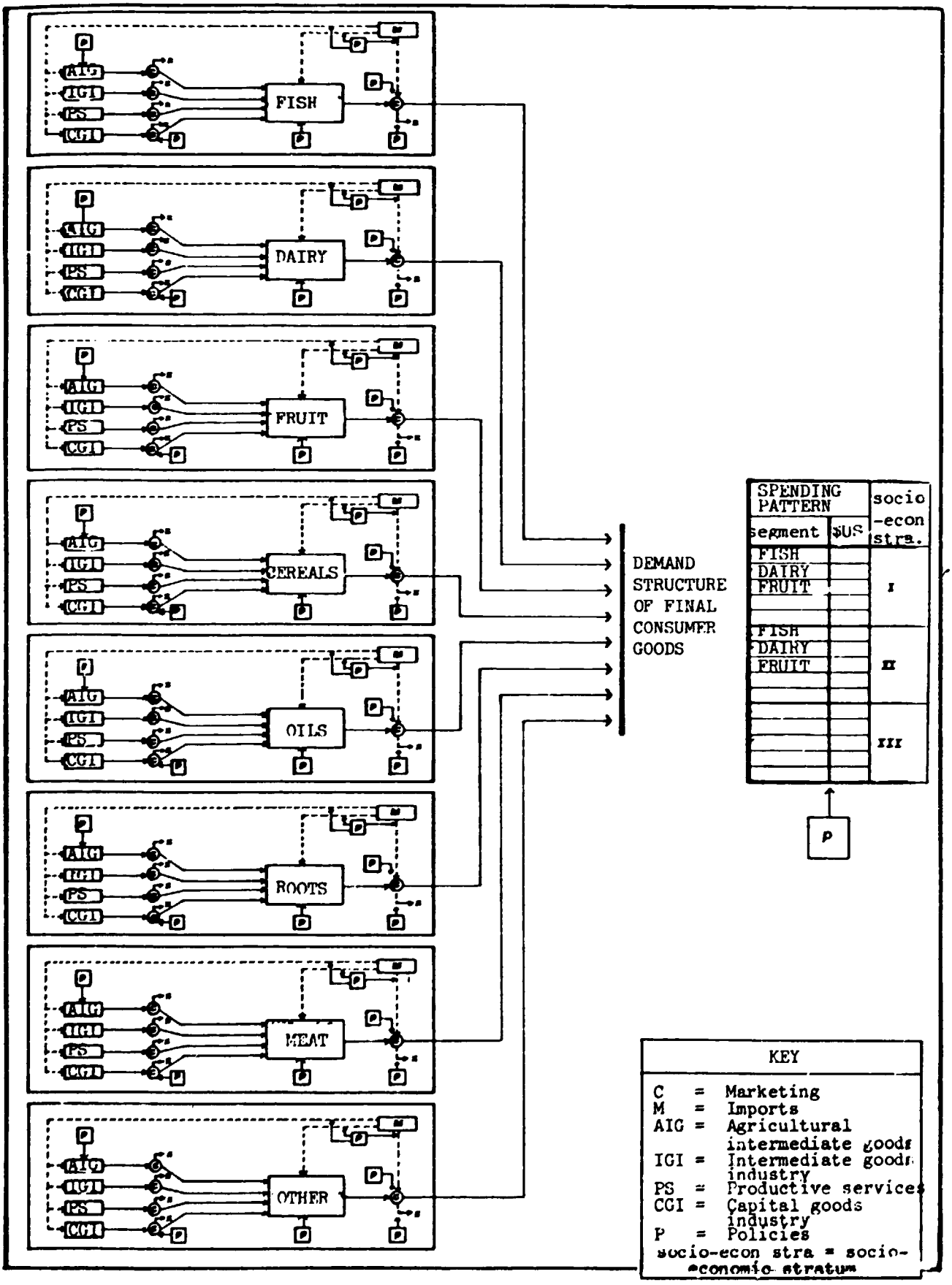
- Services are another component of the cost of oil production, and these are provided by specific institutions (PS). In the case of the oils industry, services such as electricity and water are provided by specific enterprises;

- In common with the other inputs, capital goods needed to produce oils are manufactured by specific industries (CGI). These could include the manufacture of equipment for extraction, hydrogenation, deodorization, etc.

Production and consumption systems can be constructed for other groups of food products in the same way as for edible oils. The cereals group will have specific consumer goods such as bread, pastas, biscuits, etc. The fish products group consists of goods, such as fresh fish, frozen fish, canned fish, etc.

Each of these goods in each food products group produced by a base industry (AIFG) requires agricultural, industrial and service inputs as well as the capital goods to produce it. Agricultural inputs are produced by agricultural activity (AIG), industrial inputs by the intermediate goods industry (IGI), services by the appropriate institutions (PS) and capital goods by the capital goods industry (CGI).

Figure 2. Individual systems for the production and consumption of final goods



In addition, each of these specific systems is connected to the external sector, both through imports (final goods, intermediate goods and services destined for final consumption as well as productive activities involved in each system) and exports (of goods and services provided by productive sectors within each system).

Following the pattern of figure 1, the disaggregated base scheme takes into consideration explicit policies governing the functioning and behaviour of each system, both internally and in relation to the other systems.

3. THE METHODOLOGY OF PRODUCTION AND CONSUMPTION SYSTEMS

3.1 Introduction

In order to introduce the systems approach, a "Methodology for the Technological and Economic Development Programming of Production and Consumption Systems" was prepared within the Andean Technological Development Programme for the Food Production Sector of the Board of the Cartagena Agreement. This methodology consists of a manual and a numerical experimentation accounting model.

In general terms the methodology provides the means, both to define specific production and consumption systems and to identify each of the component parts of such systems.

Once the structure of the system has been defined, each component can be disaggregated at different levels. When detailed information is available for each component and for the system as a whole, each can be assessed in relation to specific accounts.

Finally, by recognizing the relationships, behaviour and variables contained within each system, the methodology makes it possible firstly to programme the development of the system and its components and then to manage its operation.

In the context of disaggregation it should be noted that the methodology comprises two forms of analyzing the construction of each component of the system: simple disaggregation, which is the process for obtaining a preliminary broad overview by studying and analyzing the variables making up each component, and structural disaggregation, which is the study in depth of the variables and provides the means to move from the simple to the complex and from the apparent to the underlying reality. Two basic analytical tools have been designed for structural disaggregation. These are:

The structure of consumption, and

The productive structure.

3.1.1 The structure of consumption

This analysis is shown in table 1 and comprises:

(a) The pattern of expenditure on food, grouped under the following main headings:2/ dairy, fruit, fish, oils, cereals, vegetables, meat, rootcrops, etc. This pattern of expenditure is accounted for in the structure of consumption, both in physical terms (physical units of consumption) and in value terms (first column);

(b) The pattern of family expenditure in the various expenditure groups: food and drink, housing, transport, clothing, health, education, mobility, recreation, others (second column);

2/ Each of these headings can be subdivided according to its respective specific products.

Table 1. Structure of consumption

(1) Food expenditure and pattern				Pattern of family expenditure (2)										Socio-economic structure (3)
Product	F	V		Food/drink	Housing	Transport	Clothing	Health	Education	Mobility	Recreat'n	Other	Total	
		US$	%											
DAIRY														I
FRUIT														
FISH														
OILS														
CEREALS														
VEGETABLES														
MEAT														
ROOT CROPS														
OTHER														
TOTAL														
DAIRY														II
FRUIT														
FISH														
OILS														
CEREALS														
VEGETABLES														
MEAT														
ROOT CROPS														
OTHER														
TOTAL														
DAIRY														III
FRUIT														
FISH														
OILS														
CEREALS														
VEGETABLES														
MEAT														
ROOT CROPS														
OTHER														
TOTAL														
DAIRY														IV
FRUIT														
FISH														
OILS														
CEREALS														
VEGETABLES														
MEAT														
ROOT CROPS														
OTHER														
TOTAL														
DAIRY														V
FRUIT														
FISH														
OILS														
CEREALS														
VEGETABLES														
MEAT														
ROOT CROPS														
OTHER														
TOTAL														

(c) The consumer population distributed according to its income level and/or geographical location. In the structure of consumption shown, the population is divided into five socio-economic strata, defined by family income level (third column).

The structure of the consumption concept is an analytical and programming tool which makes it possible to:

- Assess the importance of the consumer goods under consideration within the pattern of expenditure of socio-economic strata, by geographical location;

- Set programmed consumption targets for particular sections of the population;

- Design and select policies for income, expenditure and consumption distribution.

3.1.2 The productive structure analysis

This is the basic tool for analyzing productive components as shown in table 2. These include:

(a) Factors of production (inputs of services, capital goods, natural resources, labour) required for the production of a good and/or service;

(b) The components of value added (salaries/wages, taxation, gross savings, returns);

(c) Price components for each of the factors;

(d) Value of production; and

(e) Market or destination of products and by-products.

The productive structure concept is a techno-economic tool for analysis and programming of the input-product type. Capital goods and production services are the inputs and goods or services produced by using these productive factors are the outputs.

With the productive structure it is possible:

(a) To assess production technologies (input/input and input/product ratios);

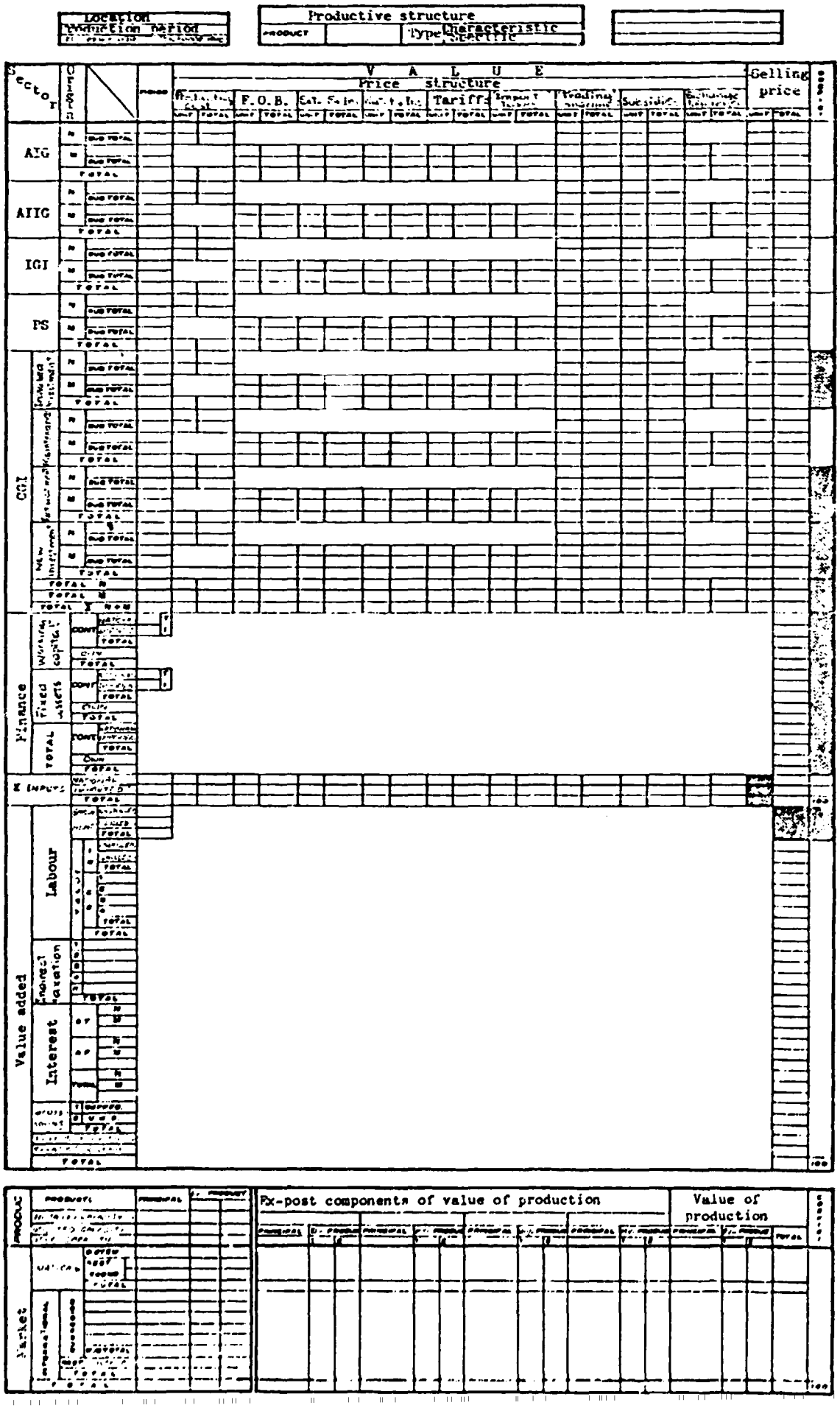
(b) To assess the price structure of each of the factors of production;

(c) To assess the composition of value added;

(d) To assess the cost structure;

(e) To assess the effects on a productive component of economic policies (tariffs, exchange rates, interest rates, subsidies, taxation, etc.);

Table 2. Productive structure



(f) To assess national and international relationships of the components;

(g) To design and select technological and economic policies.

Broadly speaking, the structure of consumption and the productive structure can be described as two accounting systems by which the components of a system can be analyzed in technical and economic terms.3/

From the point of view of evaluation, the methodology for production and consumption systems also gives a combination of accounts. It is a macro-economic assessment system, which permits the analysis of the effects on each component and on the system as a whole of variables, such as: resources (investment, employment, finance, foreign exchange, natural resources, etc.), income (distribution), government (income and expenditure), foreign exchange and imports, intersectoral relationships, external competition and impact on the remainder of the economy. These accounts will be analyzed in greater detail later in the report. As far as programming and management is concerned, this is planned on the basis of testing, simulating and experimenting with a variety of projections. These projections involve changes in the components and the system, whereby development alternatives and specific economic and technological policies are defined to permit the programming and management of the alternative system chosen.

3.2 Methodological sequence

The methodology of production and consumption systems analysis comprises three main sequences:

Sequence A: Identification and disaggregation of the components of the production and consumption system.

Sequence B: Assessment of the components and the system.

Sequence C: Programming the development of the system.

In the first sequence components making up a given system are defined and differentiated in accordance with the base scheme. Next, depending on the techno-economic importance and targeted objectives, the development of which is to be programmed, components for specific analysis are selected.

When information on productive structures has been incorporated in the numerical experimentation model, the result is a set of assessment accounts which can be used as tools for the macro-economic and structural assessment of the system and its components. As in the disaggregation stage, this

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3/ This does not mean that a productive structure is an input/output table or matrix as developed by V. Leontief. This table is the representation of a combination of economic variables based on a theoretical model of production which takes into account elements of final demand and portrays the hypothetical operation of the economy as a whole.

assessment takes place at two levels: simple assessment, which is similar to conventional diagnostic and structural assessment which provides more knowledge of the composition and relationships of each component and the system.

The system programming stage takes as its starting point three main interrelated objectives:

(a) Final demand objectives for different consumer groups expressed in terms of consumption quantities, quality and price of goods;

(b) Objectives of different producers and economic agents, involved in or linked to a specific production or consumption system: maximization of income (wages for workers, returns to entrepreneurs and fiscal revenue to the state);

(c) National and/or subregional social and economic development objectives:

(i) Rational use of resources: human, natural, technological, financial, etc.;

(ii) Even growth of the trade balance, foreign exchange balance, balance of payments, tax revenue;

(iii) Social targets in respect of employment and income distribution;

(iv) Reduction of regional and/or sectoral imbalances;

(v) Economic autonomy of systems with upgrading of national production in the components.

There is a multiple interdependence between the three groups of objectives. For example, the objective of consumers to have the desired goods in sufficient quantities, of acceptable quality and at an accessible price will depend on or be a function of the technical, economic and social characteristics of production and demand.

The quantity supplied will depend on the level of local production or imports and the quality of the goods will depend on the technology utilized in its production.

The price paid by consumers will depend on their income level and their pattern of expenditure, level of production, productivity of the factors utilized (technology) and the level of profit.

The scale of production will be a function of the installed capacity, the relationship between costs, returns on investment and the price paid by the consumer.

The level of return depends on the pattern of distribution of production value added: profits, wages, taxation, interest and thus on the specific features of the distributive interests of different agents (owners, workers and government).

The structure of functional relationships between the three groups of stated objectives can then be seen, and also the fact, that in the course of programming the development of the system, particular efforts will have to be made conceptually and technically to harmonize these three objectives and make them functionally compatible with each other.

Figure 3 outlines the interrelationship between development programming objectives, agents and tools.

The development of these three stages making up the Methodology for Assessment and Programming Production and Consumption Systems will be dealt with in greater detail below.

In order to better explain the stages of the methodology, a case study will be used, i.e. the results obtained in the research project entitled "Assessment and Programming of the Production and Consumption System for Oils and Fats in Peru" which was based on this methodology.

3.2.1 Disaggregation

This first stage of the methodology seeks to define the components and features of a given system. It can in turn be divided into:

(a) Identification, linkages and graphical representation of components;

(b) Simple disaggregation;

(c) Structural disaggregation;

(d) Spatial disaggregation.

Identification, linkages and graphical representation of components

The first stage in defining a given system is to identify those goods and inputs required to produce a good for final consumption.

Figure 4 shows the procedure to follow in identifying components of the system.

First, the final goods must be specified and these are linked to a consumption structure and the productive components of such goods.

In the same way that oils are produced in Peru, the oils processing industry also produces other similar final goods. If the production of oils is to be modified, this will directly or indirectly affect production of the other goods (installed capacity, supply of raw materials, etc.) For this reason the following are defined as final goods: compound oil, vegetable oil, margarine, butter, soap, glycerine (phase A1).

Each of these final goods requires a production process and therefore raw materials, inputs, machinery, etc. Figure 4 shows as an example the inputs required for the production of compound oil, vegetable oil, margarine and butter. The other products may also be differentiated if they are considered to be sufficiently important (phase A2).

Figure 3. Interrelationships between development objectives, agents and tools

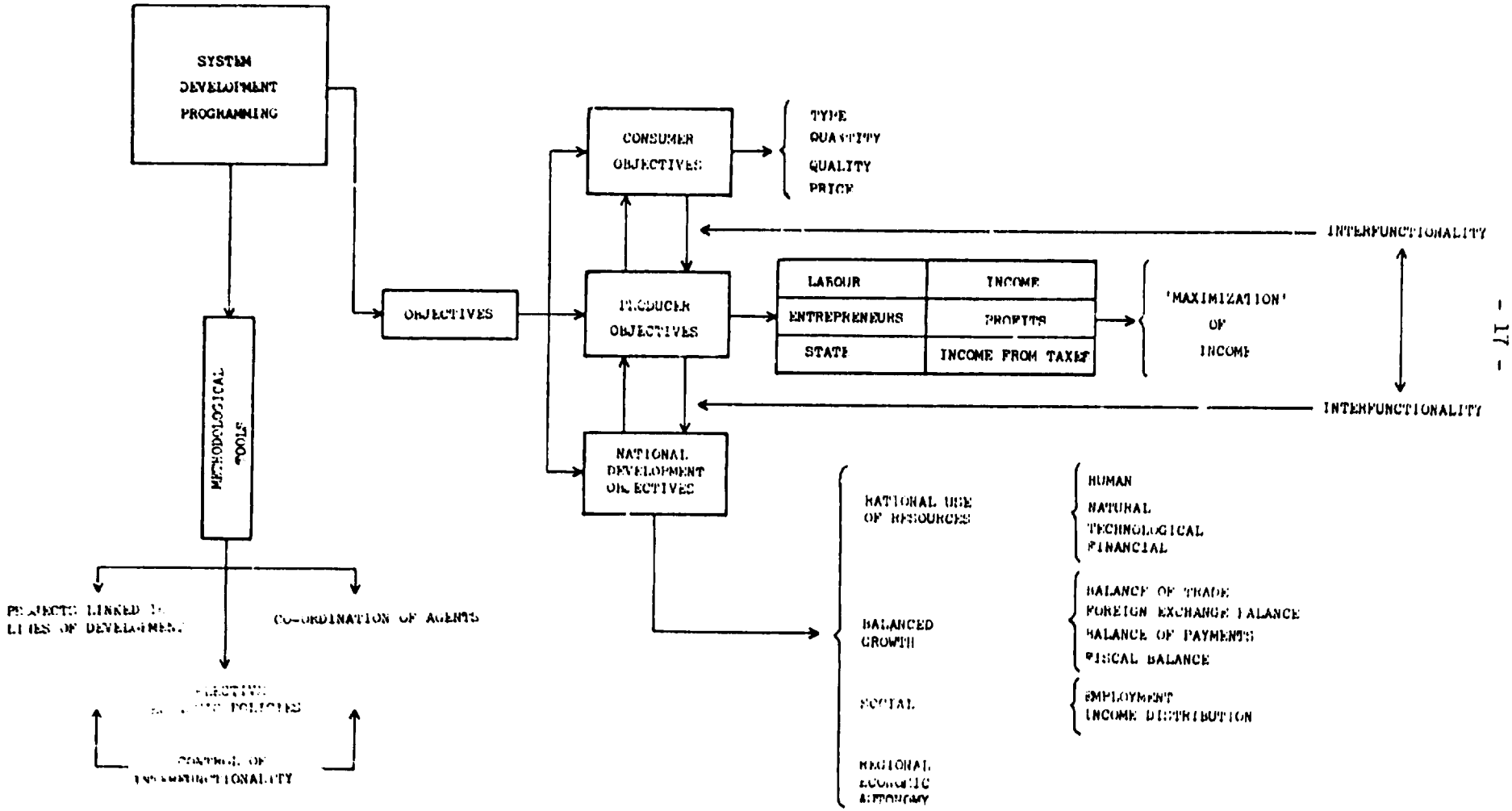
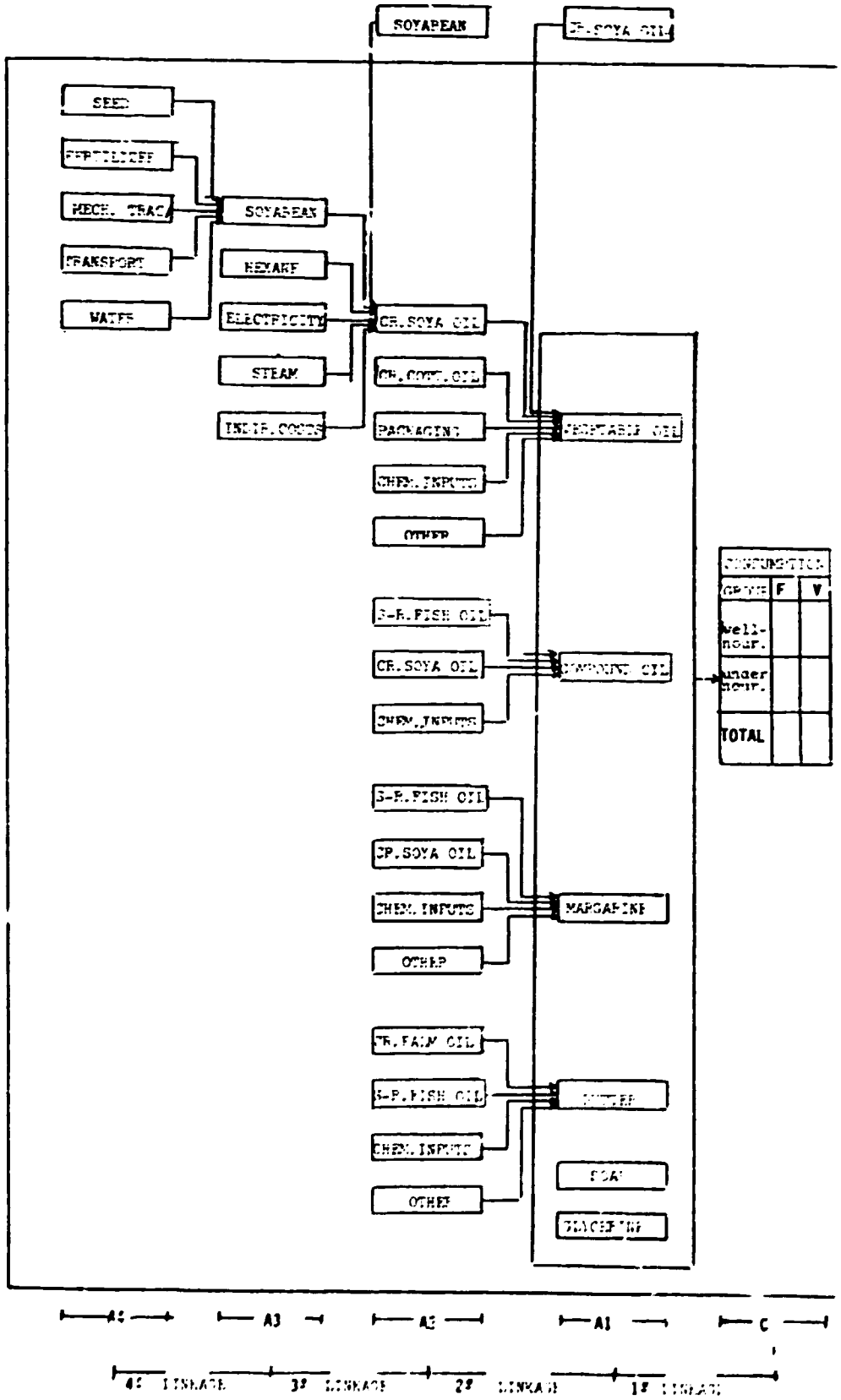


Figure 4. Procedure for the identification of the system's components (oils processing industry in Peru)



This phase constitutes the second linkage, linking final goods to the inputs needed to produce them.

The inputs to final goods will also in their turn require a production process and will need resources. Depending on the importance attached to each in the analysis and depending on the programming objectives, the inputs, services and capital goods needed to produce these constituents of final goods (phase A3) will be identified.

In the example shown in figure 4, the inputs required to produce vegetable oil are identified as crude soya oil, crude cotton oil and packaging; to produce compound oils, semi-refined fish oil is required; for butter, crude palm oil. Each of these inputs has been differentiated on the basis of its significance in the gross value of production, possibility of technical changes, etc. This second stage of relationships is called the second linkage.

In order to produce crude soya oil the following are required: soya bean, hexane, electricity, steam and indirect expenditure, the most important of which in techno-economic terms is soya bean. Consequently it will be necessary to identify the inputs, services and capital goods required to produce this raw material (phase A3).

The relationship between soya bean production and its inputs is called the fourth linkage (phase A4).

Just as disaggregation is shown for certain inputs, more of them may be similarly differentiated, both within each linkage (i.e. besides soya bean, hexane production, cottonseed, crude fish oil, etc. could be disaggregated) or in a further linkage (fertilizer production could be disaggregated in soya cultivation, making a fifth linkage). It should be noted that for the sake of simplicity in this chart capital goods have not been included but they too could be disaggregated.

The whole of the stage described above is phase one and is defined as the identification and differentiation of productive components.

The second phase in identifying the system under analysis is to determine external linkages, in other words to define which components contain imported or exported inputs or capital goods.

In the example given in figure 4 crude soya oil is imported for the production of final goods and soya bean is imported for national production of this oil.

The third phase is to identify the consumption of the final good, i.e. to differentiate consumption on the basis of consumer markets. In figure 4 the oil-consuming population has been divided on the basis of food requirements. The division is made between the part of the population that is well-nourished and the part that is under-nourished.

The relationship between consumers and final goods consumed is defined as the first linkage. Figure 4 shows the basic general model, containing all goods and inputs required to define a given system. As previously stated this disaggregation may be extended to an undefined nth linkage and for this reason

it will be necessary to set limits to the system. Thus, a differentiated base scheme is established, showing the components to be analyzed, the degree of disaggregation depending on the objectives of the study.

In the case of oils, figure 5 shows the base scheme for differentiated components, where only those factors which will have the greatest impact on the objectives set out previously are taken into account.

While the process of identifying the system may culminate in the process described above, consideration must also be given to the indirect effects of certain components which, although they conform to the system under analysis, show a behaviour pattern that depends on a different market for final goods.

In the case of oils, it must be borne in mind that one of the components, the production of crude fish oil, is not a primary good but rather a by-product of fish meal processing. As a result, this component will have to be further linked with the components involved in the processing of this input.

Figure 6 shows how fish oil and fish meal production components are also included in the balanced feed component which in turn is part of the poultry industry, producing chickens and eggs as final goods. In this way this figure represents the total oils and fats system.

Simple disaggregation

The objective of this stage is to set out the main features of each of the components making up a particular system. In general terms, this analysis is carried out for each component. In addition, there must be an analysis of the institutional framework showing the way in which the state and private organizations act within the system.

This simple disaggregation stage is subdivided into five key analytical sections, as follows:

- The consumption component;
- The productive component;
- The quantification and representation of the system;
- The institutional framework;
- The types of market which make up the system.

The first two sections deal with a detailed analysis of each of the components making up the system, showing the main variables which characterize the component in question. The objective of this analysis is to obtain a preliminary broad overview of the past behaviour of the components under analysis.

A set of technical tables is used to give a general description of the production features and producers in each component. This set of tables will be used in subsequent stages of the methodology.

Figure 5. Base scheme for differentiated components of the production and consumption system of oils and fats, Peru

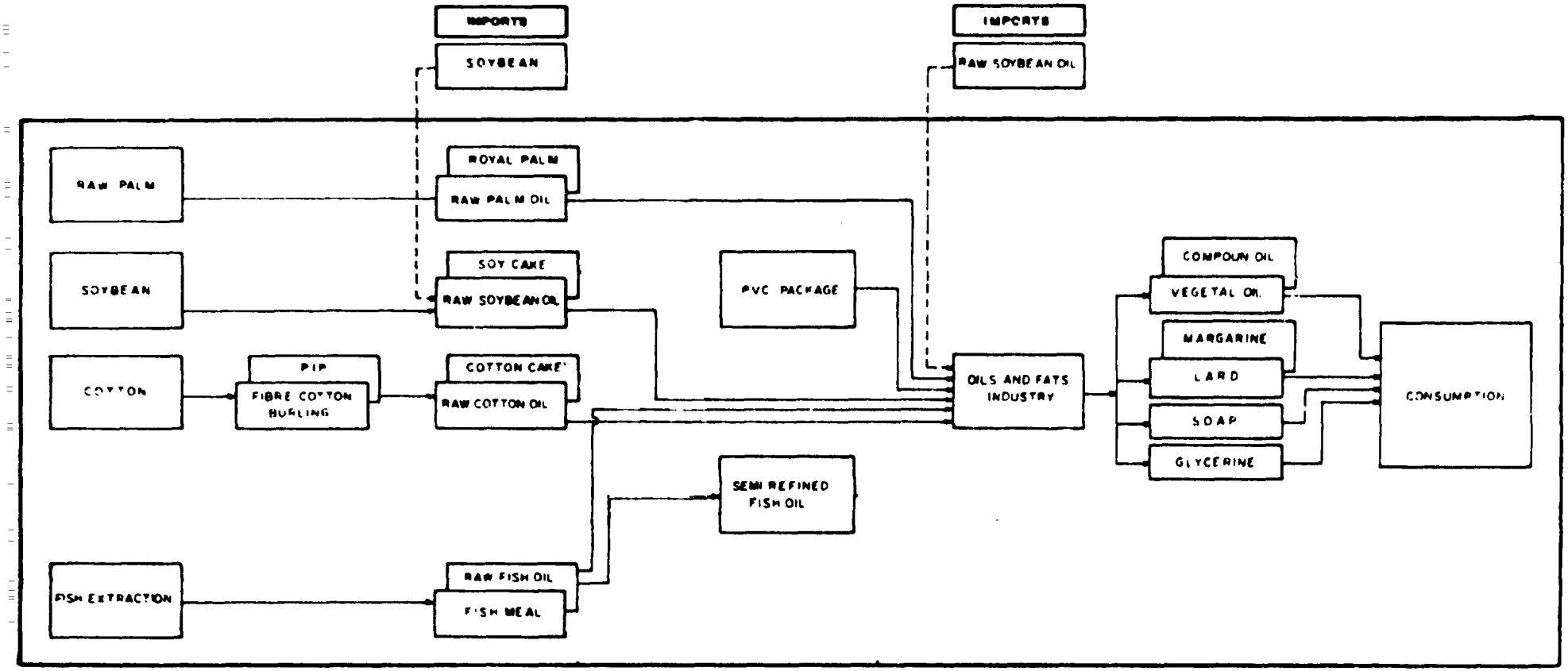
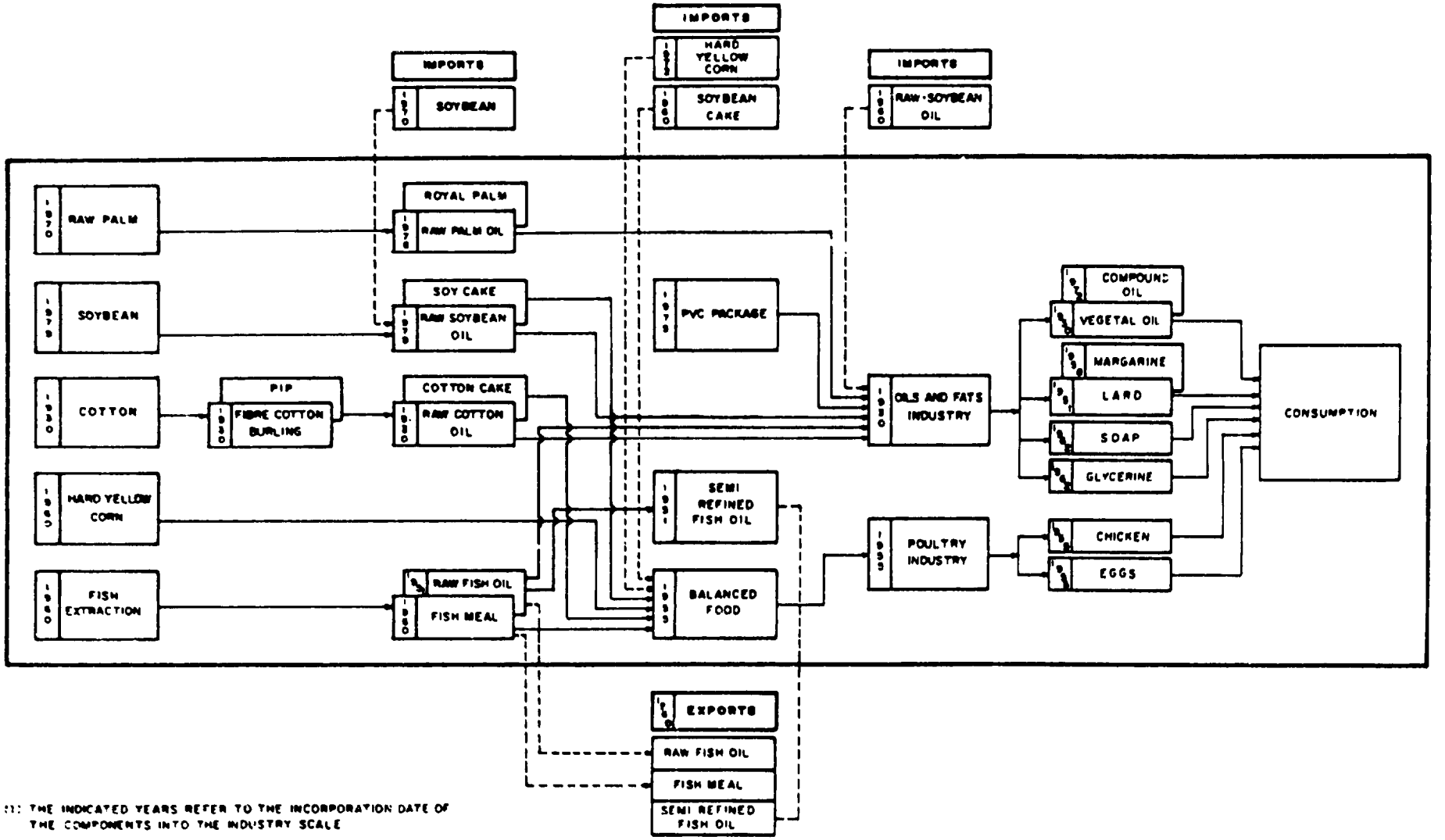


Figure 6. Total base scheme for productive components of the production and consumption system of oils and fats, Peru



It is important to emphasize that the required information relates both to production absorbed in the system, and production going to the remainder of the economy. The impact of the latter on the behaviour of the system is to be ascertained.

In the third section the principal indicators which characterize each component are shown in the previously defined base scheme.

Taking the case of oils, figures 7 and 8 give quantified models with production indicators for all the components making up the system. This representation further clarifies the composition of the model, showing productive flows and existing bottlenecks.

When the model has been defined in this way, initial proposals for possible changes in the components can be made. In addition more complex models can be constructed taking into account prices, marketing channels, etc. All these will depend on the objectives of the study and on whether individual variables have a greater or lesser impact.

The aspect relating to the institutional framework allows an identification of the public and private organizations operating in the system, the legal framework, state programmes, policies and all those aspects which support the development of a particular component or the system as a whole.

The final point, concerning types of markets, attempts to classify and describe linkages which exist between the various components of the system, in other words to identify and analyze markets of goods and services.

From this general information given in the simple disaggregation, the market relationship existing between the components is ascertained. Using the example of oils and fats, table 3 shows the types of market in each component, both as suppliers of products and in terms of demand for inputs.

Table 3. Nature of the markets for the components disaggregated by system

	Supply	Demand
Consumption	-	Competition
Oils and fats industry	Oligopoly	Oligopsony/Competition[a/]
Chicken and eggs production	Competition	Competition
Brooding and hatching birds production	Oligopoly	Competition
Balanced feeds	Oligopoly	Competition
Palm	Monopoly	-
Soybean grain	Competition	-
Cotton	Competition	-
Fishmeal and fish oil	Competition/Oligopoly[b/]	Competition
Fish	Competition	-

a/ Oligopsony: palm and soybean; competition in fish oil
b/ Competition: international market; oligopoly in national market

Figure 7. BASE SCHEME OF THE ECONOMIC FLOWS OF THE PRODUCTION AND CONSUMPTION SYSTEM OF OILS AND FATS - PERU
YEAR 1984 (M T AND THOUSANDS U.S. $.)

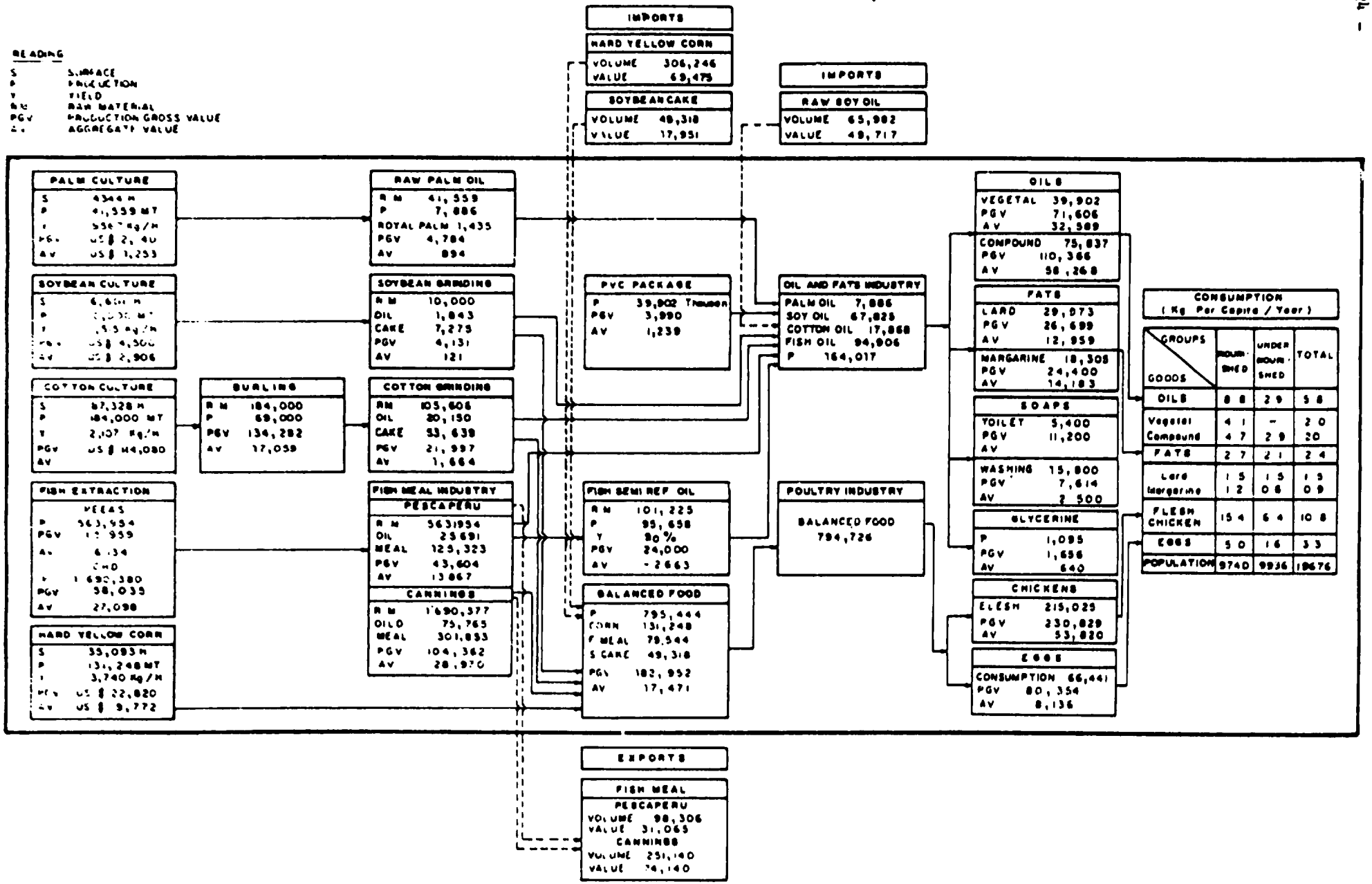
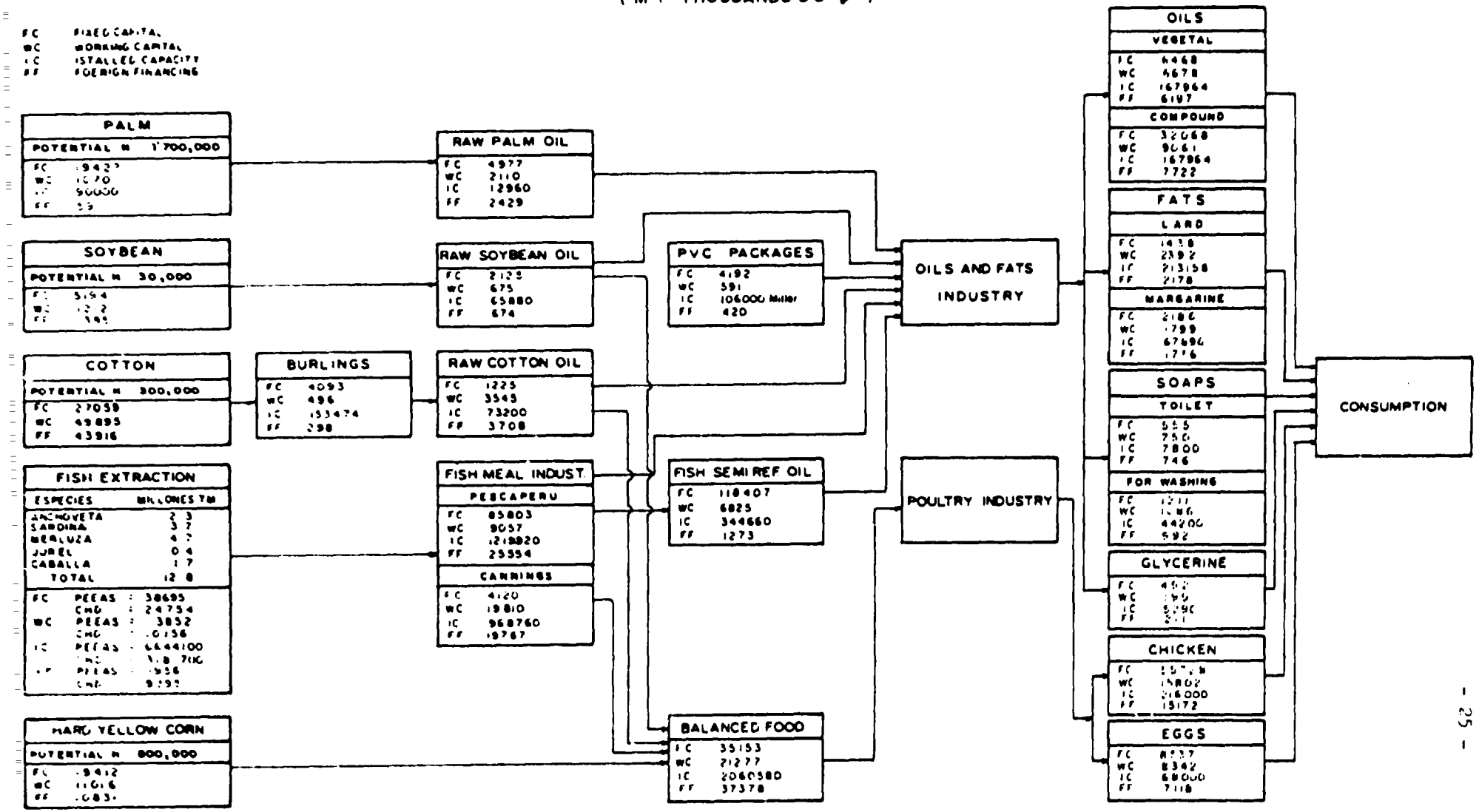


Figure 8. **BASE SCHEME OF THE STOCK OF THE CONSUMPTION AND PRODUCTION SYSTEM OF OILS AND FATS**

(M T THOUSANDS U S $)



Structural disaggregation

Structural disaggregation is the analysis of each component in terms of its individual characteristic features, and its relationship with other components making up the system.

This disaggregation is at two levels, one relating to the consumption component and the other to the productive components. The disaggregation of the consumption component is based on six determining variables: socio-demographic, income, expenditure-consumption, family unit and food economy (the latter only in the case of systems involving food products).

Each of these variables is analyzed in a set of tables which explain their behaviour and as a group they explain the demand for the final good defined by the system (table 4).

Structural disaggregation of the productive components is based on the unit known as productive structure, which is a tool of the input-product type, into which enter inputs, services and capital goods; the output is a good or service produced by the use of the productive factors as described in section 3.1.

By way of an example, table 5 shows the productive structure of the vegetable oil production component in the oils and fats system being analyzed. Its format follows the model included in the programme developed for mini-computers.

The first part, table 5 (I), contains the inputs necessary to produce a particular good, showing both physical quantities required and the purchase value of those quantities. In addition, it shows how this value is made up. To take the case of the input of imported crude soya oil, this component requires a quantity of 26,926 metric tons representing a value of $US 20,303,000; this value is determined by the sum of the f.o.b. value at port of embarkation ($US 15,989,000), freight and insurance ($US 915,000), payment of tariffs ($US 2,706,000), import taxes ($US 169,000) and trading margin ($US 524,000). Thus, each input and capital good will have a defined value and its own price structure.

The second part, table 5 (II), contains the production value structure of the final good which, with the inclusion of by-products, forms the gross value of production of the component.

The value of the final good is analyzed according to its distribution, both in physical quantities and value. By-products are also distinguished by name and by physical quantity and value.

The third part shows the composition of value added and the principal results of the given component.

Table 4. Variables, information required and analytical objectives for the study of demand, income and consumption

Determining variables	Information required	Analytical Objectives
Socio-demographic	POPULATION: - Division by age - Division by sex - Division by socio-economic stratum - Urban-rural division - Division by region - Birth rates - Mortality rates - Observed growth - Vegetative growth - Immigration rates EDUCATION: - Levels of education EMPLOYMENT: - Distribution of the economically active population between employed, unemployed and under-employed - Distribution of the population by type of activity and occupational category	- Determination of the basic population indices to calculate national and regional demand by socio-economic stratum, sex, age and urban-rural division. - Estimate and projection of population growth at national, regional and urban-rural level by socio-economic stratum, sex and age. - Determination of the correlation between demographic structure, employment and level of education.
Income	- Origin and composition of income - Sources of income - Types of income - Average income for each class of activity and occupational category - Distribution of income - Per capita income	- To estimate the extent of access by the population to income distribution. - Determination of the level of demand as a function of population and income level. - To estimate per capita income on a regional basis, and comparing town and country.
Expenditure-Consumption	- Pattern of expenditure on consumer goods - Food expenditure - Pattern of consumption	- Determination of expenditure on groups of consumer goods (and/or specific products) at national, regional and town-country level by socio-economic stratum or population group. - Estimate of consumption habits for each socio-economic stratum or population group at national, regional and town-country level. - Determination of elasticities.
The Family	- Composition of the family - Family income - Family wealth - Family expenditure	- Determination of the division of labour within the family according to occupational category by socio-economic stratum or population group at national regional and town-country level. - Determination of family income structure. - Estimate of family capital wealth. - Determination of the pattern of total family expenditure on food (and/or specific products).
Nutritional Economy (only for the study of consumption of food-goods)	- Consumption of food products by physical quantity and value - Per capita nutritional needs - Consumption of fresh and processed foods	- Determination of intake of proteins and calories. - Determination of expenditure on food and/or specific products quantifiable in terms of proteins and calories. - Determination of deficit in proteins and calories by socio-economic strata age and sex at national, regional and town-country level. - Quantification of actual and potential demand for food and/or specific products. - Determination of the origin, domestic or imported, of food consumption (and/or specific products) prices or materials.

Table 5. Productive structure of the vegetable oil component[a/]

I

Component: A Product: Vegetable oil (70%S-30%A)
Period: Initial Unit: M.T. Total production: 39902

Inputs	Quantity	Value	Components of value									
			Production cost	FOB cost	External F + ins.	Internal F + ins.	Tariffs	Import. tax	Trade margin	Subsidy	Exchange difference	Rest of components
Cr.Soya O.Nat.(MT)	1843	1390	1390	0	0	0	0	0	0	0	0	0
Cr.Soya O. (MT)	26926	20303	0	15989	915	0	2706	169	524	0	0	0
Cr.Cott.O. (MT)	12968	9078	9078	0	0	0	0	0	0	0	0	0
Chem.Inp.N (kg)	429	429	343	0	0	0	0	0	86	0	0	0
Chem.Inp.M. (kg)	258	258	0	127	26	0	38	15	52	0	0	0
Electricity (KWh)	3990200	302	302	0	0	0	0	0	0	0	0	0
Steam (kg)	26335320	273	273	0	0	0	0	0	0	0	0	0
Water (M3)	119706	40	40	0	0	0	0	0	0	0	0	0
Bottles (1 lt.)	39902000	3990	3990	0	0	0	0	0	0	0	0	0
Lables (unit)	39902000	124	124	0	0	0	0	0	0	0	0	0
Cartons (12 bot.)	3311866	1586	1586	0	0	0	0	0	0	0	0	0
Indir. Costs (US$)	1244	1244	1244	0	0	0	0	0	0	0	0	0
Total		39017	18370	16116	941	0	2744	185	662	0	0	0

a/ Values are given in thousand US$. The format corresponds to the one developed for the micro-computer.

Table 5 (cont'd)

II

Production	Quantity	Value
Subsystem	39902	71562
Export	0	0
Rest of economy	0	0
Total subproducts		44

Subproduct	Quantity	Value
Lees (50% MG/kg)	1859	44

III. Productive component - Results

Gross production value	71606		Production	Quantity	Value
National inputs	21960		Subsystem	39902	71562
Imported inputs	17056		Export	0	0
			Rest of economy	0	0
Total inputs	39017		Total subproducts		44
Value added	32589		Labour		219
			Unskilled		0
Wages	1053	3.23%	Skilled		219
Unskilled	0	0.00%			
Skilled	1053	3.23%	Idle capacity		76.24%
			Units		128062
Indirect taxes	3259	10.00%			
Production	3259	10.00%	Gross investment		0
Export (net)	0	0.00%	Imported		0
			Domestic		0
Interests	815	2.50%			
Short term	801	2.46%	Generated capacity		167964
Long term	13	0.04%			
Gross saving	323	0.99%	Finance		6388
			External		0
Profits	18998	58.29%	Internal		6388
Revenue taxation	8142	24.98%			
			Natural resources		0

Spatial disaggregation

This covers the analysis of a system and its components when geographical location is a significant factor. For example, when particular features of each region have an impact on the components and also when the established objectives include items such as the analysis of the geographical concentration of production and consumption, balance of geographical exchange etc. and also where programmes for regional integration are being sought.

Spatial disaggregation corresponds to the simple and structural disaggregation of production and consumption components. Consequently, spatial disaggregation is a process combining economic and geographical factors and it is thus possible to distinguish between simple spatial disaggregation and structural spatial disaggregation.

Each component and type of analysis will be carried out separately on the basis of the defined geographical distribution.

For example, figure 9 shows the geographical distribution of the oils and fats system. This model is differentiated on the basis of the six regions defined in figure 10.

3.2.2 Assessment

This stage consists of analyzing the existing system. For this there are three types of assessment:

(a) Simple, based on the information shown in the simple disaggregation;

(b) Structural, which is the analysis of the productive and consumption structures; and

(c) Spatial assessment, which combines economic factors with those of geographical distribution.

Simple assessment

Like simple disaggregation, this stage is subdivided into the assessment of the consumption components, productive components, the institutional framework and the market.

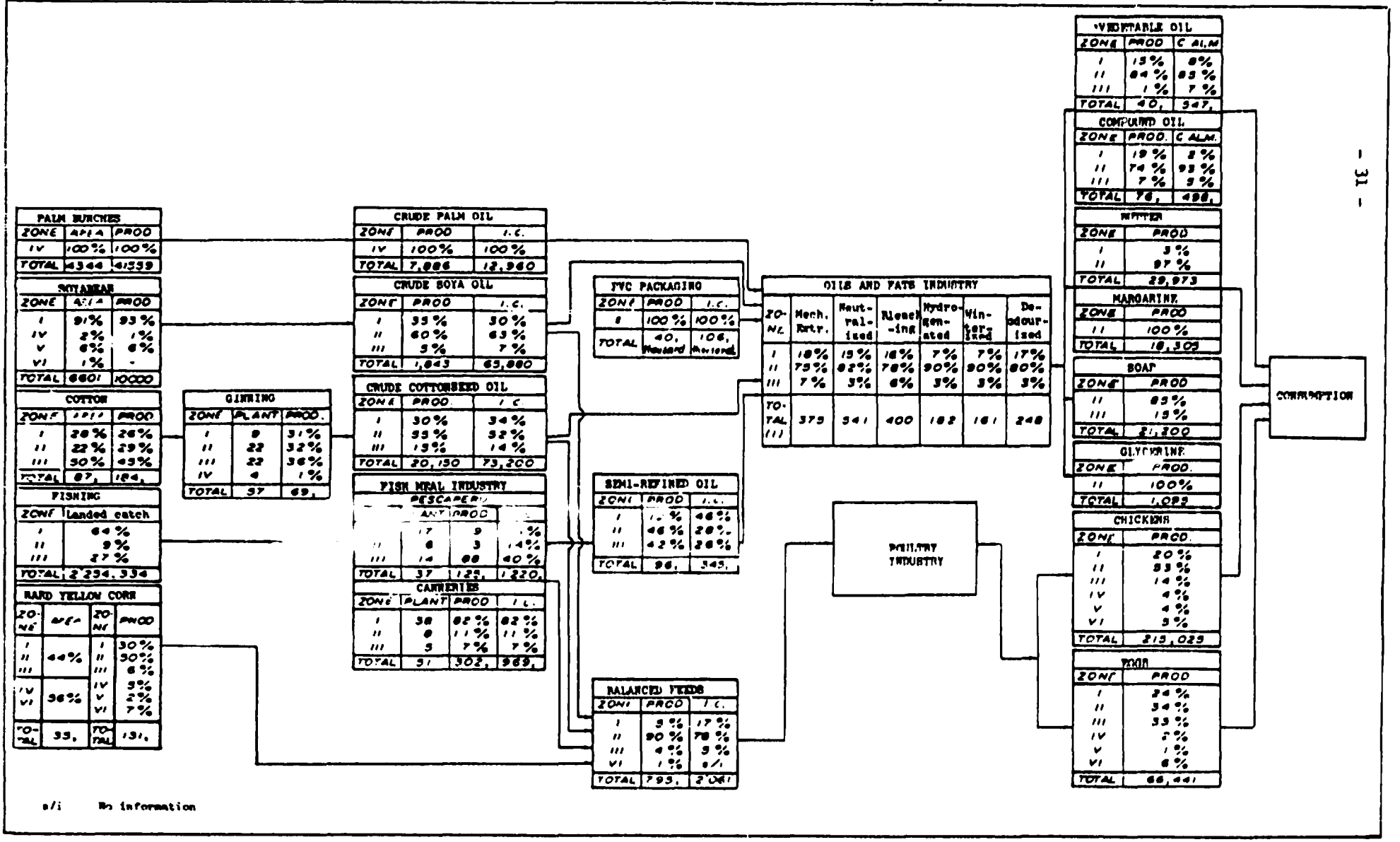
Generally, simple assessment corresponds to a conventional diagnostic analysis.

Structural assessment

The structural assessment is based on information obtained through structural disaggregation and is shown by means of a combination of accounts which permit such analysis, both at individual component levels and for the system as a whole.

Assessment of the consumption component can in turn be broken down on the basis of data tables obtained in the disaggregation stage (table 4) and of four accounts which define the possible programming of demand in the system. These four accounts are:

Figure 9. Regional base scheme of the oils and fats production and consumption system - Peru



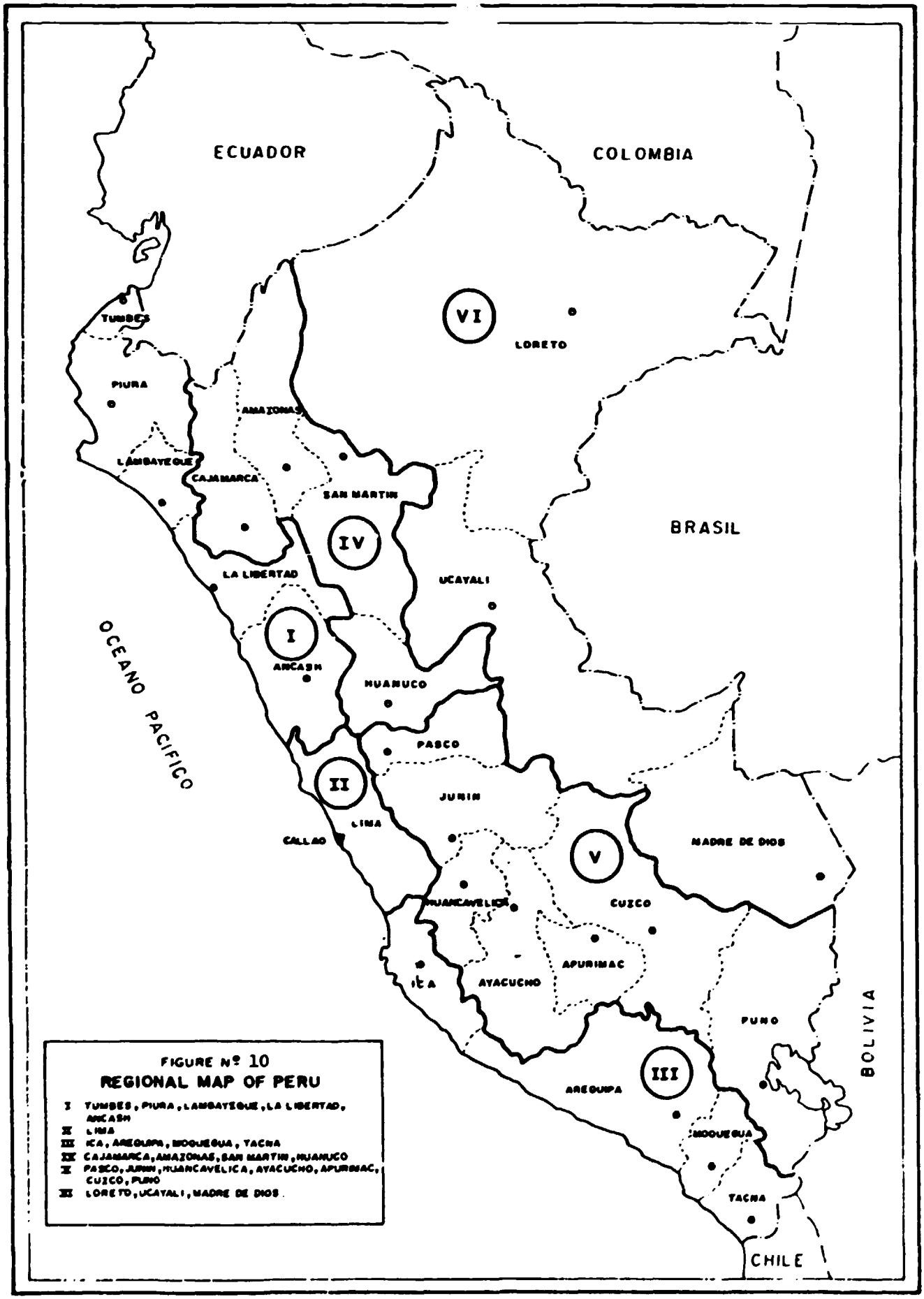


FIGURE Nº 10

REGIONAL MAP OF PERU

I TUMBES, PIURA, LAMBAYEQUE, LA LIBERTAD, ANCASH
II LIMA
III ICA, AREQUIPA, MOQUEGUA, TACNA
IV CAJAMARCA, AMAZONAS, SAN MARTIN, HUANUCO
V PASCO, JUNIN, HUANCAVELICA, AYACUCHO, APURIMAC, CUZCO, PUNO
VI LORETO, UCAYALI, MADRE DE DIOS

(a) Coverage of demand: making it possible to plan coverage of a deficit for a determined level of satisfaction for a final good;

(b) Origin of goods: differentiates goods to be covered on the basis of origin, national or imported;

(c) Alternative distribution of national consumption: from the amount of national production, it determines the extent to which each good contributes to total satisfaction of demand;

(d) Total demand for goods: this is a final overview showing total volumes of final goods, both of imported and national origin and according to alternative products.

The structural assessment of the productive components is a process that goes from the micro-economics to the sectoral and from the sectoral to the macro-economics. The micro-economic aspects refer to an assessment at the enterprise and/or plant level. In the same manner the assessment can go from the concrete technology at the plant to the activity and from this to the sector and the system. The objective of the structural assessment of the productive component is combined with that of system programming. For this reason, there must be a correlation and correspondence between the assessment and the programming, the first being an instrument of the latter. The management of the components and of the system as a whole is a process of interdependence between the micro and the macro economic factors. It is an interactive combination of levels which includes everything from the enterprise to the national economy. This concept not only allows interrelation of different levels of the economy but also the selective programming of the systems and its components through economic, technological and social policies.

Structural assessment of productive components is performed by means of a combination of 24 accounts, based on information obtained in the productive structures making up the system. These accounts show the results for each component separately and for the system as a whole, thus permitting micro-economic analysis at individual component level and macro-economic analysis based on general information concerning the system and its relationship with the remainder of the economy.

The accounts showing results for each component and the system as a whole are:

(a) Production: shows physical quantity and value of principal products of final goods and secondary or by-products;

(b) Productive structure: strictly speaking the same unit of account, as above, permitting analysis of the composition of the productive structure of each component;

(c) Capacities: for industrial components, this account shows installed capacities, utilized capacities, demand in the component and excess capacity;

(d) Resources: investment requirements, domestic or imported, employment needs divided into skilled and unskilled; financing for each component, both internal and external and the use of specific natural resources;

(e) Credits: distinguishing between those to provide working capital and those for the purchase of fixed assets;

(f) External resources: shows foreign exchange requirements for imports, foreign remittances, investment, loans, exports and balances;

(g) Income distribution: share of wages, taxation, interest, saving and profits;

(h) Government account: payments received or made by the state in the system, such as, tariffs, taxes, subsidies, exchange difference;

(i) Trading value added: for each good or input sold within the system there is a trading margin. This account shows how such margins are made up;

(j) Imports: gives details of imports required in each component expressed in FOB and CIF value and purchase or selling price;

(k) Input-product matrix: this is the aggregation of productive structures in each of the components regrouped by sector;

(l) National price gap: in order to analyze the difference between production cost and selling price both for intermediate and final demand;

(m) External price gap: similar to the previous account but relating to foreign goods;

(n) External trading margin: showing details of margins for external inputs and goods in each component;

(o) Internal trading margin: similar to the previous account but relating to national inputs and goods;

(p) National subsidies: details of subsidies given to intermediate and final demand;

(q) External subsidies: similar to the previous account but relating to imported goods and inputs;

(r) Tariffs: all payments to the state made at intermediate and final demand stages;

(s) External taxation: similar to the previous account and relating to taxes on imports;

(t) Exchange rate differences: details of differentiated rates of exchange for external linkages;

(u) External competition: to measure the degree of protection and competitiveness of final goods and inputs in each component;

(v) Share in the economy: measures the system's share and that of each component in relation to total demand in the economy;

(w) Co-efficient of the system: a series of co-efficients calculated from previous tables (table 6);

Table 6. Coefficients of the system

System coefficients

Country		System		Hypothesis	
Year		Sector	Good	Run	

Indicators / Components	FORMULAS	AIG 1	AIIG 2	IGI 3	PS 4	CGI 5	AIFG 6	7
1 Investment value added accelerator	$\frac{VA}{INST.INV.}$							
2 Investment imports accelerator	$\frac{IM}{INST.INV.}$							
3 Investment employment accelerator	$\frac{LAB.}{INST.INV.}$							
4 Basic project investment accelerator	$\frac{INST.INV.}{PB.INST.INV.}$							
5 Labour productivity	$\frac{VA}{LAB.}$							
6 Capital intensity per unit of labour	$\frac{INST.INV.}{LAB.}$							
7 Dependence on external inputs	$\frac{IM}{\Sigma I}$							
8 Product import tendency	$\frac{IM}{VA}$							
9 Dependence on final demand	$\frac{IM}{GVP}$							
10 Local integration of inputs	$\frac{IN}{\Sigma I}$							
11 Vertical integration of the system	$\frac{\Sigma VA}{GVP - \Sigma UNDIF.INPUTS}$							
12 Return - Product	$\frac{VA}{GVP}$							
13 Government transfers balance	$\frac{(TAX+TAR'F)-(SUBS+EX.D.)}{GVP}$							
14 Taxation charged to value added	$\frac{\Sigma. TAX\ on\ VA}{VA}$							
15 Labour training requirements	$\frac{SKILLED\ LABOUR}{UNSKILLED\ LABOUR}$							
16 Direct employment	$\frac{LAB.}{AIFG}$							
17 Net taxation payable on imports	$\frac{(TAX+TAR'F)-SUBS+EX.D.}{M}$							
18 Net export promotion	$\frac{RETURNS-TAXATION}{X}$							

(x) Potential product: calculated on the basis of idle installed capacity, value added, employment, profits, government account and potential demand for foreign exchange.

As an example, tables 7, 8, 9 and 10 show results of some accounts in the oils and fats system.

Spatial assessment

This stage analyzes results using both simple and structural assessment for a defined region. Table 11 shows some results of such a disaggregation in the oils and fats system.

3.2.3 Programming

System development programming is the stage in which the achievement of three major objectives is attempted: those relating to final demand for the defined goods; those of the various producers and economic agents involved in the system or linked with it; and national and/or regional social and economic development objectives.

There is a multiple interrelationship between these three groups of objectives. For example, the availability of a good to satisfy a demand in terms of desired quantity, quality and price will depend on the technical, economic and social features of the producers of these goods and in turn of those producing the inputs. In addition, the state will participate in these activities, either directly or indirectly, in accordance with its social policies with respect to income distribution, employment, food, foreign exchange balance, sectoral priorities etc.

This programming stage is subdivided into demand programming and programming of the productive components. Complementing this is a control and reprogramming stage to assess the impact achieved by changes in instruments of economic policy, productive components or demand in a particular system.

Demand programming

Demand programming has a dual effect. On the one hand, it improves the quantity and quality of goods and services produced, since it involves a better mix of resources. On the other hand, there is an effort to improve the level and quality of consumption among different groups of the population.

The extent to which these objectives will be achieved depends on the analysis of different possible secenarios resulting from changes in variables determining their behaviour. Changes in demand consist mainly of the following:

- Demographic changes with consumption remaining constant: by area or region, socio-economic strata, age, etc.;
- Changes in physical consumption: by region, socio-economic strata, age, sex, etc.;
- Changes in income: by region, by socio-economic strata, etc.;

Table 7. General results for oils and fats subsystem ($US thousands)

Component	Gross production value	Value added	Employ-ment: men/year	Foreign exchange needs	Government account	Required finance
Vegetable oil (70%S-30%Cott)	71,606	32,589	219	22,779	14,330	6,388
Compound oil (50%SRFO-50%S)	110,366	58,269	472	35,037	24,376	7,623
Butter	26,699	12,959	128	2,390	4,552	2,328
Margarine	24,400	14,183	121	2,922	5,049	1,702
Crude cotton seed oil	21,997	1,664	195	107	130	3,565
Crude soya oil	4,131	121	9	-	-	677
Soya cultivation	4,500	2,906	1,290	190	42	1,212
Semi-refined fish oil	24,008	-2,633	270	203	-9,887	903
Crude palm oil	4,784	894	118	496	-164	2,256
Palm cultivation	2,140	1,253	949	1,490	-3,150	1,328
PVC packaging (1 lt)	3,990	1,239	166	124	51	383
Washing soap (30%B-65%SRFO-5%C)	7,614	2,150	220	936	561	1,032
Toilet soap (80%P-20%C)	11,200	6,945	52	2,634	2,767	726
Glycerine	1,656	640	37	-334	112	177
Total	319,092	133,180	4,245	68,974	38,769	30,299

Table 8. External sector account for the oils and fats subsystem ($US thousands)

Component	Total effect	Imports		Remittances		Exports	Net external borrowing
		Inputs	Equipment	Profits	Interest		
Vegetable oils (70%S-30%Cott)	22,779	17,056	-	5,699	7	-	17
Compound oil (50%SRFO-50%S)	35,037	24,963	-	9,958	33	-	83
Butter	2,390	140	-	2,245	2	-	4
Margarine	2,922	425	-	2,489	2	-	6
Crude cottonseed oil	107	-	-	91	6	-	10
Crude soya oil	-	-	-	-1	-	-	1
Soya cultivation	190	190	-	-	-	-	-
Semi-refined fish oil	203	203	-	-	-	-	-
Crude palm oil	496	-	-	-	220	-	275
Palm cultivation	1,490	-	-	-	662	-	828
PVC packaging (1 lt)	124	90	-	34	-	-	-
Washing soap (30%B-65%SRFO-5%C)	936	791	-	144	-	-	-
Toilet soap (80%P-20%C)	2,634	1,393	-	1,242	-	-	-
Glycerine	-334	20	-	92	-	-446	-
Total	68,974	45,272	-	21,992	933	-446	1,223

Table 9. Distribution of value added in the oils and fats subsystem ($US thousands)

Component	Total	Percentage of total					
		Wages	Taxation	Interest	Gross savings	Profits	Revenue taxation
Vegetable oils (70%S-30%Cott)	32,589	3.23	10.00	2.50	0.99	58.29	24.98
Compound oil (50%SRFO-50%S)	58,269	3.89	10.00	1.98	2.75	56.96	24.41
Butter	12,959	4.72	10.00	2.24	0.55	57.74	24.74
Margarine	14,183	4.09	10.00	1.55	0.77	58.51	25.07
Crude cottonseed oil	1,664	56.24	-	17.76	-	18.20	7.80
Crude soya oil	121	36.56	-	67.36	-	-3.92	-
Soya cultivation	2,906	49.46	-	-8.35	-	58.89	-
Semi-refined fish oil	-2,633	-24.75	10.00	-25.92	-224.87	365.53	-
Crude palm oil	894	37.00	-	59.14	22.27	-18.40	-
Palm cultivation	1,253	213.09	-	76.33	62.00	-251.42	-
PVC packaging (1 lt)	1,239	64.38	-	5.75	16.91	9.06	3.88
Washing soap (30%B-65%SRFO-5%C)	2,150	49.09	10.00	6.18	2.82	22.34	9.58
Toilet soap (80%P-20%C)	6,945	3.56	10.00	0.89	0.40	59.60	25.54
Glycerine	640	27.70	-3.95	3.91	3.85	47.95	20.55
Total	133,180	9.66	9.33	3.81	7.00	46.61	23.59

Table 10. Government account for the oils and fats subsystem ($US thousands)

Component	Total effect	Tariffs and taxation			Public enterprise profits
		Imports/ inputs	Indirect	Revenue	
Vegetable oils (70%S-30%Cott)	14,330	2,929	3,259	8,142	-
Compound oil (50%SRFO-50%S)	24,376	4,324	5,827	14,225	-
Butter	4,552	50	1,296	3,207	-
Margarine	5,049	79	1,418	3,556	-
Crude cottonseed oil	130	-	-	130	-
Crude soya oil	-	-	-	-	-
Soya cultivation	42	42	-	-	-
Semi-refined fish oil	-9,887	-	-263	-	-9,624
Crude palm oil	-164	-	-	-	-164
Palm cultivation	-3,150	-	-	-	-3,150
PVC packaging (1 lt)	51	3	-	48	-
Washing soap (30%B-65%SRFO-5%C)	561	140	215	206	-
Toilet soap (80%P-20%C)	2,767	298	695	1,774	-
Glycerine	112	6	-25	131	-
Total	38,769	7,871	12,421	31,419	-12,938

Table 11. General results for oils and fats subsytem by region

Component	Variable	I	II	III	IV	V	Total
Vegetable oil	VA	4,888	27,375	326	-	-	32,589
	N	33	184	2	-	-	219
	$US	3,408	19,084	227	-	-	22,719
	CG	2,150	12,037	143	-	-	14,330
Compound oil	VA	11,071	43,119	4,079	-	-	58,269
	N	90	349	33	-	-	472
	$US	6,657	25,927	2,453	-	-	35,037
	CG	4,631	18,038	1,706	-	-	24,376
Butter	VA	389	12,570	-	-	-	12,959
	N	4	124	-	-	-	128
	$US	72	2,318	-	-	-	2,390
	CG	137	4,415	-	-	-	4,552
Margarine	VA	-	14,183	-	-	-	14,183
	N	-	121	-	-	-	121
	$US	-	2,922	-	-	-	2,922
	CG	-	5,049	-	-	-	5,049
Crude cotton seed oil	VA	499	915	250	-	-	1,664
	N	59	107	29	-	-	195
	$US	32	59	16	-	-	107
	CG	39	72	20	-	-	130
Crude soya oil	VA	42	73	6	-	-	121
	N	3	5	1	-	-	9
	$US	-	-	-	-	-	-
	CG	-	-	-	-	-	-
Soya cultivation	VA	2,703	-	-	29	174	2,906
	N	1,200	-	-	13	77	1,290
	$US	177	-	-	2	11	190
	CG	39	-	-	-	3	42
Semi-refined fish oil	VA	-316	-1,211	-1,106	-	-	-2,633
	N	32	124	113	-	-	270
	$US	24	93	85	-	-	203
	CG	-1,186	-4,584	-4,153	-	-	-9,887
Crude palm oil	VA	-	-	-	894	-	894
	N	-	-	-	118	-	118
	$US	-	-	-	496	-	496
	CG	-	-	-	-164	-	-164
Palm cultivation	VA	-	-	-	1,253	-	1,253
	N	-	-	-	949	-	949
	$US	-	-	-	1,490	-	1,490
	CG	-	-	-	-3,150	-	-3,150
PVC packaging	VA	-	1,239	-	-	-	1,239
	N	-	166	-	-	-	166
	$US	-	124	-	-	-	124
	CG	-	51	-	-	-	51
Washing soap	VA	-	1,828	323	-	-	2,151
	N	-	187	33	-	-	220
	$US	-	796	140	-	-	936
	CG	-	477	84	-	-	561

Table 11. General results for oils and fats subsytem by region (cont'd)

Component	Region / Variable	I	II	III	IV	V	Total
Toilet soap	VA	-	6,945	-	-	-	6,945
	N	-	52	-	-	-	52
	$US	-	2,634	-	-	-	2,634
	CG	-	2,767	-	-	-	2,767
Glycerine	VA	-	640	-	-	-	640
	N	-	37	-	-	-	37
	$US	-	-334	-	-	-	-334
	CG	-	112	-	-	-	112
Total	VA	19,234	107,603	3,872	2,176	174	133,180
	N	1,418	1,456	210	1,080	77	4,245
	$US	10,370	53,623	2,921	1,988	11	68,974
	CG	5,810	38,434	-2,200	-3,314	3	38,769

VA: Value added
N: Employment
$US: Foreign exchange
CG: Government account

The horizontal sum of the variables does not exactly agree due to rounding.

- Changes in price;
- Changes in population, income, prices and elasticities;
- Programming of physical consumption targets outside specific groups of consumers.

Each of these specific effects requires a combination of tools to programme this demand. The methodology proposes a combination of econometric and policy responses to define demand. These tools are:

- Estimation of the change in the pattern of consumption due to inflation;
- Estimation of the necessary increase in income for a population group to reach its assigned caloric level;
- Estimation of the time required for a given population group to reach the required nutritional level;
- Estimation of the extent of overcoming the protein-calorie deficit in the nutritional scheme;
- Designing food policies.

It should be emphasized that this combination of tools is specifically defined for food products.

The results obtained by using these demand programming mechanisms are in all cases based on the set of tables prepared at the disaggregation stage which, taken together, provide definitions of the principal demand programming indicators.

Figure 11 shows the sequence in which demand policies are formed.

In the case of oils and fats, the basic demand programming instrument was the nutritional gap; consequently the policies and actions to be developed are based on covering this gap or some part of it.

For this purpose, the population is divided into well-nourished and under-nourished, the distinction being made on the basis of protein and calorie consumption. The minimum consumption requirements of the well-nourished section of the pupulation were fully satisfied, whilst there was a deficit amongst the under-nourished (table 12). The nutritional gap is determined with reference to the total calorie and protein consumption for both groups.

The goods under consideration in the system represent about 10<per<cent of current consumption, thus it is considered that these goods may be able to cover up to 10<per<cent of the gap. It was proposed to partially fill the gap with foods produced within the system, such as fats and oils, chicken meat and eggs.

In order to define the share of each final good, a cost minimization programme was defined for each component based on the calorie and protein contribution of each. The result of this procedure is shown in table 13 which establishes the additional consumption requirement for the under-nourished group. Thus, the demand programme will result in covering this additional consumption.

Programming of productive components

The programming of productive components is designed to determine the policies, projects and activities required to achieve the proposed system development objectives and measure the effects of that programme.

For this purpose, this stage of the methodology comprises three sections: design and selection of industrial development lines, definition of selective policies and development of a programme of co-ordination.

(a) Design and selection of industrial development lines

The elaboration of development lines means linked component growth in a specific system. Each component can evolve in various forms, which will affect components with which it is linked in different degrees, leading to the need to undertake projects in each of the components subject to change. In this sense, the feasibility of a given project includes a high degree of interdependence on the feasibility of other projects in other components. This implies the need to undertake interlinked studies, in other words to achieve a linked development of the components in the context of the development of the system as lines of growth. The alternative development options arising for each component in the system are as follows (see figure<12):

Figure 11. Policy design sequence

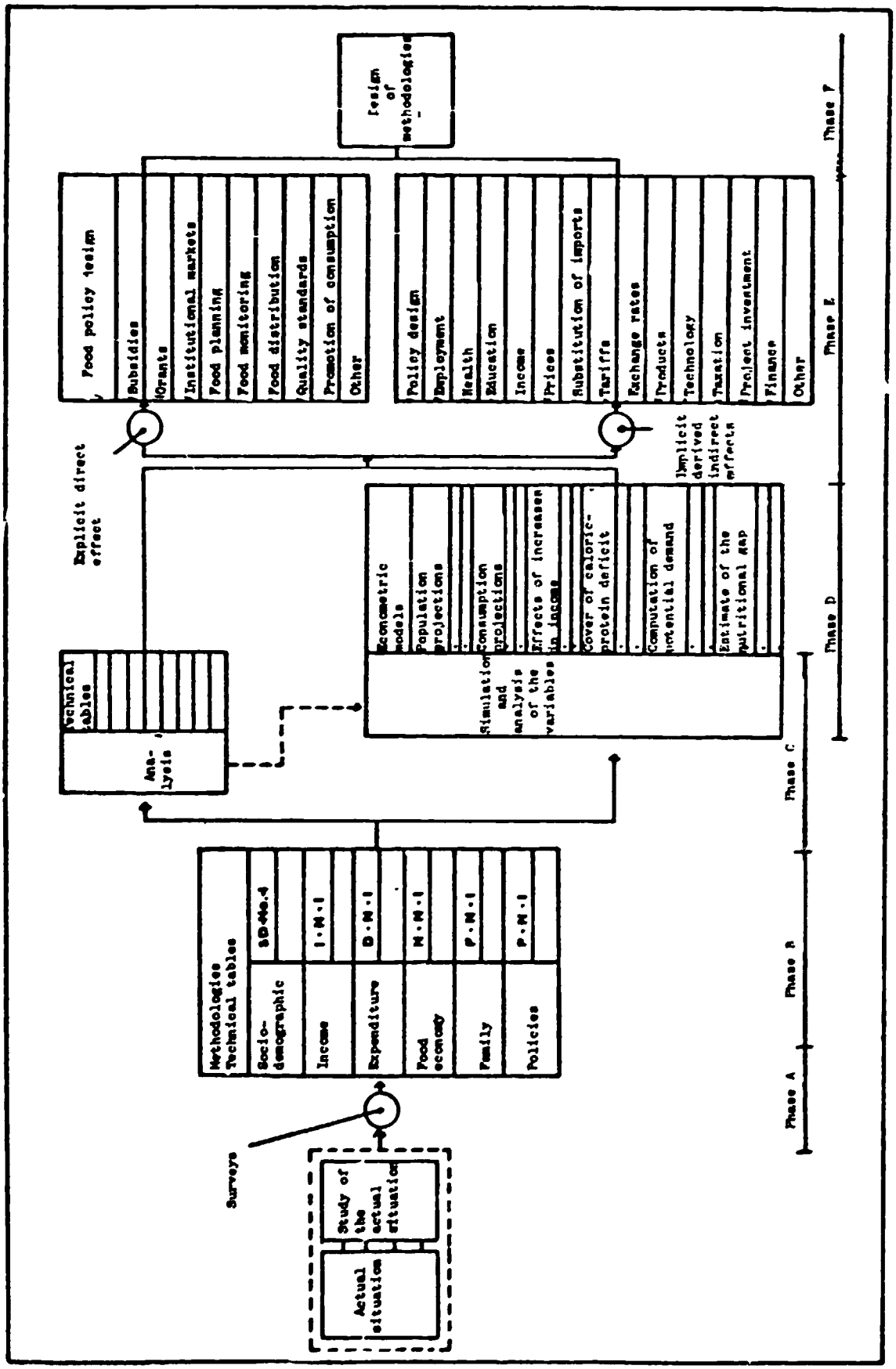


Table 12. Estimating the nutritional gaps

Group Average consumption	Well nourished group (1)	Malnourished group (2)	Nutritional gap (1) - (2)
Monthly kilocalories	94,993	44,828	50,165
Monthly protein (gr/kg)	2,619	1,629	990

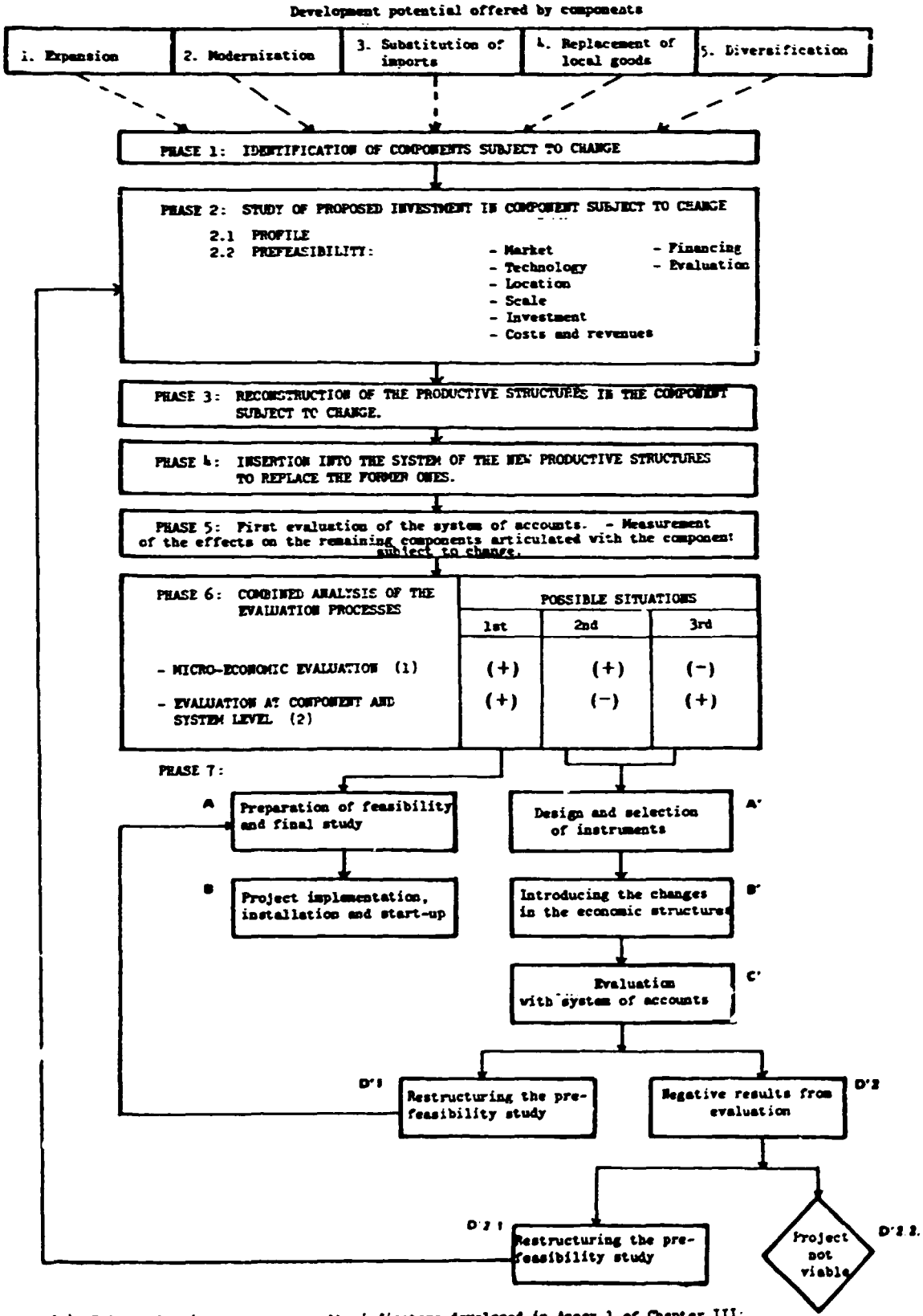
Source: Junta del Acuerdo de Cartagena (JUNAC), Lima.

Table 13. Additional required consumption and its nutritional contribution

Goods	Additional required consumption (Kg/per-capita/year)	Nutritional contribution	
		Kilocalories	Protein (gr)
Oils and fats	6.0	52,104	...
Chicken	4.5	4,860	864
Eggs	2.7	4,104	327
Total	13.2	60,068	1,191
Nutritional gap (10 per cent)		60,204	1,188

Source: Junta del Acuerdo de Cartagena (JUNAC), Lima.

Figure 12 . Generic operative sequence for the identification, design and selection of lines of development



(1) This evaluation process uses the indicators developed in Annex 1 of Chapter III: "Instruments for the segmentation and micro-economic evaluation of the productive components.

(2) This evaluation process uses the production and demand accounts set out in Chapter II of the Manual.

- Expansion of productive activity;

- Modernization and/or technological change;

- Substitution of imports by national goods, whether or not produced in the region;

- Substitution of local products by other goods also produced nationally;

- Diversification of production.

Each of these options requires specific analysis, both at micro and macro level of the development potential of the component itself and as part of the system to which it belongs.

In order to provide a general operative procedure, figure 12 shows the generic operative sequence for designing and selecting lines of development.

Phases 1, 2, 3 and 4 would correspond to the disaggregation of components subject to change, showing the effects on the system.

Phases 5 and 6 represent the stages at which the changes are assessed.

In phase 7 ways to improve the results at system and/or component level are identified and specific projects and actions are determined for implementing the modified system.

In the case of oils and fats five development options for different components of the system are presented. These options are briefly described below:

(i) For final goods:

- Modernization: technological alternatives are offered for the manufacture of final goods based on the use of new raw materials.

- Substitution: the consumption of imported crude soya oil is reduced by using different national raw materials.

- Substitution of local goods: the use of fish oil in the manufacture of compound oil is reduced.

- Diversification: a greater number of oils are manufactured.

(ii) For industrial goods:

- Expansion: production of crude palm oil is expanded.

- Modernization: in the manufacture of crude corn oil, the preparation of crude rice bran oil, crude tarwi oil, extraction of residual fish oil is modernized.

- Substitution: increased national production is substituted for imported soya cake.

- Diversification: in the manufacture of crude rice bran oil and crude corn oil diversification is envisaged. In both cases, these products are new in the rice milling and balanced feeds plant components. The processes of stabilization and degermination respectively, which previously did not exist, are carried out in these components.

(iii) For agricultural goods:

- Expansion: cultivation of palm, soya and tarwi is expanded.

- Modernization: technical changes are made in the production of soya and cotton seed.

- Substitution: import of soya beans.

This group of options for developing the oils and fats system is outlined in figure 13, which shows the new components included in the system.

When the features of each of the changes have been analyzed, the effects on the system as a whole and specifically on each component are assessed. Table 14 shows the final result distinguishing requirements and supply of inputs and goods, leaving production balances of soya and tarwi cake.

In order to obtain a new equilibrium in the system, a further analysis of development options for these components is made.

As a result of this, the following alternatives for achieving greater integration in the system were considered; developing milk extender, a product similar to milk, and composite flours as a substitute for wheat flour.

These subsystems were in turn disaggregated and assessed and then included in the final systems.

Figure 14 shows the base scheme of the alternative system.

Phases 5 and 6 for the analysis and selection of lines of development were carried out by comparing the projections for the current system with that of the alternative system. Tables 15 and 16 show the result of this operation, with the determination of the most viable final system (table 17).

Once the final system for the production and consumption of oils and fats had been determined, the study was prepared and actions and projects required for its implementation were programmed. Among the principal projects in this system, the following were considered:

- Project for the expansion of soya cultivation;

- Project for the expansion of tarwi cultivation;

- Project for the installation of a palm fractionation plant;

- Technological adaptation project for processing tarwi;

Figure 13. Simple disaggregation of the components of the oils and fats production and consumption system
First simulation

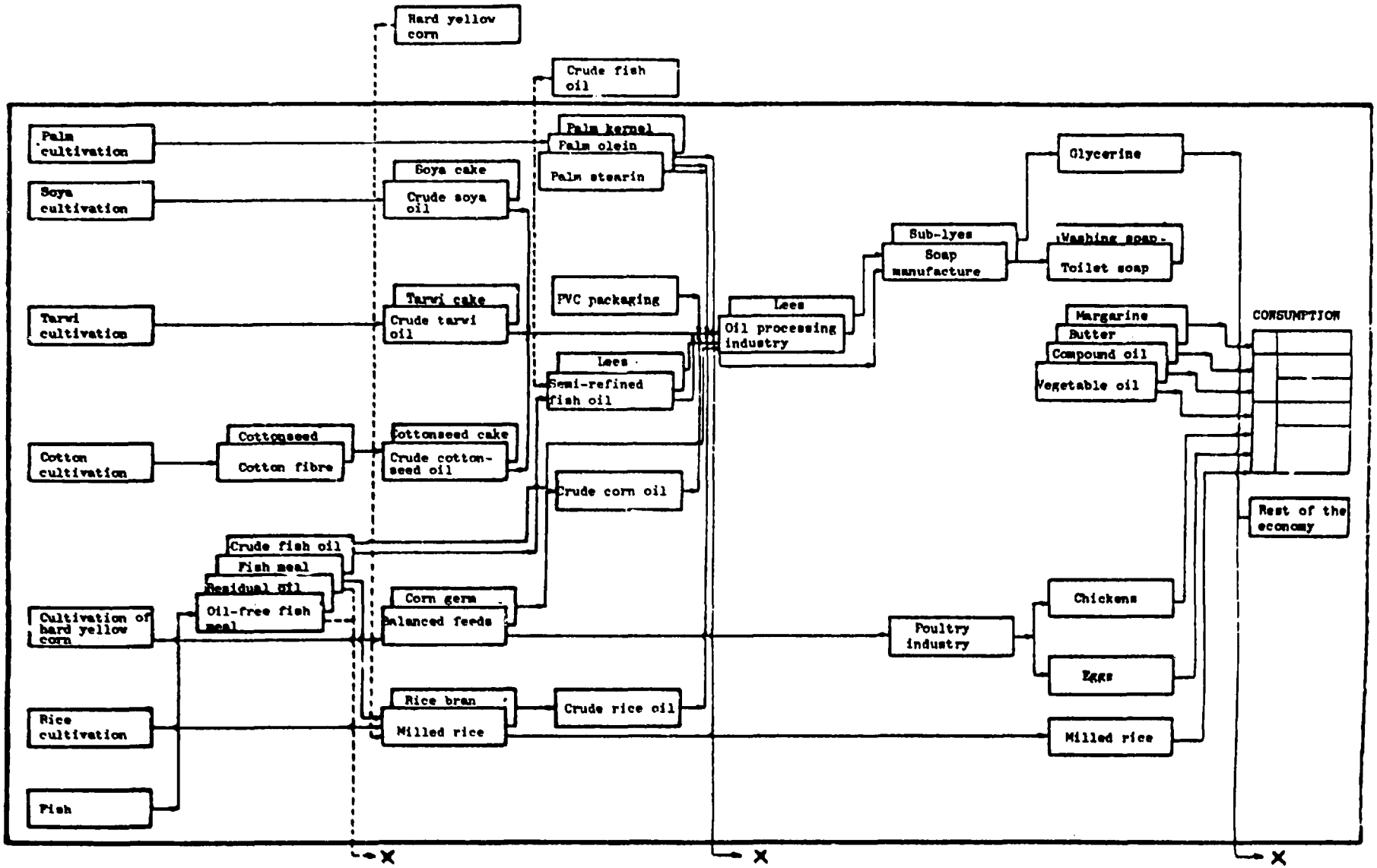


Table 14. Equilibrium between quantity demanded and supplied in the oils and fats subsystem (metric tons)

Production \ Destination	Total	Oils and fats sub-system	Rest of economy	Exports	Balance
Vegetable oil	71,424	71,424	-	-	-
Compound oil	164,367	164,367	-	-	-
Butter	110,525	110,525	-	-	-
Margarine	38,028	38,028	-	-	-
Crude cotton seed oil	20,150	20,150	-	-	-
Crude soya oil	20,748	20,748	-	-	-
Crude tarwi oil	14,420	14,420	-	-	-
Semi-refined fish oil	110,461	110,461	-	-	-
Fr. palm oil	135,027	111,798	-	23,229	-
Crude corn oil	60,345	60,345	-	-	-
Crude rice oil	10,000	10,000	-	-	-
Soya cultivation	11,258	11,258	-	-	-
Palm cultivation	1,094,800	1,094,800	-	-	-
Tarwi cultivation	90,000	90,000	-	-	-
PVC packaging (1 lt)	71,424	71,424	-	-	-
Crude palm kernel oil	4,030	1,065	-	2,965	-
Washing soap	25,000	25,000	-	-	-
Toilet soap	5,800	5,800	-	-	-
Glycerine	1,800	-	1,300	500	-
Lyes	38,913	24,960	13,953	-	-
Cotton cake	53,639	-	53,639	-	-
Cotton hulls	22,777	-	22,777	-	-
Linter	827	-	827	-	-
Soya cake	81,898	-	-	-	81,898
Soya hulls	1,746	-	1,746	-	-
Lecithin	446	-	446	-	-
Tarwi cake	62,928	-	-	-	62,928
Fatty acids	8,019	-	8,019	-	-
Stearin	72,710	72,710	-	-	-
Palm kernel	8,310	8,310	-	-	-
Unfermented rice bran	55,336	-	55,336	-	-

Source: Junta del Acuerdo de Cartagena (JUNAC), Lima.

Figure 14. BASE SCHEME BY COMPONENTS FOR THE ALTERNATIVE OILS AND FATS PRODUCTION AND CONSUMPTION SYSTEM

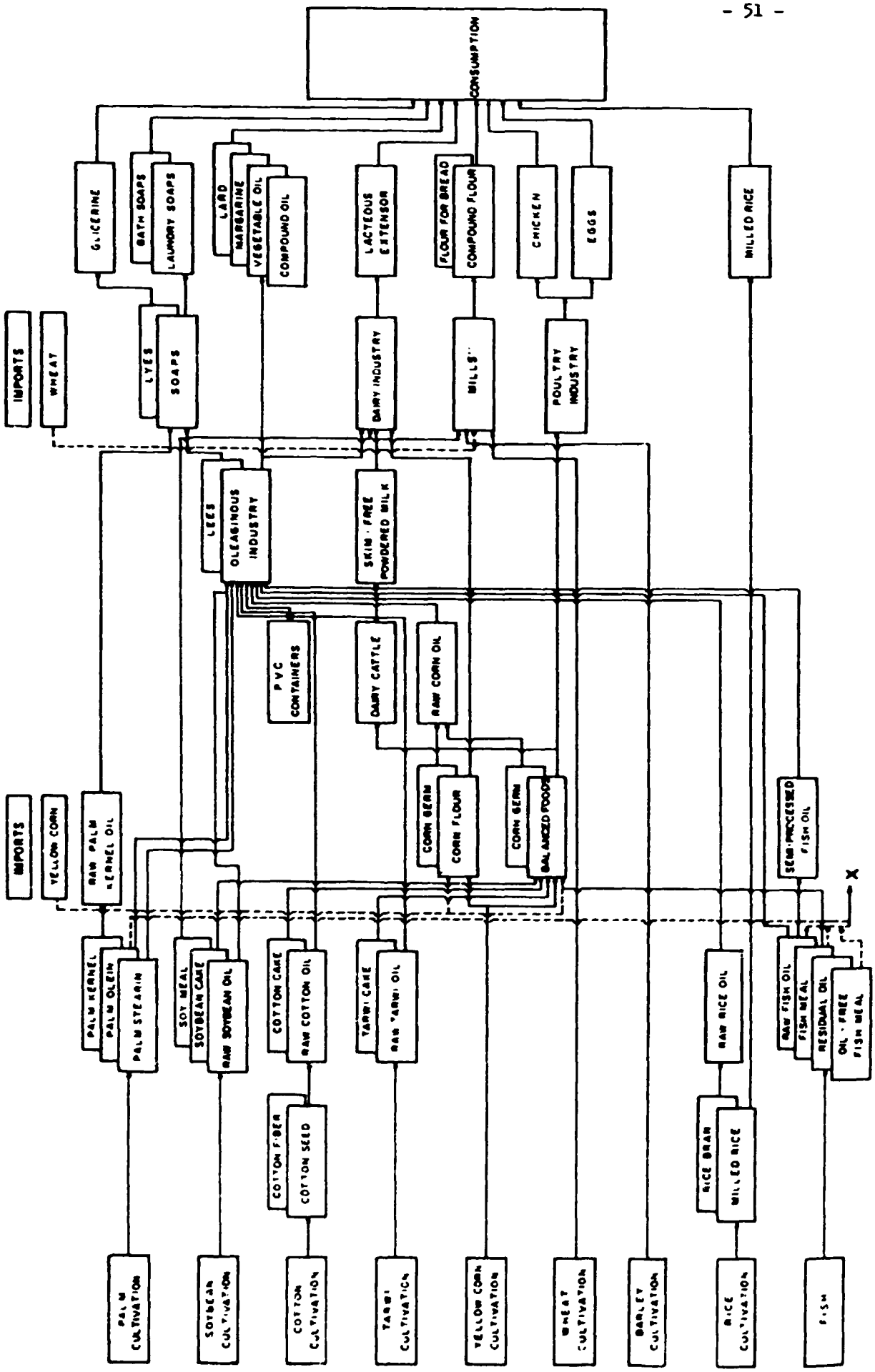


Table 15. General results of the projection of the current system (10 year programme)

	Oils and fats	Poultry	Cotton	Fishmeal	Powdered whole milk	Wheat flour for pasta	Rice	Total
Value added ($US thousands)	208,000	137,429	60,427	91,300	-	30,076	184,047	711,279
Income distribution (per cent)								
-Wages	7.74	28.47	50.21	30.67	-	8.10	17.43	20.82
-Indirect taxes	8.54	9.29	2.82	12.73	-	9.88	3.23	7.42
-Interests	5.12	3.18	-16.41	13.36	-	3.27	9.85	5.12
-Gross savings	5.00	6.53	0.34	5.90	-	0.53	1.24	3.85
-Profits	51.53	37.43	56.17	26.13	-	54.83	67.75	50.28
-Income tax	22.07	15.11	6.86	11.21	-	23.39	0.50	12.51
Foreign exchange Account ($US thousands)	92,379	103,401	-31,512	-94,075	119,225	96,543	17,284	303,245
Employment (men/year)	6,058	26,845	26,023	8,851	-	788	21,387	89,952
Fiscal account ($US thousands)	59,048	52,912	8,572	22,256	2,393	-417	11,840	156,604
Required investment ($US thousands)								
FC:	84,514	67,393	50,163	50,453	-	8,769	269,966	531,258
TC:	26,056	27,977	-	-45,713	-	-	-	8,320
Total:	110,564	95,370	50,163	4,740	-	8,769	269,966	539,578
Technological innovation (new products)	-	-	-	-	-	-	-	-
Regional development ($US thousands)								
DIST. VA								
REGION I	27,418	23,653	16,564	52,820	-	3,861	92,576	216,892
(per cent)	13.2	17.2	27.4	57.9	-	13.0	50.3	30.5
REGION II	154,261	83,113	18,036	7,627	-	20,501	-	283,538
(per cent)	74.2	60.5	29.8	8.4	-	68.0	-	39.9
REGION III	3,829	17,572	25,656	30,852	-	4,442	18,957	101,308
(per cent)	1.8	12.8	42.5	33.8	-	15.0	10.3	14.2
REGION IV	19,150	3,876	171	-	-	-	53,742	76,939
(per cent)	9.2	2.8	0.3	-	-	-	29.2	10.8
REGION V	-	3,441	-	-	-	379	1,288	5,108
(per cent)	-	2.5	-	-	-	1.0	0.7	0.7
REGION VI	3,343	5,774	-	-	-	893	17,484	27,494
(per cent)	1.6	4.2	-	-	-	3.0	9.5	3.9

	Oils and fats	Poultry	Cotton	Fishmeal	Milk extenders	Composite flour	Rice	Total
Value added ($US thousands)	277,360	149,176	60,427	87,173	6,058	39,564	184,047	803,805
Income distribution (per cent)								
-Wages	13.28	29.49	50.21	32.63	16.37	27.81	17.43	22.85
-Indirect taxes	6.95	8.99	2.82	12.07	8.55	4.40	3.23	6.61
-Interests	2.06	2.07	-16.41	10.93	2.81	-0.58	9.85	3.29
-Gross savings	7.20	6.01	0.34	6.20	41.38	1.92	1.24	4.99
-Profits	52.88	38.35	56.17	26.74	22.95	58.13	67.75	51.03
-Income tax	17.63	15.08	6.86	11.43	7.94	8.32	0.50	11.23
Foreign exchange Account ($US thousands)	35,394	75,271	-31,512	-84,719	2,042	72,245	17,284	86,005
Employment (men/year)	21,747	32,650	26,023	8,964	1,008	8,268	21,387	120,047
Fiscal account ($US thousands)	59,603	49,768	8,572	21,604	1,207	-2,753	11,840	149,841
Required investment ($US thousands)								
TC:	59,077	74,446	50,163	46,335	1,554	19,164	269,966	520,705
FC:	161,397	42,596	-	-25,713	2,992	1,715	4,088	187,075
Total:	220,474	117,042	50,163	20,622	4,546	20,879	274,058	707,780
Technological innovation (new products)	Palm kernel oil Tarwi oil Palm stearin Palm olein Rice oil Corn oil Soya meal	Tarwi cake Corn germ	-	Oil-free fishmeal	Milk extender	Composite flour for pasta	Stabilized rice bran	-
Regional development ($US thousands)								
DIST. VA								
REGION I	56,004	25,564	16,564	49,703	263	3,877	92,576	244,551
(per cent)	20.2	17.1	27.4	57.0	4.3	9.8	50.3	30.4
REGION II	160,215	91,566	18,036	7,157	5,618	10,564	-	293,156
(per cent)	57.7	61.4	29.8	8.2	92.8	26.7	-	36.5
REGION III	6,575	18,148	25,656	30,313	53	2,690	18,957	102,392
(per cent)	2.4	12.1	42.5	34.8	0.9	6.8	10.3	12.7
REGION IV	45,964	4,141	171	-	44	2,255	53,742	106,317
(per cent)	16.6	2.8	0.3	-	0.7	5.7	29.2	13.2
REGION V	827	3,547	-	-	18	19,861	1,288	25,541
(per cent)	0.3	2.4	-	-	0.3	50.2	0.7	3.2
REGION VI	7,775	6,210	-	-	61	317	17,484	31,847
(per cent)	2.8	4.2	-	-	1.0	0.8	9.5	4.0

Table 17. Selecting the best system (ten year programme)

Objective/effect	Indicator	System: Actual system projection (ASP)	System: Alternative system (AS)	Preferred system
1. Value added	Value added ($US thousands)	711,279	803,805	AS
2. Income distribution	Distribution of value added			
	Wages	20.82	22.85	Depends
	Indirect taxes	7.42	6.61	upon
	Interests	5.12	3.29	policy
	Gross savings	3.85	4.99	criteria
	Profits	50.28	51.03	
	Income tax	12.51	11.23	
3. Foreign exchange account	Foreign exchange account balance ($US thousands)	303,245	86,005	AS
4. Employment	Men/year	89,952	120,047	AS
5. Fiscal accounts	Fiscal account balance ($US thousands)	156,604	149,841	AS
6. Utilization of installed capacity	Oleaginous fats extraction	15.8%	39.3%	AS
7. Required investment	Total investment ($US thousands)	539,578	707,780	ASP
8. Degree of food security	Calorie gap/month	n.a.	n.a.	
	Protein gap/month	n.a.	n.a	
	Effect of international prices:			
	Oils subsystem	10.4%	1.0%	AS
	Poultry subsystem	17.04%	12.02%	AS
	Effect of external protectionism:			
	Oils subsystem	76.3%	1.0%	AS
	Poultry subsystem	17.04%	12.02%	AS
	Effect of external protectionism:			
	Oils subsystem	76.3%	96.7%	AS
	Poultry subsystem	84.5%	89.3%	AS
	Supply coverage effect	53.8%	45.2%	AS

9. Regional development	Distribution of value added among regions	Oils subs.	Oils system	Oils subs.	Oils system
	Region I	13.2	30.5	20.2	30.4
	Region II	74.2	39.9	57.7	36.5
	Region III	1.8	14.2	2.4	12.7
	Region IV	9.2	10.8	16.6	13.2
	Region V	-	0.7	0.3	3.2
	Region VI	1.6	3.9	2.8	4.0

10. Degree of technological innovation	New final products	None	-Milk extender -Composite flours	AS
	New intermediate products	None	-Palm-kernel oil -Tarwi oil -Corn oil -Palm stearin -Palm olein -Rice bran oil -Tarwi cake -Oil-free fishmeal -Soy lecithin	AS

- Project for the expansion of capacity in the production of corn flour, etc.

In connection with these projects, the necessary investment for their execution, financing and the chronological sequence of activities were defined. This completed the determination of the selected line of development.

(b) Selective policies

At this point, policies are designed to attain specific techno-economic and/or social objectives. Through simulation the effects of those policies on the different components of the system are assessed.

Figure 15 shows an example of design and selection of export oriented policies. In this case there are various forms of intervention affecting the productive structure:

- By modifications in price: reducing export taxes, differential exchange rates, export subsidies, etc.;

- By modifications in the components: structure of direct costs and price structure (tariff reductions, differential exchange rates, reduction in marketing, etc.), configuration of value added (reduction in interest rates, reduction in stocks, etc.).

These and other measures can be managed at different levels of intensity, producing varying responses in the component and thus new results in the system. From these the selection of the instruments required to achieve the objectives can be made. In the study of oils and fats it is assumed that policy measures would be taken in the context of the co-ordination programme; thus levels of sensitivity relating to the main policy instruments were shown for each component of the system, permitting the subsequent selection of policy actions necessary to give direction to the development of a given component (table 18).

(c) Co-ordination

Co-ordination is conceived as a process for harmonizing interests in a context characterized by a greater or lesser degree of competition as well as certain differences in interest in social and economic relations.

In a given production and consumption system, three major co-ordination processes can be identified: that between producers linked in the same system, called co-ordination in productive linkages; co-ordination between agents participating in the same enterprise, unit or component, called value added co-ordination; and subregional co-ordination, which relates similar systems in different regions. Each of these three types of co-ordination requires its own methodology which must in turn be mutually compatible since as part of a specific system they are interrelated. Co-ordination between producers will permit the setting up of agreements between producers, avoiding conflicting interests and achieve greater economic rationality in the regulatory action of the market through production, supply and trading agreements.

Figure 15. Selective policies applied to component X

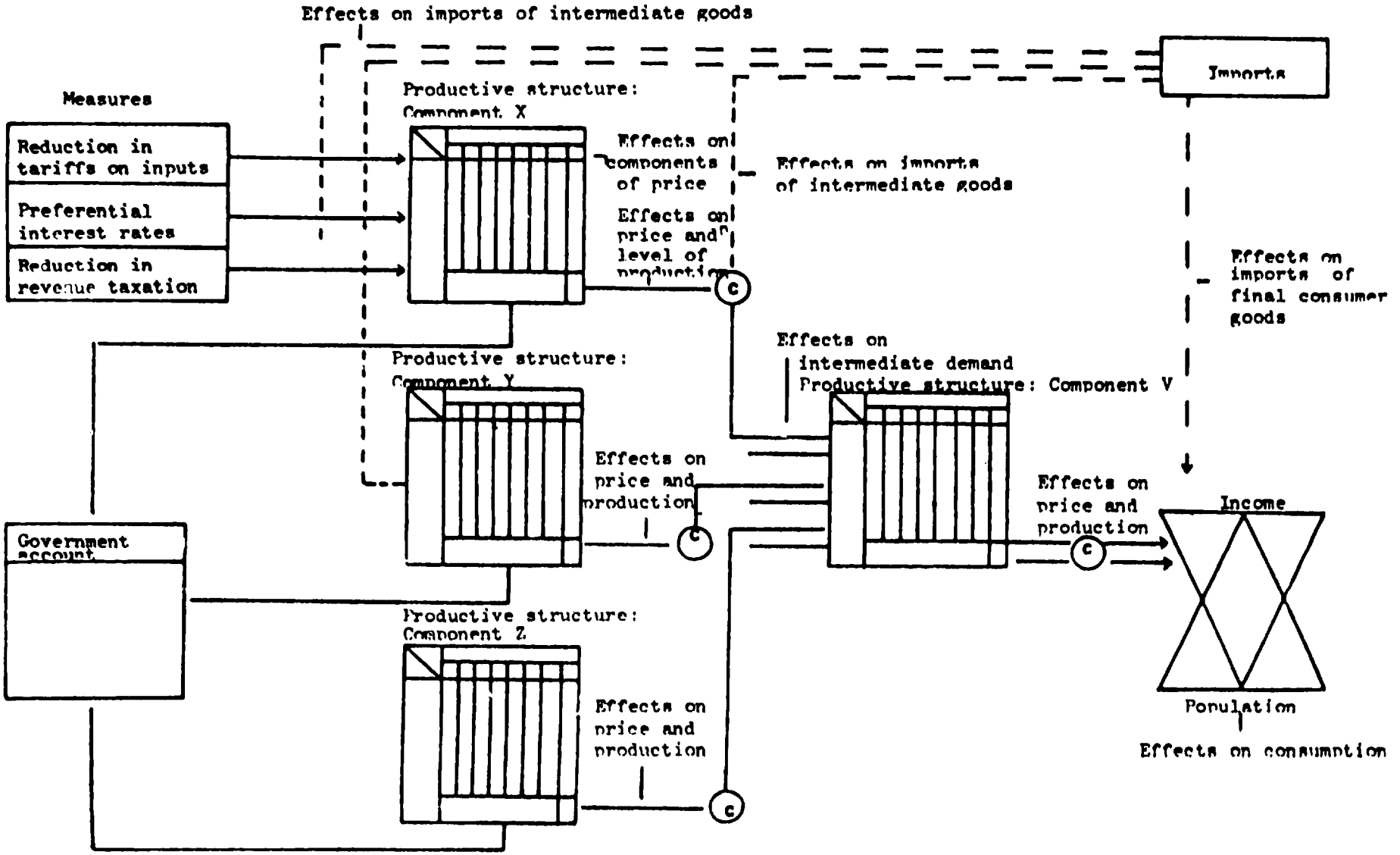


Table 18. Sensitivity in the cost structure of productive components to certain instruments of policy 1/
Alternative system

Components \ Instruments of policy	Rate of exchange	Interest rate	Tariffs	Remuneration	Taxation	Credit
OILS AND FATS SUBSYSTEM						
- Vegetable oil	3	3	3	3	3	2
- Compound oil	3	3	3	3	3	2
- Butter	3	3	3	3	3	2
- Margarine	3	3	3	3	3	2
- Crude soya oil	3	1	3	2	3	2
- Crude cottonseed oil	3	2	3	2	2	2
- Fractionated palm oil	3	1	3	3	3	1
- Crude corn oil	3	3	3	3	2	2
- Crude rice oil	3	3	3	3	2	2
- Crude tarwi oil	3	2	3	3	2	2
- Semi-refined fish oil	1	1	1	1	1	1
- PVC packaging	2	1	3	3	2	2
- Soya cultivation	3	1	3	1	1	1
- Palm cultivation	3	1	1	1	1	1
- Tarwi cultivation	3	1	3	1	3	1
- Crude palm kernel oil	3	2	3	3	3	2
- Washing soap	2	3	3	3	3	2
- Toilet soap	3	3	3	3	3	2
- Glycerine	3	3	3	3	3	2
POULTRY SUBSYSTEM						
- Chickens	3	3	3	2	2	2
- Eggs	3	3	3	1	2	2
- Balanced feeds	1	3	1	2	2	2
- Hard yellow corn	3	1	3	1	1	1
FISHING SUBSYSTEM						
- PESCA-PERU fish meal	3	2	3	2	1	1
- Canneries fish meal	3	3	3	3	2	2
- Oil-free fish meal	3	3	3	2	2	2
- Fishing	3	2	3	2	2	1
COTTON SUBSYSTEM						
- Cotton fibre	3	3	3	3	3	2
- Cotton cultivation	2	1	2	1	1	1
RICE SUBSYSTEM						
- Rice milling	3	1	3	1	1	2
- Rice cultivation	2	1	2	1	2	1
DAIRY SUBSYSTEM						
- Milk extenders	2	3	3	3	3	2
- Corn flour	3	3	3	3	3	2
COMPOUND FLOUR SYSTEM						
- Compound flour for pastas	1	2	1	2	3	2
- Soya flour	3	2	3	1	3	2
- Cultivation of naked barley	3	1	3	1	1	1
- Wheat cultivation	3	1	3	1	1	1

1/ Sensitivity scale
1 : very sensitive
2 : sensitive
3 : not sensitive

The object of value added co-ordination is to stabilize production, but it is envisaged not only as a purely entrepreneurial measure but also as a factor at the level of agents and components since they will depend on the features of the productive structure, its relation with the other components in the system, the social and economic dynamics of the remaining national systems and the overall state of equilibrium of the national economy.

Subregional co-ordination takes as its starting point the definition of a subregional system in which each component is assigned and located in the national context. The programming and assessment of its interdependences will make it possible to identify an economic instrument for harmonizing the economic policy mechanisms in each region in order to maintain a balance between national components linked within the system.

In the case of oils and fats a co-ordination programme for linkages in the productive sector was defined which in turn was to be included within an institutional organization for the administration of the national food security system.

This organization is shown in figure 16 and would constitute the central model of an institutional organization for a general food system. The oils and fats system would be part of this, and co-ordinating actions would take place both at co-ordinating committee level between agents participating in the oils system and in the National Food Security Council covering the food system as a whole.

Control and reprogramming

While the system's methodology permits the linkage of the principal components and establishment of a development equilibrium in the system, it should be borne in mind that the system is itself interlinked with the remainder of the national and international economic system thus contributing to and being affected by macro-economic equilibriums and disequilibriums. For this reason it is necessary to have a control instrument to allow this interdependence to be assessed.

The control system itself will be the methodology, applied to the definition of specific systems and their numerical expression on the basis of the results obtained in the numerical experimentation model. The same system development programme will make it possible to monitor progress towards achieving targets and to assess the necessary reprogrammings.

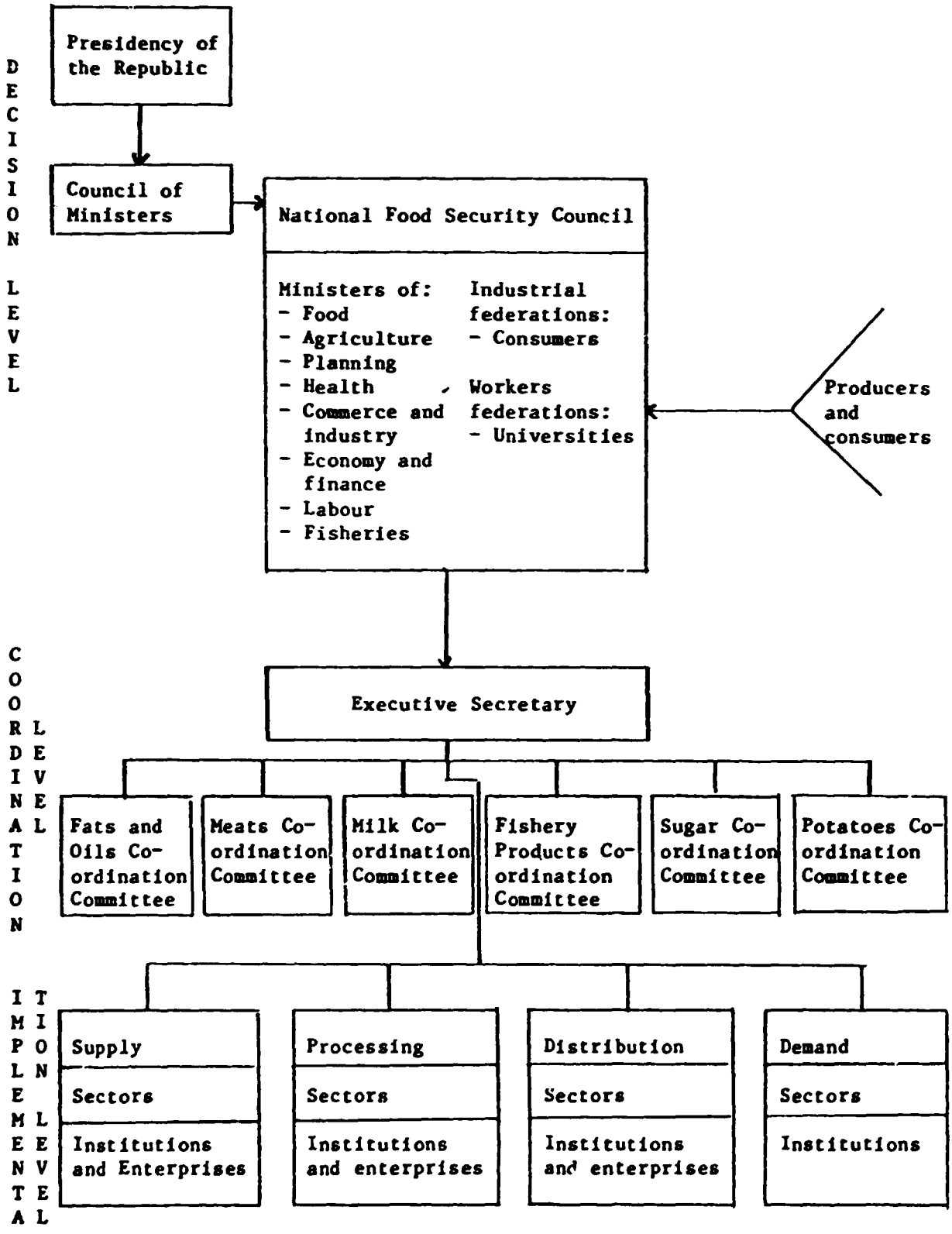
3.3 Numerical experimentation model

Using mathematical language, this model expresses the techno-economic interrelationships obtained between the variables making up a given system.

It is an accounting model, a combination of expressions or equations defining variables, enabling the calculations of results as a function of exogenously determined co-efficients and parameters.

In other words it does not include behaviour equations nor functional relations which would give implicit structural change. On the contrary, the values which are introduced as data are individual technical parameters of a

Figure 16. Proposal for an institutional organization for implementing the Food Security Scheme



specific case to be investigated or explicit hypotheses and controllable variables or policy variables (consumption targets, subsidies, tariffs, taxes, etc.). On the basis of these - through the equations of the model - calculations can be made of the effects of the assessment system on the economy as a whole.

As mentioned before, this model is different from econometric projections which are based on an analysis of historical data, or from optimization models (e.g. linear programming) which imply the aggregation of results into one unique objective function. Nor is it a predictive model, but more an instrument to "help to think" making it possible to compare hypotheses and policy alternatives through successive approximations.

The equations of the model appear in the complete version of MEPS which will be issued later. A summary of the basic equations is presented in the next section. The user manual and the numerical model constitute the second volume of the present study.

In general terms, the model makes it possible:

- To calculate the sectoral demands derived from the production of final goods, based on the level of diaggregation of the components linked with this production;

- To determine the effects of operating the system on resources (natural, external, investment and financial) and on agents (wages, profits, taxation);

- To analyze intersectoral linkages concerning technology, marketing and state intervention in the setting of prices.

- To reflect through a combination of indicators the specific features of the system as related to the remainder of the economy.

The calculation process is carried out through a series of simulations at different levels of demand for final goods, exogenously defined and differentiated. This demand will determine levels of production of final goods which in turn will require the production of inputs, services and capital goods. In general, the definition of levels of production will be determined by requirements for its utilization in other components within the system, and so on up to the point where the demand for the final goods is determined.

The performing of different simulations with changes in specific co-efficients (technical, economic, income distribution, policy, etc.) allows the evaluation of these alternatives, leading in turn to the drawing of final conclusions from the study and the formulation of corresponding policy recommendations.

3.4 Summary of technical numerical model

This section contains introductory comments, a description of the basic equations and a number of examples of the use of MEPS in connection with the establishment of targets.

It should be kept in mind that though the following exposition is in terms of one final good the actual numerical model is capable of handling an arbitrary number of final goods simultaneously. Note that, even with just one final good, however, it is not unusual for a well articulated MEPS model to have 400 to 1,000 equations and identities once the economic agents, regions and intermediate goods have been appropriately disaggregated.

In the stylized form outlined below, the model is presented with input/output-type production functions. It should be kept in mind that more sophisticated descriptions of alternative production functions are possible within the model's framework. This is also true for the description of consumption behaviour, (e.g. by including relevant price effects).

Since development policy is typically concerned with a target group within the population (e.g. stratified by geography, demography, income, culture, etc.), total consumption in period t of the final good is modelled as the sum of consumption, C_{gt}, by each group, g, (of which there are G groups in total) and foreign consumption (exports), E_t.

$$(1) \qquad C_t = E_t + \sum_{g}^{G} C_{gt}$$

Consumption of each group is modelled as a separable function of population, N_{gt}, and per capita consumption, c_{gt}, i.e.,

$$(2) \qquad C_{gt} = N_{gt}\, c_{gt}$$

where

$$(3) \qquad N_{gt} = N_{gt_o} \prod_{i=t_o}^{t} (1 + r_{gi}),$$

and N_{gt_o} and r_{gt} are the exogenous base period population and population growth rate, respectively.

Per capita consumption of the final good may be specified flexibly, e.g., as a function, $f(.)$, of the vector of relevant prices, $\underline{P}$, per capita income, y_{gt}, and other related variables, Z_{gt}:

$$c_{gt} = f(\underline{P}_t, y_{gt}, Z_{gt}) \tag{4}$$

The part of total consumption serviced from domestic sources may be computed either by specifying an import share, u_t, or by inserting a more complicated relationship, e.g., an import demand dependent on relative prices. Once consumption is determined and the domestic component to be provided identified, the effect on domestic industry is derived by constraining sector output, Q_t, to meet this consumption level, i.e.,

$$Q_t = u_t C_t \quad . \tag{5}$$

Taking as an example an input-output production structure, such a level of final good output will imply derived demands for intermediate inputs X_{1t}, $\ldots X_{kt}$, $\ldots$, X_{Kt} and factor inputs L_{1t}, $\ldots L_{ft}$, $\ldots L_{Ft}$ (where different quality levels imply distinct factors) of the form

$$X_{kt} = a_k Q_t \tag{6}$$

and

$$L_{ft} = v_f Q_t \quad , \tag{7}$$

respectively, where

(8) $$a_k \equiv X_k / Q$$

and

(9) $$v_f \equiv I_f / Q \quad .$$

Time subscripts are dropped from the last two equations to indicate the constancy of the technology.

Letting intermediate and factor prices be $P_{1t}, \ldots P_{kt}, \ldots P_{Kt}$ and $W_{1t}, \ldots W_{ft}, \ldots W_{Ft}$, respectively, and m be the markup factor, then the price of the domestically produced final good, P_t (no k subscript), before indirect taxes (e.g. sales tax, value added tax) will be

(10) $$P_t = [\sum_k^K P_{kt} X_{kt} + \sum_f^F W_{ft} L_{ft}] (1+m)/Q_t \quad .$$

The corresponding price of the imported good (intermediate or final) provides an example of how policy instruments may be incorporated. In particular, the price of the imported good, P^*_{kt}, is computed as

(11) $$P^*_{kt} = P_{FOB,kt} + K_{IF,kt} + K_{CD,kt} + K_{MT,kt} + K_{MM,kt} - K_{US,kt} - K_{XD,kt}$$

where the "free on board" price of the imported good, P_{FOB}, is adjusted by various costs: K_{IF}, the cost of insurance and freight, K_{CD}, the cost of custom duties, K_{MT}, import tariff costs, K_{MM}, domestic marketing margins, K_{US}, user subsidies, and K_{XD}, exchange rate differentials.

To this basic framework are added a multitude of structural and accounting details. Broadly, these include inter and intra-firm financial flows and requirements (covering e.g., investment,[4/] working capital, various debt maturities and obligations), value added and income distribution

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4/ No theory of investment behaviour is imposed; except for that which addresses depreciation, investment is exogenous and must be specified period by period.

computations, accounts tracking utilization of domestic resources (e.g. human, natural, financial, know-how), computations measuring the impact on the government, capital and current accounts, and various profitability and capacity utilization analyses.

MEPS may be used in conjunction with preset goals or targets. On the consumption side, one such typical case is when final consumption targets are taken as policy goals in themselves as in the case of food industrial systems. Here equation (4) may be more usefully specified in terms of the target parameters. Consider the following example.

If a caloric or protein intake level, d_{gt}, is taken as a per capita target, and b is the amount of the nutrient per kilogram in the final good then the per capita consumption function may be replaced by

$$c_{gt} = s_{gt} d_{gt} / b \qquad (12)$$

where s_{gt} is the share the final product is to have as a supplier of the nutrient (the rest presumably supplied by other final goods). Thus, by selecting appropriate per capita nutrition targets, d_{gt}, total consumption may be generated, i.e.,

$$C_t = \sum_{g}^{G} s_{gt} d_{gt} N_{gt_o} \left[\prod_{i=t_o}^{t} (1+r_{gi}) \right] / b \qquad (13)$$

Hence, starting from nutritional considerations, total consumption and thus production requirements may be generated. This, in turn, permits the consequences of such nutritional goals to be evaluated in light of their impact on related economic variables as well as other up and downstream activities.

As a second example of the use of MEPS in conjunction with goal setting, consider the case where it is national policy to reduce energy consumption or increase the energy efficiency of existing production methods. Such a goal may be specified directly as the total amount of energy consumed by the

industrial system, say in barrels of crude oil equivalent or <u>indirectly</u> through the use of indicators such as VA/Q_e, the amount of value added generated by the industrial system being studied per barr of crude oil equivalent used.

Consider the former case. The total energy requirements (in barrels of crude oil equivalent) of the system may be determined from the equation

$$(14) \qquad Q_{et} = \sum_{k}^{K} (a_{ek}\, Q_{kt}\, q_k) + (a_e\, Q_t\, q)$$

where a_{ek} is the input-output coefficient of the energy form utilized by the producers of intermediate good k, q_k is the conversion factor of this energy form to barrels of crude oil equivalent (or any other common measure), and a_e and q are the analogous exogenous parameters for final good production. Hence, the two terms in equation (14) represent the energy consumption of intermediate good producers and final good producers, respectively. With this sum in hand, the energy impact of alternative production techniques, product lines and consumption patterns may be more accurately assessed.

Consider the case of choosing the appropriate policy mix between foreign exchange generation (via the export of the final good or its inputs) and the satisfaction of domestic consumption requirements. Simplifying greatly, a policy could be characterized by the parameter

$$(15) \qquad h \equiv X_t \,/\, Q_t,$$

the share of the good domestically available going to foreign consumption, where Q_t has been held constant to underscore domestic capacity limitations or production bottlenecks. Thus, each choice of h will imply a corresponding contribution to the balance of trade (current) account, BTA, and domestic consumption goal satisfaction, DCS. The trade off between BTA and DCS and, hence, h itself can only be determined politically. Nonetheless, the virtue of MEPS is in its ability to provide a transparent framework to analyse the economic consequences of such political decisions.

Naturally the use of targets and goal setting in the MEPS, may be applied, in principle, on any of the numerous physical and financial variables appearing in the many accounts generated by the computer programme. These would, for example, include variables appearing in the impact statements associated with the government accounts, balance of trade accounts and income distribution.

SOMMAIRE

La présente étude constitue une version abrégée de la méthodologie d'évaluation, programmation et gestion de systèmes de production et consommation (MEPS) provenant du Secrétariat de la "Junta del Acuerdo de Cartagena" (JUNAC). En coopération avec l'Organisation des Nations Unies pour le Développement Industriel (ONUDI), JUNAC a poursuivi le perfectionnement de cette méthodologie qui permet d'évaluer de facon pratique et de programmer les systèmes de production et de consommation de biens industriels. Dans son application, on a considéré toutes les variables économiques, technologiques et politiques susceptibles d'affecter les systèmes de production et de consommation, les liens entre ses composantes et l'interdépendance entre les aspects micro-économiques et macro-économiques. La relation entre les instruments de politique économique et les composantes du système production- consommation est également considérée dans les cadres de cette méthodologie.

L'instrument principal de la méthodologie est un modèle de comptabilité et d'ingénierie de simulation numérique qui contient un grand nombre d'équations où les paramètres reliés à la production, intrants, investissements, main d'oeuvre, importations, etc. sont calculés pour chaque composante et pour le système dans son entier à partir de données exogènes qui s'insèrent dans le modèle. Ces données découlent de l'analyse du système dans les étapes de désagrégation et d'identification.

Le document décrit les principales étapes de la méthodologie et en illustre la description en citant les résultats obtenus au Pérou où, dans un travail réalisé conjointement par l'ONUDI et la JUNAC, on appliqua cette méthodologie à la programmation du développement intégré du système de production et de consommation d'huiles et de graisses.

Les chapitres de l'étude correspondent aux principales étapes de la méthodologie, c'est-à-dire désagrégation (simple, structurelle et géographique), évaluation (simple, structurelle et géographique) et programmation. La dernière section décrit brièvement le modèle de comptabilité mentionné.

On peut obtenir cette méthodologie de l'ONUDI qui prévoit l'appliquer à d'autres pays en développement par l'entremise d'études de cas spécifiques qui seront exécutés en coopération avec les fonctionnaires publics et les associations industrielles des pays intéressés.

EXTRACTO

El presente documento contiene la versión resumida de la metodología de evaluación, programación y gestión de sistemas de producción y consumo (MEPS) originada en la Secretaría de la Junta del Acuerdo de Cartagena (JUNAC). JUNAC en cooperación con la Organización de las Naciones Unidas para el Desarrollo Industrial (ONUDI) ha seguido perfeccionando esta metodología, la cual permite de una manera práctica evaluar y programar los sistemas de producción y consumo de bienes industriales. En su aplicación se consideran todas las variables económicas, tecnológicas y políticas que afectan los sistemas de producción y consumo, los vínculos entre sus componentes y la interdependencia entre los aspectos microeconómicos y macroeconómicos. La relación entre los instrumentos de política económica y los componentes del sistema producción-consumo, es también considerada dentro de esta metodología.

El instrumento principal de la metodología es un modelo de cuentas y de ingeniería de simulación numérica el cual contiene un gran número de ecuaciones en las cuales los parámetros relacionados con producción, insumos, inversiones, mano de obra, importaciones, etc., se estiman para cada componente y para el sistema como un todo, a partir de datos exógenos que se le introducen al modelo. Estos datos se obtienen al analizar el sistema en la etapas de desagregación y de identificación.

El presente documento describe las etapas principales de la metodología y la descripción se ilustra con los resultados obtenidos al aplicarla a la programación del desarrollo integrado del sistema de producción y consumo de aceites y grasas en el Perú, trabajo realizado conjuntamente por la ONUDI y JUNAC.

Los capítulos del documento corresponden a las principales etapas de la metodología, es decir desagregación (simple, estructural y espacial), evaluación (simple, estructural y espacial) y programación. La sección final describe brevemente el modelo contable mencionado.

Se puede obtener esta metodología de la ONUDI y se ha previsto su transferencia a otros países en desarrollo mediante estudios de casos específicos que se llevarían a cabo con la cooperación de los funcionarios públicos y de las asociaciones industriales del país interesado.

For the guidance of our publications programme in order to assist in our publication activities, we would appreciate your completing the questionnaire below and returning it to UNIDO, Studies and Research Division, D-2119, P.O. Box 300, A-1400 Vienna, Austria

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