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THE FOOD AND AGRICULTURE MODEL OF THE INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS*

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PREFACE

The central objectives of the research in IIASA's Food and Agriculture Program are to:

- evaluate the nature and dimensions of the world food situation;
- identify the underlying factors;
- investigate alternative courses of policy action at the national, regional and global level that may alleviate existing and emerging food problems in years ahead.

The problems of production, distribution and consumption of agricultural products vary according to the particular country, as does the nature and effectiveness of the specific policy action adopted. Therefore the starting point in our research program is the modeling of a national food and agricultural system. The national models are to be descriptive policy models which are also helpful in the exploration of international interactions.

This memorandum describes the overall approach of the program as well as a brief comparison with other existing global models emphasizing food and agriculture.

ABSTRACT

The report summarizes objectives and scope of a global system of national agricultural sector models which is currently being developed as part of the Food and Agriculture Program at IIASA.

The paper starts with a very brief characterization of the recent world food situation. It is emphasized that the main efforts to overcome current and expected food scarcities will have to be made within the affected developing nations themselves. International food policies, however, will have an important role to play in supporting these efforts. Three problem domains of international relevance are briefly discussed: instability of world markets, insecurity of food aid and deterioration of international trade.

The third section contains a summary of available global models insofar as they emphasize food and agriculture. No results or policy recommendations are reported here, rather the basic structural differences are discussed.

This schematic comparison of models leads then to a more detailed discussion of the international food and agriculture model of IIASA. The objective of the IIASA program is to define and quantify alternative sets of international and national policies which seem appropriate to reduce world hunger within the next 5-15 years by exploiting the international interactions between developing and industrial nations and by increasing local production in developing countries. The emphasis of the program lies on international cooperation.

A stepwise procedure is envisaged, where in the first phase a set of national agricultural sector models will be specified and empirically tested which will then, during the second phase, be linked through a world consistency model to simulate the global system. The national models will have some common properties to achieve operationality. They will typically consist of a disaggregated agricultural production

component, an aggregated submodel for the rest of the economy as well as a consistent national expenditure system. These components define a so-called "real world bloc" which is controlled by a "policy bloc" describing goals and instruments at the government decision level.

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1. Introduction

The purpose of this paper is to give a summary of the Food and Agriculture Program, a research project which is currently underway at IIASA. The main emphasis of the paper will lie on the problem assessment for the proposed system of quantitative models and, a brief comparison with existing global models of agricultural elements, at the level of both the national policy models and the international link between those models.

The paper does not contain many details on model specification, testing and application. This cannot be surprising considering the fact that the paper describes an ongoing project, one and a half years after its beginning and - according to current plans - with at least four more years to go.

2. The World Food Situation and the Role of International Cooperation

During the early 1970s the world has gone through a series of food crises which were more serious and widespread than most previous periods of food scarcity. In spite of the comparatively favorable situation which has prevailed more recently, the shock resulting from this experience should not be forgotten, but rather be transformed into effective measures to prevent a repetition. Due to crop failures in a great number of countries and rising energy and fertilizer prices, many countries suffered from insufficient food supplies in large parts of the population and a severe widening of their foreign exchange gap. The FAO estimates that even in average years close to 500 million people are underfed. A more exact measurement of the inequality in the distribution of food among different socio-economic groups would probably reveal an even greater number of malnourished persons.

The causes for the instability and the deficient levels of food supplies, and hence appropriate strategies to overcome the problems are manifold. Many different proposals have been made, but no single policy will guarantee a unique solution. Most measures require a rather long time horizon to become effective at all.

Certainly, the heaviest burden to generate a change will lie on the developing economies themselves. Depending on the respective situation (income level, distribution, usable reserves of natural resources) they will need to sustain high rates of growth of agricultural and nonagricultural production as well as to reduce the internal inequalities in the distribution of resources and income. The expected scale of the effective and latent demand for food in the developing countries, compared to realistic estimates of future foreign agricultural trade and of the economic and technical capacities of international food aid leave little doubt that these national measures will need high priority.

International activities and collaboration, however small their relative contribution to the solution of the overall problem may be, are nonetheless of great importance. This is especially evident as far as they are seen as additional and not alternative measures to alleviate hunger. Moreover, their relative importance is probably much higher in the short run than in the long run. The experience during the last years and especially during the food crisis revealed clear deficiencies of the international food policy in at least three problem domains: instability of world markets, insecurity of food aid and deterioration of international trade.

The capacity of bufferstocks - if they existed at all - so far, was obviously not sufficient to stabilize the price movements. International decisions concerning size, financing, localization, and operating rules for those stocks are still to be made. International stabilization policies might have to include also a revision of existing national protection

measures in many industrial countries. Those policies, installed to protect the domestic consumers and producers against price fluctuations at the world market level (e.g. variable levies at the border of the EEC) do not only not contribute to stabilize the world markets, they even destabilize them by exporting domestic instability.

Food aid has, in spite of considerable efforts by some countries with undoubtedly humanitarian purposes, still too much played the role of being a useful way to dispose of fluctuating domestic surpluses. Just during the years of world wide scarcity, when food aid was most badly needed, it was reduced in favor of profitable commercial sales. Since then, much has been achieved through bilateral and multilateral cooperation. However, agreements with guaranteed quantities and sufficiently high growth rates and program to appropriately integrate food aid in national development plans will have to be further developed.

The third problem area where international activities in agriculture are to be improved is related to international trade with agricultural products. Agreement is comparatively easy on recommendations to reduce protection measures on the side of industrial countries for so-called "non-competing" tropical goods. The pressure on developed countries to expand their markets for imports of other agricultural products from developing countries (fruit, vegetables, sugar, beef) will, however, most likely become much stronger in future. Agricultural exports are a main source of foreign exchange for most developing countries. For some of them, those exports comprise of so-called "competing products" also, not to speak of the unknown potential, which so far under the given protectionism in industrial countries, could not be economically mobilized.

In summary, there are more questions than answers in the area of international relations in agriculture. Many hypotheses are not yet empirically tested. Recommendations for certain

strategies, however, depend very much on numerical estimates of the expected effects. A reduction of the rate of protection in the EC, for instance, which is frequently called for by economists to improve the allocation efficiency, would undoubtedly - within a medium time horizon - result in a reduction of domestic production and increased world market prices. However, at the current state of empirical knowledge it would be rather difficult to predict: what the range of the price increase might be in the long run, which other countries would take over the EC's market share, and to which extent etc. The answer, which would have to be given product specific, determines to a great extent the evaluation of such a policy alternative from the standpoint of the European Community's development policy goals.

For the future development and analysis of the world food economy the existence of this broad set of international linkages and national feedbacks has two consequences. Firstly, any national policy related to food and agricultural will have to be aware - this has often been the case in the past - of its repercussions on other countries and other policies. Secondly, analysis will have to be much more concentrated on the international interdependence of national agricultural sectors than has been so far. IIASA plans to analyze some of these problems.

3. A Brief Summary of Global Models with Emphasis on Food and Agriculture

The uncertainty with respect to the future development of level and distribution of food in the world in connection with fears for an exhaustion of other resources have given rise to an increasing number of global models. The starting point for all of them is the notion of a world wide interdependence of resource use and distribution as well as a plea for global responsibility bearing. The models differ, however, both in their basis problem interpretation and in their "global welfare" concept.

The early world models (Forrester, Meadows) started from the hypothesis that the main challenge to mankind would be the limited capacity of various resources including the potential for food production. Later studies emphasize, in accordance with a variety of empirical estimates, but also with the declared resolution of the FAO Conference, that it is not so much the global capacity for food production which causes problems, but much more the lack of political will to improve the distribution of economic welfare between and within the nations. Depending on the respective model the need for redistribution is emphasized through international agricultural trade, transfers of capital and know-how, adjustments of population growth rates, inter- and intranational income transfers, and also through a shift in political power.

The welfare criteria indicate a distinction between two theoretical concepts. One of them (e.g. pure international trade models) bases any recommendations on the establishment of an international market equilibrium which would, at a given distribution of resources, lead to something like a "pareto-optimal" distribution of goods and services. Another criterion, widely discussed but only partially included in formal models (e.g. Bariloche-World-Model) assumes something like a world wide accepted lexicographic preference ordering, according to which priority would be given to all those measures which promise to raise the welfare of the poorest nations or population groups.

Quantitative models can generally only consider some of the aforementioned aspects. The diversity in particular structures, level of aggregation and empirical foundation is immense and will not be discussed here. Some basic structural elements are mentioned in Figure 1. The IIASA Food and Agricultural Model as it is planned at this time is characterized in the right column.

Insofar as a regional disaggregation is included, all models emphasize the rather unfavorable situation of South

East Asia and the need for a redistribution of resources. However, only very few proposals for practical agricultural policies are made. One example where concrete recommendations are given is the MOIRA project, which calls upon the industrial countries to stabilize world prices at a high level through food purchases in order to simulate production in developing countries and at the same time enable a high level of food aid to those parts of the urban population which lack a sufficient purchasing power.

In spite of a variety of improvements which have been made in this - rather young - research area of global modelling, there are at least four problem domains where further research is necessary:

- more emphasis has to be put on the country specific internal structures and the inclusion of positive information on the effects of various policies on agricultural growth and income distribution. An internationally identical model structure, which only allows differences in variable levels (as is the case with MOIRA) does probably not suffice to capture the differences;
- the national agricultural sector models should be product specific. Otherwise, such important aspects as the effects of a trade liberalization, which depend on product specific supply elasticities and comparative advantages can hardly be examined;
- the response of third countries to one country's aid and trade policy measures is the result of policy decisions also. Therefore, a complete international model requires that each national model includes a positive component describing the effect of price and income changes on the level of policy instruments (tariffs, subsidies, quota). This may be done in reduced form models or under explicit consideration of a policy

Figure 1: Structure and Basic Hypotheses of Selected World Models with Special Emphasis on the Agricultural Sector

	FAO: Commodity Projections	Takayama/Hashimoto: World Food Economic Model	Meadows: Limits to Growth	Mesarovic/Pestel: Mankind at the Turning Point	Bariloche: Latin American World Model	Linnemann et al: MOIRA	IIASA: Food and Agriculture Model (Planned)
Main Area of Interest	regional deficits or surpluses	international trade equilibrium	global resource bottlenecks	global resource capacities and interregional distribution	regional land, input and capital needs for minimum nutritional standards	scope of "hunger" in countries and regions under alternative international trade and aid policies	effect of product specific national and international policies on the food situation
Level of Aggregation							
- regional	all countries	group of countries	global	10 regions	4 regions	10-6 countries resp. groups	10-12 groups of countries
- sectoral	agr. sector	agr. sector	economy(agr.,ind., services)	economy(nine sectors)	economy(five sectors)	economy(agr.other)	economy(agr.,other)
- agr.commodities	many	8	"food"	"food"	3(crop,livestock,fish)	"food"	14 product groups
Model Type and Methodology							
- parameter estimation	L.S.Q.	non formal	non formal	non formal	non formal	L.S.Q.,international cross section	country specific,econometric time series estimation
- algorithm for international relations	none	Quadr.programming	-	non-formal linking (real time adaptation)	-	iterative formal linking (general equilibrium)	iterative formal linking
Agricultural Sector Components							
- inputs included	-	-	land,capital,variable inputs,"soil fertility"	land,labor,fertilizer, capital	land,capital,fertilizer	land,fertilizer,labor capital	various,country specific
- allocation criteria	not included (linear trends of supply and demand)	not included (linear supply and demand functions)	agr.investment depending on food deficit	"scenario"(exogenous)	lexicographic preference function	one dimensional profit maximization	country specific,possibly nonlinear optimization
- ecological effects included	-	-	yes	(yes)	yes	none	country specific
- determinants of population growth	exogenous	exogenous	endogenous(food,ecology)	endogenous(food)	endogenous (income)	exogenous	country specific (endogenous in L.D.C.'s?)
- income distribution explicitely considered	-	no	no	no	no	yes	in L.D.C.'s only
- endogenous agricultural policies	-	price policy,stock mutation	none	none	none	price and trade policies	price, trade and structural policies
- endogenous agr.prices	no	yes	not included	no	no	yes	yes
- global consistency of trade flows	no	yes	-	-	no	yes	yes

objective function - indeed one of the most difficult tasks where much work needs to be done;

- finally, one major problem of international concern which is closely related to agricultural trade is the increasing indebtedness of developing countries towards industrial countries. A realistic representation of a country's food import capacity requires that balance of payments and foreign exchange effects of nonagricultural trade are somehow included in the analysis, possibly at a rather high level of aggregation.

The IIASA Food and Agriculture Model is an attempt to contribute to some of these open questions. A brief summary will follow.

4. The International Food and Agricultural Model of IIASA

4.1 Problem Assessment and Range of Policies

Generally speaking, the objective of the IIASA program FAP is to define and quantify alternative sets of international and national policies which could reduce world hunger within the next 5-15 years, by

- exploiting the international interactions between developing and developed nations, as well as among developing nations, and by
- increasing local production in the developing countries.

The inclusion of both national problems of raising the factor productivity and production in developing countries and international problems of improving trade and aid relations is the logical consequence of the country specific approach. However, it is clearly impossible to tackle both aspects with the same intensity. As indicated before, the emphasis lies on the interactions. Since international linkages, however, are not studied for their own sake, but rather as a "channel" through which national economies interact, policy effects on the structure of prices in

national food and factor markets as well as the effects of national government actions on international markets have to be included.

No specific set of national growth or redistribution problems will be listed here. The approach of the IIASA program leaves the question of which intranational problems to include in the respective country model, according to the specific situation of the respective country. Viewed from the international food trade and aid relations the structure of the national models should be such that a proper mapping of the reactions of supply and demand and foreign exchange to world market events is possible. It is this criterion which determines whether the representation of aspects like weather dependent yield fluctuations, farm size distribution or the regional distribution of industries should be included in addition to the basic common problem of inefficient resource allocation and insufficient consumption. In addition to this, any specific set of national problems may be analyzed within the respective country models as long as the basic requirement is fulfilled that all national models be consistently linkable on the international level.

The range of questions to which the model will hopefully contribute is broad; some answers may be summarized as follows:

a) What kind and level of investment is needed to achieve a desired level of nutrition?

b) Which set of national and international policies would yield an acceptable distribution of food consumption between countries and population groups?

c) What would be the likely effects on production and income in industrial and developing countries of a reduction of frictions in international agricultural trade?

d) Which policy measures should be used to stabilize the

international markets? What would be the likely distribution of costs and benefits among the nations?

The end product is expected to be a policy analysis model, suitable to project consequences of alternative courses of action, not a model to generate one "optimal" policy set for all countries or even any one country. The model should thus help to indicate and quantify conflicts of interest between industrial and developing countries, importing and exporting countries, but also between policies with shorter (food aid) and longer term (structural policies) effects.

Typical international policies to be analyzed include

- stabilization policies (e.g. international buffer stocks)
- food aid policies (e.g. in kind, concessional loans, etc.).

National agricultural policies in developed countries will be restricted to those with direct international effects (e.g. quotas, tariffs, export, subsidies). National policies in developing countries will comprise

- policies with international effects (e.g. export subsidies, fixing foreign exchange for food imports) and
- policies with internal effects (e.g. population policies, tax policies, asset or income redistribution, price subsidies).

4.2 Selection and Grouping of Countries

The final model will be closed with respect to the world's agriculture. To achieve operationality, a grouping is necessary for countries with relatively small shares in the relevant variables, while an individual representation will be maintained in the most important countries, either because of their high share in world production, trade or consumption or because a significant nutrition problem exists in those countries. Thus the approach is an attempt to include - in spite of the global character - real world decision units. A stepwise, procedure is envisaged:

1. Identify the most important countries covering altogether, say 80 per cent of the world's production, population, consumption or trade respectively. A rather stable group of 25 countries could be identified.

2. Define a limited number (10-12) of subgroups representing countries at a similar stage of development, with similar resource bases, nutritional situation, foreign trade structure and policy alternatives.

3. Choose one important country of each subgroup, construct a detailed model for this country, estimate parameters for this country and evaluate the quality of the model.

4. Consider the basic structure of this model to be representative for every country of the same subgroup within the group of 25, and estimate parameters for all these countries on the basis of the respective prototype model structure.

5. Infer from the tested models on structure and parameters of those countries belonging to the "rest of the world".

6. Link all national models to simulate the global system.

The grouping approach is given preference against modeling countries one by one, firstly because the international linking would be easier and the number of man-years for the project is limited, but also because it seems more convenient to think in terms of some typical constellations of problems than in terms of a great number of single countries with, in part, only slightly different problems.

The criteria defining subgroups are policy options and - in most cases closely related - real world situations. A distinction between industrialized countries should be made according to their position on the world market. There is a different attitude towards protectionism and international agreements depending on whether a country is a major net exporter, importer or nearly self-sufficient.

Other than in the case of industrialized countries, the world market position is not used as an explicit classification criterion for developing countries. The prevalence of malnutrition, the availability of so far unused natural resources and the relative importance of income distribution problems as opposed to level of income problems appear to be more relevant criteria in this study.

For both groups of countries a distinction between market economies and centrally planned economies has to be made. Figure 2 contains a proposed grouping system.

4.3 Basic Structure of National Agricultural Sector Models

Since no particular national model will be described here, no detailed specification of model structures will be given. The following remarks refer just to some basic elements of all national models. Each national model will consist of

- a real world bloc and
- a policy bloc.

In the real world bloc the technical and behavioral relationships determining the reactions of the producing and consuming units are described. This bloc would comprise resource allocation, production and consumption functions. Among the variables exogenous to this bloc are the instruments of government policy. These instruments are determined endogenously in the policy bloc. The endogenous representation of policies is a necessary model property within an international link. Other than in individual national sector models, the level and composition of instruments cannot be determined exogenously. One of the potential benefits of an international linkage is just this: to simulate how the rest of the world would react to one country's trade or internal policies. While for the respective one country under consideration, policies will be exogenous, they have to be endogenous for

Figure 2: Outline of Country Grouping

A. Industrialized market economies

1. Major food exporters

2. Major food importers

3. Nearly self-sufficient countries

B. Industrialized centrally planned economies

4. Industrialized centrally planned economies

C. Developing countries

Market Economies and Mixed Economies

natural resources reserves so far not utilized	Major Nutritional Problem		
	No	Yes, most important reason:	
	calorie intake cal. norm	low income level	uneven income distribution
relatively low	5	6	7
relatively high	8	9	10

11. Centrally planned developing countries

the others. A schematic description of the overall structure is given in figure 3.

Typical components of the real world bloc[1] are

a) an agricultural production component, including

- a set of factor input functions to simulate the change in agricultural resource capacities (land, capital, labor, fertilizer etc.)
- a set of input-output-relationships or production functions, appropriately disaggregated by commodities and shifting in time due to investment and technical progress. Where relevant, the relationships have to be stochastic (crop yields)
- a resource allocation model simulating substitution between enterprises and technologies; if relevant (e.g. some developing countries), risk aversion will be explicitly included

b) an aggregated production component for the rest of the economy

c) a consistent national expenditure system, including

- a set of consumption functions for the agricultural commodities and the nonagricultural residual
- aggregate investment functions for agriculture and the rest of the economy.

  Where relevant, this component will distinguish different income classes of consumers.

The policy bloc will be formulated either as reduced form model or assuming an explicit objective function. Typical policy variables include price policies (tariffs, subsidies), grain stock mutation, quotas, income transfers and subsidies for factor input.

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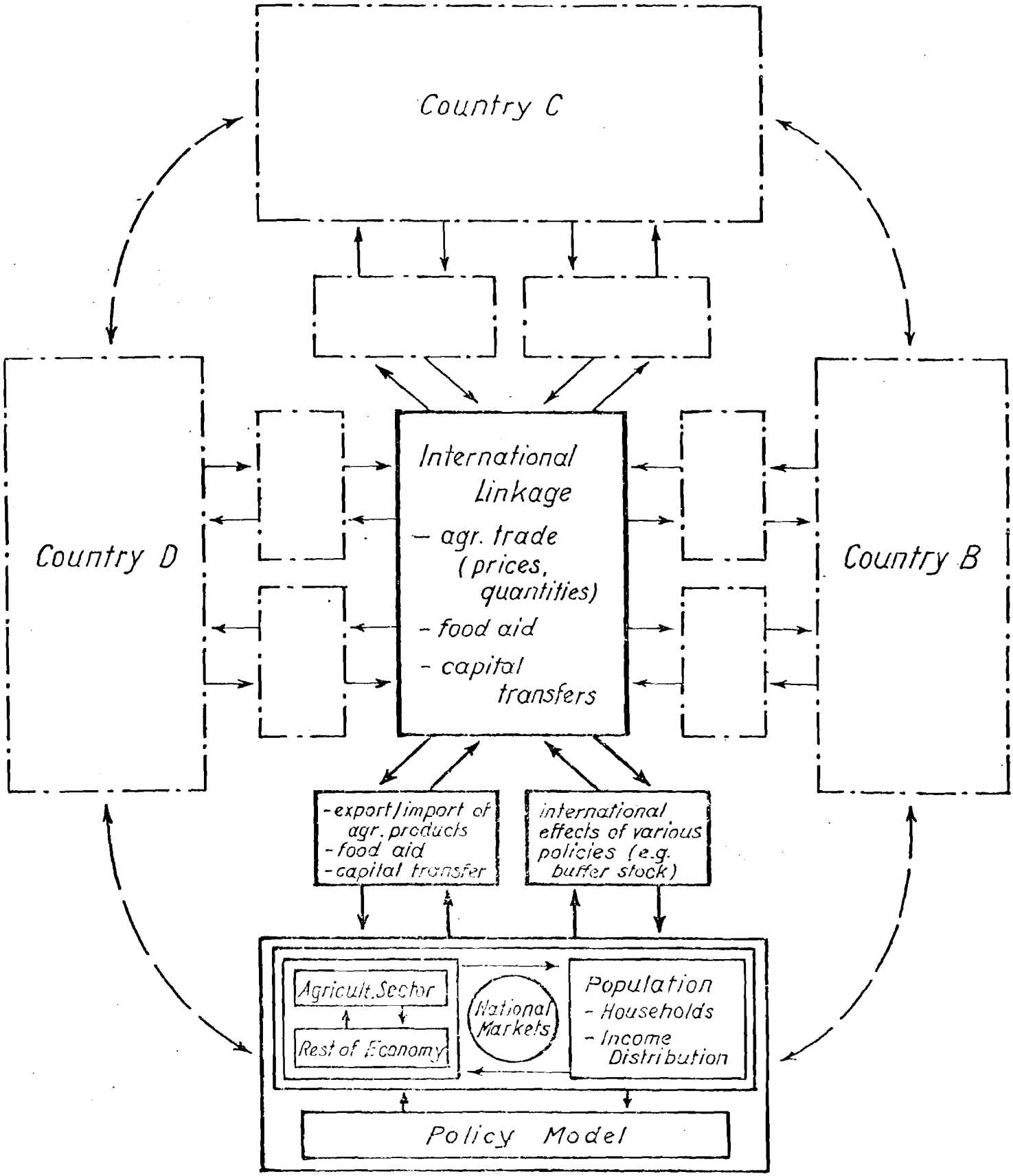
1) The described structure corresponds closely to the EC model, to take an example.

Figure 3: Basic Structure of the International Model of Food and Agriculture



National Model: Country A

Seen from the international markets, the national models react to world market prices with a response of net excess demand, [1] possibly also stock mutation. Since commodity supply will be predetermined in the national models, changes in demand (and stocks) will be the only adjustment mechanism on the world market. The national demand equations will therefore need special attention. KEYZER (1977,b) discusses necessary properties for the consumption functions to ensure unique and computable equilibrium solutions for the international linkage.

4.4 International Linkage Mechanism and Common Requirements for National Models

Two modeling aspects have to be discussed at the level of international linkage. One is the problem of defining common requirements for all national models and the other relates to the mechanism of linkage itself. Both are closely related, because finding an equilibrium solution depends on the behavior of the national models.

The central problem of linkage is to achieve consistency, i.e. the summation of all imports has, within a given error margin, to equal the summation of all exports for every commodity group. Three linkage mechanisms are conceivable: [2] loose linking, nonformal (recursive) linking and formal ("equilibrium") linking.

Loose linking would mean that all national models are run separately for exogenous world market prices and the resulting quantity deficits or surpluses are recorded without any internal adaptation. This approach lacks any interaction and seems inappropriate for policy alternatives which lead to world market prices deviating more or less from historical trends. It does not necessarily lead to consistency.

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1) In the case of export countries, the net excess demand is defined to be positive.
2) KEYZER, 1977a

Nonformal linking means that the national models respond with a lag to world market prices and previous supply/deficit situations. Some slack variables (mostly stock mutations or net supply of "the rest of the world") are introduced to yield intraperiod consistency. This kind of "real time iteration" seems unrealistic because there is no "rest of the world" in a closed model and stock mutations are the result of explicit decisions also. In order to avoid the deficiencies of the first two approaches, the IIASA project will aim at a formal linkage mechanism. Formal linking is defined as an iterative procedure which would converge onto sets of national net excess demand vectors where there are no longer inconsistencies and which, under certain conditions, would even imply a "general equilibrium".[1] Of course, the solution may include wanted stock mutations.

The formal linking has undoubtedly several advantages. However, since the solution of an interdependent set of nonlinear equations is involved, the computational difficulties may be a limiting factor and require simplifications.

Whether or not the resulting world market prices, production, consumption and trade variables define an equilibrium solution in the sense that producers maximize profits and consumers maximize utility under the given physical and institutional constraints, depends on the structure of the models. Any a priori test would be difficult, given the desired flexibility in national modeling which does not prescribe any particular form of the excess demand functions. Some internal requirements concerning especially the consumption functions in the country models which are necessary for the existence of a solution vector of world market prices are discussed by KEYZER (1977a).

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1) KEYZER, 1977a p.7

Moreover, to achieve operationality some external requirements must be fulfilled by the models as well:

- all national models must react to world market prices for identical system of commodity classification. 14 agricultural commodity groups have been defined which are listed in the appendix;
- all national models have to be dynamic with an identical time increment of one year;
- the models should be descriptive, (not prescriptive), based on positive information, econometrically estimated and validated as much as possible.

5. Potential and Limits of the IIASA Approach

The description so far may have shown that the international linkage, if it can be completed to cover the world as a closed system, can be a powerful instrument to address real world decision-makers with global food issues. Such a model would be able to project

- the effects of food aid on world market prices, the net world market position of developing countries and possibly also the internal income distribution in those countries;
- the effects of bufferstock policies on the stability of world market prices;
- the effects of a reduced protectionism in international trade on geographical distribution and level of food production.

It is also clear that even a complete model would not be able to map many real world developments, e.g. such realistic phenomena as

- trade deviations and speculative transactions due to intraperiod (seasonal) and interregional price differences,
- links between bilateral or multilateral political factors

and trade or aid agreements (see the discussion about "food as a weapon").

In case the covering of all important countries should not be possible within the available amount of time, then the linkage would not be possible and the modeling part of the project would fail to achieve one of its major objectives. However, the effort of developing national agricultural models of different prototype countries can even then be very valuable considering the following aspects:

- Countries which had to be left out from explicit national modeling could be grouped in a "rest of the world" bloc and the international linkage could proceed as described. Of course, the residual group would be rather inhomogeneous and politically unidentifiable if too many "important" countries are put into it. But for an initial analysis phase this approach may still yield valuable insights.
- Every country model is in any case designed to be used separately for exogenous world market prices or a given set of aggregated world market supply and demand functions. It can thus be used for national sector planning.
- Another valuable contribution of the national models might be the international perspective which has guided the model building process. To give an example, trade liberalization and food aid alternatives (e.g. transfer in kind or conditional income transfers) will probably receive more attention than would be the case otherwise.
- Finally, any national model which meets the common requirements is a mile stone along the long road towards a more complete international linkage.

6. Conclusions

Comparing the complexity of the real world, the immense scale of current and expected problems in the world food economy, one should clearly not be too optimistic about the

potential contribution of an international food model. However, it is not the relative but rather the absolute contribution to the overall problem solution which matters. To fulfil even the stated objectives, the project has to cope with a variety of problems, like recruitment of personnel, data collection, development of appropriate algorithms and estimation routines, contacting real world decision-makers and institutions concerned with world food problems.

Currently, models are being developed for India, Hungary, EC-countries, Kenya, Brazil and USA. Some others are in the planning phase. Moreover, the theoretical and computational foundations for international linkage are being laid.

An important precondition for project success is certainly an improved international cooperation between IIASA and research teams working on national agricultural sector models. The flexible approach allows linkage to any other national model as long as it fulfils the common requirements (dynamic common commodity list, etc.). If at least some of the agricultural planning projects which are currently underway could be coordinated in this way, the optimism would be much more justified if at some point in time this joint effort would lead to better quantitative proposals to improve international cooperation within the world food economy.

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