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AGRO-INDUSTRIAL COMPLEXES AND THE POTENTIAL  
USE OF PETRO-PROTEIN PRODUCTS ✓

prepared by

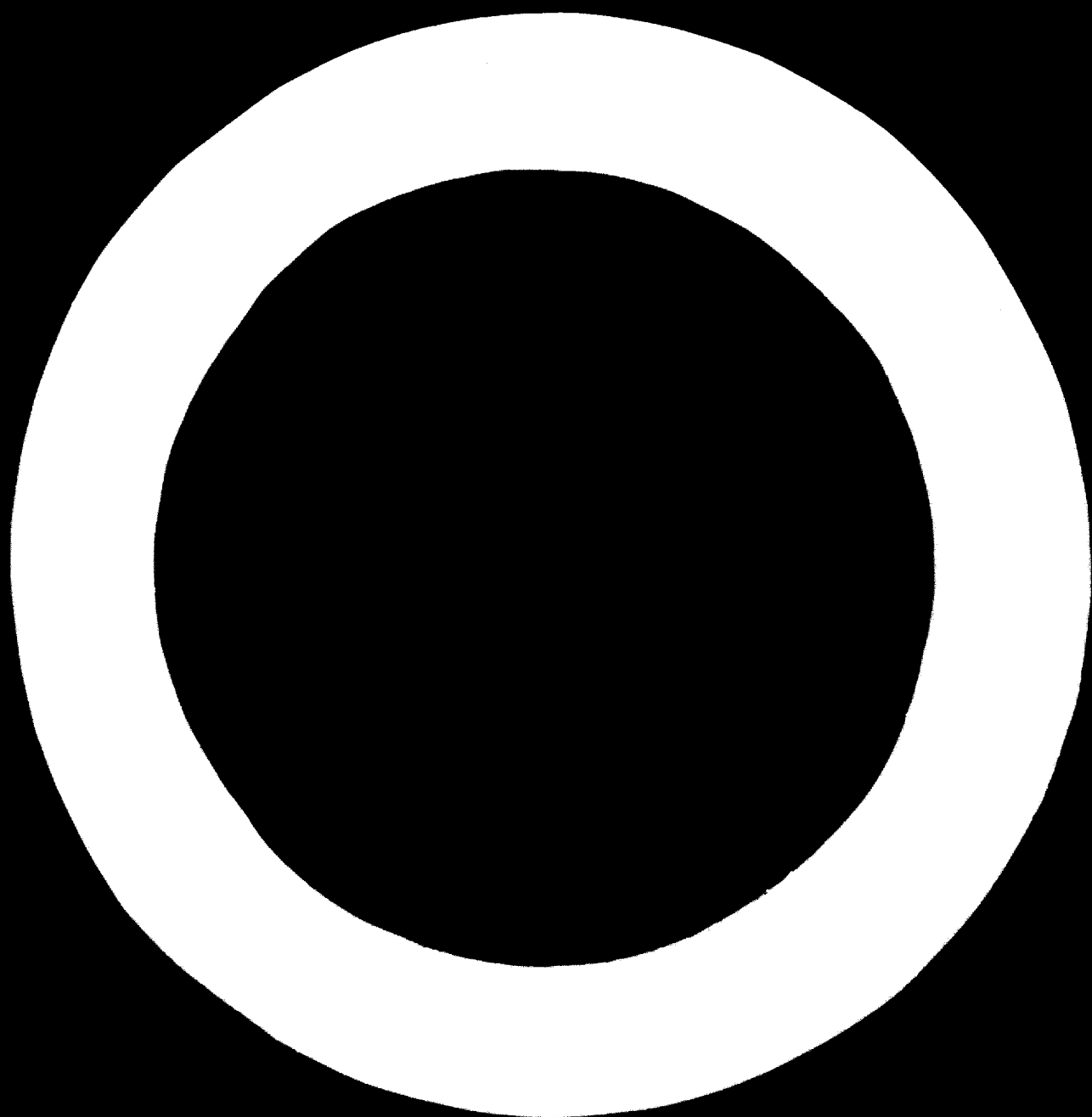
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## Introduction

The use of petro-proteins for animal and human consumption will undoubtedly encounter numerous difficulties, not the least of which will be the problems of acceptability, sanitation, nutritive value and feedstuff formulation - factors that have been discussed at length elsewhere. Disregarding, for the purposes of this paper, the question of competition, attention is drawn to the superstructure a developing country needs for the establishment of an unbroken chain from the refinery to the consumer's mouth, converting a sluggish economy into a fully developed infrastructure which continuously generates new investment and employment opportunities, thus contributing steadily to national economic growth.

The exclusion of such important issues as the acceptability of petro-protein, its substitution for vegetable protein in feed formulations and the competitiveness of other materials does not minimize the difficulties to be overcome when marketing petro-proteins. However, simplification of this kind is necessary, if one is to obtain a clear view of the other problems confronting countries which produce and process significant quantities of petroleum products, but are unable to develop independently the basic production of animal protein (milk, meat, poultry, eggs, fish) which would otherwise permit the revitalization of animal husbandry and pave the way for the establishment of a modern economic infrastructure.

Numerous countries in the Middle East, such as Egypt, Iran, Iraq, Kuwait, Libya, Saudi Arabia and even Algeria, have only restricted areas of fertile land. On the other hand, they have abundant petroleum industries, numerous refineries and rapidly expanding markets for eggs, chicken, meat and milk. Most of the latter commodities still have to be imported, as new land can only be reclaimed at great expense (US \$ 3-8,000 per hectare) and irrigation frequently increases agricultural production costs to an intolerable degree. Furthermore, a significant section of the population in these countries are nomads who for centuries have accepted a stagnant economy as a fact of life in these desert or semi-desert areas. Assuming that acceptability problems can be overcome, that petro-protein can serve as the main ingredient in feed formulations and that fears of competition are shown to be groundless, the production of petro-protein as a main animal feedstuff component and the establishment of a modern, integrated

animal agro-industry can but prove attractive to such countries.

Given the elimination of the above problems, the question of exporting petro-proteins to other countries would need to be investigated. Without embarking upon an in-depth analysis of marketing problems which would necessitate a special case study, it can be maintained that petro-protein can only be exported to countries with similar arid or semi-arid climates, where both the social structure and ecological conditions are comparable and which are equally dependent upon imported animal products. The major European, Japanese or US markets cannot be taken into consideration as the refineries in those countries will produce their own gas-oil and separate n-paraffin, consequently the sole realistic proposition is the domestic market.

Most of the countries concerned, however, will have to develop their local markets - not solely for reasons of petro-protein sales but also to ensure the successful independent development of all important branches of the national economy, thus contributing to the country's economic and political independence.

Market structure, however, cannot be oriented towards the requirements of the small farmers and nomads in the peripheral, arid areas: it must be based on an animal feedstuff plant producing feed concentrate or ready-made feed formulations.

Roughly speaking, formulated feeds could be envisaged with a fodder yeast content in the order of five per cent, assuming that acceptability problems and competition can be overcome. Thus, a plant producing 50,000 tons of petro-protein yearly would provide a basis for the production of one million tons of animal feedstuff, the total annual output of at least twenty medium-sized feedstuff plants situated throughout the country. An annual output of one million tons of animal feedstuff would permit the following scale of production (see table 1 below).

Table 1

<u>Feedstuffs</u> (tons)	<u>Description</u>	<u>Products</u> (tons)
400.000	<b>Beef carcasses</b>	40.000
250.000	Eggs	80.000
250.000	Broilers	80.000
100.000	Fish, other animal protein (pork etc.)	20.000
<hr/>		
Total 1,000.000		220.000
<hr/>		

- i) 40,000 tons of carcasses entail the slaughtering of some 200,000 head of cattle, 440 kg live weight each.
- ii) 8-10 million laying hens are needed throughout the year to lay 80,000 tons of eggs (1,600 million eggs).
- iii) 10 chicken farms are needed to accomodate 8-10 million laying hens.
- iv) A further 10 chicken farms with ancillary slaughtering, cold storage and transportation systems (for eggs and poultry) are needed to process 250,000 tons of broilers.
- v) The remaining protein production would necessitate the erection of feed lots and the provision of processing and distribution facilities.

Estimated Investment

1. To obtain 220,000 cattle, 20 fully equipped feed lots each producing 10,000 cattle yearly, are needed, these being complemented by co-operation with private farmers to ensure supply of young animals, as well as by veterinary and extension services.  
Total cost: 20 x US \$ 10,000,000 = US \$ 200 million.
2. 20 fully equipped chicken farms are also necessary, including silos, hatcheries, transportation facilities, slaughterhouses, cold storage amenities and cold chain network.  
Total cost: 20 x US\$ -5,000,000 = US\$ 300 million.

3. 4 slaughterhouses are needed to process the animals.  
Total cost: 4 x US\$15,000,000 = US\$60 million.
4. 1 million tons of animal feedstuff would be produced in 20 plants with all auxiliary facilities.  
Total cost: 20 x US\$7,000,000 = US\$140 million.
5. 950,000 tons of other ingredients (dried alfalfa, hay etc.) are needed, which would be produced on at least 100,000 ha of fertile irrigated land, reclamation and irrigation costs being US\$1,500 per ha.  
Total cost: 100,000 x US\$1,500 = US\$150 million.
6. Processing and handling of the feedstuff at the agricultural level will involve extra costs of at least US\$100,000,000.
7. Investment will also have to be made in the retail and distribution of the processed animal products, involving transportation, distribution and refrigeration facilities (the latter being normally unavailable in developing countries.)  
Total cost: US\$ 100,000,000.

Total investments necessitated by the sale of 50,000 tons of petro-protein would thus be of the following order of magnitude:-

Item 1	200,000,000
2	300,000,000
3	60,000,000
4	140,000,000
5	150,000,000
6	100,000,000
7	100,000,000
	<hr/>
	US\$1,050,000,000
	<hr/>

Investments could be even higher, were one to set up a soya-extraction plant (US\$20-30 million) to obtain an additional 50,000 tons of proteinaceous material, thus increasing the added protein content to 12-15 per cent. Moreover, further investment will be necessary in workers' accommodation, social amenities, etc.



This impressive scale of investment heavily outweighs the capital investment of US\$30 million in a plant designed to produce 50,000 tons of petro-protein. Output values can also be compared. Whereas, optimistically speaking, 50,000 tons of petro-protein (50% protein) represents a value of US\$25 million (soy meal (42% protein) costs US\$0,30 per kg), the value of the 220,000 tons of beef, eggs, broilers, fish and other animal protein touches upon US\$320 million. The figures are most revealing: an investment of only US\$ 30 million in the production of petro-protein as against an investment of US\$1,050 million in an agro-industrial processing-cum-distribution structure - a 34-fold increase. Alternatively, a petro-protein output valued at US\$25 million compared with the agro-industrial products valued at US\$320 million - a 13-fold increase.

The establishment of a domestic market for protein thus costs thirty times more than the establishment of the petro-protein plant. However, the increase in the value-added is a more significant factor. Whereas a petro-protein plant can be assumed to employ no more than 280 workers, the superstructure indicated above retailing some US\$500 million would provide employment opportunities in rural areas and communities for some 250,000 people, ensuring a GNP per capita of US\$2,000. These figures reveal the dilemma.

Whereas it is comparatively simple to obtain the know-how necessary for the establishment of a petro-protein plant and the time involved is less than three years, the development of the superstructure described above is thirty times more expensive and would take at least twenty years, though the retail value is twenty times as great.

From the standpoint of national economy, the investment is not being made in the market for petro-protein alone but in reality in a superstructure necessary for any developed economy irrespective of the proteinaceous ingredient. In fact, not only can this superstructure be developed independently of the production of petro-protein but it should also be initiated some twelve to sixteen years in advance of the plant.

A more encouraging assessment of the points raised however would reveal:

1. Petro-protein production does indicate the definite possibility of there being assured chances of employment for 250,000 people, offering them a comparatively high standard of living in a fairly well developed modern social structure;
2. The hope that one day domestic synthetic production will completely replace the protein component, thus establishing national independence in this field;
3. The necessity of creating a superstructure for the continued economic development in keeping with the latest, more rational development in this sector;
4. An agro-industrial superstructure, in which modern animal husbandry is closely linked with processing and distribution, can contribute significantly to rural development through the co-operation of agro-industrial complexes and the adjacent areas, and by virtue of the material advantages inherent in integrated agro-industrial development.

Proceeding from the basis of identified market requirements, the benefits to be derived from agro-industrialization are:

- i) Agro-industrial projects can be specified more closely than the traditional projects in terms of investments, financing, time-schedule, production and profits;
- ii) Integrated agro-industrial projects are thus bankable and competitive;
- iii) Under the guidance of industry, agro-industrial complexes can be implemented in countries with different (even extreme!) socio-political structures at very different levels of economic development;
- iv) Agro-industrial complexes create long-term employment opportunities with the possibility of self sufficiency and independence as a result of their own high productivity;
- v) Agro-industrial projects of this type need not be subsidised: on the contrary, they create profit openings and expand as a result of their own creativity;
- vi) Integrated agro-industrial complexes are the sole means of rational production under world market conditions thus enabling a country to export finished products and create its own market without taking recourse to extreme protectionist measures;

vii) Agro-industrial complexes permit a better follow-up of investments and production development by the Governments of developing countries, the automatic exclusion of various middle-men reducing production and investment costs;

viii) Agro-industrial complexes also have the best chance of attracting foreign finance or business partnerships as different social clashes of interest can be avoided;

ix) From the very outset, the management of agro-industrial complexes can be exclusively based on up-to-date computerized systems, thus excluding the great number of unknown factors normally associated with traditional development schemes; and

x) Agro-industrial projects permit the horizontal linking of production lines of different complexes thus enhancing research capacities and improving the supply of energy, seeds and auxiliary materials; technical services can be merged for the import, repair and maintenance of agro-industrial equipment; and a unified domestic or export marketing system can be set up to create national brands.

The productivity figures in the table below, which is based on the production of a Yugoslav agro-industrial combine specialized in animal husbandry, clearly show the merits of modern integrated agro-industrial operations in comparison with traditional rural development schemes:

**Table 2** Milk production from 1947 to 1970 in PIK - Beograd Pad. Skela

	1947	1957	1968	1969	1970
Number of cows	723	7.703	13.146	17.384	20.000
Total milk production (litres)	618.000	13,000.000	52,000.000	13,000.000	83,000.000
Milk yield per cow (litres)	1,418	3,095	3,985	4,250	4,324

A developing country using traditional methods could not hope to achieve such results in twenty-three years, let alone in a much longer period of time. In 1975 the PIK Beograd combine will have a herd of 27,900 cows, the productivity of which will be increased to 4,600 litres per cow - an all-time European record.

One has no reason to doubt these figures. Furthermore, careful comparison of these industrial results with the various green revolution projects and forecasts, financed by countless international organizations, through bi-lateral schemes or contributions from many developing countries, confirms the validity of the approach expounded in this paper.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

International Consultation on  
Agro-Industrial Development

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UNIDO 's activities include a number of supporting studies in which optimum industrial development policies are examined and elaborated. Attention has been drawn to agro-industry, yet despite the great interest no specific attempt has been made to discuss or analyse the various problems or define the socio-economic concept involved.

For the last eight years UNIDO has been acquiring experience in this field and the Organization is convinced that agro-industrial development enjoys a certain inherent advantage over other economic development policies in the less developed countries. The benefits to be derived from agro-industrial development can be summarized as follows:

- agro-industrial development projects can be accomplished in only a few years
- agro-industrial projects are bankable
- agro-industrial projects can be implemented in countries with different (even extreme) political and social structures and at different stages of development

- agro-industrial projects will raise long-term employment levels higher than any other rural development scheme;
- agro-industrial projects need not be permanently subsidized as they are self-sufficient and conducive towards the creation of markets, domestic and foreign.

The key to agro-industry's success lies in the vertical integration of production, whether this involves ownership of the means of production, common management, or the contracting of common interests in marketing, processing and agricultural production.

This definition differs widely from those established in recent literature on the subject. Agro-industries are not merely industries based on agricultural raw materials nor does the term refer to the suppliers of such auxiliary materials as pesticides, fertilizers, and agricultural machinery. Agro-industry is a much wider concept involving the integration of marketing, processing and agricultural production under a comprehensive management responsible for the production, harvesting, processing and marketing of the products by the most direct means. Thus, from its very inception, agro-industrial production is a highly planned streamlined process serving a common interest, i.e. the production of marketable goods from minimum inputs to obtain maximum outputs.

This form of production involves either a high degree of specialization or a wide range of products, a characteristic feature being the utilization of all by-products by other sections in the integrated enterprise or association of enterprises. A further advantage of an agro-industrial system is the close relationship it establishes with the various markets.

The establishment of an agro-industry does not start with an analysis of agricultural production nor with the examination of the unutilized production capacities in the relevant industrial branches. The only admissible first step is an exact analysis of existing and potential markets at home and abroad, whereafter an industrial survey is carried out to establish the profile of the factories needed to meet the demands of the markets analysed.

This stage is then followed by agricultural considerations and the selection of agricultural branches as raw material suppliers to the planned programme. Whereas this market-oriented approach would inevitably reject certain items, new products would be introduced on the basis of improved utilization of by-products, land or human resources and capacities. A second market analysis to be made would then confirm the suitability of the programme selected and by means of regular checks, an optimum ~~agro-industrial development programme can~~ be elaborated for both limited and broader areas of application.

This close correlation between marketing, industrial processing and agricultural production or importation of raw materials does not end with the establishment of planning methodology. The brief summary below indicates other major problems which could be discussed at a meeting or international consultation on the promotion of agro-industrial development.

1. Long-range agro-industrial development planning

Agro-industrial development should be planned carefully in order to achieve:

- rapid, yet economic results;
- rapid rural development;
- large-scale colonization of virgin territories (including deserts);
- optimum utilization of capital-intensive irrigation facilities;
- solution of socio-economic and political problems;
- best export results.

Careful planning is also necessary to avoid:

- competition with ongoing economic or political measures;
- dissatisfaction within existing industrial and agricultural sectors;
- economic failures.

Planning could be effected stepwise and limited to one region at a time. Furthermore, it must be adapted to the political structure prevailing in different countries, and a discussion of these specific problems would be most desirable.

## 2. Agro-industrial engineering techniques

Agro-industry is characterized by the very close relationships in terms of time, distance, economic interests and management between marketing and industrial processing on the one hand and between processing and agricultural production on the other. Such relationships constitute the most significant advantages of the integrated process, yet to derive maximum benefit appropriate techniques and engineering must be applied.

It is an undisputed fact that in a fully integrated sugar-cane enterprise agricultural production, harvesting activities and processing can be timed and co-ordinated in such a manner as to ensure minimum quantitative and qualitative losses. In an efficiently integrated agro-industry, for example green peas can be mechanically harvested, immediately chilled and transferred to the processing line for canning or freezing within an hour and one half.

Furthermore, a fully integrated agro-industry closely observes market behaviour at all stages of the operation so as to be able to derive the greatest long or short-term benefits. Consequently, particular importance is attached to the discussion of appropriate techniques and the engineering approach to be adopted in the distribution, processing and production sectors of agro-industry.

## 3. Agro-industrial management

There are numerous management problems peculiar to agro-industrial production. Special accounting systems are needed for the precise price structures of each operation or group of operations and for each management unit in the production, processing and marketing sectors. Such systems must meet the requirements of the various participants in the integrated process, contributing to the effectiveness of their contribution.



In most cases, profits are to be seen at the end of a long process, i.e. on the markets themselves, hence the profit redistribution systems are very new and hotly disputed on account of their importance to the individual participants.

Other management problems should also be discussed, such as:

- the establishment of common services in agro-industrial enterprises;
- the position of quality control throughout the processing line;
- upgrading of participant skills;
- private farmers and their co-operation with agro-industry;
- establishment of checklists and time schedules throughout;
- the planning of balanced comprehensive investment programmes;
- the introduction of computerized management systems into agro-industrial enterprises.

#### 4. Agro-industry and rural development

This specific issue should be discussed at such a meeting because of its major influence upon the regional development of backward areas in need of industrial and agricultural assistance.

Particular benefit could be derived from the examination and discussion of the conflicting opinions held on the influence the establishment of integrated agro-industrial enterprises has upon:

- the raising of regional economic standards;
- labour intensity;
- the bankability of projected investments;
- time needed to materialize such projects;
- pre-investment and production costs;
- infrastructural requirements.

It would be interesting to compare the agro-industrial approach with the traditional rural development schemes headed by the concept of agrarian reform and colonization.

5. Agro-industry and the co-operative system

The co-operative system is going from strength to strength and has already been adopted by numerous developing countries as an organisational structure for the development of backward regions or new areas.

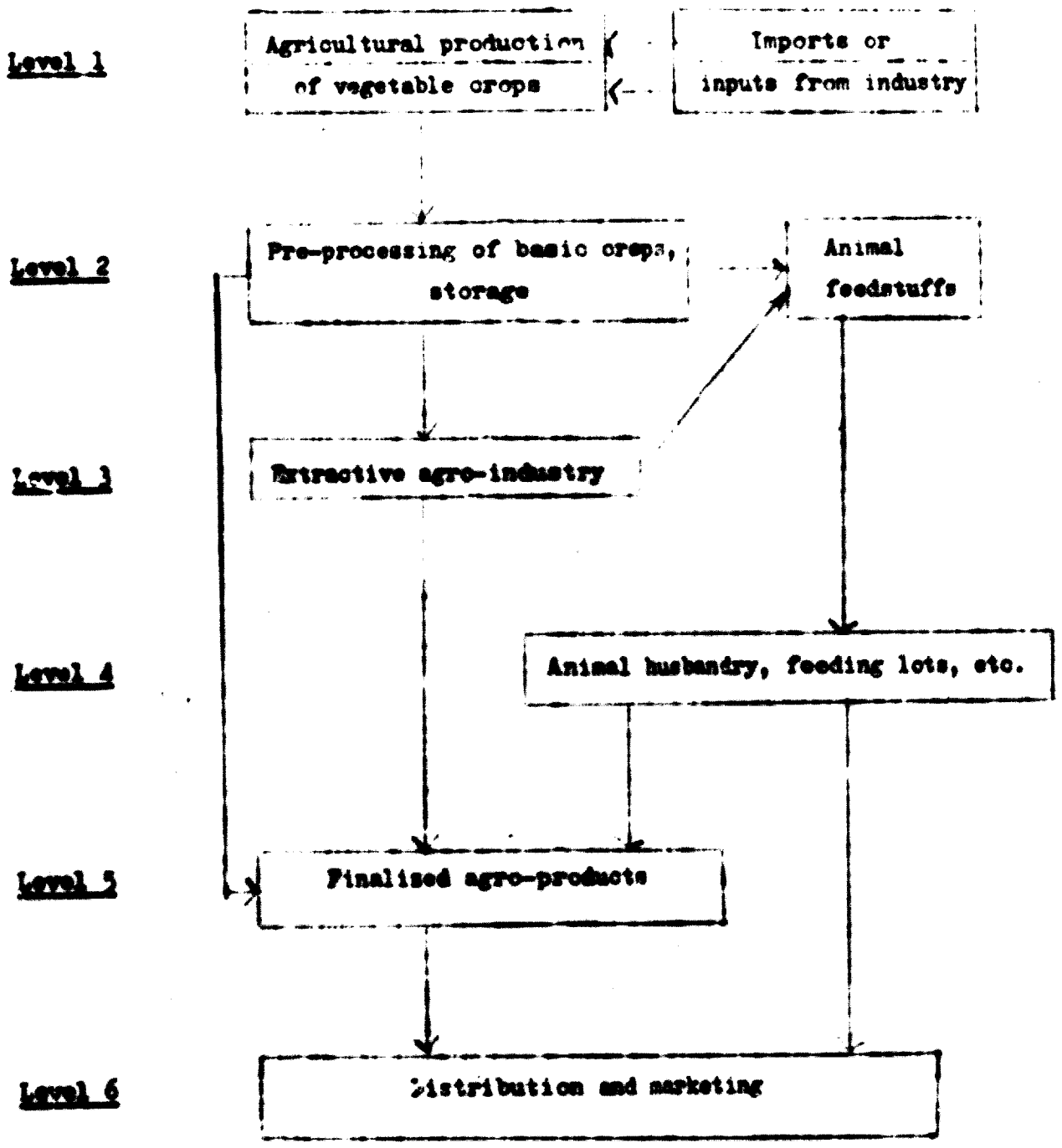
In some European countries and elsewhere, co-operatives were set up by private farmers with a view to rationalizing production, providing their members with low-priced inputs, and improving current distribution and marketing systems. The movement developed into larger associations and co-operative organizations, which in turn contributed significantly to the establishment of their own independent industrial enterprises and distribution networks.

This stepwise integration can of course be planned as a single operation in areas where a co-operative system is more desirable than other forms of integrated agriculture.

Planning an agro-industry on a co-operative basis as a possible alternative to ownership of the land by the industry or co-operation with private farmers has specific features which are worthy of presentation in a case study.

6. The substantial structure as a criterion for agro-industrial planning

The technological process of an integrated agro-industry has a very specific structure which is normally subdivided into the following six levels:



A group of interesting problems arising from this structure could be discussed and studied, such as:

1. Is the stepwise development of an integrated structure such as this possible ?
2. At what levels should one start, 1 or 6, and under what circumstances is it preferable to start at level 6 ?
3. How are the different levels interrelated ? Undoubtedly levels 1 and 2 have to be established together and it is equally clear that capital flow can be more easily obtained for investments at level 5 than level 3.
4. At what level should central planning and management be introduced ?

7. Higher forms of agro-industrial integration

An agro-industrial system is often not large enough to take over a whole colonization programme, establish factories and national marketing networks or to compete in foreign markets as a serious supplier and exporter. Furthermore, the merging of agro-industrial enterprises with different social structures and production programmes from different regions, raises numerous problems which should be investigated and discussed.

The organization, structure and joint services are particularly interesting at this stage of integration. Moreover, this is the most suitable stage to assess the feasibility of establishing extension services for agricultural or process engineering; special export services for finished and semi-finished products; a joint banking system or common input production facilities (pesticides, repair and maintenance shop for agricultural equipment, etc.).

8. Co-operation with developed countries in the field of agro-industrial development

Particular attention should be devoted to the problems of establishing an agro-industry in a developing country with the assistance of a multi-national company or a governmental agency in a developed country.

The developed countries are endeavouring to co-operate with developing countries in the field of agro-industry for many reasons:

- raw materials are produced only in the developing countries
- production is competitive as long as the wage levels of the developing countries are maintained;
- traditional techniques can be improved (e.g. refining of brown sugar);
- certain products are in increasingly short supply in world markets.

It is remarkable that, despite the beef deficiency no major developed country, except Japan, has made any serious attempt to organize meat production so as to close this gap. Apart from the low prices imposed upon the meat producers on domestic markets, the lack of sanitary conditions and many other reasons, one of the major obstacles would seem to be the social and political structure peculiar to this branch (butchers, large ranches, small private farms, etc.) which would have to be changed, prior to agro-industrial integration.

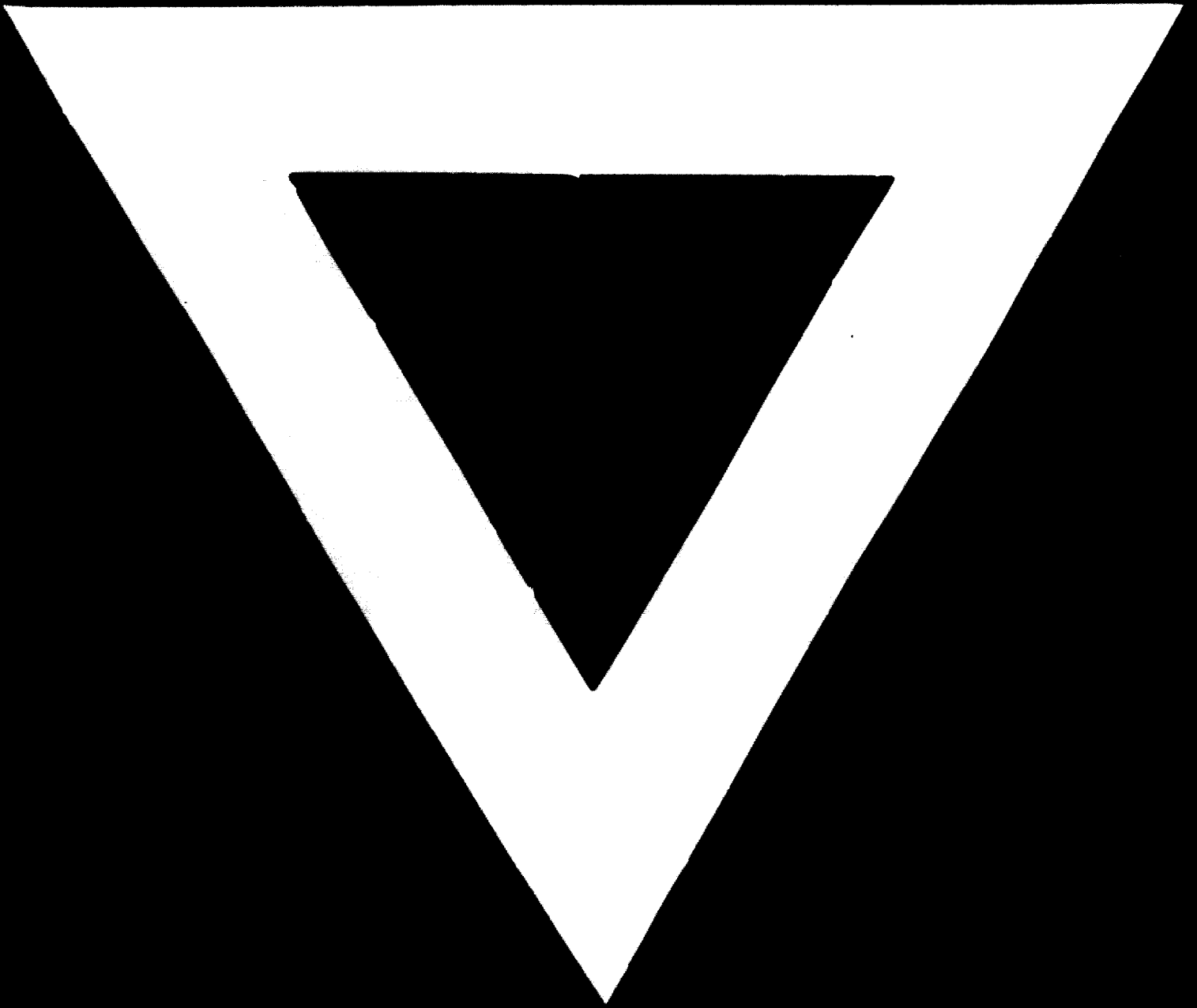
The major multinational companies and/or importers of agro-products in the advanced world would like to identify forms of co-operation which would overcome all these obstacles. Such alternative forms would be smaller mixed companies in neutral territories or standardized agreements on financial and technical co-operation on the basis of royalties or other quantifiable systems.

#### 9. International agencies and agro-industrial development

The activities of international and national agencies and their assistance in the field of agro-industrial development should be reviewed and discrepancies in approach, planning and implementation identified in order to formulate a concise policy and define actions which do not overlap or lead to duplication.

Such papers could be presented by agencies with the greatest interest (UNIDO) in close co-operation with other interested national and international organisations.





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