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Distr.
LIMITED
ID/WG. 282/118
27 October 1978
ENGLISH

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL FORUM ON APPROPRIATE INDUSTRIAL TECHNOLOGY

New Delhi/Anand, India 20–30 November 1978

WORKING GROUP No.9

APPROPRIATE TECHNOLOGY FOR THE PRODUCTION OF OILS AND FATS

APPROPRIATE INDUSTRIAL TECHNOLOGY IN OILS AND FATS INDUSTRIES: THE CASE OF EGYPT

Background Paper

APPROPRIATE INDUSTRIAL TECHNOLOGY IN OILS AND FATS INDUSTRIES:
THE CASE OF EGYPT

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CONTENTS

PREAMBLE

In the target set by the Lima Declaration and Plan of Action for industrial production in developing countries to reach 25% at least of that ot that of the world by the year 2000, it may help, within the context of this paper, to draw a global sketch of the current unbalanced socio-economic status of the world revealing the development wide gaps between developing and least developed countries on one side and developed industrialised countries on the other side. The following section of this paper is an attempt in this respect configurating these gaps, and obviating the magnitude of efforts to be invested by developing countries to achieve the target envisaged by the Lima Declaration and Plan of Action for the year 2000.

The industrialization efforts in most of the developing countries, in fact, is seriously handipped by deep rooted problems, featured by - the **least** to say - the non existance of a balanced structure of a "technology system ", or in the best cases, the presence of such system, but unbalanced and fragmented. While they are endowed with substantial renewable and drastic shortages of technical capabilities (including managerial skills), capital (particularly foreign), research and development institutions, and skilled labour. They face problems of rapid population growth, rural-urban migration, which augment the complications of social and political unstability. These are only few of the features characterising the actual situation in the majority of developing and least developed countries. Few of the developing countries, however, could achieve a fairly rapid industrial development in the last two decades, establishing reasonably modern industries several of their products forced themselves into international markets in competition with foreign production. As in the case of Mexico, a well prepared indicative six year plan for the development of science and technology as an attempt to laid a foundation of a national technology system, the presence of which is vital for the selection, transfer, adabtation and application of technologies which, in this case become appropriate.

As will be explained later in this paper the national technology system is an off shoot of the national socio-economic development plans, both firmly geared together and responding to each other's demands in reciprocation.

In this sence any discussion about industrial development of developing countries, and when viewing the chances for developing countries to achieve the Lima Declaration and Plan of Action target, one should consider, by necessity the presence or absence in developing countries of a technology system as a prerequisite for benefiting from transfered and locally generated technologies, which in both cases should be appropriate.

The term "technology", being adequately used in industrial development litterature, as a main actor in the process of development, never the less, needs an insight to clarify its dimensions, and the difference between it and the term technique.

Technology, in fact, is a totality of a process involving all the society systems and procedures, including the State as legislator and initiator of policies, the educational system and training institutions, the investors (private and public) as source of finance, the institutional set-up, including the administration, universities, research and development, Documentation and information centers,the leadership (Managers) who know how to combine capital, labour, raw material and appropriate technology for successful production in such a way as to assist in the socio-economic development of their countries, the holders of protected technology and know-how, and the public at large. In this sense technology becomes closely associated not only with science and research, but also with the totality of production factors, and the process of development as a whole (economical, social, political, ideological and value system... etc). It could not be isolated from the total structure of the overall system,as it can only function and delivers its benefits to the society when it becomes one of the components of the whole machine. Thus policies, institutions and legal instruments, established for technology in a specific society at a specific phase of its development,should be in harmony and be complementary to those established for the complete process of development of the country. This insures the most efficient role of technology in the process and also the most efficient use of the techniques produced and or adapted. Hence as a prerequisite, the development objectives of the specific society should be carefully identified which in turn provide the guidelines for the technology development objectives and consequently the appropriate policies, institutions and legal instruments could be established. Technologies, imported should necessarely respond to the requirement of this whole process.

In this sence technology, as a complete process, could not, in reality, be transfered. The products of the process, the"techniques" are the ones subject to the process of transfer and could be bought as a commodity in the market. However, we will continue using the term technology, when we really mean techniques, for the purpose of simplicity.

This paper, being mainly devoted for assessing the appropriatness of technologies used in oils and fats industries, necessitates and expression the term "appropriate technology" in general, the way we see it, inorder that we can specifically judge the extent appropriatness of oils and fats technologies already in operation. The requirements of technological appropriatness should thus be **analytically** discussed, and listed if possible, and this will be covered in a later section of this paper.

THE CURRENT UNBALANCED SOCIO-ECONOMIC STATUS OF THE WORLD

The socio-economic unabalnce between developed (rich) and developing (poor) countries, and the wide gaps of development separating them have been of high concern. Many analyses and diagnoses, in this respect, have been published, but perhaps those published by the World Bank (as economic and social indicators), and those presented in the US "Overseas Development Council " in their well prepared report titled " The United States and World Development, Agenda 1977 ", were among the best indicative studies.

Tables 1 and 2 appended, retabulate the World Bank economic and social indicators, while table 3 presents a recapitulation of the economic indicators for further clarification of their significances.

The features indicated by the figures in table 3, presents important significances, including :

- About 17.5% of the world population in 1975 had about 63.5% of the total world income, and an average per capita income of $ 5503 per year.

- About 52.2% of the world population had only 15.9% of the world total income and average per capita income of $ 478 per year.

- The total foreign debts of the poor countries amounted to about $ 121 Billion, and a deficit of about $ 29.7 Billion in their balance of payment.

- In 1980, as shown in the table 3 the situation is not expected to show improvements. Although there will expectedly be an increase in the total national income of the poor countries of $ 333 Billion (34.7% of 1975), and in turn an increase of per capita income per year from $ 478 to $ 549, yet, the gap between the industrial and petroleum countries on one side, and the poor countries on the other side, will expectedly become wider. The average per capita income of the former countries in 1980 is also expected to expand to become 12.1 times that of the latter countries, instead of having been 11.5 times in 1975. The foreign debt of the poor countries, expected to swell to more than $ 150 Billion, offers another proof that in 1980 is not expected to be a relief year.

- The social indicators in table 2, if accepted as rough measures for the extent of development reveals the wide gaps separating industrial and poor countries. An important feature to be realised, however is the fact that although the petroleum countries are listed among the richest countries, yet they socially fall into the category of the poor countries. This is a significant feature leading to the fact that in many instances neither national and per capita income figures, nor G.N.P. and per capita G.N.P. indicators, could be utilised as an effective means of progress achieved in terms of socio-economic development. Obviously, there is no clear relationship between the rate of growth of G.N.P. and improvement in such indicators as average life spans, death rates, illeteracy, infant mortality, nourishment.... Even in cases where there is increase in G.N.P. and per capita G.N.P. there may not be any guarantee that this increase will be spent for improving the physical well being of the poorer sectors of a society.

Realising the above described -efficiencies in utilising G.N.P. and per capita G.N.P. as measures of progress in socio-economic development, the U.S. Overseas Development Council had developed a composite measure that will summarise the different rates of improvement (or deterioration) in various categories and that will make it possible to estimate the extent to which the basic human needs of all people, have or have not been equitably met.

The main concern of the O.D.C. staff was to measure how effectively various " Development Strategies " distribute the most basic benefits of development progress to all parts of the society. Their efforts resulted in establishing what they called " PHYSICAL QUALITY OF LIFE INDEX - P.Q.L.I." *

Applying this index, the term developed countries, in O.D.C. opinion refers to countries with per capita income in 1974 of $ 2000 or more and had attained high standards of living as reflected in a P.Q.L.I. rating of 90 or more.

Thus not all high income countries are considered developed countries.

Accordingly, the O.D.C., compiling indicators from 160 countries has classified them into four categories as follows :

- LOW INCOME COUNTRIES (49 countries), which per capita income under $ 300 and P.Q.L.I. average in mid-seventies of 39.

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* For further explanation of the P.Q.L.I., reference is to be made to the O.D.C. report : "The United States and World Development, Agenda 1977", pp.

- LOWER MIDDLE INCOME COUNTRIES (39 countries) with 1974 per capita income of $ 300 and less than $ 700 and P.Q.L.I. average in mid-seventies of 59.

- UPPER MIDDLE INCOME COUNTRIES (35 countries) with 1974 per capita income of $ 700 and less than $ 2000 and P.Q.L.I. average in mid-seventies of 67.

- HIGH INCOME COUNTRIES (37 countries) with 1974 per capita income of $ 2000 or more, and P.Q.L.I. average in mid-seventies of 95.

Based on the work of O.D.C. the following table was compiled to show the development gap by groups of countries, as categorised in the above four categories.

DEVELOPMENT GAP, BY GROUPS OF COUNTRIES*

Description	Low Income (49 Countries)	Lower-Middle Income (39 Countries)	Upper-Middle Income (35 Countries)	High-Income (37 Countries)
Mid-1976 Population (Millions	1,341.3	1,145.5	470.6	1,057.0
Average per Capita G.N.P. (1974)	$ 152	$ 338	$ 1,091	$ 4,381
Average P.Q.L.I.	39	59	67	95
Average Birth Rate (per 1000)	40	30	36	17
Average Death Rate (per 1000)	17	11	10	9
Average Life Expectancy (Years)	48	61	61	71
Average Infant Mortality Rate (per 1000 Live Births)	134	70	82	21
Average Literacy Rate[(a)]	33%	34%	65%	97%
Average per Capita Education Expenditures	$ 2	$ 10	$ 28	$ 217
Average per Capita Military Expenditures	$ 6	$ 17	$ 31	$ 232

(a) Represents proportion of adult population (15 years of age and over) able to read and write.

* "The United States and World Development - Agenda 1977", p. 157.

APPROPRIATNESS OF TECHNOLOGY

With the above in mind, it becomes clear that the extent of appropriatness of technology for development, depends on the pattern and strategy of socio-economic development adopted by a country, whether developed or developing. In other words technology must respond to the demands of the development process and to resolve the problems facing it.

The appropriatness of technology for a given developing country at a certain phase of development can be generally judged by the extent to which the technology meets the following requirements which involves three aspects, namely the engineering and other technical aspects, the economic aspects and the social aspects.

All such aspects are, and should be closely related to the demands of the socio-economic development plans and their specific strategies and objectives. Such aspects could be formulated as follows :

- The level of engineering and technical sophistication vis-a-vis the available skill level of operators and other production factors.

- The labour skill structure available quantitatively and qualitatively in the country.

- Availability of maintenance facilities and possibilities of spare parts procurement, either locally or through importation, considering the adequacy or shortage of foreign currency needed for this purpose.

- Power and utilities available on site at reasonable economic cost.

- Suitability of techniques selected to local available raw materials, and flexibility of such technology for dual or more purposes.

- The most suitable economy of scale appropriate to the national development strategy adopted by the country.

- The optimisation of input-output ratio of the technology selected.

- Maximisation of output, of fundamental consumption of goods and services and of the rate of growth.

- Reduction of balance of payments deficits and serving the purpose of foreign currency earning and/or foreign currency saving.

- Reduction of unemployment or underemployment.

- Greater equity of the distribution of income and improvement of the quality of life, especially in rural areas.

- The optimum utilisation of natural renewable and non-renewable resources and of human resources.

- The ability of solve or avoid environmental and ecological problems.

- Promotion of political development and stability.

- Relevance to the cultural environment and social traditions.

- Participation in regional development.

- Relevance to national pattern and strategy of development.

In economic terms, the selection of technology in any specific technology, (or more broadly in the development policy of a sector for a country) should conserve scarce resources and attain higher economic efficiency. It is understood that there must be some real opportunity for selection,the range of which involves the intensity of use of capital, labour, raw materials, provided that there exists engineering and organisational options to substitute one factor for another.

Selection of technology in this sense of course has complex repercussions which must be examined in detail before decisions are made, and with these fundamentals in mind the judgement of technology appropriatness in oils and fats industries will subsequently be made.

TRANSFER OF TECHNOLOGY

The basic assumption is that developing countries should benefit from the technologies already existing in the advanced countries,instead of trying on their own to reinvent it. If properly done such transfer of technology can be of great help to the socio-economic development of developing countries.

In order to ensure that such transfer does not lead to adverse effects, the means, institutions and conditions necessary for the proper selection, negociations, licensing, adaptation, and application of the imported technology, must be established.

As previously stated, technology is not simply a set of technological information, or simple a set of equipment and tools nor a set of products whether goods or services. It is rather a complex system which contains the informations the know-how, the equipment, and the products, as well as the institutions,personnel, legislations and the process of innovation and application.... with all these connected to economic social, and political characteristics and objectives of a society. Technological capacity and technological development must be understood in this comprehensive manner.

In this sense the efficiency and the benefit from the process of technology transfer are thus a factor of establishing what we may call the "technological system" involving and instrumenting all the above.

The net result, and the ultimate aim will always remain within the context of the appropriatness of the technology selected, transfered adapted if (necessary) and applied.

THE IMPORTANCE OF PLANNED PRODUCTION AND UTILISATION OF VEGETABLE OIL BEARING MATERIALS

Oil industries depend in their supply of raw material on what agriculture provides of oil seeds, fruits, and oil bearing by-products. Examples of these are : cotton seed, linseed, soyabean, coconut,olives, oil palm, rice bran, maize germ etc... Each of these require certain specific industrial technology for its processing and for optimising its techno-economic results and values.

However the same technology or almost the same, could be used for processing more than one of these vegetable oil bearing materials.

For any country to formulate its policy for cultivating or expanding the cultivation of any of such crops, several agronomic conditions are to be taken into consideration, among which are the following :

1. Suitability of soil for the cultivation of one or alternatively, other oil crops.

2. The country's national policy and planning for agricultural development, should however consider other agro-economic preferential factors in balancing between expanding in oil crops and other non-oil crops cultivation, including the agricultural rotation system and cropping pattern. Such consideration amplify in countries suffering from limited arable lands in general.

3. Adequacy of irrigation water (rain, artisian wells, springs rivers and canals....) and the quality of irrigation water in terms of salt content.

4. Suitable climatic conditions for any of such crops during its growth period.

5. Availability and adequacy of suitable fertilizers, insecticides and pesticides.

6. The cost elements of the crops production not only including the land rental, seeds, fertilizers... etc but also including the techniques adopted, whether manual or mechanical, taking into consideration the appropriatness of the technology used and the availability of the labour trained for utilising it.

7. The post-harvesting operation including packing, baling, transportation and storage, whether manual, semi or fully mechanical. In the selection of techniques suitable for local conditions one must consider several appropriatness factors including not only the engineering aspects which may affect the quality of seed produced and oil yields, but also other economic and social aspects. Availability of trained labour for operating the selected technology and the adequacy of the motive power, and ultimately the cost of the whole operation, are among the important factors to be considered.

The above stated conditions only constitute few indicators which may serve as guidelines in formulating agricultural policies and plans related to oil crops cultivation. The scope of the situation, infact, is much wider, as it relates to national socio-economic and political development plans, policies and strategies, agricultural development and policies being only one of their components. Nevertheless, it should be expected that decisions taken in this respect, may not necessarily be based on what one feddan (4200 sq.meter) yields in terms of oil and cakes after processing, nor they become direct conclusions of the economic aspects at the post-harvesting stage. The crop or crops to be planned for cultivation or expansion in their cultivation, may not accordingly be netting the highest oil and cake yield per feddan, and also may not be obtaining the highest net agricultural economic return. The crucial factors may relate to national policies concerning industrial developments of other industrial sectors conservation of certain scarce resources, inherited social habits... the development of animal walth, the status of infrastructure elements in the country..... etc.

For further clarity the following table demonstrates that although the net return of one feddan in terms of values of cotton seed produced per feddan is insignificant compared with those of ground nut, sesame soyabeans and linseed in Egypt, yet cotton seed is the main source of oil and cake. Reasons need not be explained. The cotton crop in Egypt is a main and vital crop in the economic structure of the country and so is the textile industry.

Groundnuts, sesame, soyabeans, and linseed are relatively minor crops in Egypt, yet they partially supplement the local needs of oil and cake, in addition to their necessity for supplying other industries with raw materials.

AVERAGE YIELDS OF OIL SEEDS/FEDDAN IN EGYPT FOR FIVE SELECTED CROPS, PRODUCTION COSTS OF SEEDS YIELDED (PER FEDDAN AND PER TON), AND POST-HARVESTING NET RETURN/ FEDDAN.

Crops	Av. Yield / feddan (ton)	Av. Production Cost of seeds /feddan ($)	Av. Production Cost of Seeds/ Ton ($)	Av. Net Return/ Feddan ($)
Groundnuts	0.849	136.60	160.71	206.59
Cottonseed	0.482	3.44	7.13	2.39
Sesame	0.442	88.22	199.31	134.27
Soyabean	1.000	128.57	128.57	157.14
Linseed	0.505	74.84	148.24	96.04

Remarks :

1. Figures presented were calculated on the basis of information obtained from different departments of the Egyptian Ministry of Agriculture.

2. Dollar values were based on the rate of exchange L.E. 1.00 = $ 1.428

3. As cotton is a dual crop, the average production cost of cottonseed per feddan, and the average net return per feddan, were obtained by calculation.
   The same principle was applied in case of flax (for linseed production), being also a dual crop.
4. No value was given the by-products such as cotton stalks and foliage of other crops (though used as primary products for other industries and for other end uses).

THE MARKET FOR OILS AND CAKES

In oils and fats industries the products in most cases are market-oriented whether towards local markets or for export.

The local market conditions and forces, should, however have more weight based on the fact that oils, fats and cakes are strategic and basic nutritional materials whose domestic adequacy play a role in providing one of the requirements of Basic Human Needs in least developed countries and rural areas. Domestic consumption habits in oils and fats however should not be neglected as a condition affecting production and consumption in each area. In several sectors of the population in many countries preference goes to linseed oil, olive oil, rapeseed oil, sesame oil... etc in crude form. Thus such situation becomes influential in marketing oils and fats.

In the world market the price structure of oil bearing materials and their products is mostly subject to the market forces. The prices fluctuate up and down accordingly, responding to such forces. The pricing structure in such a system left a positive impact on the technological development of this industry. The development of screw pressing system and further of solvent extraction and continuous centrifugal refining were undoubtedly affected by factors relating to the prices of raw materials and products. Whether such technologies, innovated by highly industrialised countries, are most appropriate or not for developing countries remains to be discussed later in this paper.

In several developing countries however the pricing system and marketing policies adopted were different. They were not subject to the normal market forces. The raw materials (oilseeds) and products (oils and cakes) were artificially priced independent of the world market prices.

In the case of Egypt, as an illustration, cottonseed was artificially priced. While Sudanese (Bulk) cottonseed wholesale prices in Europear markets ranged between $ 97/ton in 1960 and $ 230/ton in 1974 CIF Europe, the Egyptian cottonseed was priced for the domestic market at a fixed price of $ 9.42/ton franco oil mill stores. This fixed price was imposed by the Government more than three decades ago and still applies. Consequently cottonseed oil and cake were artificially priced at the low levels of about $ 71/ton of neutralised oil (bulk) and about $ 10.7/ ton of undecorticated cake. In the European market cottonseed oil prices ranged between $ 235/ton in 1960 and $ 939/ton in 1974 CIF Rotterdam. Cottonseed undecorticated cake slabs called for prices ranging between $ 45 - 100/ton.

Obviously there is a complete divorce of the price structures of raw materials and products between price movements in the European market and the artificial constant prices in the Egyptian domestic market which for years has not been an export market. This artificial pricing system might have had acceptable reasons to justify its applicable years ago, and may be until now under certain local conditions. But undobtedly it had repercussions negatively reflecting on many techno-economic aspects of this industry in Egypt.

Two main considerations are to be realised in assessing the unfavourable effects of the long time artificial pricing system applied in Egypt : the first is that this industry is almost totally State owned since 1961 when it was nationalised. The second is that since 1949 the selling prices of cottonseed oil and cake were fixed on the basis of the artificial cost/ton of cottonseed <u>plus</u> fixed cost elements estimated at that time and has not changed until now inspite of the escalating inflation rate plus a slim margin of profit which was completely absorbed years ago. These two considerations have not only limited the freedom of action of the oil mills management to enforce their own policies and development plans, but also deprived them from utilising their marketing skills. The result was their inability to replace, in due time, the old time technologies suffering from drop of efficiency by more up-to-date ones. Consequently,increasing losses and affectinv the quality of products. Their chances for replacements and modernising were limited, and they faced obstacles of Government financial rules and regulations and shortage of foreign currency. Reaching such a critical situation, the Government had set plans and raised funds for renewal of oil industries. The ration system for marketing oils and cakes had also handicapped the management of oil mills, by isolating them from the demands of the consumers in terms of quality of product, and eliminating almost completely the factors of competition. Moreover the system had also isolated the processors from the foreign market pricing conditions.

The above description of this actual case, may sound gloomy and may bring to the mind a question of how could such industry under such conditions survive and realise the necessary profits ? In fact such realisation was not obtained from the crushing and refining operations but from the production of a product mix of other products in the same plant, and from selling by-products of lower value at higher prices than what they warrant. Parallel to this higher yields, and better quality, were gratified by bonus payments by the Government.

APPROPRIATE INDUSTRIAL TECHNOLOGY IN OILS AND FATS INDUSTRIES.

The oils and fats industry, historically, goes as far back as history itself and one can read in the litterature about formidable but primitive presses utilised to extract different kinds of oils and fats at the times of the Egyptian Pharaohs and the Chinese and Indian ancient dynasties. The importance of oil extraction lies mainly in the fact that oils and fats are vital ingredients in the nutrition of human beings and animals for their survival, in addition to many other utilisations.

The technologies used at that time, though primitive judging by nowadays measurements, yet one should imagine that under the socio-economic conditions of those times they could be considered appropriate. In many parts of under and least developed areas in our present world, one should not consider it a surprise when he sees simple designs of presses having similar features which had characterised those drawn on the walls of the temples. Such simple designs scattered in small villages to serve primitive communities are usually bullock driven where no other sources of energy exist. The quality of oil produced is low, wastes are high and the high residual oil in cake does not mean such to the processors, as the economics of the operation was not among their considerations. The high oil content cakes deteriorate quickly and limit their use in animal nutrition. The crude oils produced, do not go through refining processes, as the natives were used to their tastes as such, and most probably would give their preference to such inferior qualities rather than the refined oils of today.

Through centuries, however, industrial techno-economic development fundamentals had imposed themselves on this industry, aiming at more efficient processing of oil bearing materials and improved economic conditions of their operations. The quality of oils and cakes produced was another important demand. Industrial research and development operations, systematically took place accordingly, yielding several technologies/techniques, which by time, passed through successive stages of mechanical and chemical improvements. Hydraulic presses, in different designs and capacities were constructed and marketed as early as the late years of the seventeenth century, in addition of the other components of the production lines including crushing (size reduction of oils bearing materials), cookong, oil fittering... etc. The operation of such hydraulic pressing production lines, though simple and relatively lower in energy consumption, yet it was a handicap for operations in areas where labour was either scarce or demanding high wages. Research and development activities, facing the challenge of such handicaps, proceeded into the development of screw-pressing (expellers), the operation of which, though higher in power consumption and other factors, yet their operation was labour saving. Such technology had better suited conditions in areas where energy was relatively cheaper and labour was in shortage but higher in skill levels. Such areas were, generally speaking, in highly industrialised countries, though it proved suitable for operation in many less advanced countries.

In fact, the techno-economic balances in the selection of either one of these two technologies for operation under certain specific conditions, need much more than a comparison between energy requirements and labour intensity. Such a preferential study should not only deal with these two factors but should necessarily cover all the elements featuring the technological appropriatness as previously outlined in this paper.

Residual oil in cakes produced, was in both hydraulic and screw pressing operations, a matter of high concern, not only because of economic factors, but also because of the continuous increase in the demands for oils and fats by a continuously growing population,in addition to the gradual improvement in conditions of living in developing areas, Although large capacity and heavy duty expellers succeeded in reducing the residual oi, in certain cakes to as low as three percent, but this was on the expense of high cost of power needed for operating such presses. Technological researche and development again mobilised its forces to lower such percentage to a minimum of one percent or even lwaa. Thus solvent extraction technology came by as an effective mean in this respect. In high oil content seeds, a combination of pre-pressing in screw pressing followed by solvent extraction was established as another technology. Again one should go into details of intricate studies to assess the pros and cons of each technology in terms of the extent of appropriatness for certain countries under specific condition and at certain phases of their socio-economic development.

Here again one should always keep in mind the engineering,economic, and the social indicators of appropriatness mentioned previously.

Oils and fats refining, aiming at the economic improvement of the quality of oils and fats for edible purposes, had also passed through technological developments. The simple open kettle caustic refining followed by earth bleaching and deodorisation, had been greatly improves technically and economically through research and development activities.

Continuous centrifugal caustic refining had markedly reduced refining losses and facilited the bleachability of the oil. But when it comes to a decision on which is more appropriate as an alternative technology one should not limit the comparison to this narrow area as it should be extended to the other factors of appropriatness for a certain locality under certain conditions.

The open kettle batch bleaching and vacuum kettle deodorisers developed technologically into continuous operations had also demonstrated several economic and technical advantages but one cannot judge their technological appropriatness without balancing such advantages with other factors of appropriatness.

Technologies have been developed other than the above for oil extraction and refining, but for the sake of brevity, we find it irrelevant to include them in this sjort expose, though the assessment of their technological appropriatness will always be judged within the context of the socio-economic and engineering indicators.

Oils and fats basic industries are characterised by penetrating through many other industries; their main or by-products being utilised as primary materials for these industries. Soap industry is basically inherent in the domain of oil and fats industries. Production of hydrogenated oils for edible and industrial purposes is another important industry founded mainly on oils and fats. The hydraulysis of oil for the production of fatty acids for soap making (or otherwise) and commercial glycerine (and consequently the pharmaceutical grades) is another industry directly related to the oils and fats industrial complex. Paints and varnishes obtain may of their primary material from the products of oils and fats processing. The cakes and meals produced as by-products of the oil extraction, become important ingredience of balanced formula feeds for cattle and poultry, thus serving, in addition,other industries like meat packing fat rendering and dairy industry. Processed cakes and meals also produce fractions utilised as protein supplement and sauces for human nutrition. The husks produced as a by-product in hulling operations have also a value when burnt in boilers for energy generation, or for using them as soil conditioners. They can also pass through a process of fermentation for the production of furfural.

All such industries utilised different technologies, the appropriateness of which could be assessed following the same guidelines. However one should not forget that the totality of industrial operations based on the extraction and refining of oils and fats, constitutes a broad and concrete foundation for socio-economic development in countries varying from least developed to highly industrialised. In this sense fats and oils agro-industrial complex should be viewed as an essential means in instrumenting the process of socio-economic development.

A CASE STUDY FOR ASSESSING THE TECHNOLOGICAL APPROPRIATNESS OF OILS AND FATS INDUSTRIES

For a better presentation of the appropriate industrial technology in oils and fats industries a study case should always assist in materialising and/or configurating the assessment of such appropriatness. The status of this industry in Egypt was selected for the availability of facts figures and information.

BACKGROUND :

Before the cotton crop was introduced to Egypt in the year 1800's, the main sources of oils were linseed and sesameseed, which were crused in animal driven stone crushers which were slightly improved by time to the designs which are still in operation in few of the Egyptian villages until now. The crude sesame oil produced in Egypt mainly by this process, (popularly called "SERIG" oil), is still used in rural and some urban areas. The same simple technology is being used for crushing considerable quantities of linseed for the production of crude linseed oil popularly called "HAR" oil. This primitive technology was gradually replaced in the last two decades by electrically operated small size screw presses whose operation proved to be more efficient and more economic in addition to improvement of the quality of the crude produced. The quantities of seeds crushed by those small crushers are slowly diminishing. Enough data and information for assessing the appropriatness of this low cost or intermediate technology was not available and thus will not, unfortunately be covered in this study.

With the introduction of the cotton crop in Egypt, cottonseed appeared in the market but only for export. In the late years of that century the first hydraulic press mill was established in Alexandria for crushing part of the crop and exporting the products. With the expansion of the cultivation of cotton in the country, other mills were established for the same purpose close to the shipping port in Alexandria and gradually spreading into different parts in the Nile Valley. Until the end of World War II there were two considerably large mills in Alexandria and Kafr El Zayat in the Middle of the Delta Area. About seven more relatively small mills were in operation in Alexandria and Lower Egypt.

The Post-War few Years witnessed the establishment of an additional number of small oil mills scattered all over the country including Upper-Egypt, thus bringing their number to about 36. The technologies used in the older and the newer mills were mainly hydraulic presses with few, installing a limited number screw-press mostly for crushing linseed.

The oil refining in all these mills (with the exception of one) was open kettle caustic refining and batch bleaching and deodorication.

For a clearer diagnosis of the status of this industry in Egypt. The following may be stated :

I. The oils and fats industries in Egypt at present embraces the following :

   a) Oil seed extraction (mainly cottonseed), utilising hydraulic-presses, screw-pressing, solvent extraction, and pre-pressing combined with solvent extraction.

   b) Oil refining utilising open kettle process and the centifugal continuous refining, open kettles and continuous bleaching, and vacuum deodoriciation (batch and continuous).

c) Hydrogenation for the production of edible shortening, margarines and ghee, and non-edible hydrogenated oils for soap making and other products.

d) Laundry and toilet soap making utilising open kettles and continuous centrifugal process in addition to a variety of technologies for further processing.

e) Fat splitting for the production of fatty acids and glycerine including fatty acid distillation.

f) Animal feed industry for the production of balanced rations in powder and pellet forms.

g) Paints and varnishes industry utilising vegetable oils as main ingredient.

Following the almost complete nationalisation of this industry in 1961 and 1963, planning for its development and modernising took place, aiming at :

1. **Amalgamation** of oil milling small factories into a smaller number large capacity mills.

2. Gradual abolishment of the hydraulic pressing system, to be replaced by direct solvent extraction or by pre-pressing and solvent extraction.

3. Replacement of the caustic open kettle refining system by the continuous centrifugal system.

4. Replacement of the batch systems of bleaching and deodorisation by continuous systems.

5. Expanding in P.V.C. bottling of refined oil rather than oil distribution in iron barrels.

- Modernising laundry and toilet soap making and packing processes bv instalina continuous svstems.

- Expanding the capacities of the glycerine water concentration and refining vats to process all the glycerine water produced in soap plants.

- Expanding the production of pelleted mixed feed to utilise all the cake produced in the oil mills in addition to other feed materials.

- Establishing solvent extraction mills for extracting oil from rice bran.

- Establishing ventilated cotton seed stores.

In the following few ten years all such plans were gradually implemented with the exception of the vemtilated cotton seed stores, of which one was built utilising local material of construction and applying indegeniously generated technology.

While implementing those plants the companies had also added improvements, including :

- replacement of hydrogen production battery system in some plants by continuous system.

- replacement of margarine production batch system by a continuous system.

- replacement of fatty acid distillation equipment in some plants by new ones.

The amalgamation of small oil mills into a smaller number of large capacity ones, indicated the shift in the plan from the policy of decentralisation to that of centeralisation, in which the bigger units becoming more or less an industrial oil complex including several operations starting from oil extraction and ending into the production of several oil products.

At the time when this plan was set the factors favering centralisation overweight those in favour of decentralisation. One of the important factors favouring the former was the synchronization between the amount of cotton-seed produced in different localities in the country and the almost equivalent inpot capacities of oil mills in the same locations. This had resulted in considerable savings in cost of seed transportation and had assisted in avoiding seed deterioration during transport. This advantage still exists. The centralisation policy adopted, did not, in fact, affect the employment of labour in the new larger complexes, as their employment continued in other operations in the larger complex according to the previously formulated plan.

As previously stated, each operation in this industry complex in Egypt had utilised different technologies, the information collected about them enables us to assess their relative appropriatness as practicable as possible. The following is an attempt :

Cotton seed oil extraction :

As previously mentioned three technologies were and are utilised namely, hydraulic, direct solvent extraction and pre-pressing followed by solvent extraction.

It should be realised that these three technologies were developed and gradually improved in the last two centeries in the industrialised countries and were purchased and put into operation in Egypt in intermi-ttenant periods. Little improvements in the processes might have been locally introduced, but not to the extent that the original basic technologies were changed. The only exception we may consider is the designs and of the ventilated seed store which was implemented locally, and which could be considered a new technology resulting from the adaptation of foreign one. In other words the three basic technologies used in Egypt for cotton seed oil extraction, could not be an adaptation of the basic imported technology.

For this reason the assessment of appropriatness of these technologies is not in fact a comparison between them and a different technology generated locally. It is, in essence a study of the relative appropriatness of three imported technologies applied almost as originally developed in industrial countries.

The following table presents a few indicators which will assist in the evaluation of the relative appropriatness of the three technologies applied.

SOME INDICATORS FOR ASSESSING THE RELATIVE APPROPRIATNESS OF THREE TECHNOLOGIES APPLIED IN EGYPT FOR CRUDE COTTONSEED OIL EXTRACTION

	Hydraulic Press System	Direct Solvent Extraction system	Pre-Press and solv.extraction system
- Input capacity (tons/year of 300 days)	60,000.-	54,000.-	135,000.-
- Actual cap. occupied (tons/year)	35,832.-	31,976.-	91,570.-
- Cap. occupied (% of total)	59.72 %	59.21%	67.82%
- Crude oil produced (tons)	5062	5735	16788
- Crude oil recovery (% of seed)	14.13 %	17.94 %	18.33 %
- **Employment Analysis** :			
* Total number employed	208	44	128
- Engineers (Univ.Degrees)	5	5	5
- Technicians (tech. schools)	8	6	17
- Skilled labour (total)	80	15	26
. Prim.School Certif.	-	5	26
. Read and write	31	10	-
. Illeterate	49	-	-
- Semi-Skilled (total)	100	14	64
. Prim. School Certif.	-	-	-
. Read and Write	-	14	64
. Illeterate	100	-	-
- Unskilled (total)	15	4	16
. Illeterate	15	4	16
- **Salaries and Wages** :			
- Total (Operation) : $	78,727.-	24,020.-	62,050.-
. Av./Worker/Year $	380.-	546.-	485.-
. Av./Ton of seed $	2.19	0.75	0.67
. Av./ton of crude oil $	15.55	4.18	3.69
- **Marketing** :			
. Av./ton of seed $	0.19	0.04	0.24
. Av./ton of crude oil $	1.32	0.18	1.29
- **Overhead** :			
. Av./ton of seed $	0.56	0.23	0.72
. Av./ton of crude oil $	3.97	1.30	3.90

Table (Continued)

	Hydraulic Press System	Direct Solvent Extraction System	Pre-Press and Solv.Extraction System
- **Utilities** :			
- **Electricity** :			
. Consumption/ton of seed $	0.14	0.26	0.49
. Consumption/ton of crude oil $	0.96	1.44	2.67
- **Steam** :			
. Consumption/ton of seed $	0.43	1.84	1.06
. " /ton of crude oil $	2.98	10.12	5.99
- **Water** :			
. Consumption/ton of seed $	-	0.14	0.15
. " /ton of crude oil $	-	0.77	0.80
- **Repairs, Maintenance & Spare Parts**			
- **Spare Parts** :			
. Per ton of seed $	0.38	1.07	0.05
. Per ton of crude oil $	2.68	5.91	0.32
- **Repairs and Maintenance**			
. Per ton of seed $	1.46	2.13	0.85
. Per ton of crude oil $	10.22	11.75	4.59
- **Lubrication & Greasing** :			
. Per ton of seed $	0.01	0.22	0.02
. Per ton of crude oil $	0.07	1.23	0.12
- **Packing & Despatching** :			
- **Packing** :			
. Per ton of seed $	0.05	0.06	0.05
. Per ton of crude oil $	0.38	0.35	0.29
- **Despatching (transport)**			
. Per ton of seed $	0.28	0.62	0.10
. Per ton of crude oil $	1.99	3.40	0.56
- **Depreciation** :			
. Per ton of seed $	0.06	1.54	0.35
. Per ton of crude oil $	0.41	8.51	1.88

Table (continued)

		Hydraulic Press System	Direct Solvent Extraction System	Pre-Press and Solv. Extraction System
- Initial Cost of Equipment	$	91,800.-	426,400.-	190,000.-
- Extent of mechanisation :				
. Initial cost of equipment/ number of workers	$	441.-	9,690.-	1,485.-
. Electric power used/number of workers	KW	378.50	15.909.-	13,604.-
. Initial cost of equipment/ total salaries & wages	$	1.67	25.36	4.4
. Electric power used/ton of seed crushed	KW	2.20	21.89	19.-
- Productivity Norms :				
. Value of products/number of workers	$	1565.-	8380.-	4684.-
. Value of products/Total salaries & Wages	$	5.90	21.90	17.39
. Value of products/initial cost of equipment	$	5.10	1.24	5.68

REMARKS :

1. The figures expressed in Dollars in the table resulted from conversion of Egyptian Pounds to Dollars at the rate of exchange of $ 1.00 = L.E. 0.700.

2. The initial cost of the pre-press and solvent extraction vis-a-vis its yearly input capacity of 135 000 tons is relatively much lower than that of the much smaller direct solvent extraction system, due to the fact that the former was purchased about 30 years ago, while the latter was purchased in the late sixties. The hydraulic press system plant was purchased even earlier than the pre-press and solvent extraction, when evaluating any of the indicator appearing in the table.

3. The input capacity occupied is relatively low due to limitations of cottonseed quotas imposed by the Government, and lack of freedom of the management to import additional quantities.

4. The cost elements indicated in the table per ton of seed crushed and per ton of crude oil produced were all calculated with allocating any cost figures for the cake produced, according to the costing system adopted.

5. No value was given to the consumption of water per ton of seed crushed and per ton of crude oil produced in the hydraulic system, as the quantities were relatively little.

Engineering Aspects of Appropriatness :

Without going into details of the extent of engineering sofistication of one technology developed after the other, one could generalise that the hydraulic press technology is the less sofisticated relative to the screw-press system, and this latter is less than both the direct solvent extraction and the pre-press and solvent extraction. This fact is confirmed by several indicators stated in the table, including :

- the electric power used/one worker.
- the electric power used/ton of seed crushed.
- Initial cost of equipment/one worker.
- Initial cost of equipment/one $ of salaries and wages.

  N.B. Please refer to our reservation on the last three items in remark No.2 following the table.
- The consumption/ton of seed crushed and/ton of crude oil produced, of utilities (electricity, steam, and water).
- The costs of repairs, maintenance and spare parts/ton of seed crushed and/ton of crude oil produced. It is to be noticed that the figures stated in the column for the pre-press and solvent extraction show low levels of costs, which may indicate abnormality relative to the high level of engineering sofistication. The fact is that this particular company operating this technology constitutes one of the largest complexes in this industry, and is well equipped with complete maintenance shops and skilled well trained technical staff. Completed with good management, the company was able to economise in the costs of repair and maintenance operations, and on the costs of spare parts, a good deal of which were manufactured in their own workshops and others in the country.

The different levels of engineering sofistication in the three technologies were not a problem from the point of view of the workers skill structure existing in Egypt. Skilled labour needed for efficiently operating the direct solvent extraction and the pre-press and solvent extraction, were available, untill few years ago when many of them were tempted by much higher salaries abroad, mainly in the rich **Arab** oil-exporting countries. This difficulty had affected the industry for a period of time, but was overcome by intensive training programs arranged by the Government and by the Companies.

For few decades Egypt had suffered, and still is, from considerable shortage of foreign currencies. Though this was a serious handicap to all industries in Egypt, yet it motivated the industrial enterprises and local workshops to invest their experience and ingenuity in manufacturing reasonably good quality spare parts and replacements for machinaries and equipment. This was a relief for oils and fats industries, although it did not proceed into adaptation and generation of new local technologies.

The Social Aspects :

Employment opportunities through industrialization is one of the main social aspects of technology appropriatness, "Employing a person who would otherwise" be out of work, is a net gain for the economy.* With this viable concept in mind, one may immediately consider that the hydraulic press technology is relation by more appropriate than the other technologies applied in Egypt, the former having offered more employment opportunities than the latters (see table). One may ever further question any justifiability suggested for not applying low-cost small units of intermidate technology

* Jequier, Nicolas, "Appropriate Technology Problems and Promises", OECD Development Centre, Paris, 1976, p.19.

to be decentralised in rural areas, thus offering more employment opportunities As previously mentioned, the development plans for this industry was based on centralisation, contrary to that principle. The justification was that the social factor of employment was offset by the more important demand for efficient operations extracting the highest oil yields from the limited quantities of cottonseed and other oil bearing materials produced in Egypt, compared with the continuously increasing/capita consumption. The country, being short of foreign currency, could not afford neglecting high residual oils in cakes (in inefficient operations), to be replaced by imported substitutes of oils or additional oilseeds. Another consideration was the unavailability in the world market, of economic low-cost, small scale foreign technologies suitable for the application of a policy based on decentralisation. On the other hand no local technologies were generated for this purpose, bearing in mind that until recently, power sources were not available in several parts of the rural areas, where oil seeds were produced.

The question ultimately remains, whether or not, this industry, with its present structure and the technologies applied, had nationally maximised the social function of employment. The answer, so far, may not be easy to give.

The Economic Aspect :

Within the context of the specific three technologies applied, their economic dimensions could be measured by several means, including, as more important, the total of the value added in the case of each technology. Bearing in mind that we are not in this paper taking a situation of technology selection for the purpose of cotton seed extraction, several other economic factors will not be included. The main consideration in balancing between the appropriatness of the already applied three technologies will be based on the production cost and profit making and broadly the amount value added. Of course these two factors may more concern the interest of the entrepreneur in the private sector and, may not conform with the national strategies adopted by the national planners. But in our specific case, the technologies previously selected, and presently in operation, there is little to take about more than these two factors.

As indicated in the following table, the total cost of production applying the pre-press and solvent extraction technology is the least among three technologies. The solvent extraction technology comes next and the hydraulic press technology follows:

	Hydraulic Presses	Solvent Extraction	Pre-press & Solv. Extr.
Total cost of crushing/ton of seed $	17.324	16.772	13.752
Total cost of production of one ton of crude oil $	121.485	92.517	74.421

As the selling prices of cotton seed oil and cake are obligatory, being fixed by the Government the profatability becomes more in the case of pre-press and solvent extraction, followed by the solvent extraction and then by the hydraulic pressing. Of course this factor depends to a great extent on the ability of the technology management and the technicians in charge of the operations, but our conclusion is based on the assumption of unifying this basis among the three. Without going into details of calculating the amount of value added in each of the three cases, it goes more or less paralıel to the profitability indicators.

Productivity factors in each of the three technologies may also be of interest in discussing the economic aspects of their relative appropriatness. According to the productivity norms stated in (the table pages 32-34), the value of products per one worker, per one $ of salaries and wages,and of one $ of initial cost of equipment, may be indicative.

COTTONSEED OIL NEUTRALISATION AND PARTIAL BLEACHING

Two technologies were and are in operation in Egypt, namely the open kettle batch caustic refining and continuous centrifugal refaining.

The open bottle batch system has been developed several centuries ago and is characterised by being simple in design, and a sence it could be considered as an intermediate technology. The simplicity of its design enabled many developing countries to manufacture its components and even introduce minor improvements in it. However to obtain good results in processing crude oil in it demands high individual skills in the operator. By utilising depend on uncontrolable factors relating to his moods from time to time. This proved to be a handicap in the application of this technology. The continuous centrifugal technology had eliminated this critical weakness, as it mechanised the operation and instrumentally controlled it to a great extent.

This latter technology had been developed in industrialised countries passing through stages of improvements in the last four decades. Little if any, modifications or adaptation had been introduced into this technology by its users in developing countries who are dependant to a grate extent on the manufacturers for spare parts and replacements.

The following table presents some indicators which assist in the evaluation of the relative appropriatness of the two technologies applied.

SOME INDICATORS FOR ASSESSING THE RELATIVE APPROPRIATNESS OF TWO TECHNOLOGIES FOR CAUSTIC REFINING OF CRUDE COTTON-SEED OIL

	Batch Caustic Refining	Continuous Centrifugal Refining
- Input capacity (tons/year of 300 day)	4500	9000
- Actual capacity occupied (tons/year)	3638	9000
- Capacity occupied (% of total)	75.2	100.0
- Crude oil processed (ton)	3638	9000
- Neutralised oil produced (Ton)	3384	8600
- Av. Refining loss (%)	7.5%	4.4%
- Employment Analysis		
. Total number employed	51	24
- Engineers (Univ. Degrees)	3	4
- Technicians (Tech. School)	3	4
- Skilled labour (Total)	24	4
. Prim. (School Certif.)	-	-
. Read and Write	24	4
. Illiterate	-	-
- Semi-Skilled (Total)	15	4
. Read and Write	5	4
. Illiterate	10	-
- Unskilled (Total	6	8
. Read and Write	-	8
. Illiterate	6	-
- Salaries and Wages :		
- Total (Operation) $	24000	12657
. Av./Water/year $	471	527
. Av./ton of crude oil $	6.60	1.41
. Av./ton of Net. oil $	7.09	1.47
- Marketing :		
. Av./ton of Neut.Oil $	0.63	0.71
- Overhead :		
. Av./ton of Neut. Oil $	1.81	4.84

		Batch Caustic Refining	Continuous Centrifugal Refining
- Utilities :			
. Electricity per ton of Neut. Oil	$	0.09	0.15
. Steam per ton of Neut. Oil	$	1.38	1.03
. Water per ton of Neut. Oil	$	0.09	0.04
- Repairs, Maintenance and Spare Parts:			
- Spare parts/ton of Neut.Oil	$	.24	.13
- Repairs & Maint./ton of Neut.Oil	$	.78	.14
- Lubrication & greasing/ton of Neut. Oil	$	.08	.05
- Depreciation :			
. Per ton of Neut. Oil	$	0.60	0.77
_ Initial cost of equipment	$	20593	66343
- Extent of Mechanisation :			
. Initial cost of Equipment/number of workers	$	403.78	2764.29
. Initial cost of equipment/total salaries and wages	$	0.86	5.24
. Electric power used/number of workers	KW	341.3	3834.2
. Electric power used/ton of Neut. oil	KW	6.5	10.7
- Productivity Norms :			
. Value of products/No.of workers	$	4711.-	25442.-
. Value of products/total salaries and wages	$	10.00	48.24
. Value of products/Initial cost of equipment	$	11.66	9.20

THE ENGINEERING ASPECTS OF APPROPRIATENESS

Obviously the continuous centrifugal technology is the one characterised by considerable engineering sophistication. This fact is confirmed by several indicators stated in the above table, including :

- The initial cost of equipment per one worker.
- The initial cost of equipment per one $ of salaries and wages.
- Electric power used per one worker (K.W.)
- Electric power used per one ton of neutral oil produced (K.W.)
- The cost of electricity consumed per one ton of neutral oil produced ($)
- The cost of spare parts, repairs and maintenance and lubrication and greasing per one ton of neutral oil produced.

The extent of engineering sophistication in the continuous centrifugal system did not create any serious difficulty from the point of view skilled labour availability.

The Social Aspects :

From the table it is obvious the social necessity of employment opportunities was not served by substituting the open kettle batch system by the continuous centrifugal. While 51 workers (including three engineers, three technicians and twenty four skilled labour) were needed to operate a 4500 tons of crude oil per year input capacity, only 24 workers were needed to operate a continuous centrifugal plant of double the input capacity, including four engineers, four technicians and only four skilled labour. It is to be noticed that non of the workers in this latter plant is illiterate. The minimum qualification was the ability to read and write. This had reflected itself in a higher average of salaries and wages of $ 527 per worker per year, as compared to $ 471 per worker per year in the open kettle batch refining technology.

The failure of the continuous centrifugal technology to respond to the demand of social development through more employment opportunities, was over compensated by the much lower average refining losses and several other cost factors. This had justified the ,aterial planners decision to apply this technology.

The Economic Aspect :

In line with what was explained before concerning the economic aspect of appropriatness in the technologies applied for extracting crude oil from cottonseed, one may also state here that the operation costs in the refining of crude oil in the continuous centrifugal system is considerably lower than that in the batch refining. The value added may also record another economic advantage for the centrifugal system.

The value of products per one worker and per one $ of total salaries and wages, show a considerable economic advantage on the centrifugal system over the batch system (see table), which justifies its application.

Technology Appropriateness of Other Industries Already in Operation, Related to or Based on Vegetable Oil Industries :

The two cases analysed above, namely of the cottonseed oil extraction and crude cottonseed oil refining, involving different technologies in operation in the country are merit to be a demonstration of a procedure suggested to be followed if and when such assessment exercise for the different technologies, is needed. There may be other more elaborate and better procedures for this purpose. Nevertheless, the one suggested may at least offer guide lines. Hence, one can apply this suggested procedure or anyother for the purpose of evaluating the relative appropriatness of existing industries in operation, such as those based on vegetable industry or related to it.

PRE-INVESTMENT CONSIDATIONS FOR THE SETTING-UP OF VIABLE VEGETABLE OIL FACTORIES

For a successful and secure investment in a vegetable oil factory a complete range. Studies should be prepared starting from the pre-feasibility of the project idea to a complete techno-economic feasibility study.

For the specific purpose of this paper, the most important element in the series of studies to be made, should be the selection of the technology (process) most appropriate for the conditions of the country and of the investors. However, the rest of the conditions which define the appropriatness of technology- previously stated - on a national level, should not be neglected. This is important, as the investment in the project should always **conform** with the national development plans and strategies adopted by the country.

In addition to this important consideration, the project preparation should carefully cover four essential components which are briefly listed below :

- The market study :
  - The domestic market for oil, cake and meal (domestic consumption imports, exports production, quality, prices, packing and distribution, transport, consumption patterns, rate of population increase distribution and levels of income, future demand, forecast of sales national plans and legislations...etc
  - The export market for oil, cake and meal (world production, levels prices, price prospects, buyers requirements, transport and freight costs, tariffs and quotas, sales forecast, possible selling arrangements, market intelligence .... etc.)

- Raw Material :

  Domestic agriculture, imports, specifications, prices,transport, storage... etc.

- The type of processing plant
  . Economic factors (Scale of Plant, location, labour and Staff availability... etc.
  . Process (technology selection)
  (suitability for the seed to be worked, its yield and the quality of products to be achieved, utilities and supporting services, buildings required, overall area requirements, possible sites, infrastructure... etc.

- Financial Assessment
  . Basic operating cost and price assumption. (raw material, utilities, labour, repair and maintenance, packaging,selling prices of oil and meal... etc)
  . Capital costs in local and foreign currency
  (Plant and equipment, freight and insurance, civil designs, construction, engineering designs, purchasing, start up training.. etc.)
  . Working Capital
  (Operating cost, utilities and chemicals, investment insentives, sales forecast, cash flow, return on investment and pay-back period... etc).

These are the main and essential components of a complete techno-economic feasibility study of a new project which should be carefully covered. Out of this the investor, whether private or public can take secured decissions not only concerning the viability of the project as a whole, but also related to the appropriatness of the technology selected.

APPENDIX (1)

Table (1)

Economic Indicators (WORLD BANK)

	Units	Rich Countries			Poor Countries			
		Industries	Socialist	Petroleum	Above Average	Average	Below Average	Lower Income
- Population 1975	Million	682	1202	13	203	387	301	1178
- Population 1980	Million	713	1291	15	220	445	348	1340
- Rate of Growth	%	0.7	1.5	4.6	1.7	2.5	2.6	2.5
- National Income 75	Billion $	3768	1238	57	340	337	106	176
- National Income 80	Billion $	4768	1618	78	480	445	145	222
- Rate of Growth	%	1.4	4.1	5.5	2.1	3.4	3.8	3.7
- Per Capita Income 75	$	5521	1029	4549	1824	871	353	149
- Per Capita Income 80	$	6683	1253	5281	2178	999	418	166
- Rate of Growth	%	2.1	2.6	0.9	0.4	0.8	1.1	1.2
- Domestic Savings/National Income	%	20.3		60.4	23.9	18.4	17.9	11.0
- Domestic Investment/ National Income	%	20.1		14.8	24.8	24.5	25.2	14.8
- Balance of Payment	Billion $	3.28		29.7	1.84	(-) 20.7	(-) 4.98	(-) 5.82
- Foreign Reserves/Imports	%	19.1		127.8	N.A.	32.7		
- Foreign Debt 75	Billion $				20.6	53.1	13.7	33.5
- Foreign Debt 80	Billion $				27.0	66.9	18.4	38.0

APPENDIX (2)

TABLE (2)

Sociological Indicators (WORLD BANK)

	Units	Rich Countries			Poor Countries			
		Industrial	Socialist	Petroleum	Above Average	Average	Below Average	Lower Average
- Urban Population	% of total population	73.9		20.6	52.1	48.6	27.2	15.4
- Deaths	per 1000 of population	8.7		21.7	10.3	10.1	13.4	19.6
- Deaths of Newly Born	for each 1500 births	15.4		118.2	42.4	60.8	104.5	110.6
- Average Life Span	years	72.5		45.4	63.1	59.9	52.3	45.2
- Nourishment	Calories/basic need (100 calories)	119.5		90.8	83.9	105.2	99.4	93.2
- Protein	gram/day	94.8		57.3	N.A.	62.6	54.5	59.4
- Illiteracy	% of population	1.6		82.4	33.9	41.6	75.3	82.0
- Primary Education	% of age groups	109		51.8	93.9	102.3	73.2	43.2
- Housing	person/room	0.7		1.9	1.5	2.2	2.2	2.8
- Motor Cars	motor car/100 persons	198.1		21.	43.2	11.9	7.4	2.5
- Energy Consumption	kgms.of coal/year per person	4668.2		1426.3	1555.7	630.6	252.3	60.6
- Information	kgms.of paper/year per person	20.3		0.2	2.8	2.4	0.8	0.3
- Icome of Rich*	% of national income	14		22.4	22.4	28.4	24.2	23.2
- Income of Poor*	% of national income	7		4.8	4.8	4.2	4.6	5.2
- Ratio of Rich Income to Poor		8:1		17:1	17:1	27:1	21:1	18:1

* The rich population constitute 5% of the total population. The poor population constitute 20% of the total population.

APPENDIX (3)

Table (3)

Recapitulation of Economic Indicators (WORLD BANK)

	Industrial and Petroleum Countries		Socialist Countries		Poor Countries	
	1975	1980	1975	1980	1975	1980
- Population (Millions)	695	728	1202	1291	2069	2353
- Population (% age of world total	17.52	16.65	30.31	29.53	52.17	53.82
- National Income (Billion Dollars)	3825	4846	1238	1618	959	1292
- National Income (% age of World total)	63.52	62.48	20.56	20.86	15.92	16.66
- Average per capita (Income ($)	5503	6655	1029	1253	478	549
- Balance of Payment (Billion $)	(+) 33	-	-	-	(-) 29.7	-
- Foreign Debt (Billion $)	-	-	-	-	120.8	150.3

APPENDIX 4

SOME INDICATORS FOR ASSESSING THE RELATIVE APPROPRIATENESS OF TWO TECHNOLOGIES APPLIED IN EGYPT FOR LAUNDRY SOAP SAPONIFICATION PROCESS (*)

		BATCH OPEN KETTLE	CONTINUOUS CENTRIFUGAL SYSTEMS
- Input capacity(tons of tallow + oils/year of 300 days)		14400	14237
- Actual Cap. occupied (tons/year)		12960	12999
- Cap. occupied (% of total)		90%	91.3%
- Tallow and oils used (ton)		12960	12999
- Laundry soap produced (ton)		18000	21000
- Av. output (% of raw materials)		140%	160%
- Employment Analysis			
. Total number employed		29	20
- Engineers (Univ. Degree)		-	4
- Technicians (tech. school)		1	4
- Skilled Labour (total)		4	-
. Prim School Certif.		4	-
. Read and Write		-	-
. Illiterate		-	-
- Semi Skilled (Total)		8	4
. Read and Write		8	4
. Illiterate		-	-
- Unskilled (total		16	8
. Read and write		-	8
. Illiterate		16	-
- Salaries and Wages			
- Total (Operation)	$	13785.7	10694
. Av./worker/year	$	475.4	534.7
. Av./ton of soap	$	. 765	.509
- Marketing			
. Av./ton of soap	$	.368	.315
- Overhead :			
. Av./ton of soap	$	2.581	2.211
- Utilities			
- Electricity per ton of soap	$	.274	1.143
- Steam per ton of soap	$	4.925	.571
- Water per ton of soap	$	.018	.014
- Repairs, Maintenance and Spare Parts :			
- Spare parts per ton of soap	$	.124	.185
- Repair and maintenance/ton soap	$	.728	.451
- Lubrication and greasing	$	.021	.164
- Initial cost of Equipment	$	91885	498571
- Extent of Mechanisation			
. Init.cost/number of workers	$	3168	24928
. Init.Cost/total salaries & wages		6.7	46.62
. Electric power used/number of workers		2483	10800
. Electric power used/tons of soap produced		4.0	10.28
- Productivity Norms :			
. Value of products/number of workers	$	89464	151344
. Value of products/total salaries & wages		188.2	283.
. Value of Products/Int.Cost of equipment		28.2	6.1

* **Remarks:**
- The figures in this table do not include those for soap finishing and preparation. They only cover the saponification process as stated above.
- It is to be noticed that the cost of water used in the process is exceptionally low. The reason is that this water is artisian on site.
- The large difference between the initial costs of equipment in both technologies is due to the fact that the batch open kettle technology was purchased and installed about thirty years ago.

APPENDIX 5

SOME INDICATORS FOR ASSESSING THE RELATIVE APPROPRIATENESS OF TWO TECHNOLOGIES APPLIED IN EGYPT FOR DISTILLATION OF GLYCERIN

		1	2
- Input capacity/tons of 80% glycerol/year of 300 days)		1300	2500
- Actual cap. occupier (tons/year)		1129	2160
- Cap. occupied (% of total		86.8	86.4
- 80% glycerol used (tons)		1129	2160
- Distilled glycerine produced		600	1500
- Av. Output (% of in put)		53.14%	69.49%
- Employment Analysis			
. Total number employed		13	13
. Engineers (Univ. Degree)		1	1
. Technicians (tech. School)		4	4
. Skilled labour (total)		4	4
. Prim. School Certif.		4	4
. Read & Write		-	-
. Illiterate		-	-
. Semi Skilled (Total)		4	4
. Read and Write		4	4
. Illiterate		-	-
. Unskilled (total		-	-
. Read and Write		-	-
. Illiterate		-	-
- Salaries and Wages :			
- Total (Operation)	$	8571	10000
. Av./Worker/year	$	659.3	769.2
. Av./ton of dist. glyc.	$	14.28	6.66
- Marketing			
. Av./ton of dist. glycer.	$	4.032	1.612
- Overhead			
. Av./ton of dist. glyc.	$	28.338	11.335
- Utilities			
- Electricity per ton of dis. glyc.	$	1.395	1.395
- Steam per ton of Dis. glyc.	$	7.707	7.707
- Water per ton of Dis. glyc.	$	.953	.953
- Repairs, Maintenance and Spare parts			
- Spare parts per ton of Dis.Glyc.	$	-	.341
- Repair and maintenance/ton Dis. Glyc.		5.154	1.57
- Lubrication greasing	$	-	-
- Depreciation			
- per ton of Dis. glyc.	$	3.48	18.33
- Packing			
- Per ton of Dis. glyc.	$	51.32	51.32
- Initial Cost of Equipment	$	38907	133640
- Extent of mechanisation			
. Int.cost/number of workers	$	2992	10280
. Int. cost/total salaries & wages		4.5	13.4
. Electric power used/number of workers		4509	11273
. Electric power used /tons of Dis. glyc.		97.7	97.7
- Productivity Norms :			
. Value of Products/number of workers		26374	65934
. Value of Products/total salaries & Wages		40	85.7
. Value of products/Int.Cost of Equipt.		8.8	6.4

Remarks :

- THE difference between the two technologies No.1 and No.2 in the table is that in the former the condensation of glycerine vapours takes place in condensers cooled by glycerine at temperature ranging between 130-140 °C. In the latter technology the condersation of glycerine vapour takes place in air cooled condensers.
- The figure of $ 5.154 representing repair and maintenance for technology No.1 includes spare parts per ton of output.

APPENDIX 6

SOME INDICATORS FOR ASSESSING THE RELATIVE APPROPRIATENESS OF TWO TECHNOLOGIES APPLIED IN EGYPT FOR THE PRODUCTION OF ANIMAL FEED

		Manual Mixing + Pelleting	Semi-Mech. & Pelleting
- Input capacity(tons/year of 300 days)		25000	60000
- Actual Cap.occupied(tons/year)		23621	58800
- Cap. occupied		94.4%	98%
- Raw materials used (grains,cakes..etc) ton		23621	58800
- Animal Fodder produced		23000	58391
- Av. output %		97.3	99.3
- Employment Analysis			
. Total number employed		224	51
. Engineers (Univ. Degree)		4	3
. Technicians (Tech. School)		16	12
. Skilled labour (total		44	12
. Prim. School Certif.		24	6
. Read and Write		20	6
. Illiterate		-	-
. Semi Skilled (total)		-	13
. Read and Write		-	13
. Illiterate		-	-
. Unskilled (total)		160	11
. Read and Write		-	-
. Illiterate		160	11
- Salaries and Wages			
. Total (Operation)	$	111075.7	28571.4
. Av./Worker/year	$	495.87	560.21
. Av./ton of fodder	$	4.829	.489
- Marketing			
. Av./ton of fodder	$	.09	.35
- Overhead			
. Av./ton of fodder	$	.718	.283
- Utilities			
- Electricity per ton of fodder	$	.161	.317
- Steam per ton of fodder	$	.185	.185
- Water per ton of fodder	$	.007	.007
- Repairs,Maintenance & Spare parts			
- Spare parts per ton of fodder	$	.107	.185
- Repairs and maintenance/ton/Fodder		.624	.17
- Lubrication & greasing	$	.015	.025
- Packing			
- Per ton of fodder	$	.487	.487
- Depreciation			
- Per ton of fodder		.183	.355
- Initial Cost of Equipment		44160	243197
- Extent of Mechanisation			
. Init.cost/number of workers	$	197.14	4768.56
. Init.cost/total salaries & Wages		.4	8.5
. Electric power used/number of workers		933	21765
. Electric power used /ton of fodder		9.09	19.1
- Productivity Norms			
. Value of Products/number of workers		2483	24790
. Value of Products/total salaries & Wages		3.50	30.97
. Value of Products/Init.Cost of Equipt.		8.81	3.6

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