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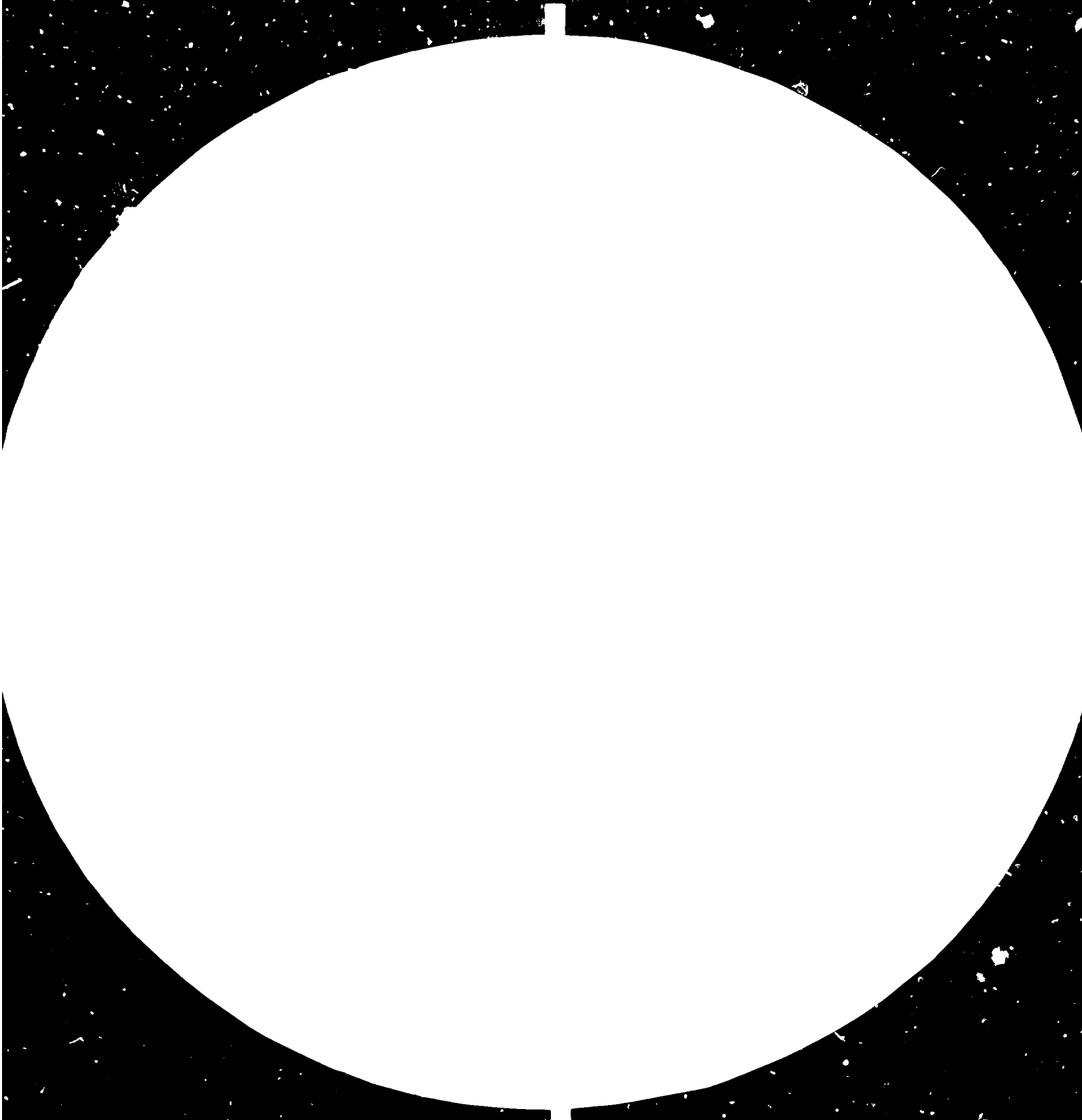

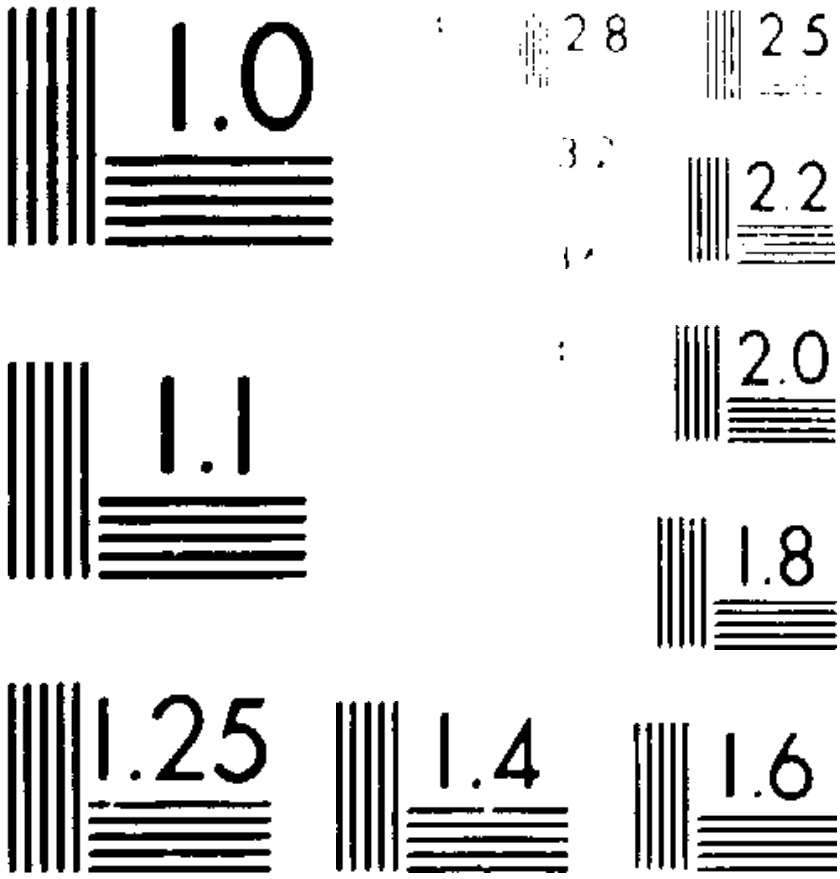
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ESTABLISHMENT OF THE ARAB REGIONAL PACKAGING CENTRE

DP/RAB/80/013

MOROCCO

Technical Report: Plastic Packages for Agricultural Products*

Prepared for the Government of Morocco
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Allen Jones,
Expert in Plastic Packages for Agricultural Products

United Nations Industrial Development Organization
Vienna

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I SUMMARY

The Moroccan Institute of Packaging (IMEC) is being developed as a platform for the Arab Regional Packaging Centre (ARPC). This report concerns plastics packaging and agricultural products within the proposed ARPC structure. The report should be related to reports on other packaging material groups and product groups. The essential requirement is a plastics packaging section within IMEC and ultimately within ARPC. Such a section will take at least two years to become defined from studies of demands and resources, and another five years to become an effective unit serving ARPC.

The priorities for such a unit are plastic tape sacks, PET to replace glass for bottles, the broad pattern of liquid packaging, LLDPE as a new material, tinplate can replacement, developments of processed foods and milk, in association with the Food Federation etc.

There will be a great need for transfer of technology, much of the transfer being inter-regional. ARPC should become organized to act as agent in the obtaining and transfer of technology.

Much more effort is required to develop training and information services. ARPC will require a special unit for techno-economic studies, and will need to contract some studies from external sources.

This report details a Unified Plan for Development, lists 45 items for consideration in the organization of ARPC and 22 items for techno-economic studies.

II TERMS OF REFERENCE

(a) Become acquainted with the structure and technical resources of the Moroccan Institute of Packaging in terms of personnel and equipment, and with the aims, plans and studies already carried out in its conversion into the Arab Regional Packaging Centre.

(b) Carry out a survey of the present situation of the packaging industry in selected countries in the region in terms of supply and demand of plastic packages for agricultural products and of available raw materials and appropriate technology for the local or regional production of the concerned plastic packages.

(c) Work out a unified plan for the development of new or existing plastic packaging industries in the selected countries in the region, aimed at achieving or substantially contributing to the national and regional self-sufficiency within the field of plastic packaging, taking into account financial, economic and social conditions involved.

(d) Ascertain the availability and need of national and regional expertise which would be required for implementation of the aforementioned unified plan, as well as the type and extension of technological support services which should be granted by the Arab Regional Packaging Centre and existing or forthcoming national packaging institutions.

(e) Give ad hoc advice on other related matters upon specific request from the General Director of the Moroccan Institute of Packaging.

III WORK PROGRAMME

The period of three months was intended to be broadly divided into an initial study of available documents, brief visits to Jordan and Iraq, followed by formulation of a unified plan. The visit to Jordan, although coinciding with national holidays, provided very useful information but entry into Iraq was not allowed by immigration officials. This report is based almost entirely on documents and conversations, not on experience outside Morocco and Jordan.

The author expresses his thanks to M. Bennouna Abdelhaq, Director General of IMEC, to Mme. Z. Zahidi, for noteworthy assistance and translation, and to the others in IMEC who provided an environment in which a beneficial report could be produced.

IV BACKGROUND

Arab countries are seeking regional development as well as national development. The intention is to develop packaging through the Arab Regional Packaging Centre (ARPC). The Moroccan Institute of Packaging (IMEC) was designated in 1973 to carry out the task of documentation pending the creation of ARPC. In 1980 a four-year programme was proposed by AIDO and approved by a meeting of Arab National Packaging Committees.

The programme concentrated on documentation/information activities, justifiably considered to be a first essential component of development.

The four-year programme was converted in August 1982 into a Project Document and subsequently into Project DP/RAB/80/013.

V PROJECT PROGRAMME

The details of the programme are stated in the Draft Project Document DP/PAB/83. Broadly, the programme is to introduce regionalisation into IMEC in the period to 1983, operate as a joint IMEC/ARPC Project through 1983 to 1985 and operate as ARPC from 1985.

In 1983 there will be inputs of finance, equipment, UNIDO experts and Arab nationals. The Arab nationals will have specified functions within ARPC and may be regarded as the permanent staff. The intended outputs concern:

- Documentation/Information:
- Training:
- Research/Testing/Design Services:
- Standardisation/Quality Control:
- Techno-Economic Studies.

The project activities are intended to concern IMEC/AIDO/UNDP/UNIDO.

The activities may be grouped as:

(a) Related to the expansion of IMEC;
(b) Implementing the ARPC work plan:
(c) Implementing UNDP assistance.

Inputs intended are:

(a) Staff from IMEC;
(b) Staff from Arab countries:
(c) Finance from Arab governments:
(d) UNDP inputs including consultants, equipment and training facilities.

For the purposes of this report, the Arab Region is understood to include countries in which Arabic is the working language.

The working language of ARPC should consequently be Arabic. Insofar that most of packaging information is in French, English, German, and Spanish, the translation services will be of high priority, particularly since the region is divided into countries where English is second language and countries where French is second language. There is a further division of countries with regard to relationship with EEC, which is a significant export market and will have influence on packaging development.

The work plan for ARPC has yet to be detailed. This report is based on the Draft Project Document, and is concerned with Plastics Packaging and Agricultural Products. It is appreciated that it is not possible to isolate plastics from other material groups or agricultural products from other product groups.

VI COMMENT ON FINAL DRAFT PROJECT DOCUMENT

It is appreciated that the Project Document and consequent work plan must be formulated according to probable human and fiscal resources. The following comments are related to plastics packaging and agriculture:

(a) Concerning the projects so far accomplished by IMEC the only listed item of plastics interest is an evaluation of metal and plastics strapping for pallets in 1980. Since then informed opinion is that increasing costs and depletion of supplies of wood make it essential to find alternatives to conventional wooden pallets, particularly in regions which have to import wood, and particularly for exports in which the use of wooden pallets is export of valuable resources.

(b) The extended laboratory services include flexible materials, which presumably cover both paper and plastics. There is no declared intention with regard to retail plastic packages, sack packaging or specific rigid plastics replacements for tinplate cans and bottles of glass. The programme of research includes testing of high barrier multi-layer plastic films (1986) and substitution of packaging materials (1986). It does not include research into the use of common single-layer plastic films, which have very high significance in economics and food conservation.

(c) Under standardisation there is no mention of standardised processing units, such as a fully-detailed tape sack production unit. Progress in the region will be accelerated by the provision of Project Specifications to be used in technology transfer and development.

(d) In the Applied Research Activities there is regard for substitution of PP for cellophane, PS versus PVC, glass versus plastics, plastics versus tinplate, although these are not covered by the extended laboratory services (see (b)). The substitution of natural fibres in sacks is not included.

(e) Under techno-economic studies the establishment of the data bank is not a techno-economic study but is a straightforward part of information service development. The requirements for techno-economic studies related to plastics and agriculture have been listed in this report, including studies of allied subjects which have significant influence on plastics development, such as small-scale can production,

coated particle board and pulp moulding. The Project Document also mentions a pilot plant activity which could cost more than half the total budget - and for plastics could be ineffective if the installed equipment differs from production equipment.

..... End of Unified Plan.

There is a further complication in that France continues to maintain the individual relationships with North Africa. Mainly the protection results in restrictions of imports when domestic supplies are available to self-sufficiency, and control of import prices. Thus with regard to fresh products the market concession is restricted to seasons, for examples, tomatoes 15 November to 30 April and potatoes 1 January to 31 March with extension to 15 April at a higher tariff. When the EEC domestic seasons provide self-sufficiency, particularly with import-price control, the profitability of imports from the Arab region will be low.

The major problem is that scientific agriculture is constantly extending the EEC seasons and improving EEC yields and qualities. It must be appreciated that the EEC policy is to develop self-sufficiency by all possible means and in many products this has already led to over-supply. This is evidenced by the history of wine imports.

Furthermore, there have been significant advances in EEC use of methods of extending shelf lives. The Arab region must regard the EEC market as one in which there will be reduced demand for some important agricultural products, and in which the profitable periods for imports will become shorter.

In general the Draft Project Document does not appear to take into account the individuality of plastics insofar that product performance (strength, stiffness, barrier performance, durability, clarity, etc.) depends on the visco-elastic flow as it occurs when a specific grade or blend of polymer is processed on a specific machine. For other materials it is possible to simulate production on laboratory or pilot equipment, but not for plastics.

VII RELATIONSHIP WITH EEC

The relationship of the Arab region to EEC needs to be fully understood by ARPC, which should establish close contact with the EEC office at 4 rue Jaafar As Sadik, BP 1302, Rabat-Agdal, tel. 742.95.

EEC issue marketing reports for Egypt, Jordan, Syria, Lebanon, Tunisia, Algeria and Morocco. These reports have value since they are written from the point of view of EEC, as a trading partner and an origin of assistance.

Morocco, Tunisia and Algeria are favoured nations with somewhat complex concessions of duty and of packaging materials. These concessions are variable and it is suggested that one of the first items of information to be processed by ARPC is the current statement of concessions, with constant revision as advised through EEC Rabat office.

With regard to agricultural products there are problems. EEC is about 45 per cent deficient in the supply of citrus from domestic production, and imports from the Arab region may be expected to continue with little complication. Likewise, EEC is about 65 per cent deficient in olive oil, but there are some complications in which unrefined oil is differentiated from refined oil. The major problems arise in trade in agricultural fresh products as supplied by EEC farmers who are protected by the CAP regulations of EEC.

VIII UNIFIED PLAN FOR DEVELOPMENT

The stated aim of a plan is to achieve national and regional self-sufficiency. This aim may be misunderstood, partly because there are language problems and partly because the term "self-sufficiency" is emotive and is frequently used in the sense of "independent". It is a fact of the times that no nation or region can develop and maintain a satisfactory level of welfare without international trade, or without appropriate use of domestic resources.

In its correct translation "self-sufficiency" in any sector means finding domestic resources and using sufficient of such resources to satisfy the needs of self. In appropriate development the resources are found and used to the maximum extent in application where they produce most benefit. The maximum extent of use is that which does not deplete the resources beyond the period of natural recovery, or does not deplete the resources to a point where further extraction would be prohibitively difficult. There are two essential directions of use of resources:

(a) To directly contribute to national health, wealth, comfort and culture, at less cost than by using some alternative resources.

(b) To export as exchange for some foreign resources which as imports have less cost than national resources, or are resources which the exporter does not have.

In effect, the first essential phase of development is a study of resources and a consequent statement of:

(a) For each resource the rate of maximum extent of use without environmental damage, as the resource exists and also if the availability of the resource was to be deliberately increased.

(b) For each resource the use or uses which bring most benefits in terms of economic, social and cultural welfare.

The Arab region is understood to include countries which use the Arabic language as a first language. Due to the migratory and trading activities of early Arabic speakers the region is a mixture of differing countries, each of which has an individual pattern of resources (labour, skills, energy, water, fossil materials, renewable agricultural and marine products, etc.).

Where they exist, statistics are not always available as reliable documents, and it is doubted that many potential resources (other than oil) have been quantified.

The first step towards a plan is consequently for each country to appoint a researcher to prepare a statement of actual and potential resources.

The logical approach to a unified plan is to assess:

(a) Background services such as information and technical backing.

(b) Establishment of priorities.

(c) Quantity analysis.

(d) Determination of location of production facilities.

(e) Standardisation of technology amongst the facilities.

The statement of background services requirement has been made. Broadly, they coincide with the intentions of IMEC expansion of services, but there are points of further development to consider. Previous experience by this expert suggests that information services must be in the common language Arabic, that the mechanics of processing enquiries and requests must be detailed, and that a special unit for techno-economic studies should be organized. Also, it is suspected that the translation services should be greatly increased. Obviously, the IMEC services will depend on the availability of capable workers and it is not possible at this time to say exactly what can be done.

A. BACKGROUND SERVICES

1. Education and Training

IMEC, as the formative body for ARPC, has developed extensive plans for education and training. The following details of a course and workshops are intended to fit into such plans. Symposia have not been detailed because the subjects are obvious from the text of this report. It is beneficial to detail courses and workshops because the aim in such meetings must be to confine subject matter to information which can be used, and to limit inputs of information so that students may know more about appropriate subjects without the confusion of trying to absorb information of general interest but of little immediate application. Experience by this expert elsewhere had indicated that:

(a) No student can concentrate on a lecture in a language other than his/her own for more than ten minutes, and in general is less prepared to accept information from a foreigner.

(b) No student can concentrate on any speaker for more than half an hour.

(c) Learning is most effective by personal involvement in discussions and by practical use of the information in personal effort, such as in the production of a personal written document as part of the training.

(d) Courses should be limited to no more than ten students and they should have the common interest of the subject. Workshops should be similarly limited but should have a wider range of interests, bringing together technology, production, distribution and trade.

(e) Students should be provided with pre-printed documentation.

(f) Students should have some form of certification of attendance.

(g) Every occasion should be initiated by an informal gathering and each student should have a name-badge and a list of students.

2. Plastics Packaging Training Course

Plastics compared against other materials - all students.

Plastics advantages and weaknesses. Differences with metal, glass, paper, fibres.

Influence of conversion conditions on package performance.

(5 hours education by lectures, issue pre-print general notes) (split into groups as under):

Economists and Planners	Technologists
Concept of appropriate technology -	Thermal and chemical considerations in processing
Cost benefit related to economics based only on money	Visco-elastic flow and strain and cold-drawing
Costs of using plastics	Property development - strength stiffness, barrier, chemical requirements of performance of plastics
Benefits of using plastics	
Relationship of plastics to resource exploitation	
Markets -	
Based on waterproofing properties	Polyolefines
Based on ability to use plastics for variable scales of output	PVC
Based on ability to design in many shapes and sizes	Polystyrenes
Regional demands existing and potential	High temperature plastics
	Modification of materials and blending

Workshop -

Each student to prepare a one-page answer to the question "Why use plastics"

Group discussion with each student relating what he/she has learned to his/her country situation.

Conversion techniques -
Extrusion
Film production
Blowing
Thermoforming
Injection

Group discussion on the subject "How plastics differ in conversion and package performance to other material groups".
(4 days)

(bring the groups together)

Tour of IMEC and lecture on IMEC facilities and system of service. Work visits to metal, glass, paper and plastics factories (1 day).

Collective discussion on the subject of "How and where will plastics packaging develop in the region. What else is required by the region to accelerate development" (1 day).

Total 7 days, split as 4 days one week followed by weekend before 3 days of the following week for group discussion as divided, tours of IMEC and factories, and final collective discussion.

Each student to send in due course a statement of his/her opinion of the value of the course and how future courses may be improved

Each student presented with a certificate of attendance.

Provision for each student to delay departure for detailed discussions in ARPC, to request information and services.

3. Occasional Workshops

Workshops are meetings in which students exchange experience and opinions. Preferably the students should have been through the training course but this may not always be possible. Consequently there is an optimal initial general lecture based on the subject matter of the course. The subjects must be specific.

(a) Making technology appropriate.

Suiting performances of packages to needs, maximising resource utilisation, adjusting scales of output, relating plastics package production to other plastics production.

(b) Reducing plastics packaging costs.

Economy by design, relating outputs to factory costs, standardisation of techniques and packages, specialised production for regional distribution.

(c) Plastics packaging contributions to health, wealth, comfort and culture, and conversely damage by plastics packaging to economic and social welfare.

(d) Re-use, recycling and disposal.

Re-use in return journey distribution, re-use for other applications outside packaging, second-hand applications. Recycling and disposal in terms of material content, use of incineration for energy and pyrolysation for distillation products.

(e) Specific product workshops.

Sacks, bottles, films, thermoformings, injection mouldings.

High barrier plastics packaging.

High temperature plastic packages.

Large blown containers.

Bag-in-box.

(f) Specific material workshops - problems in using specific materials LLDPE. LDPE, HDPE, PP, PVC, Polystyrenes, multi-layer films.

(g) Specific equipment/process workshops.

Extruders, blowing units, film lines, injection machines; tape stretching, film stretching, thermoforming.

A workshop should be two days - preferably as one afternoon followed by a night for students to privately discuss, and a following morning. Each workshop should produce a statement of collective realisation, formulated by a short terminal discussion and agreement of broad terms of future policy and action.

B. PLAN PRIORITIES

The priorities have been listed under the heading of techno-economic studies. The list includes not only plastics/agricultural subjects but also subjects which have direct influence on plastics and agriculture. Priorities are selected on the basis that the region lacks water and arable land, that there is actual production of oil-derived polymers, and marginal land which could provide fibres and carbohydrates for bio-mass alcohol and hence polymers.

The common factors in priorities are:

1. Tinplate can replacement;
2. Glass bottle replacement;
3. Tape sacks;
4. The handling of liquids.

1. Can Replacement

The possibilities to examine are flexible sterilisable packs and rigid sterilisable packs. In a study the major products of interest are carbonated drinks and processed foods. For both product groups there is sufficient information for a study to be mainly from literature. Such study will inevitably initiate a development of PET polyester bottles, probably in-plant where the carbonated drinks are produced (see below "Handling of Liquids"). For processed foods the packaging of interest is in flexible film or laminate (including PE-coated aluminium foil) as pouches or chub packs. For pouches it is reasonable to use a central source of supply of reeled film or laminate and it is preferable not to use in-plant packaging - so that the technology of production may be concentrated and the producer of processed food may better use his resources for the significant problems of control of infections. There are already plans to develop high-temperature films and laminates in the region. ARPC will not have the facilities for dealing with food processing technology, and should not be directly concerned because most of the problems of food processing relate to the production environment - and should therefore be solved where the food is processed. The contribution of ARPC should be confined to the supply of information including testing of packages and the formulation of guidelines of raw material selection and thicknesses and welding techniques.

Developments of rigid plastics alternatives to cans have been inhibited by the cost factors in the development areas where the economics of can usage do not resemble those in the region. It is necessary, as a first stage, for ARPC to analyse the regional cost factors, then to design a common regional pack probably based on polypropylene and aluminium or a PE/PET/PE laminate. These comments do not remove the need of the region to study small-scale can production, which will probably be included in some other report.

2. Glass Bottle Replacement

In can replacement there exists the information and foreign experience for a study to be mainly from available information. For glass bottle replacement the important event was the development of PET for carbonated liquids. The initial development of PET concerned cola drinks, the advantage of PET being that lightweight bottles could be used for up to two litre units without danger if the bottles were dropped. Literature as late as 1981 included opinion that beer could not be put into PET, but beer in PET is now commonly available in Europe. It is suggested that ARPC begin the study of glass bottle replacement by a market study of the supply of two litre non-alcoholic drink units and the supply of half litre beer bottles. Literature advises that PET-used bottles may be recycled for polyester fibres, although such advice should be regarded with suspicion until proved. It cannot be ignored that glass is easy to recycle.

3. Tape Sacks

In world trade, tape sacks replaced natural fibre sacks on the basis that a tape sack offers similar performance at one-third the weight and half the cost of jute sacks. Obviously, both the weight and cost depend on local factors but the inference is that the region should use tape sacks instead of fibre sacks where possible. The normal pattern of sack usage is to use new sacks for flour and sugar, then to pass the sacks through a chain of application of used sacks - for example, whole grain then mineral products and on to low-value products such as wood-flour or charcoal. The region may be expected to develop its own chains of applications.

One may save time and cost by estimating total sack demand by looking only at cereal flour and sugar, and allowing the markets to develop their own patterns of application. The total regional demand is for 1,400 million sacks for flour and 440 million sacks for sugar. A production unit should be rated at 3 to 5 million sacks, so the requirement is for about 400 production units. Such a scale of manufacture will obviously be inhibited by the available capital and technology.

Tape sack manufacture may start from any stage in the process of - polymer extrusion, slitting and stretching, weaving, seam sewing.

Thus a factory may start with:

(a) Polymer (HDPE or PP) for film extrusion; or
(b) Extruded film for slitting and stretching; or
(c) Wound tape; or
(d) Woven fabric.

There are some complications. For some looms one may slit stretched film on the loom during weaving. Weaving may be on circular looms or flatbed looms, producing either tubular fabric or flat fabric. Tape may be wound flat on the reel or twisted on the reel.

The information which is required from a study may be listed as:

(a) Locations of sack units;

(b) Number of sack units for each location;

(c) Circular looms or flatbed looms (or both in one factory);

(d) Material supply to the looms - stretched warp sheet, flat-wound or twisted tape;

(e) Form of material supplied to the factory - polymer, film or tape;

(f) Whether it is logical for the weaver to make the sacks or to supply fabric to some sack-sewing facility;

(g) To have a standard sack for the region or to allow flexibility of dimensions:

(h) Whether it is logical for a sack facility to supply sacks with sewn-in liners;

(i) If it is possible, to detail a standard sack production unit with full information about materials, plant, technology and costs.

4. Liquids

The division of liquids is into:

(a) Carbonated drinks;
(b) Non-carbonated drinks;
(c) Chemicals including household chemicals;
(d) Edible oils;
(e) Sauces;
(f) Milk as a special case;
(g) Drinking water as a special case.

As already said, carbonated drinks should be directed into PET bottles. In the region there is already widespread experience of non-carbonated drinks and PE or PVC bottles. It is said that there are problems of closure, but this is incidental and presumably a subject which ARPC will examine. In general, PVC offers clarity so that the purchaser may see the product, but clarity allows damage to the product by ultraviolet light (for example, vitamin C destruction and off-flavour development in orange juice). PE bottles are easier to produce using straight-line extruders, and allow more parison control (parison control is the adjustment of parison wall dimensions to allow variations of bottle wall dimensions).

For many chemicals it is useful to have a squeeze bottle, which is easier in PE than in PVC. Edible oils are usually in PVC to allow purchasers to see that the oil is not cloudy. For sauces it is preferable to use PE but PVC is frequently used. Milk and water are treated as special cases within this report.

The movement of liquids may be as:

(a) Retail packs, as discussed above; or
(b) Semi-bulk.

Information required from a study may be listed as:

(a) Division of the market into types of liquids by quantities and locations and condition of purchase or use;

(b) The relative advantage of PE or PVC for selected priority products.

(c) The patterns of distrit ..vision into retail packs and semi-bulk packs as - bag-in-box (bag-in-box is a film bag ..ually corrugated paperboards).

C. QUANTITY ANALYSIS

The apparent regional consumptions are of the orders of:

(thousand tons)

Cereals	42,353	Meat	2,518	Wine	72
Fresh vegetables	18,000	Poultry	820	Eggs	600
Fruit	10,000	Fish	1,074	Beer	3,000 (more than 3,000
Sugar	11,000	Tomatoes	5,000		
Milk	8,000	Grapes	1,623		
Vegetable oils	5,500	Citrus	2,819		

Such statistics serve only to establish priorities. It is not known what proportions of each product are processed, are not packaged, or are supplied as retail packs or semi-bulk packs. Also, in agriculture it is not possible to be accurate in statistics of consumption because much of local consumption is not recorded.

Furthermore, even the establishment of priorities requires more than statistics of consumption. For example, wine is apparently of low priority at 72,000 tons but it is a high value export to 240,000 tons (increasing) so the packaging priority is high - for bottles or semi-bulk. The tomato/grapes/citrus group of fruit is exported to more than 1.5 million tons, and deserves some priority as the significant products in export pack development for fresh vegetation.

The maximum plastics packaging requirements could be:

Cereals and sugar - 1.840 million tape sacks from 600,000 tons HDPE or PP.
6.200 million retail bags using 28,000 tons PE film.

Fresh fruit/vegetables - Export interlayers using 200 tons PVC.
5.600 million net bags using 112,000 tons PE.

Milk - 16.000 million cartons from 432,000 tons coated paperboard or bottles from 480,000 tons blended LDPE/HDPE
(unit weights increased above normal to allow for rough journeys).

Vegetable oils - 11 million bottles from 275 tons PVC.

Meat and poultry - 82 million bags from 820 tons HDPE or PE/PA films.

Wine and beer - 3.072 million bottles from 76,800 tons PET.

Plus packaging for the vital products of water, non-alcoholic drinks and various liquids, and processed foods - for which regional consumption statistics have not been obtained.

The only significant listed regional agricultural exports other than fruit/vegetables (included above) are 241,000 tons wine and 103,000 tons vegetable oils, which add 7,230 tons PVC bottles (subject to market acceptance) and 3,090 tons PVC bottles (already accepted in the export markets) - both of which would be greatly reduced by unbottled shipment.

With regard to regional domestic consumption and exports the provisional estimate is 1.2 million tons polyolefines, 11,000 tons PVC, 78,000 tons PET, plus unaccounted PE, PVC and PET for water, non-alcoholic drinks, various liquids and processed foods.

This is an ultimate target which presumes saturation of the apparent existing market demand, which has two components:

(a) Equalisation of demand throughout the region;

(b) Improvements above the equalised demand.

The forecasts for plastics conversion per capita in 1985 are:

Iraq	8.0 kg/y	Algeria	10.6 kg/y
Qatar	16.0	Tunisia	6.4
Bahrain	14.0	Syria	11.0
Kuwait	19.5	Jordan	16.0
Sudan	0.8	Morocco	2.3

These available statistics cover only half the countries of the region. They average at 10.5 kg/capita for a population of about 108 million. If all are brought up to a common level of 19.5 kg/capita, and if we presume that 25 per cent of the plastics is for packaging, the extra packaging conversion capacity would be about a quarter million tons, possibly half a million tons if all countries were included. Equalisation requires much more than the provision of extra conversion capacity, and it may be doubted that it will be rapid. Equalisation demands may be met from within the region by transfer of technology.

Unfortunately in this report, it is not possible to analyse the existing forms of conversion, but for examples:

Morocco has the technology of PVC water bottles;
Jordan has the technology of stretched tape sacks;
Saudi Arabia has the technology of polyolefine production;
Tunisia has the technology of injection moulding;
etc.

Improvement demands (increasing all levels) are best met by the introduction of new technology such as the introduction of LLDPE by Saudi Arabia and the development of PET. This concerns about 1.28 million tons as a maximum not counting the packaging for unaccountable products. Such technology may arise within the region or may be obtained from elsewhere (according to the levels of development of conversion within the region).

D. LOCATION OF CONVERSION FACILITIES

In theory the location of a conversion facility should be where the product is grown or manufactured. Hence, it should be in-plant if a producer has sufficient product to justify in-plant package manufacture. The problem then is that expansion is inhibited because the producer manufactures packaging only to his own requirement.

Preferably, packaging manufacture should be specialised, serving the product suppliers within easy reach and expanding to meet demands. The subject is far too wide for treatment in a short-term assignment. It requires study of:

(a) Urbanisation - which influences returnability and the characters of retail outlets.

(b) Income groups - which influence the location of high or low package-using industries, and the feasibility of specific package introduction.

(c) Distances, quality of transport and cost of transport.

(d) Area prejudices and preferences - for example attitude to alcoholic drinks or fresh milk or processed cheese.

(e) Transportability of packages - for example carrying empty bottles to fillers is expensive but carrying reeled film is less expensive.

The first three factors are left for ARPC to study but it is possible to indicate transportability to some extent. Sacks and films are transportable at reasonable cost, so the location within a country is less important and it should be possible to organize inter-country traffic. Empty bottles are 97 per cent air when transported and should be within easy reach of the products (the estimate for tinplate cans is not more than 50 kilometers).

E. STANDARDIZATION OF CONVERSION FACILITIES

In theory each conversion facility has a minimum scale of output to be economic.

In fact, there has been sufficient development of reduced scale conversion for most of the academic minimum scales to be ignored. One advantage of plastics is the ability to scale outputs to demands and expand as required. For the priority conversion facilities, it would be useful for ARPC to formulate standard units which will be required in sufficient number. Potential producers will require full details of the economics, materials, plant and conversion technology. The indicated priorities are:

(a) Tape sack factories rated at five million;

(b) PE blowing factories rated at about 500 tons/year;

(c) PVC blowing factories also rated at 500 tons/year;

This would:

(a) Save a very large sum of money which would otherwise be spent by potential producers;

(b) Make it easier to solve problems, exchange ideas, and to develop;

(c) Avoid the purchase of inferior materials and equipment, or being misled by inaccurate claims or suspect contracts;

(d) Facilitate regional production of spare parts and moulds (and in due course production of equipment within the region).

The Unified Plan may be summarised as:

(a) Establish Arabic as the language of all the background from ARPC as quickly as possible.

(b) Accept the priorities as can replacement, glass replacement, sacks and liquid packaging.

(c) As a platform for further study, accept an equalisation demand of about half a million tons (plus packaging for unaccounted products) and one million tons for improvement dema..'.

(d) Consider the equalisation demand as a subject for technology transfer within the region. Consider the improvement demand as a subject for partly regional and partly non-regional technology transfer.

(e) Study in detail the factors of location of facilities and issue guidelines.

(f) Formulate detailed standard units of conversion, starting with tape sacks, blown PE and blown PVC bottles.

(g) Accept that this plan for regional development is restricted to plastics and agriculture. It needs to be related to plans for plastics and other product groups (notably phosphates and fertilisers) and to other packaging for agriculture (notably paperboard and wood). It would be ineffective and uneconomic to have a regional plan restricted to one packaging material group and one product group.

F. TECHNO-ECONOMIC STUDIES REQUIRED

When the necessary skilled staff have been organised ARPC should set up a techno-economic study group comprising one co-ordinator, two or three researchers, and a translator who is specific to the techno-economic unit.

Subjects for study include:

(a) Alternative to tinplate cans.

(b) Small and medium scale production of cans, including possible regional breaking of scrap steel, arc furnace remelting, reduced-scale rolling, dip-coating and regional supply of reeled plate or blanks.

(c) Particle boards, possibly with plastics coating, to replace wood.

(d) Raw materials for sacks, including stretched olefine tape but also existing or potential natural fibres.

(e) Re-use and recycling.

(f) The fermentation route to olefines.

(g) Non-wood fibres for paper and the contribution of plastic binders and wet-strength agents.

(h) Alternatives to glass bottles.

(i) Linear low density polyethylene in packaging.

(j) PET (polyester) bottles for carbonated liquids and in the replacement of tinplate.

(k) The appropriate distribution of standard production units for tape sacks.

(l) Losses in fresh fruit/vegetables in terms of location of loss and methods of control - thereby determination of the possible contribution of improved packaging.

(m) Milk handling in terms of conditions of production, processing and packaging.

(n) Squeeze tubes and chub packs for semi-solids including protein foods, vegetables including tomato paste.

(o) Egg packaging in moulded pulp, and the issue of details of small-scale pulp moulding.

(p) Primary cuts of fresh meat in vacuum or shrink film packs.

(q) PVC and polyethylene bottles, bag-in-box and bulk shipment systems for non-carbonated liquids including wine.

(r) Returnability of packages.

(s) Packaging systems for dehydrated foods.

(t) Packaging of frozen foods.

(u) Returnable containers for school meals and similar institutional food.

(v) Packaging of drinking water.

Any one of the above could be a three man-month study. It is the duty of ARPC to establish a priority list according to the availability of skilled workers and the extent of co-operation possible through international agencies.

G. COUNTRIES LISTED FOR POTENTIAL TECHNOLOGY TRANSFER

	Population Million		Forecast 1985 Plastics Conversion Per Capita	Comments
Syria	8.5		11 kg	More than 150 conversion factories. Injection moulding dominates. Output varied but includes tape sacks.
Tunisia	6.25		6.4	More than 120 conversion factories, many large. In 1985 half the material will be PE. 1985 forecast is 40,000 tons/y plastics of which 12,400 will be packaging
Algeria	18		10.6	PVC produced 25,000 tons/y for the home market, using domestic monomer. Ethylene produced to 100,000 t/y, half for export and half converted to LDPE. 1985 forecast PVC and LDPE both to 70,000 t/y. HDPE forecasted to 37,000 t/y with one project for 40,000 t/y on stream 1985.
Sudan	25		0.8	1980 production included 2,200 tons LDPE for packaging, 800 tons LDPE for bottles, 2,000 tons HDPE for crates, 2,000 tons PVC for bottles, 700 tons PP for sacks.
Kuwait	1.25 (half foreign workers)		19	Many imports from Asia. Has 20 conversion factories. 1,750 tons PP for sacks and some bottles. Produces 350,000 t/y ethylene and 320,000 t/y styrene. Also produces 130,000 t/y LDPE.
Bahrain	0.35	8	14	Produce 1,500 t/y film, 750 t/y crates and jerrycans, 100 t/y disposable cups.
Qatar	0.25		16	Production is 800 t/y LDPE film, 200 t/y disposable cups. Also ethylene to 140,000 t/y, the LDPE being sold by Chemie de France. Plans to produce 70,000 t/y HDPE by 1983.
Iraq	16		8	400 factories converting most polymers to thin and thick film, sacks, cups, crates, plans for 60,000 t/y LDPE, 30,000 t/y HDPE, 60,000 t/y PVC.

(This table indicates some of the potential technology transfer possible within the region. It needs expansion to cover the other 12 countries.)

IX NOTES ON COUNTRIES AND REGION

To be fully effective this section should be repeated using an Arabic-speaking researcher sent to spend at least one week in each country. It has been possible to obtain reasonable information on Morocco, Jordan and Saudi Arabia, plus limited information on eight other countries. The region may be divided into an eastern end which includes countries rich in oil but poor in agriculture, and a western end. The major difference is in trade patterns, the eastern end having a proximate market in Arab countries whilst the western end has historic links which encourage trade with Europe. It would be reasonable to suggest preferable trading facilities within the region (including trade in polymers), although this could disturb relationships with EEC. It would also be reasonable to suggest regional standards, but such standards would have to be appropriate to the region, not carbon copies of standards formulated for countries dominated by supermarket retailing, and in which much of the legislation is suspect in value and could be inhibitive to progress if adopted for Arab countries. During the period much literature was obtained in Arabic, and isolated items of information were extracted. This Arabic literature contains much more valuable information and has been left for ARPC to expand this section and to correct any involuntary mistakes.

Brief information on the eight countries other than Morocco, Jordan and Saudi Arabia has been tabulated at the end of the section on Unified Plan.

A. REGION

The establishment of the region is justified by the spread of Islam and the consequent common language Arabic. The history includes colonialisation and long-distance trade, resulting in a broad split of cultures and languages into French and English orientation, with links to Asiatic countries and the middle belt of Africa. Other than a minor length of Atlantic there is protected coastline and consequently developed marine communication. For the most part, overland traffic includes rough handling. The mechanical hazards of port-handling and rough overland handling encourage the use of sacks, baskets and wooden boxes, but the region lacks arable land for natural fibres and wood. Where sophisticated handling has been developed

there is use of paperboard, but not all routes have sophisticated handling. Thus, a recognised aim in packaging is to find alternatives to fibres and wood, and also to extend production of fibres on marginal land. For example, Morocco has four million hectares of forests, plus plans for another four million hectares of eucalyptus trees, and 2.4 million hectares of alfa. But firewood takes six million cubic metres of wood per year, the eucalyptus is intended for alcohol production, and the alfa could provide 16,000 t/y of dry fuel for electricity production. Although the domestic production of packaging fibres and wood is attractive, one must accept that packaging is only one outlet for cellulosic products, and that alternatives used may be more appropriate.

Insofar that part of the region has oil, oil-derived polymers are encouraged for packaging development. It is possible that within ten years there will be active development of biomass-derived polymers as a second stage following the production of fuel alcohol. Total regional demand is more than 2 million tons/year of plastics for packaging, and more for agriculture and construction. The emphasis is inevitably on polyolefines, as the easiest polymers to produce from oil and the most versatile group of polymers in development. This report has the unreliable statistics that oil-based polyolefines by 1985 will be produced in the region to 1.5 million tons, of which perhaps only half will be for packaging. If so, much of the plastics packaging must rely on imports for two-thirds of its polyolefine packaging for probably the next ten years. Much the same may be said of PVC, although PVC developments will be more oriented to construction and water control. It may also be said of polystyrene, which competes against PVC in some packaging.

The situation suggests that ARPC services must be oriented in the directions of liaison between Arab countries, and liaison between the region and the rest of the world. The major constraint is recognised as translation into a common language and standard understanding of which words to use. The problem is both internal and external - for example, tape for sacks is internally known as raffia (which is a grass), and externally there is confusion in the description of paperboard packages (cartons, cases, boxes). A dictionary of terms is already being produced.

Much of the conversion capacity is reported to be under-used, for many reasons. This could be a good fault insofar that it allows expansion without the purchase of extra plant. The requirements for more capacity may be split into two parts of:

(a) For meeting equalisation demand - bringing all countries to a common level of domestic consumption.

(b) For improvement demands - bringing the region to a common higher level of domestic consumption.

The extra capacity may consequently be from within the region or from external sources, as detailed in the section on Unified Plan.

Agriculture in the region suffers from shortages of water, and is consequently unable to meet domestic requirements of food. This favours dry land crops, so it affects not only yield but the patterns of output. There is historic trade in agricultural products to other regions, but it is doubted that there will be significant expansion of this trade as world competition increases and importers use scientific agriculture to reduce their imports. Consequently the emphasis in packaging for agricultural products must be mainly in the domestic markets. The competition in world trade also affects inter-regional traffic in food (this expert has been actively engaged in at least three countries in the possible food trade with the Gulf).

B. MOROCCO

Morocco has an exposed coastline, a large fertile plain and a range of high mountains. West of the mountains it is humid, and east of the mountains it is dry. The major climatic problem is the variability of the rains provided by the Atlantic, and not only in quantity but also in timing. As a consequence the agricultural output varies in quantity and quality. To some extent this inhibits the development of export markets in the face of competition from countries with more reliable climates.

The pattern of agriculture is mixed but with a small number of crops dominant.

In rounded numbers the production pattern is:

Cereals - 2 to 5 million tons according to the rains, including hard and soft wheat, barley and maize with minor contributions of canary grass, oats, sorghum and some others.

Horticultural Crops - probably 300,000 tons of which 150,000 tons may be exported. Tomatoes dominate at more than 200,000 tons but there could be up to 70,000 tons of legumes and up to 50,000 tons of potatoes, plus minor contribution of most crops possible in Mediterranean climates. The statistics are confused by the inability to be accurate in any fragmented agriculture, by the fact that some quantities are passed into storage and by the climatic variation.

Oilseeds - about 30,000 tons as one-third sunflower and two-thirds groundnuts.

Sugar Sources - about 2 million tons beet and 600,000 tons can.

Citrus - a variable one million tons of which 700,000 tons is exported.

There are also unrecorded other tree crops of which olives, almonds and dates are important. There are also grapes, eaten fresh but also used for nearly half a million hectalitres of wine. There is a project to grow tea.

From the packaging point of view the production pattern may be regarded as presently about 5 million tons of stored granular crops plus half a million tons of fresh vegetation of which there is a significant export fraction. There is also half a million tons of domestic sugar and half a million tons of imported sugar. One must also include any repackaged imports which enter into distribution.

The first reaction is that Moroccan agriculture could use sack production to 200 million, which means 80,000 tons of polypropylene or HDPE, or a quarter million tons of natural fibre. It could also use paperboard to 10,000 tons or the equivalent in other materials for fresh product packaging. This is, however, no more than a platform for modification. A major consideration is the replacement of wood and there has been significant development of alfa board based on a grass.

The Moroccan retail distribution system does not have, or need, large supermarkets. Most of trade is through small multiple-product shops. Fresh fruit and vegetables are selected by the purchaser from open display, and there seems to be very little unsold residue. There is no apparent justification for prepackaged retail packs for fresh fruit and vegetables. In fact, the introduction of such packs could increase losses, increase retail prices and reduce trading efficiency. The only requirement is polyethylene bags available in retail stores for filling by the purchaser (as exist).

Much the same may be said of nuts and other dehydrated products, although there could be some justification for prepacking for convenience of sale, using polyethylene and bags. Perforated film bags would reduce some losses. There is justification for prepackaging perishable processed foods, such as cooked meat or cheese. Many of these are protein-rich and their decay is mostly invisible and lethal (botulinum, salmonella, etc.) - unlike in fresh fruit/vegetables where decay is mainly visible rot which is not dangerous. Prepackaging cooked meat, cheese and the like could use welded HDPE film as is presently made into retail bags. There is no reason to use more expensive films or laminates.

There is examination of "Teal" fibre, available wild to about 200t/y. This is evidently a sisal type fibre which is rurally used for nets and ropes.

It is more important that Morocco should seek domestic paper-making fibres than domestic sacking. Much of future prosperity depends on recovery and improvement of agricultural export earrings. Most of the traders in agricultural products have accepted paperboard as the logical replacement for wooden boxes. To satisfy the market requirements and to be competitively economic, it is now essential that any country exporting agricultural products considers domestic fibres for paper production. Furthermore, in developments of domestic packaging the currently growing sector is coated paperboard, wax or polyethylene coating for untreated or pasteurised liquids, and PET coating for sterilised products.

Whilst the demand for paper sacks is expected to fall in favour of plastics and bulking, the demand for corrugated paperboard is expected to increase. Some years ago the conviction was that only pulp from softwood was satisfactory for paper for corrugated, although recycled paper could be accepted for the fluting. It is now evident that fibres other than softwood will provide papers which may in fact be superior to softwood paper, and that the economic route of paper production is by using non-wood fibres - mainly grasses including bagasse, bamboo, cereal straw, or reeds but also including non-grasses such as sisal or forest trimmings. At present Morocco produces paper from eucalyptus and recycled waste. It would be beneficial if a project started to develop other fibres for dilution of the eucalyptus pulp or for the production of alternative pulp for coated board.

Plastics processing is relatively new to Morocco and about half of it is packaging. Ethylene is imported and converted to PVC but otherwise polymers are imported. The converting industry is diversified and amongst many small firms, mainly concentrated near Casablanca.

Although such a fragmented industry has its problems, it is a useful platform for the introduction of innovations, and it provides the flexibility required for sales development. On the other hand there are certain major items of plastics packaging which require mass production and concentrated capital/technology.

Morocco has, in rounded figures, capacity for metal packaging to 63,000 t/y but only uses 38,500 t/y. The lack of business is blamed on a decline in real terms of business in canned fish and vegetables. It would be possible to develop the replacement of much of the metal packaging by plastics packaging but this could further depress the metal packaging industry. Such an action would require analysis in terms of national interests, including study of possible extra trade in fish and vegetables.

In the case of glass in Morocco the situation is more simple than the case of metal. There is a worldwide trend away from glass packaging to plastics packaging, mainly because glass is uneconomic to carry. In many countries this has resulted in lightweight glass bottles, but it is doubted that Morocco has the demand to justify investment in lightweight bottle manufacture. When one examines the glass situation in world packaging it is difficult to understand the potential increase in Moroccan glass. Particular note should be made of world developments in polyester (...) for bottles. It is probable that within the next ten years the liquid-packaging business will be variously divided between PVC, polyolefines, PET, and coated paper (coated variously with wax, polyolefines, and PET). No doubt high-temperature plastic laminates will claim some markets but there appears to be little long-term future for glass other than in specialised liquid packaging (and even this is doubted by some forecasters). PET is used widely for bottles for carbonated liquids including beers, so will take business away from both cans and bottles.

Morocco imports jute and jute sacks. Sack production capacity is about 11,000 t/y, but this statistic is relatively useless in estimating demand. Variable numbers of made-up sacks are imported, sacks pass through several stages of re-use, and the looms are being modernised.

The simple statement with regard to jute packaging is that it would be logical to replace all jute by stretched HDPE and/or PP tape, using existing sack-making capacity. Tape sacks should have about one-third the sack weight of equivalent jute sacks and about half the production cost. Consequently, for the same number of sacks produced the output and value figures would need revising (7,000 t/47,700 t DH for jute to 2,300 t/23,850 t DH for tape). Total conversion to tape sacks would save 23 million DH, avoid the complications of reliance on Bangladesh for jute, and contribute to better health by the consumers of sugar, cereals and potatoes. Note that one reason why world sugar trades adopted tape sacks was the better hygiene of tapes.

Imported polyolefines are taxed at 40/50 per cent, which seems to be an illogical imposition on users. It should be noted that polyolefines and PVC are rarely rivals in plastics fabrication, and higher prices for polyolefines will not influence demands for PVC. Current world opinion is that the proportion of PVC in packaging will decline, not because it may liberate toxic monomer but because polyolefines have improved and PET has been developed. The future of PVC is seen mainly in the building and irrigation/drainage industries, not in packaging.

In considering the relationship of domestic PVC to imported other polymers it should be appreciated that:

(a) Although relatively little of total plastics are exported as packaging, the extra cost arising from import taxation could have influence on export prices.

(b) The machinery installed is geared to specific materials, and it would be expensive and disruptive to convert from polyolefines to PVC (note that PVC has a narrow melt/burn range and will not run on equipment designed for easy flow materials such as polyolefines).

(c) PVC could probably replace polystyrene in thermoforming and pharmaceutical packaging, but such replacement would not unduly disturb the situation.

(d) The real potential danger to PVC in packaging is PET (polyester), which is proving to be the first significantly serious rival to glass and tinplate in the mass-distributed liquids. It is now proven by trial for lager beers, common wines, coca-cola, lemonades and similar carbonated drinks. It would be justified for ARPC to carry out a study of the impact of adoption of PET in terms of:

(i) Reduction of costs of transporting liquids in bottles;

(ii) Reduction of demand for glass and tinplate packages;

(iii) Increased export potential using PET containers.

Morocco has a recorded population of 20 million but the 1982 census may show 30 million. The 1985 forecast of plastics conversion is worth only 2.3 kg/capita/year (or 1.5 for a 30 million population). There are more than 200 factories in conversion but packaging appears to be low in proportion. The pattern of conversion is dominated by PE (forecasted 28,000 tons 1985) and PVC (forecasted 15,000 tons 1985) with the other materials of little importance. PVC is produced from imported monomer to 13,000 tons, meeting domestic needs, and this factory could increase to 25,000 t/y. Development is inhibited by the high import duties. Packaging probably accounts for 45 per cent of conversion. There is a project in discussion for LDPE production from imported ethylene to 60,000 t/y capacity.

In 1980 Morocco imported 315,000 DH value of plastics (not all packaging), 22,800 DH of paper and cartons and presumably 7,000 tons of jute to supply the sack mill. Imports also include 470,000 DH value of wood.

Conversely, xports included 121,000 DH value of paper pulp. It has been said that packaging accounts for 45 per cent of conversion of plastics (142,000 DH value of the imported polymers).

In terms of available technology for regional transfer, Morocco has an excellent development of PVC bottles for drinking water.

1. Morocco Production Variability, Agriculture - 1980/81

1980 was a year in which the rains were sufficient for the year to be taken as typical in agricultural output. Cereals were up to 3 to 5 million tons and although fruit/vegetable production is impossible to account for accurately, fresh tomato exports reached 130,000 tons, and there was an impressive list of minor (development) agricultural exports. Citrus was produced to 1 million tons of which 590,000 tons were exported. Juice output dropped but wine production increased from half a million to one million hectalitres because yields were good and new vines became productive. In hand were plans for a second sugar mill (420,000 t/y) and for the growing of tea. However, one must consider agriculture within the broad economic pattern. In values the major import was inevitably petrol at 3.6 million DH, but this was closely followed by wheat (1.6 million) and sugar (0.6 million). Other agricultural imports included vegetable oils (434,000 DH) and milk products (251,000 DH).

Exports were dominated by phosphates and phosphoric acid with a joint value of 3.8 million DH, followed by citrus at 1.16 million DH. There then follows a significant drop in values to preserved fish (342,000 DH), tomatoes (248,000 DH) and preserved vegetables (220,000 DH). The rest of agricultural output is not a major contributor to export income, but it is significant insofar that it has growth potential. Notably the potential is in processed foods (including frozen and dried), which will have influence on the packaging picture.

1981 was a dry year. Cereal production dropped to 2 million tons and wheat imports increased in value 39 per cent, with similar increases for the other agricultural products. Export values showed relatively little change and if one uses inflation costing they dropped in real terms. The major damage to the economy was the rise in value of imported petrol, from 3.6 million to 5.6 million DH. Fortunately the export values for phosphates (including acid) increased to add an extra nearly 1.4 million DH.

The variability of product output and consequently the difficulty of forecasting package demand, is obvious.

MOROCCO (TONS)

PRODUCT	Produced 1980	Produced 1981	Imported 1980	Imported 1981	Exported 1980	Exported 1981
Cereals	3 - 5 M	2 Mil.	-	-	-	-
Fresh fruit and vegetables	300,000	67,000	-	-	130,000	30,000
Tomatoes	230,000	-	-	-	746,000	84,800
Potatoes	52,000	-	-	-	-	-
Citrus	1 Mil.	-	-	-	592,000	691,000
Sugar	360,000	-	250,000	-	-	-
Groundnuts	20,000	17,800	-	-	-	-
Canned fish	100,000	-	-	-	-	-
Canned fruit and vegetables	-	-	-	-	52,300	98,000
Wine	540,000 hl	1 M hl	-	-	172,000 hl	298,000 hl
Juices	69,500	-	-	-	-	-

MINOR PRODUCTS

Green beans	852
Aubergines	255
Courgette	1,641
Peas	30
Hot peppers	702
Capsicum	2,253
Watermelon	380
Avocado	118
Mushrooms	129
Artichokes	50
Asparagus	5
Melons	4
Strawberries	6
Nectarines	278
Apricots	304
Beetroot	145
Peaches	14
Kumquat	21
Ortanique	4
Cucumbers	4

FROZEN PRODUCTS

(Refrigeration capacity 40,000 tons; handling 261,000 tons per year.)

Strawberries	286
Green beans	785
Artichokes	30
Mushrooms	56
Cauliflower	5
Aubergines	18
Onions	45
Sweet corn	312
Ratatuoille	132
Peeled citrus	8

2. Morocco Export Pattern

In 1980, which may be regarded as a typical production year for Morocco, the increases in citrus exports compensated for decreases of exports of processed foods. In that year, packaging costs increased 20 per cent mainly by high material costs - and one must appreciate that Morocco is yet limited in domestic packaging resources.

1980 agricultural exports reached 768,000 tons, which was 43 per cent better than 1979 exports. The destinations were:

In 1980 to :	Western Europe	- 495,000 tons	(64.5 per cent):
	Eastern Europe	- 217,000	(28 per cent):
	Middle East	- 48,000	(6.25 per cent):
	Canada	- 6,000	(0.8 per cent);
	Africa	- 3,000	(0.4 per cent).

The inference is polarisation of exports towards Europe with a 2:1 ratio of west:east. In fact, the polarisation is much more insofar that France took 43 per cent of the Western European total. Since France has a roughly similar agricultural pattern other than citrus, exports to France must be regarded as suspect. Germany took 28 per cent of the Western European total, but is less suspect as a long-term market because it has no mediterranean climate (but with Holland it has advanced scientific cultivation which could reduce the need for Moroccan products). The Eastern European destination total is unbalanced by USSR taking 159,000 hectalitres of wine, a little more than half the exported wine. France took 122,000 hectalitres, so the USSR and France jointly took 94 per cent of the exported wine. This is far too much polarisation and, since the wines are good quality, IMEC might well investigate the possibilities of broadening the market by introducing semi-bulked exports and bag-in-box packaging.

In terms of values in 1980 the pattern was, in DH:

	Imports	Exports	Balance
Europe	10,631	5,268	2,179
Other OECD	3,686	1,469	2,217
Comecom	1,051	1,096	45
Arab countries	3,185	337	2,848

In 1981 the Arab countries took 616 and supplied 5,019, increasing the balance to 4,403, but 1981 was not a typical year, and we may ignore this statistic. The important point is that Arab countries, which are not mainly agricultural producers, took much less than France, which is an agricultural producer likely to reduce its import requirements. It is important that IMEC studies and supplies packaging as required by Arab countries.

C. JORDAN

Jordan has a total area of 94,500 square kilometers. The official population (East Bank) is 2.2 million of which half are involved in agriculture. The important crops are wheat, citrus, grapes and olives. Rain falls from November to March and is variable. In development plans the emphasis is on industry more than on agriculture. From 1980 to 1985 the average growth rate has been 69 per cent within which growth:

	Per Cent
Electricity and water	137.5
Manufacture and mining	128
Construction	80.8
Services	40.4
Agriculture	43

(Agriculture showing the least growth.)

Investment over the period has been, in millions of JD:

Soil/water conservation	18.66
Sheep	8.6
Poultry	26.5
Market construction (mostly tomatoes)	3.11
Cold storage	2.35
Feed production (supporting poultry)	5.5
Tomato paste	1.3
Total Public Investment	66.02
Plus private investment estimated	133 7
Total investment in agriculture	199.72 (200 million rounded)

Over the same period:

Non-oil, non-plastics, chemicals	520.0	
Oil and plastics	60	
Glass - sheet	12	
- bottles	6.6	
Plastics and solvents	4	- including PVC mainly directed at compounds such as floor tiles and an 8 million JD cable project.
Applicable Industrial Developments	602.6	(600 million rounded)

There are plans for a fruit and vegetable packing factory of value 1.4 million and for two industrial estates of value 18 million. Oil developments have value 60 million.

In terms of contribution to GDP in millions JD the growths have been:

	1980	1985	Extra Value
Industry and mining	154	350	196
Electricity and water	8	19	11
Construction	52	94	42
Trade	138	222	84
Transport and communications	91	154	63
Public administration and defence	122	145	23
Other services	80	123	43
Agriculture	60	86	26
Total at factor cost	705	1,193	488

In other words agriculture contributed 8.5 per cent in 1980 and 7.2 per cent in 1985, whilst industry increased its contribution from 21.8 per cent to 29.3 per cent.

The average annual growth rate for agriculture was 7.5 per cent whilst that of industry was 17.8 per cent.

The plastics conversion industry is equivalent to 16 kg/capita/year. With the injection of capital the conversion industry could grow. In the forecasts for 1985 there is 20,000 tons of PE and 14,000 tons of PVC, and relatively little of other polymers. This would be a 55 per cent increase for PE and 43 per cent increase for PVC compared against 1980.

The general situation is that agriculture has not grown as it should have done, only two-thirds of the overall growth rate and one-third the growth rate for industry. The pattern of investment does not suggest that there will be significant growth in agriculture other than in poultry production and slaughter, aimed at both Jordan and neighbour markets. Considerable investment is required in the improvement of yields and qualities of agricultural products before any improvements of packaging will bring significant economic or social benefits. There is also a need for developments in water supply (which are in hand) and in the development of scientific agriculture to offset seasonal variation of climate. In 1979 the output of cereals dropped by two-thirds and the output of fresh vegetables dropped by about one-fifth. In the following year output of cereals increased five times and fresh vegetables increased by 10 per cent (although tomato production remained low for some unknown reason). As said during one conversation, in Jordan, agriculture is not reliable but industry and mining are.

1. Packaging - Wood

The conditions of travel dictate that packaging for fruit and vegetables should be of wood. The ECWA region has 368 million hectares of land but only 14 million hectares are arable. Consequently wood is not readily available and there are few prospects for forestation because the available land is needed for food production. ECWA region in 1977 produced 52,000 cubic metres of sawn wood, 19,000 cubic metres of particle boards and 40,000 tons of paper (not all from wood from ECWA). This is a typical example of the world problem of deforestation with consequent damage to the environment. In fact, the wood used in Jordan is mainly beech imported from Turkey, Portugal and Yugoslavia, and it is by no means certain that these sources will be able to continue supply at economic prices for box production in Jordan. The box production from wood is well-developed in two factories, although one factory may pull out of Jordan because the other factory has an advantage in the import tax situation. Nailed plywood boxes are used for exports of fruit/vegetables, using plywood and claiming output of 50,000 boxes per day, in two sizes holding 10 or 20 kilogrammes. These sizes are nominal since filling is variable, overfilling is evidently a major cause of damage to the production.

There is also production of wire-bound boxes with imported hardboard ends. About 6,000 cubic metres of wood are imported per year for the wire-bound boxes.

Box sizes are to regional standards at 480 x 270 x 250 mm or 400 x 300 x 150 mm.

Since the standardisation is to fit pallets it is difficult to understand the specified height (only flat area dimensions influence fitting to pallets). A variable height would allow flexibility of filling and reduce some damage to products. Wooden boxes are favoured for the rough conditions of exports to neighbour markets. There are conflicting estimates of numbers of boxes for export but the number could grow to about 18 million per year within a few years (but only if qualities and yields improve to provide competitive products). It is unlikely that corrugated cases will replace wooden boxes other than if airfreighted exports develop.

ARPC should consider the transfer of particle board technology from Morocco to Jordan.

2. Glass

In 1981 Jordan imported 5,313 tons of glass bottles. There is at present no glass bottle industry but a bottle factory is intended. The main users are two breweries and a soft drink industry. Almost all the bottles are returnable against a deposit. There are no lightweight bottles, and the bottles average 12 trips, which is a good average. Bottled products are exported to neighbour states. Soft drinks are only in relatively heavy small bottles. It would be of value for Jordan to investigate PET as a bottle material for larger volumes of soft drinks and also for the beer.

Beer is also in cans, about half a million per month. The beer glass bottles are brown and green, evidently because customers want it that way. It would be logical to use only one colour when the new factory exists.

3. Tinplate Cans

In 1981 Jordan imported 9,775 tons of tinplate and 810 tons of made-up cans probably mainly for beer. Can-making is done by specialist firms and also in-plant by product suppliers. Most of the in-plant production is for tomato concentrate and possibly six types of vegetables. The local cans are said to be of poor quality, including cans which leak or have blown (a blown can is one in which

infection has entered and there is decay of the product with gas production. This is not a particular health hazard but it does indicate the possibility of infection. More serious is decay without gas production - because there is no visible evidence of decay which could be fatal). There is no system of returning faulty cans to the suppliers, which means that suspect products are held by retailers for longer periods, and the dangers from infection are consequently greater.

The only satisfactory answer to the health problem from cans is to concentrate can-making with one modernised factory. Unfortunately, an economic can-making plant could cost over 3 million JD with an output of around 300 million cans/year. Jordan does not have a market for cans of this order, even if beer cans are included, and the establishment of such a can-making plant would not overcome the problem of having to import tinplate.

There are consequently two required actions. The first is to set minimum standards for canned food, with the right of return of faulty products and with legal liability of the supplier for any damage done to consumers. The second is to move away from cans into sterilisable plastics.

4. Paper

There is one paper-maker rated at 6,000 tons/year and one factory for making corrugated board rated at 9,000 tons/year. In 1981 the imports of kraft paper were 5,527 tons, plus 412 tons of corrugated board. In effect, this suggests that some 2,500 tons/year are used for paper sacks production. The paper situation is confusing. There is one company making paper sacks, rated at 30 million capacity but only 8 million output, supporting the above estimate of 2,500 tons. Total demand is however, 25 million/year with some possibility of increasing to 150 million by 1985 if all the plans for cement and other mineral products develop. There is no tax on imported paper sacks and it could be that many sacks are imported without registration.

The domestic corrugated board is not excellent but of the 9,000 tons output possibly 5,000 tons are exported. The corrugated cases from domestic manufacture are also not excellent and there is importation of 1,449 tons of cases.

There is no coating of board and coated board imports in 1981 were 2,472 tons, possibly mainly for the Purepak and Tetrapak cartons. Pulp moulding is established for egg trays, so there must be a collection system for waste paper, presumably with the recycled pulp split between pulp mouldings and paper production. It is doubted that Jordan could develop more paper production, and the inevitable policy must be to replace paper where possible - at the same time improving the quality of domestic corrugated cases for any future demand from air-freighted products. One obvious form of replacement would be by more use of woven tape sacks.

5. Plastics

Imports of plastics do not appear to be listed other than 676 tons of PVC (probably all for blown water bottles), and 271 tons of film. The PVC for blown bottles is from France and the output of bottles is of the order of 10 million per year - one-third for use in Jordan and two-thirds for export to Saudi Arabia. Some polyolefines are imported from Qatar and Saudi Arabia. There is also importation of polystyrene for thermoformed pots. Plastics corrugated board is under consideration (in general the world reaction to corrugated plastics cases is that they offer few advantages but many problems).

Laminates are not produced and it is doubted that the market would justify production.

Woven stretched polyolefine sacks are produced using polypropylene from Holland and probably HDPE. Woven sacks are also being imported from Taiwan. The main products in the sacks are flour, feed and phosphates. The observed sacks appear to be from circular weaving at widths 450, 530 and 600 mm.

There is an interest in big bags from tape fabrics (holding up to one ton) but production would require a wide flatbed loom - which would be under-used if it is not possible to find some wrapping applications for wide fabric.

All the flour is now in tape sacks, which are used only once for flour.

There is a new flour mill intended, which will increase the demand for tape sacks. Presumably the used sacks are passed into the feed industry and then into the phosphate industry.

Output of tape sacks is said to be only 2 million; if so, there is justification for much more capacity because the forecast for paper sacks is 150 million by 1985. Sack production in Jordan will require imported raw material. There are techno-economic advantages for tape sacks which paper sacks do not have. Notably, tape sacks have second-hand value and they do not suffer in use in wet conditions (and one must appreciate that Jordan has some rain).

There are 10 large firms blowing film and possibly 40 small firms. There are countless small bagmakers. The film is HDPE and LDPE, but evidently not polypropylene. There could be considerable reduction in losses of retailed fruit and vegetables if perforated film were produced and used for bags. There are possibly 50 firms blowing bottles. Many of these are product suppliers with in-plant equipment and the total bottle production is not known. The problem in bottle blowing is evidently that there is overcapacity and users seek low prices. Consequently qualities are low and there is little expenditure on design. It seems logical to seek a national or regional standard bottle and to establish a national or regional mould-maker. There are said to be problems from unsatisfactory closures although this was not confirmed by observation of retailers.

Polystyrene tubs for yoghurt and similar products are produced to possibly 60 million per year by four or five firms. Perhaps a quarter of output is for export to neighbour countries.

6. Quality Control

There does not appear to be any quality control in plastics packaging. The packaging industry needs a central testing laboratory capable of serving national package-makers, package-users, and legislative authorities. The problem is that such a laboratory might cost one million JD and it would require at least five skilled technologists to perform tests and translate the results into useful information. Furthermore, if the declared function was only quality control the equipment would be under-used. The Royal Scientific Society has a packaging laboratory which is well-equipped, but it is not known how far the RSS is willing to undertake the very large task of establishing quality control and enforcement.

D. SAUDI ARABIA

In 1980 there were 2,114 industrial licences within which 56 per cent applied to operative factories of capital value SR 17 billion and 60,000 jobs. The potential factories will have capital value SR 44 billion and also 60,000 jobs. The potential for packaging includes:

Eggs - 250 million; equivalent to about 400 tonnes/year of recycled waste paper.

Table poultry - 11.5 million; possibly 200 t/y of heat-shrink or common PE film.

Processed meat - 75,000 t; 750 t/y barrier film.

Cut meat - 65,000 t; 650 t/y shrink or barrier film.

Milk - 180 million litres; 4,500 t/y of HDPE bottles or coated paperboard.

Semi-solid dairy products - 300 million litres; up to 30,000 t/y of thermoforming/injection PS, PVC or PP/HDPE.

Water and still beverages - 240 million litres; 6,000 t/y of coated board or cans or HDPE or PVC or PET bottles.

School meals - 77 million; now cans but could use PET-coated board.

Processed vegetables - 37,000 t; now cans but could develop alternatives.

Oils and fats - 60,000 t; PVC bottles and thermoformed PVC, PS or PP/HDPE.

Bread - 400,000 t; could take up to 4,000 t/y of perforated thin PP/HDPE film.

Rice and similar - 200,000 t; up to 2,000 t/y of common PE film.

Sugar - 100,000 t; up to 1,000 t/y of common PE film, 4 million tape sacks.

Carbonated drinks - 1,345 million litres; possibly 15,000 t/y of PET bottles.

Various processed foods - 76,000 t; very mixed collection needing specialised study.

The available packaging production in the intended development includes:

Paper pulp from Tamarisk - 40,000 t;
Tissue paper - 10,000 t;
Cladding paper - 19,300 t;
Corrugated paper - 15,000 t.

The paper industry has a conversion capacity of 188,000 t, of which most is kraft bags.

The plastics package production industry has an output of 30,000 t.

About half of this is film bags.

With regard to cans, the evidence is that there is in-plant can production which is not directly recorded or is duplicated in records. The unreliable recording of cans indicates about 750 million cans capacity, of which about one-third would be for sterilised solid food products.

There is official listing of production of 1.7 million glass bottles, but 516 million caps for bottles. The inference is that either there is much hidden in-plant glass bottle manufacture, or large numbers of bottles are imported.

If one presumes 10 journeys per bottle the cap total equates to about 50 million bottles in circulation.

The range of plastics packaging produced includes thin and thick film, medical packs, thermoformed cups, blown jerrycans and bottles. Saudi Arabia claims to be the largest producer of polymers in the region. There are seven petrochemical projects supplying, or to supply, 1.5 million t/y of ethylene and consequently:

680,000 tons/year LDPE of which 130,000 t will be linear LLDPE;
180,000 tons/year HDPE.

The full output is expected in 1985.

X PACKAGES

Any package should satisfy three essential requirements:

(a) It should be accepted, and preferably desired, by people concerned with its storage, travel and purchase;

(b) Its construction and handling ability should be appropriate in terms of resources and conditions of use;

(c) It must offer some real benefit in the total handling/distribution picture.

Within the present context one may add one further requirement, i.e. it should contribute, not only to national welfare but also to regional welfare.

It is not reasonable to suppose that any package will be developed for the sake of regional benefit only. The priority must be national, with regional benefits considered.

For example, the Moroccan PVC drinking water bottle excellently satisfies the three requirements. It is accepted and it functions well as a lightweight package. It provides an outlet for domestic PVC and it enables safe drinking water to be distributed. It also allows the possibility of exporting technology or water to the region, to national and regional benefits.

The glass wine bottle does not excellently satisfy the three requirements. It is accepted because it exists without an alternative. It is expensive for storage and travel and inconvenient for the purchaser. Also, where tourism and coastal holidays are important, broken glass is a hazard to be avoided at all costs.

A. RESOURCES

In its entirety the Arab region lacks original organic resources. The historic inhibitions have been:

(a) The lack of a domestic market for organic products (food and clothing) of sufficient size to provide development capital.

(b) Unavailability of the technology required to deal with typical problems such as water shortage or salinity.

Over the past decade the region has been able to obtain development capital from oil revenues, and there have been significant advances in resources development. This led to an opinion, not only amongst Arabs, that the logical path of Arab development would be to use oil revenue for projects related to water, food and petrochemical-based industry (which in this context concerns plastics for packaging).

In the mid-1970's, the OPEC countries sought the generation of more development capital by increasing oil prices. As a direct result there was widespread research into resources other than oil, notably into carbohydrates. Such research, and some consequent development, was of particular importance to developing countries with agricultural potential but no oil or available capital for nuclear or hydro energy schemes. The production of fuel and organic chemicals from crops was seen as appropriate technology which was labour-intensive and could reduce importation costs without spending much capital.

Much of the required technology now exists for the development of a world economy based mainly on cellulose (which is the most abundant and widespread natural organic resource in the world) and lower carbohydrates. Whilst it is logical for the Arab region to continue its development in petrochemicals, it is also logical for the Arab region to develop carbohydrates as food, fibres and origins of organic chemicals.

B. FIBRES AND PAPER

Fibres in packaging mean mainly sacking fabrics and paper. It is not probable that any Arab country will compete against much wetter countries in natural sacking fibres. Also, with polyolefines being produced it is almost inevitable that stretched polyolefine tape sacks will be less expensive and more functional than natural-fibre sacks in the Arab region.

With regard to paper it should be noted that over the past decade there have been remarkable developments in non-wood paper, frequently by production on a relatively small scale. The commercial developments have concerned:

(a) Re-pulped waste paper alone or as dilution in other fibre pulps for paper.

(b) A very wide range of natural fibres, notably bagasse, bamboo and reeds.

Papers and plastics may be regarded as rivals but also co-operators in packaging. In very broad terms, papers print and glue well using water-based inks and adhesives, but by the same characteristic papers weaken and fall apart when wet. Plastics are waterproof but consequently do not print or glue well using water-based inks and adhesives.

Coated paper is an important consideration for the region. The plastics component may be 25 per cent of the paper weight per package.

C. PLASTICS PACKAGING

In comparison with other packaging material groups, plastics offer: (the combined advantages of)

(a) Barrier performance against water and microbial infections (variable).

(b) Barrier performance against gases and vapours (variable).

(c) A very wide range of forms in which they may be used.

(d) Ability to be converted over a wide range of outputs of production.

Thus, plastics progressively replace tinplate (which is economic only in mass production), glass (which cannot be made as lightweight impact-proof packages), paper (which is water-sensitive), wood (which has grain direction and which is expensive if of good quality), natural fibres (which are not barriers).

Also, plastics are used in combination with other packaging materials where such combinations provide joint performance. Most of the combinations use plastics as:

(a) Surface coatings;

(b) Binders;

(c) Adhesives;

(d) Loose overwrap or liner.

One private study in 1975 showed that nearly half the plastics in packaging were in combinations. This is important in the formulation of any packaging plan, where there is always a danger of isolation of materials and of disregarding their inter-relations.

For examples:

In long-term planning the region could develop the production of cans using recent economic and technical developments. Such developments include the breaking of obsolete shipping and other scrap, feeding arc/diffusion furnaces which provide remelted steel at 20 tons/day upwards for rolling. The economic problem for cans is then the high cost of tin metal, but plastic coatings allow the supply of cans without tinplating.

There is much development of particle boards to replace wood in packaging, and many more particle boards could be developed within the region, using plastics as binders and coatings. With regard to sacks one must consider polyolefine tapes and natural fibres. Tape sacks must develop from the availability of olefines in the region, but it may be possible for the region also to develop domestic natural fibres. In terms of total benefit the development of natural fibres offers rural benefits and reduces import costs for countries not producing ethylene or propylene. Plastic liners overcome the weaknesses of natural fibre sacks.

D. PLASTICS

There are some 1,000 significant plastics processing factories in the Arab region, plus an unaccountable number of small-scale converters in for example, bag-making from film. Ownership of factories is mixed between the private and public sectors, and many are large with modern equipment. About 40 per cent of the conversion is in Saudi Arabia, Iraq and Algeria. About 40 per cent of the converted material is PVC but most of this is converted for non-packaging products, although PVC is significant in the development of welfare in the form of bottles for drinking water. The major material for conversion to packaging is the polyolefine family, notably LDPE for thin film and thick film fertiliser sacks. The 1980 breakdown of converted polymers is:

	Tons per year
LDPE	200,000
HDPE	100,000
PP	39,000
PVC	300,000
Polystyrene)	
Polyurethane) for each about	50,000
Polyester)	

This gives a 1980 total of towards 800,000 t/y, with the national totals varying from 129,000 for Saudi Arabia to 3,000 for Qatar. These statistics are from UNIDO report UC/IDC/79/088, which interestingly lists totals for eleven Arab countries identified with a further total for other Arab countries. The total for the unidentified countries is 282,000, 36 per cent of the total.

For the 1983 statistics and the 1985 forecasts it will be essential to identify all the countries because the unlocated third of conversion could significantly influence the plan of action.

Within this report the interest is in the forecast for 1985 in which the unidentified countries account for only 29 per cent of the total. The UNIDO report forecasts:

	1,000 t/y 1985	Percentage Increase from 1980
Algeria	191	59
Bahrain	5	30
Iraq	128	17
Jordan	40	100
Kuwait	24.4	29
Morocco	46.5	10
Qatar	4	27
Saudi Arabia	190	32
Sudan	20	20
Syria	95	25
Tunisia	40	23

The average percentage increase, which may be taken as a rough indication of investment in plastics, is 33.8. In general the pattern of plastics conversion has passed through a first stage of household goods and a second stage of construction. Packaging is said to have been late in development, so it is not wise to use the conventional estimate that one-fifth of plastics conversion is packaging. The increased figures show remarkable differences between countries, a reflection of the differing economic situations, availabilities of oil, and the differing levels from which the increase starts.

It is known that the various Arabic banks are seeking to develop plastics in Arab countries, and that feasibility studies are in hand or intended. Such feasibility studies are one area of operation which should interest ARPC. There is also intended a plastics development centre in Iraq, which the table indicates as low in intended growth. This intention may of course be delayed by the present conflict but even with nil growth Iraq would be a leading converter. Iraq is also the home of AIDO, and one may presume future triangular contact between ARPC, AIDO and the plastics centre. There is also a suggestion within UNIDO for a plastics centre appended to IMEC, which would not be difficult to establish and would more directly assist ARPC. In fact, it would be logical to establish plastic centres in both Iraq and Morocco with agreed division of work and linked through AIDO.

Projects for polymer production, probably by 1985 are (1,000 t/y):

	LDPE	HDPE	PP	PVC
Algeria	48	40		36
Bahrain				
Iraq	60	30		60
Kuwait	130			
Libya	100	50	50	70
Qatar	140	70		
*Saudi Arabia	778	276		150
Emirates				
Totals	1,256	466	50	306

Bahrain and United Arab Emirates are included in the table to show that not all oil countries are anxious to become polymer producers, although Bahrain will contribute methanol and the Emirates will contribute ethylene.

*An alternative estimate for S.A. is 680,000 t/y LDPE, 180,000 t/y HDPE.

E. RE-USE AND RECYCLING

In package costing there are two costs to be recognised. The first is "package cost", which is the total of cost of material plus cost of conversion. The other is "journey cost", which is the cost of the package per occasion of use - in simple terms, the package cost divided by the number of times used (this is very much a simplification but it serves to make the point).

It will be appreciated that there are three methods whereby the cost of packaging may be reduced:

(a) By re-using the package in a closed-cycle system of distribution, such as using a bottle-crate several times to carry bottles.

(b) By directing used packages into some other application after use, such as using a sack for sugar then grain then charcoal.

(c) By rescuing the material of the package after use, for the production of new packaging or other products. An example is the rescue of paper for pulping for dilution of new paper pulp or for pulp mouldings.

General comment is that glass packaging is economic as a rule only when it is used in closed-cycle distribution, as a multi-journey package. Paper packages are rarely suited to re-use but the paper is simple to re-pulp in small-scale operations. Metals and plastics are not frequently re-used and there are difficulties in recycling the materials in small-scale operations.

One of the functions of ARPC should be to develop the regional processing of used packaging. This comes under the general heading of Resource Conservation. The subject is included in the proposals for action.

F. SACKS

Sacks are from woven fibres or tape or, by convention, from paper. The primary function is to break bulk into units for manual handling, and into units which will not develop biological heat. Up to 1970 the trade was dominated by jute fibres, but there was then development of stretched tape sacks. Early information concerning tape sacks may not be accurate since it was based on inferior materials which have since been improved. Sack technology is known in the region, and the only requirement of development is to expand production. Regional demand is probably towards 2,000 million sacks for saturation of agricultural demand (see Unified Plan) to be reached over three generations. This is double the 1985 estimates of raw material supply from Arab sources for all polyethylene/polypropylene applications, not only sacks.

Certainly for the next decade the region will depend on foreign sources for most of the raw materials, but the region could provide technology for transfer and possibly equipment.

*In academic terms a sack is from woven fibres or tapes. Correctly, paper sacks are from twisted paper yarn, but large bags from paper are by convention known as "sacks".

G. BOTTLES

In academic terms a bottle is hollow container with a narrow neck. Within this report the term "bottles" includes jars, which have wide necks. Thus we take into account all relatively small rigid or semi-rigid hollow containers with closures - but not tubs, which require individual treatment, and not cans. It is necessary to define the term because it is common to refer to the preservation of food in glass jars as "canning", not bottling. Conventional bottles are of glass or plastics or aluminium. Competing packages include cans, flexible bags and semi-bulk containers such as barrels, drums, large tinplate cans, bag-in-box. Glass is obsolescent in many of its markets but maintains some popularity because it is historic packaging, is known to be almost inert, and can be washed for re-use for return journey distribution. Plastics replace glass in all respects other than in the efficiency of washing for re-use. Consequently, glass is more suitable for return journey distribution, which means in concentrations of population in which bottling facilities exist. Even then, it is not more suitable if the collection of empty bottles is made difficult by traffic congestion or the lack of collection centres.

Plastic bottles are blown from parisons, short lengths of tube. Parisons are made by injection or extrusion. The needs of the region are best met by extrusion, with blowing units directly fed from extruders. This is simpler than injection-blowing and the extrusion technology is common to other conversion such as film. Polyethylenes are easier to extrude than PVC, and they allow more variation of bottle performance by polymer selection and blending. The main regional requirements are LDPE semi-flexible bottles for common liquids, more rigid bottles for chemicals from HDPE, and bottles of intermediate rigidity from blended LDPE/HDPE. PVC has a comparatively narrow range of temperature from melting to degrading, and the technology is more complex. PVC has high chemical resistance and low possibility of flavour development when used for foods (and water). It is common to use PVC for vegetable oils and wine. Polyolefines have relatively high absorption of organic chemicals, so are difficult to wash clean for re-use.

Neither polyolefines nor PVC are suitable for carbonated liquids. The new plastics for carbonated liquids is PET polyester - for which relatively high technology is required in blowing.

It is feasible to blow polyethylenes on plant rated at about 700 per hour with few problems. This encourages in-plant bottle production, but it also discourages efforts to improve bottle performances and machine efficiencies. It would be useful for ARPC to develop a standard for LDPE bottles, HDPE bottles and 50/50 LDPE/HDPE blend bottles to:

(a) Allow production of standard moulds;

(b) Allow easier trouble-shooting technical service;

(c) Save material by preventing wall thickness variation.

Polypropylene and PVC require more technical input for production and are suitable for in-plant manufacture only if the output of product justifies the cost - which usually means production on several machines. PET requires a high input of technology and is usually only feasible from specialised conversion facilities. One of the most important items of information required is the breakdown of regional demand for bottles into the various materials - which would provide ARPC with priorities for its activities.

H. THERMOFORMINGS

Thermoformings are from plastics sheet which has been softened by heat. The forming is by pressure or vacuum with the assistance of a solid plug for deep drawing. The technology is well-known throughout the region. The materials are commonly polystyrene and PVC, chosen for their relative costs more than for performance differences. It is usual to seal either with a welded-on cover or a snap-on lid. For the region the applications are many, including:

(a) Cups for yoghurt-type fermented milks, etc.;

(b) Tubs for solid fats, short-life processed foods, etc.

The usual mechanics of production are for specialised sheet producers to supply forming facilities. If a forming facility reaches an output of more than 500 t/y it may consider in-line forming, which is transfer of the hot sheet from the extruder into the forming stage (which saves energy and cost because the polymer does not cool down to be re-heated).

The further stage of development is extrusion/forming/filling, which also saves money but also allows the filling of processed food directly into thermoformings with minimum contamination. In general, thermoformings are only satisfactory for products of short life or products which are preserved by chemical addition. It should be relatively easy to organize technology transfer regarding thermoformings within the region.

In theory, ARPC could provide technical service with regard to the materials but in fact most of the performance characteristics of the packages are dictated by conversion conditions and rates of outputs, and technical service should be in the location of the equipment (but ARPC could, of course, contribute by holding group-training workshops for potential users).

I. FILMS

Films are thick for heavy duty bags, thin down to ten micron for small bags, produced with included strain for shrinkfilm, as cling-film which adheres to itself on contact, stretch-film which is stretched around products then adheres to itself, with maximum cold-stretching for tape production for sacks. Most of the information in literature has been confused by the development of linear low density polyethylene (Saudi Arabia intends production of LLDPE).

Furthermore, films may be cold-stretched in both directions for better strength and clarity. They may be laminated with or without a barrier layer of aluminium or co-extruded by passing two or more materials through combined extruders to give multilayer films. They may be extruded directly onto other materials as coatings.

This list is far from complete but it shows the diversity of film technology, which is far too wide for detail in this report. All forms have some bearing on agricultural packaging.

It is economic for new ventures to start with the extrusion of agricultural film, which may be of relatively low quality. Thus the enterprise has a market for the film during the period in which technology is improved, after which packaging films may be produced, leading to more sophisticated films and laminates and to films with controlled cold-stretching for shrinkfilm and tapes. The new developments to appreciate are the introduction of LLDPE, and vacuum deposition of aluminium onto film. Vacuum deposition gives a metallic surface of limited but useful barrier performance.

The largest area demand for film will be low-cost polyethylene film, as thin as can be produced without problems (probably ten to twenty micron), to serve as simple short-term waterproofing of retail bags - as direct replacement for paper.

One vital item of information is that fresh vegetables and fruit in bags need ventilation by perforation of the film (in one retail shop all the fresh products in polyethylene bags had decayed by lack of ventilation). Subject to investigation this could be the largest single cause of loss in retailing in the region.

The usual pattern of application is for a specialised producer of film to supply reeled film to specifications, to a large number of users down to very small users with simple manual welders. Reeled film is economic cargo, so it should be possible to move it amongst countries.

The largest weight demand could be thick-wall bags and liners for sacks, or it could be stretched film for tape sacks.

J. INJECTION

In the region, injection concerns mainly pots and crates. The technology is known and this report can contribute no more than can regional producers.

K. FUTURE CONSIDERATIONS

Lack of time and opportunity has prevented a study of developments within the region. The following are subjects which may arise in the near future:

(a) Large bags, in effect large sacks or bags of plastics-coated fabric, usually to about one ton capacity. Large sacks use stretched tape. Large bags of coated fabric have facilities for top-lifting and bottom-discharge, and are related to fork-lifting and hoisting by cranes. They are effective and economic for sugar and other products of easy flow which require sealed travel.

(b) Bag-in-box, which is a flexible bag in a rigid paperboard outer. Bag-in-box is economic for most liquids in volumes 2 to 10 litres. It eliminates the cost of bottles and is sufficiently economic for throw-away packaging. Wine and milk are specific products using bag-in-box.

(c) Stretch and cling films. These are alternatives to shrinkfilm used for manual wrapping small-scale. The introduction of LLDPE will modify the technology.

(d) PET-coated paperboard, which is a sterilisable barrier. This will influence replacement of tinplate (already developed for baking tins for bread because it is suitable for microwave heating) and reconstruction of coated paperboard cartons for liquids (replacing wax or PE-coated paperboard).

(e) Sintered polymer containers, which are produced by inserting powder into a sheet-metal vessel, heating to melt the polymer and rotating to cover the internal surface. It is low-cost production of limited numbers of containers, usually above 50 litre capacity.

(f) Co-extrudates, notably LDPE/nylon which offer weldability and barrier performance, and black/white opaque two-layer LDPE, which excludes light from sensitive products - as for milk sachets.

(g) Individual-dose packs, usually by thermoforming with in-line filling and sealing, for weights of a few grammes.

XI PRODUCTS

A. CEREALS

Cereals dominate the agricultural demand for sacks, as new sacks for flour or broken grain, and as second-hand sacks for whole grain. Regional cereal production is 24 million tons augmented by imports to 20 million tons.

Exports are stated as 13 million tons. In theory this gives a consumption of 31 million tons, but the stated consumption is estimated at 42 million tons. For this report we may take an approximation of 35 million tons. At 40 per ton this represents a sack demand of 1,400 million. In due course, because they lack oil for polymers and polymers from biomass (carbohydrates) are not yet developed, some countries may be expected to develop natural-fibre sacks from domestic crops. On the other hand, the land may have more value for food crops, so at present we may consider the entire sack demand as a market for tape sacks. A typical sack factory would produce tape sacks at 3 per kilogramme of raw material, and have output 3 to 5 million per year.

Thus we are discussing half a million tons of HDPE or PP converted in possibly 375 sack-making factories. These would presumably be located where the cereals are milled.

A proportion of the milled flour would be delivered directly to bakeries in sacks. Some would be broken in bulk to retail packages, which could be simple polyethylene bags. If we take a typical bag as 4.5 g, and presume half of the milled cereal is retailed, we could require 4,000 million bags or 18,000 tons of film.

These statistics are unavoidably suspect but they indicate the order of priority of sack development (they also indicate the need to develop bulking and the direct retail packaging at the mills). Bulking and direct retail packaging obviously reduce the demand for sacks.

B. VEGETABLES

It is impossible to be accurate in estimation of vegetables but regional production is said to be nearly 18 million tons. Within this context foreign trade in fresh vegetables and processing are ignored for lack of statistics, and because the vegetables for trade and processing must suffer a primary journey from the field of production. One of the problems for the region is loss in production, in harvesting, and in the

primary journey. Observation indicates that, as in all fragmented agricultural production, the main cause of loss is in the field stage - infection, infestation, climatic damage, wrong selection of varieties, harvesting at the wrong stage of maturity, rough handling in harvesting, etc. The Arab region is not unusual in its need for quality development in production and harvesting. It is not probable that packaging could contribute much to quality improvement - and ARPC should not accept responsibility for improving quality through package development.

C. FRUIT

The remarks made about vegetables also apply to fruit, but fruit is more sensitive to the factors which cause losses. Regional production is stated as nearly 10 million tons (grapes 1.9, citrus 3.4, olives 1.3, dates 2).

There are exported fresh fruits but one may doubt that the profitability of trade in fresh fruits will increase at the same rate as marketing costs in such a competitive world market. The only fruit which offers the Arab region a marketing advantage is dates. Otherwise, not only in the Arab region, the future profit is in processing - plus some specialised fresh fruit traffic using air freighting. The region should initiate a major market study, possibly with the assistance of ITC, of potential markets for fresh fruit. Such a study would provide priorities of individual fruits in selected markets, so that development capital may be concentrated. Meanwhile, the best function of ARPC is to act as an information centre so that exporters may know and copy the packaging being used in trade directions.

D. SUGAR

Refined sugar production is of the order of 11 million tons. The world sugar trades have mostly accepted that the semi-bulk packaging should be woven tape sacks with LDPE film liners, breaking the bulk into retail bags of paper or film. In effect, this adds to the sack totals (see cereals) another 440 million sacks (146,000 tons HDPE or PP) and further supplies of retail packages.

E. MILK

Milk production is about 3 million tons of which about half is from cows and the rest is from buffalo, sheep and goats. Milk packaging is part of a pattern of complex technology, notably health technology, which has developed around cow milk. It would be illogical to develop milk packaging for cow milk only, by the simple adoption of foreign technology. There is a need for a major study of all milks, including reconstituted milk, before the packaging can be effectively decided. One may expect a pattern of pasteurised, sterilised, UHT, condensed, evaporated milk, using cartons, cans and plastic bottles - but the pattern of package choice can only arise from the pattern of milk types and processing. Meanwhile, it would be advisable to concentrate on sterilised milk in plastic bottles (blown-blended HDPE/LDPE).

F. VEGETABLE OILS

Production is said to be 4.5 million tons, plus 1 million tons imported. The satisfactory packaging is blown PVC bottles, with blown polyolefines as an alternative. PVC is better because it allows sight of the oils, and purchasers prefer to see if the oil is clear.

G. TOMATOES

Production, at slightly more than 5 million tons, is little more than consumption. The major problem is local surplus in production (as in all countries) which causes waste and depresses selling prices (and thereby discourages increases of output). It would be advisable to develop processing on small-scale in the production areas, but for food conservation, not export.

For export trades it is essential to use the plum shaped variety of tomato with stronger flavour and higher solids content. The common beefsteak variety as grown would be less satisfactory. The processing is familiar for canned whole tomatoes, juice and concentrate. The best contribution of ARPC would be to provide library services to potential processors. Notably it is worth developing squeeze tubes for tomato paste (as part of a general supply of information of tubes for vegetable pastes and ground meat products).

H. EGGS

The consumption of eggs is about 0.6 million tons, but this statistic conflicts with production and import figures. For eggs the only fully satisfactory packaging is pulp-moulded trays from waste paper. Trials elsewhere have shown plastic trays and paperboard cartons to be less satisfactory - and the production of pulp-mouldings should be encouraged. ARPC should perform a full study of pulp-moulding in association with the Intermediate Technology Development Group (9 King Street, London), which is a non-profit organization devoted to small-scale industry - and who have helped to install plant in many countries down to 25 tons per year. Egg trays for 30 eggs weigh about 50 g and the plant may be located in egg-producing areas, simply and without fear of contaminating water.

I. MEAT

Meat production is 2.3 million tons, roughly split into equal parts of beef, mutton and poultry. Consumption is said to be 2.5 million tons. There is a confusing statistic of over half a million tons of imports, which is ignored in the present context. Arab preferences are for fresh meat from carcase cut by the retailer. It would be worth considering a study of primary cuts wrapped in film by vacuum machines or by shrink techniques. Primary cuts in film reduce contamination, reduce mess in handling, and maintain qualities in the meat. In anticipation, it is worth studying the entire subject of processed meat in association with the Food Federation.

J. PROCESSED PROTEIN FOODS

The major proteins in this context are meats, fish, cheese and vegetable proteins. Processing is to:

(a) Commercialise protein which would otherwise be wasted.
(b) Compound protein to a more attractive form for the consumer.
(c) Preserve protein by the use of heat and chemical addition.

The problem is that the biological breakdown of proteins produces toxins which may be fatal. Also, protein is a ready carrier of infections such as botulinum or salmonella. It is therefore essential that production is under controlled conditions with a good backing of technical know-how.

The requirement is for a major study involving the Food Federation, a health authority and ARPC.

K. WINE

Production is nearly 300,000 tons of which only 72,000 are for regional consumption. Towards a quarter million tons are exported and wine is a high-price product. There are two trends in the market to be appreciated. In Europe more wine is now being imported in bulk for supermarket own-bottling. There is more wine being sold in PVC bottles. ARPC could contribute by a study of wine movement in bulk, in bag-in-box (3 or 4 litre units), and in PVC bottles. Such a study should be market-oriented including discussions with the major retailing chains in Europe.

L. BEER

The regional statistic of production was not found but imports are about 3 million tons. The development of PET in Europe includes bottles for lager-type beer. It would be useful for ARPC to investigate the market in terms of returnability of bottles. If, as suspected, there is justification for one-way packaging, and if lightweight glass is not economic, there should be evaluation and acceptance of PET (25 g of PET replacing 650 g of glass).

M. LIQUIDS

The broad division of liquids is into carbonated and still (non-gassy) liquids. The world trend for carbonated liquids is to use PET-blown bottles, whereby a 650 g glass bottle may be replaced by a 25 g PET bottle. PET is at present the only plastic suitable for carbonated liquids. ARPC should issue a document outlining the development, with information to assist in the introduction of blown PET.

One of the major advantages of PET is that it allows larger liquid packages for carbonated drinks. If a two-litre glass bottle of carbonated drink is dropped there is an explosion which distributes glass splinters in all directions at high speed. If a two-litre PET bottle of carbonated drink is dropped, it is less likely to fracture but if it fractures there is no impulsive distribution of lethal particles. It would be useful for ARPC to devise and issue a specification for a standard two-litre PET bottle (possibly a copy based on such bottles now in use in Europe). At present, the supply of carbonated drinks in the region is dominated by small glass bottles, which do not provide sufficient per-package volume, and are expensive in production and transport.

Saudi Arabia alone consumes 1,345 million litres of carbonated drinks. Beer in Jordan is distributed at the rate of half a million bottles per month, and more is distributed as cans. In due course one may expect a total regional demand of the order of 135 litres per capita, or about 3.5 kg of PET per year per capita. It is obvious that a major study is essential. The demand for still liquids is not known. It includes many non-food products and water is an important consideration. The packaging is PVC or polyolefine-blown bottles, with cans and cartons as competitors. In general, PVC is used for clear bottles and polyolefines for products which do not need to be visible.

With regard to glass replacement the use of PVC or polyolefines means a weight reduction to about 4 per cent of the glass weight, and there is no danger from broken bottles.

The technology of blowing for still liquids is less complicated than that for carbonated drinks. Consequently, the investment is less and it is possible to manufacture on small or large scales. Half a million is a reasonable capacity per year per shift, and it is possible to produce in many shapes. The present problem of the region is mould manufacture, and it would be useful to have a regional mould design/production facility. Contrasting with PET blowing, there would be no great advantage in standardisation of bottle shapes and sizes because per-facility investment is lower and blowers should have freedom of design. The ARPC contribution should be confined to the supply of a document of technology and economics of blowing PVC and polyolefines.

For larger volumes of liquids the choice for the region is bag-in-box or drums. Bag-in-box is a film bag inside a rigid container, usually 4 to 10 litres. It is seen to be an essential development for the region and ARPC should issue an information leaflet, followed by a detailed document to assist the development. Drums are already familiar in the region. Drums are part of the broad picture of semi-bulk movement which includes tankers and static tanks filled from tankers. The agricultural interest is in the bulk movements of pulps and of edible oils. Such bulk movements are of economic value in:

(a) Food processing in which surplus crops are temporarily preserved by chemical addition for shipment to, and use by, food processors.

(b) Exports in which the importer blends or breaks bulk into his own packaging.

(c) Systems of collection of product from an area of small producers to a central packing shed.

The subject has not been studied within this report, but it should be part of the ARPC programme.

N. DEHYDRATED FOODS

Dehydrated foods may be classified as dried storage products, in which the moisture content is taken to the equivalent of 70 per cent relative humidity, dehydrated products in which the moisture content is taken as low as is economic.

Thus whole grains may be dehydrated to perhaps 12 per cent water content but dehydrated citrus juice may be dehydrated to below 2 per cent water content.

Dried storage products are not sensitive to micro-organic decay but are sensitive to infestation. Dehydrated products of very low water content resist infection and infestation, but they absorb moisture and must be isolated from the atmosphere. There is no famine of literature on dehydration of foods.

The difference between dried and dehydrated foods is important to the region because the region is fortunate in the availability of dehydrating climates.

Consequently, solar ovens of relatively simple construction may be used to reduce the moisture contents and thereby reduce the total energy required for extreme dehydration.

The packaging requirement for whole-grain storage products is sacks (the husk of the grain inhibits the absorption of water so airtight packages are not needed). For broken grain including flours the requirement is an airtight waterproof liner in a sack. For dehydrated foods of very low moisture content the packaging depends on the climate and shelf life anticipated. It varies from simple polyethylene film to sophisticated laminates.

The development of dehydrated products on a regional basis is not the responsibility of ARPC. The ARPC contribution would be to issue an information sheet on permeability of films, and to indicate practical packaging for specific applications - detailing materials, thicknesses and rates of entry of moisture, and possible shelf lives (already intended).

Note that permeability is proportional to package area and exposure. Packages which are collated are in mutual contact and have less area to absorb moisture.

Thus a collation of several film packages in a combining outer film bag will offer longer life than the loose packages.

O. SEMI-SOLID FOOD PRODUCTS

A major sector of food processing is the conversion of food into pastes. In a region where food conservation is important the conversion utilises products which would otherwise be lost as food supplies, and it assists in distribution. The range of possible packaging is wide but the main interest for the region should be in squeeze tubes of aluminium or preferably polypropylene. Products include many which are presently in cans but also new compounds which may be developed by the Arab Food Federation or national institutions. For examples:

(a) Tomato concentrate;

(b) Fish and meat pastes;

(c) Concentrated soups and sauces.

In essence, pastes are liquidized or disintegrated foods adjusted in viscosity by other food pastes, plus any necessary binder or slip agent, and with preservative. The technology is freely available and the process of filling into tubes is common. Compared against filling into cans or jars the health advantage is that part-contents may be used and the tube then reclosed, and the area of exposure when the tube is open is small (less infection and less entry of oxygen).

Other than tomato concentrate, it is evident that pastes are not commonly used in Arab diet, but there is export potential. The preservation of products from gluts and the ability to use foods which would otherwise be wasted make the production of pastes important. The subject needs, however, to be related to non-food products such as pharmaceuticals, cosmetics, lubricants and adhesives/sealants.

The requirement for ARPC is to prepare a document which details the equipment and technology of filling into tubes.

P. ANIMAL PRODUCTS

1. Meat;

2. Dairy Products;

3. Hides: and

4. Slaughterhouse Wastes.

1. Meat

Meat in the region is usually sold as carcase cut by the retailer. There appears to be under-development of preserved or compounded meat. Insofar that fresh meat is cooked, there are few health hazards in the existing system of distribution. It is, however, worth anticipating changes by study of the vacuum packaging of primary cuts. A primary cut is a few kilogrammes (up to 10) and the established packaging is vacuum packaging in laminate or shrink packaging in film or laminate.

The advantages of primary cuts packages are better preservation of meat quality in travel, easy, clean handling, and ability to direct specific cuts to selected market sectors. It is of particular interest for inter-regional trade. It would be of value if ARPC could issue an information document on primary cuts packaging and whole chicken packaging.

Preserved meat is evidently not popular in Arab diet and export trades in preserved meat are too competitive for countries lacking tinplate cans and surplus cattle. It is not suggested that ARPC give preserved meat priority.

If the packaging arises, the only practical packaging is in cans and the economics and health precautions make it only suitable for mass production.

Compounded meat, on the other hand, is of interest because it allows the utilization of tough meat and off-cuts. The usual solid compounds are meat/cereal mixtures which have value in distribution to low-income groups and school feeding, etc. The compounding allows the inclusion of chemical preservatives, which allow the use of film packaging (welded polypropylene or PE/nylon laminates). This is a subject in which ARPC could take an anticipatory interest.

2. Dairy Products

Dairy products are milk, butter and cheese - plus various fermented milks in the Arab region. Milk (and liquid fermented milks) require individual study by ARPC, as a comprehensive techno-economic study including collection, bulking, reconstitution of powder, bulk movement, beaking bulk, and retail distribution. The subject is far too wide to be detailed in this report, and it could be the subject of a specific project involving international agencies. The impression is that blown plastic bottles could have advantages but any investigation should include film sachets and cartons.

The problem in all countries is contamination - making it essential for any milk project to start with the establishment of efficient dairies.

Semi-solid fermented milks (yoghurt type) are established in thermoformed plastics tub packaging. The technology of packaging butter and cheese is available in literature. The ARPC duty appears to be no more than the collection of information.

3. Hides

Hides do not require any special packaging technology.

4. Slaughterhouse Wastes

Slaughterhouse waste is mainly blood and products for conversion into animal glues, soap and bonemeal. ARPC has no urgent interest in the packaging until other organizations present some important product.

Q. FRESH FRUIT/VEGETABLES EXPORTED

From available statistics the only significant fresh fruit/vegetable exports are:

Tomatoes	204,000 tons
Grapes	307,000 tons
Citrus	1,105,000 tons

There are also other minor quantities of products exported, and many fruits or vegetables on trial as potential exports. Within this report, concerned with plastics packaging, little may be said. For smooth

journeys the conventional pack is a wooden box. Plastics may contribute a little, as interlayers for first-grade tomatoes (maximum 200 tons PVC) or net bags for citrus (maximum 220 tons LDPE) but in general this product group may be ignored. On the other hand, if net bags were to be used for all the citrus in the domestic market, it could use 6,000 tons LDPEC (but total acceptance is not likely).

R. NOTES ON FRESH FRUIT/VEGETABLES

It is a common error to suppose that losses in fruit and vegetable trades are inevitably reduced by improved packaging. Losses may be reduced by improved packaging when the losses are due to either:

(a) mechanical hazards; or

(b) problems of ventilation;

or both.

Improved packaging will not reduce losses due to:

(a) Field infections, infestations, deficiency diseases;

(b) Field damage by predators (birds, slugs, moths, etc.):

(c) Field damage by climate (hail, rain, sun-scorch);

(d) Harvesting at the wrong stage of maturity;

(e) Physical damage in harvesting;

(f) Problems of temperature (too high or too low).

Such losses are reduced by improvements in culture, harvesting and pre-distribution handling. The pattern of culture, harvesting and pre-distribution handling should be:

(a) Grow the species and variety which is appropriate to the environment;

(b) Given a choice of varieties to avoid unicrop disasters;

(c) Harvest at exactly the correct stage of maturity;

(d) Harvest with minimum damage to the crop;

(e) Wash the harvested crop in clean cool water - to remove field heat and to remove field infections/infestations, and to make it easier to see rot and damage;

(f) Remove any fruit/vegetables which have rot or damage.

This is the basic pattern of culture, harvesting and pre-distribution handling, possible at any place of cultivation. Losses may be further reduced by:

(a) Post-harvest chemical treatment;

(b) Post-harvest temperature control;

(c) Pre-distribution handling in a building where it is possible to isolate good fruit/vegetables from mechanical, biological and environmental hazards.

The above pattern of culture, harvesting and pre-distribution handling is unlikely to be perfect, but it should provide a harvested crop which has no visible sources of early decay. For most fruit/vegetables such a visibly clean harvested crop should eventuate losses of up to 10 per cent according to the species/variety and distribution conditions. Such losses are due to the natural ripening process and to unobserved imperfections, and are accepted in trades as inevitable losses due to "inherent vice" (which means natural ripening or spoilage if ripening is prevented).

S. DISTRIBUTION

The most economic distribution pattern is "Total Corp Utilisation". In this, the harvested crop is graded by size and quality into:

(a) Optimum size and best quality to sell at highest prices including exports.

(b) Sizes and qualities as preferably accepted by domestic consumers, to sell at medium prices into the home market.

(c) Imperfect in size or appearance but sound in texture and nutritional value, sold at low prices into processing industries.

(d) Unsound in texture and unsafe for human consumption, disposed where the inherent infections/infestations will not transfer to crops.

The packaging requirements for the four fractions differ. It is common to consider tray/film retail packs for (a), film bags (either pre-packed into bags or with loose bags alongside open display for (b), washable, returnable field crates or tote boxes for (c) and (d).

Such a distribution pattern is only possible if there are facilities for food processing and if the distribution system includes groups of consumers who will accept tray/film retail packs. In all markets the consumers prefer to inspect fruit/vegetables before purchase, but in some markets a proportion of consumers will accept prepackages which prevent inspection. Such acceptance takes time to develop, being based on trust that the uninspectable fruit/vegetables are of qualities which justify the high prices.

XII CONCLUSIONS

1. There are plans for ARPC which are comprehensive within the constraints. As read, the plans do not sufficiently appreciate the individuality of plastics amongst packaging groups of materials, or of agricultural products. It is to be hoped that the comments in this report will be used to modify the final work plan, now in draft form.

2. The priorities are replacement of cans and bottles, and the packaging of liquids and sacks. The development of these requires a high input of information which should be in Arabic, and should provide full instructions for the setting up of conversion facilities, preferably as standardised production units.

3. The mechanics of technology transfer need to be organized with ARPC acting as contracted agent for the transfer. Much of such technology may be obtained within the region but much will need to be obtained from outside the region.

4. In view of the limited agricultural potential of the region, exported agricultural products should be given relatively low priority. Concentration should be on regional domestic markets.

5. The majority of requirements may be met using familiar plastics materials and familiar conversion techniques. ARPC must, however, look to the future by interest in new technology, notably linear, low density polyethylene and polyethylene tetraphthalate polyester PET.

6. Although pilot plant may have some value within ARPC for metal, paper and glass, it would have very limited value for plastics. It is not possible to simulate production conditions on reduced scale, and it would not be reasonable for ARPC to install plastics production equipment - but standard test equipment to measure basic properties of materials would have value.

7. It would be advisable for ARPC to have a plastics packaging division.

8. From observation it is evident that losses in fresh food would be reduced more by agricultural developments than by any improvements in packaging.

9. The conditions of handling in foreign trade (marine and overland) favour wood or paperboard, not plastics. Plastics may contribute as binders in particle boards to replace wood.

10. To conserve food one may expect major developments in processed food, which should be anticipated by ARPC. For this a major effort to replace tinplate cans is essential.

XIII FURTHER INTERNATIONAL INVOLVEMENT

1. The involvement of UNIDO is recognized and planned. The only additional comment is that this report advises the development of a reasonably large plastics division. It would be useful for UNIDO to provide a plastics processing expert to assist - probably for two months after ARPC has organized facilities and staff. At this stage it is not thought necessary to prepare a job description of such an expert.

2. It would be of value for ARPC to establish very close contacts with all other regional organizations, not only to study their organizational problems, but also to establish a network of communication. Contact with EEC and the packaging federations is obvious and organized, but it should be noted that Commonwealth Secretariat is involved in developments for other areas of reduced water and arable land, that the South Pacific Bureau for Economic Co-operation is involved in developments related to shortages of natural resources (notably wood), etc. All such regional organizations have information on plastics packaging and agriculture, and detailed contact will save ARPC much future effort.

3. ARPC requires more contact with FAO, for background information on subjects such as fibres versus tape for sacks, grading and post-harvest treatments as influences on packaging, etc. It also requires more contact with ITC for trade information and technical documentation (such as Export Packaging Notes which collectively form a handbook on practical packaging technology).

Note that ITC has an Inter-regional Special Programme for Export Packaging, with emphasis on information services. Part of the programme is the production of instruction manuals on selected packaging materials.

XIV LIBRARY DEVELOPMENT

A. JOURNALS

Containers of metal, glass and paper have historic origins and relatively old development of production. Plastics are new, and there is constant development of materials, equipment and processing techniques. Thus any item of information is likely to be obsolescent (for examples, PET has invalidated much of the information about liquid packaging and LLDPE has confused information about films). As it arrives, each new item of information is widely circulated and is variously converted into editorial in all interested technical press. Furthermore, the information supplied to the technical press is almost always for sales development, and technical journals frequently publish incomplete information because they rely for revenue on advertising from the information suppliers. Consequently:

(a) A library need not waste processing resources on many journals from one techno-economic environment. The regions to be covered (for plastics) are Continental Europe, U.K. and Scandinavia, U.S.A. and Japan.

(b) Journals are of two types. Newspaper types, such as Packaging News in the U.K., deal with present events and new products. Periodical types, such as Packaging Review in the U.K., deal with surveys and technical reviews. Only one of each type is necessary per region.

(c) Title of articles are not always indicative of subject matter. For example an article on PVC water bottles might be entitled, "Drowning the Fears about Monomer". Thus, journals require rapid reading to select articles for translation - by a person who has some measure of understanding of the language or print and has sufficient technical ability to select useful articles.

(d) Information concerns plastics or agriculture or packaging. The journals on plastics contain perhaps 20 per cent information on packaging and such information is also contained in packaging journals. Journals on agriculture contain perhaps 5 per cent information on packaging, and this information also is available in packaging journals. Journals on only-plastics or only-agriculture may be largely ignored to avoid duplicated effort.

(e) Most journals (plastics, agriculture or packaging) carry annual reviews. It is important to obtain such reviews, and publishers should be contacted to establish when such reviews are published.

(f) Journals constantly change their relative value. A list of desirable journals has a life of only one year. It is advisable that a visit is made to one international packaging exhibition each year to revise the list.

(g) One common practice is to appoint an abstracting correspondent in each region, not only to abstract journals but also to obtain reports and proceedings of conferences. This ensures the collection of data which does not reach publication.

B. BOOKS

Plastics technology, and particularly plastics packaging technology, has been constantly revised from its recent conception. In general, it has a life of validity of not more than five years, when some new material or process or market force causes change. Likewise, scientific agriculture and the development on post-harvest treatments cause significant changes in products. For example, trials have shown that oranges which are correctly harvested and graded may travel in bulk without packaging (and the consequent losses are lower in value than the packaging eliminated). If one takes into account that a book takes one year to write and one year to accurately translate into Arabic, the inference is that it would waste time for ARPC to translate existing books. The library needs only books which provide general background information as understood at the date of publication, with the understanding that polymers before 1960 were inferior to modern polymers, and that package designs, applications and economics before 1975 were produced before the world recession encouraged economy by design, application for function more than sales development, and the elimination of packaging where permissible. It is therefore suggested that ARPC:

(a) Contact publishing houses for a constant supply of lists of new publications and seek more new books than standard reference books (this applies less for other packaging groups and products, for which standard reference books have longer terms of validity).

(b) Produce loose-leaf books in Arabic, with constant replacement of pages as items of subject become obsolete.

C. CONFERENCE PROCEEDINGS

One private study (WJS 1970) showed that there are more than 5,000 world major conferences each year. Many of these are not reported and for many it is possible only to obtain abstracts (full proceedings are covered by copyright restrictions) only in the country of origin. In plastics and agriculture most of the conferences are designed to introduce new products, processes or marketing factors, and they have value to ARPC. It is suggested that ARPC contract a correspondent which may be an institute to provide notification of coming conferences of interest, and to obtain abstracts of conferences which ARPC cannot attend.

XV EXHIBITIONS

International exhibitions are in theory spaced and located to provide the maximum output of new information over the widest area. There are errors of judgment such as the coincidence of Paris and Chicago in 1982 but in general the possibility is to visit one international exhibition each year to obtain most of the important information about innovations and trends. For ARPC visiting exhibitions there is a special requirement insofar that exhibitors rarely speak Arabic and do not always have effective translators in English or French. Also, the translation services within ARPC require visual association of words with materials and equipment (for example, knowing the essential differences between shrinkfilm, stretchfilm and clingfilm). Where similar problems concern other visitors to exhibitions it is common for translators to be included in visiting groups, so that there can be more effective communication with exhibitors, and so that translators are better able to deal with information when they return (and can also prepare visit-reports which are comprehensive and accurate).

Pending Exhibitions to Note

1983	March	Hispack	Barcelona/Spain	
	April	TPG	Paris/France	(Printing)
	April	Pakex	Birmingham/U.K.	
	October	K 83	Dusseldorf/FRG	(Plastics)
	November	Asiapack	Singapore	
	October	Europack	Lyon/France	
1984	May	Interpack	Dusseldorf/FRG	
	September	Ipex	Birmingham/U.K.	(Printing)
	November	Emballage	Paris/France	
1985	March	Ipack	Milan/Italy	
	May	Macropack	Utrecht/Holland	
	October	Scanpack	Gothenburg/Sweden	
1986	May/June	Drupa	Dusseldorf/FRG	(Printing)

XVI INFORMATION REQUIREMENT DETAILS

Resources	Information Sources
Possibilities and patterns of development of regional: Tinplate (as a subject of replacement) Glass " Paper " Sacking fibres " Ethylene (as origin of polymers) Styrene	Mostly regional documents and discussion with regional organizations and country organizations. Some assistance from FAO, UNIDO and ITC libraries.
Plastics in General	
World trends in: Growth patterns of polymer groups by weight: Relative costs of polymer groups: Investment in polymer groups; (Note that the groups of interest are polyolefines, vinyl, styrene-based, polyesters).	Report of meetings and annual surveys in journals but not more than one year old. Best is by contracted techno-economic surveys by specialists.
Specific Plastics	
Development of performance characteristics and patterns of outlet-development for: Linear low density polyethylene (LLDPE); Polyester (PET): LDPE, HDPE, PP, PVC, Polystyrenes.	Suppliers of specific plastics or of conversion equipment. Exhibition visits.
Specific Conversion Techniques	
Developments of new equipment and modifications to reduce costs and improve performances relative to: Common films of LDPE, HDPE thin films, stretchfilm and clingfilm of PE or PVC with LLDPE modification, stretched HDPE and PP for sack tapes. Bottle blowing using LDPE, HDPE, blended PE, PVC, PET. Stretched tape handling, slitting, winding, weaving.	Suppliers of specific plastics or of equipment. Report of meetings and annual surveys of journals. Suppliers of packaged deals of material, equipment, economic analysis. Exhibition visits.

Medium and high barrier films of nylon, polyester.
Co-extrudates, notably LDPE/nylon.
High barrier laminates, rigid and flexible.
Injection-moulded crates of HDPE, PP.
Combirations, notably bag-in-box.
Chub packaging.
Thermoforming in the stages of simple forming, in-line extrusion; forming and in-line extrusion: forming, filling.
Binders and coatings for fibreboards.
Carton board coating.

Specific Products

Packaging developments for:

Cereals and flours, sugar, fresh fruit/vegetables, milk, edible oils, eggs, foods as pastes, tomato concentrates, fresh meat and poultry, processed protein foods, wine, beer, dehydrated storage products and highly dehydrated foods.

New-type journals, meetings proceedings relative to specific products. Exhibition visits.

With regard to sources, add library services of U.N. agencies, EEC and similar regional organizations, all plastics/packaging/food institutes and federations.

These sources are of more value for background information than for information about innovations. Appreciate that:

(a) Suppliers of materials and equipment provide information within days of innovation and news-type journals process such information within weeks. Other sources may take much longer.

(b) Information from suppliers is biased towards sales and it may not be accurate or comprehensive.

As illustration of the enormity of the task of abstracting journals, the following items of news have direct importance to the text of this report, and are within one single issue of Packaging News, November 1982:

1. PET widemouth bottles introduced by Linpac.
2. PVC widemouth bottles introduced by Smiths Containers.
3. VCL high-clarity PE film for bread by Vithe.
4. Vacuum flush technique developed by Weyerhaeuser.
5. New system of thermoformed packs for meat by Akerlund and Rausing.
6. Alternative closure system for bottles by Alcoa.
7. New stackable 20 litre blown jerrycan by Plysu.
8. Alternative to pallets for tea, using paperboard, by Tillotsons.
9. Paste dispensing equipment by National Instrument.
10. New vertical form-fill-seal equipment from Van Leer Group.
11. In-line thermoformer by Texas Instruments.
12. Cider in PET by Cornish Country Fayre.
13. Battery-energized stretchwrapper by Pakseal.
14. Reduced scale filler for liquid foods by Trustpak Machinery.
15. New low-bake can coating from Croda.
16. Large (1.5 kg) plastic pots for foods by Robertson.
17. Aseptic packaging for dairy products by Benco.
18. Flexible tube filling equipment from Unipac.
19. Aseptic form-fill-seal equipment from Thermoforming Milan.
20. Polypropylene containers for loads to 2 tons from Palagan.

XVII TECHNICAL SERVICE DEVELOPMENT

The requirements may be broadly classified as:

A. Assistance in the setting up of production facilities.

B. Assistance in the expansion of production facilities.

C. Trouble-shooting in existing conversion facilities.

D. The formulation of appropriate package designs, constructions and standards of package performance.

In all four respects plastics have less background experience than do other material groups, and is more influenced by the conditions of conversion in the establishment of package performance.

A. ASSISTANCE IN THE SETTING UP OF PRODUCTION FACILITIES

It is necessary to identify priorities, and further to discover if regional technology may be transferred, or if external assistance is essential. This report identifies priorities as:

(a) Common films and bags from LDPE;

(b) Specialty films, laminates and co-extrusion (of which PE/nylon is most important);

(c) Common blown bottles of polyolefines and PVC;

(d) PET-blown bottles;

(e) Common thermoformings;

(f) In-line systems including thermoforming;

(g) Sacks.

All require a specific project document which details materials, equipment, economics and probable problems with possible solutions. Such project documents will require revision every two years, and many project documents will contain common information. It is therefore suggested that the documents are loose-leaf.

B. ASSISTANCE IN THE EXPANSION OF PRODUCTION FACILITIES

In theory, ARPC should not be involved since the technology should come from within the enquiries concerned. In fact, assistance will be needed but it need be no more than information supply.

C. TROUBLE-SHOOTING

Troubles in plastics arise in conversion, and may be eliminated only in the location of conversion, not in a remote regional centre. The only exception is possibly post-distribution failures of packages, for which ARPC might venture opinion on the cause of failure - but the rectification when the cause is known must be in the location of conversion.

D. APPROPRIATE DESIGNS AND STANDARDS

In this context, "appropriate" means suited to the marketing and the conversion facilities. Any package should divide bulk, offer protection and assist distribution for the specific area of handling. Foreign (non-regional) designs and standards are unlikely to be fully effective in the region, but are useful platforms for modification. One special case of standardisation is of production units for the subjects identified as priorities above.

It would be logical for ARPC to act as agents for the formulation of contracts and the supply of materials/equipment/technology.

XVIII CONSIDERATIONS FOR ARPC

GENERAL

1. Future plastics packaging experts should be associated with counterparts who will be trainers in ARPC staff.

2. ARPC activities should be supported by a plastics packaging section at least equal in resources to the paper/carton section.

3. Plans for pilot plant should not include plant for plastics (but equipment for comparative testing is required).

4. Fellowships should be provided for translators to develop some measure of awareness of the peculiarities of plastics processing.

5. ARPC should concentrate more on Arab markets than on non-Arab markets in plastics packaging developments.

TECHNICAL SERVICE

6. Laboratory services should coincide with the listed applied research activities.

7. Laboratory services should include activities related to stretched film and tapes for sacks.

8. Laboratory services should include activities related to low-cost general-purpose polyethylene films, aimed at cost reduction and improved performance.

9. Applied research activities should include a major study of linear low density polyethylene as a new and influential material.

INFORMATION SERVICE/TRAINING

10. There should be production of project documents of standard factories for production of sacks, blown bottles and films.

11. ARPC should hold internal symposia on plastics so that staff are made aware of the relationship of plastics to other materials, notably as replacements.

12. ARPC should contract foreign correspondents to supply translated abstracts of plastics packaging information originating in German-speaking Europe, Japan and south/central Americas (LANFI Mexico?).

13. ARPC should have a special section to prepare or obtain by contracts techno-economic studies which include social considerations.

14. Training courses, workshops and symposia should use programmes appropriate to the Arab region, not programmes appropriate to other regions.

15. ARPC should produce extensive comparative literature on polyolefines, PVC and PET for bottles and films.

16. ARPC should issue guidelines in the choice of materials, thicknesses and post-extrusion treatments of films, related to shelf lives and products.

17. The section on Quantities in Unified Plan within this report should be revised and extended to include all countries in the region.

18. Techno-economic studies should be obtained by contract from abroad with regard to world trends of prices, markets and new materials/processes.

19. An Arabic-speaking researcher should revise the Region and Countries Section of Unified Plan in this report, and extend it to include all Arab countries.

20. ARPC should issue a list of abbreviations and terms used in plastics processing (note that these differ in various countries and within countries).

21. A statement should be produced of the tax and duty situations in the Arab countries and used as a platform for a symposium.

22. Liquids should be surveyed and listed in terms of types of liquids, quantities and locations of production and outlets, for each country.

PACKAGING

23. Information on pallets should be processed and the subject included in Applied Research Activities to develop pallets other than from wood, including possible use of plastics bonded/coated fibreboard.

24. Retail plastics packaging appropriate to the region should be developed and publicized in guideline information sheets.

25. The study of alternatives to cans should include rigid plastics alternatives.

26. There should be major research activity concerning the economics and performances of tape sacks versus natural fibre sacks versus paper sacks.

27. With AFFI there should be a broad programme of development of processed foods (long-life and short-life) and plastics packaging.

28. PET should be studied in detail for bottles, films and laminates.

29. Fibres and plastics binders should be examined to develop a range of boards to replace wood (Alfaboard is only one of many possibilities).

30. Polyolefines from biomass (carbohydrates) should be the subject of constant study with a view to research activity in due course.

31. Plastics net bags should be examined with market trials to discover regional applications for fruit/vegetables.

32. Studies of re-use and recycling should include study of possible movement of used packaging to regional disposal centres, and for users the possible movement between countries for second-hand applications.

33. From intended studies of return-journey distribution detail locations where glass shows distinct advantages, and elsewhere encourage the use of plastics.

34. Develop and introduce standard 1-litre and 2-litre PET bottles for carbonated liquids (and possibly oxygen-sensitive non-carbonated liquids).

35. Issue standards as guidelines for shrinkfilm, stretchfilm and clingfilm.

36. Develop and issue standards for imported polymers according to applications and performance requirements in the region (not by necessity identical to performance requirements elsewhere).

37. Research vacuum metallization for medium-barrier applications.

PRODUCTS

38. Investigate regional cereals in terms of demands for sacks and reduction of demand by bulking and retail packaging by millers.

39. With AFFI develop appropriate milk processing and packaging including bag-in-box.

40. With AFFI develop sausage tubes and chub packs for food pastes including tomato and protein derivatives.

41. Research the potential for primary cut meat in vacuum or shrink bags.

TECHNOLOGY TRANSFER

42. Establish ARPC as an agent for transfer of technology (not only adviser).

43. List technology within the region which is available for transfer.

44. Establish the pattern of demand for technology within the region and actively seek such technology (UNIDO and ITC can assist).

45. As a first step in the organization of transfer of technology, prepare a project document and promote the transfer of technology concerning PVC bottles for water and Alfaboard, from Morocco through the region.


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