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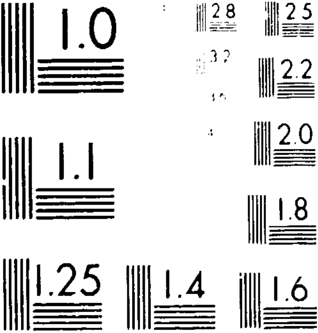
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PLASTICS IN WORLD AGRICULTURE, 1980*

by

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* The views expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been translated from an unedited original.

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1. INTRODUCTION

It has been repeated again and again that agricultural productivity must increase because every five days it must feed a million more mouths.

Increasing the volume and quality of agricultural production is a very complex problem. In fact what it involves is no less than intensifying more and more the domestication of photosynthesis - a fundamental biochemical process in our biosphere.

Such action supposes in the first place increasingly refined knowledge of the laws governing plant growth: that is the task of research workers.

Then it supposes increasingly reliable control of the ecosystem, that is to say, of vegetable matter and its environment. Then agronomists, hydraulic engineers and civil engineers come into the picture to adjust water supply (by irrigation and drainage) and the supply of mineral salts (by means of fertilizers), in order to eliminate harmful agents (by means of pesticides and herbicides) and to correct the harmful effects of a hostile climate (for example by wind breakers) or in the extreme case by creating a whole new and favourable environment (greenhouses).

One can immediately perceive the close relationship between agricultural productivity and inputs of industrial origin. Plastics, which often have a place in the most productive and complex cultivation methods therefore partly explain the extraordinary leap forward of modern agriculture during the last thirty years (in the United States of America, for example, the index of net agricultural productivity has risen from 100 to 180).

2. PLASTICS IN AGRICULTURE - THE SITUATION IN 1980

2.0 However, it is difficult to quantify the incidence of plastics and their influence on agricultural progress. The variety of materials (PE, PVC, PP, etc.), the diversity of products (films, sheet, tubes, grilles, foam, mouldings ...) and their versatility, and the large number of applications complicate the compilation of statistics. In this respect, fertilizers and pesticides have the advantage of being intended for use only in agriculture. However, plasticulture does have one advantage, namely, that of the network of co-operation consisting of the ten associations that are members of the International Committee of Plastics in Agriculture (CIPA) and the correspondents throughout the world who strive to compile the maximum amount of data possible, both statistical and technical. The national delegates will shortly report on achievements in their respective countries. For my part, I should like to try to sketch in broad outline the progress of the main applications of plastics in world agriculture.

2.1 Mulching

Whereas, logically, this technique should be adopted mainly in the semi-arid zones, it is most widely used in a very well-watered country, Japan, and the area in which this technique is used there seems to have stabilized at around 105,000 hectares. However, plastic mulching is indeed used to achieve gains in early growth and output in regions with a Mediterranean type of climate: California and Florida (70,000-80,000 hectares), Israel (2,000 hectares), Bulgaria (1,000 hectares), Italy (8,000-9,000 hectares) and France (35,000 hectares). Mulching is making satisfactory progress in Spain (figure I).

In the more northerly regions, mulching is gradually becoming widespread in greenhouses; often a two-colour film is used, black on the underside to stifle weeds, and white on the top to reflect the light towards the foliage.

It should be noted in passing that the length of the mulching period with plastics varies considerably, from 60 days for male lines of seed maize to 4 years for young plantations of trees (fruit trees, citrus trees or vines) and that consequently the figures quoted are mainly indicative.

Nevertheless, their development over time shows sustained growth, which should continue because of the interest shown by some developing countries in mulching: that is the case for example with market gardening in Morocco (90 hectares in 1979 as against 27 hectares in 1976) and in the campaign for the renewal of citrus orchards in Algeria.

In addition, the use of mulching is beginning to spread beyond horticulture towards large-scale cultivation: the cultivation of vegetables, cotton and maize in large fields (5,000 hectares in France in 1979). Three factors have combined to make possible the mechanization which is required by farming large areas, while retaining good profitability: photo degradable films, multipurpose film laying machines, which are being actively perfected, and more recently the development of extruders for films that are both very thin (20-25 microns) and have high mechanical resistance.

2.2 Semi-forcing: low tunnels and floating canopies

Three or four years ago it was predicted that low tunnels would almost go out of use, since it was alleged that they were difficult to ventilate and above all that they entailed excessive labour costs. Between 1973 and 1976 the area in which they were used had fallen from 45,000 hectares to 30,000 hectares in Japan and from 600 hectares to 300 hectares in Norway.

These predictions were doubtless over-hasty and too simplistic.

In fact, three types of development can now be discerned with regard to semi-forcing techniques under temporary plastic shelters.

(1) First of all there is a large group of countries that have shown remarkable stability in the use of these techniques for almost 10 years: Argentina (600-700 hectares, mainly in tobacco nurseries), the United Kingdom (800-1,000 hectares) and Japan, where the area rose to 45,000 hectares after the crisis.

(2) Then there are countries in which the use of low tunnels is gaining ground: Greece (5,700 hectares against 3,500 hectares in 1976), Cyprus (600 hectares against 500), Tunisia (870 hectares against 600), and Czechoslovakia (250 hectares against 195).

(3) Finally, there is a third group of countries in which the use of low tunnels is losing ground, either to large unheated tunnels or to floating canopies. Figure II shows, however, from the example of the Federal Republic of Germany that the total of low tunnels and floating canopies follows a rising curve: there is not therefore substitution pure and simple but rather progress. The technique of floating canopies (perforated or slit PE film or sheets of non-woven material) is gradually spreading from the area in which it originated, namely the Palatinate, towards Switzerland. France and the Netherlands. The scale of the tests being carried out in Czechoslovakia (40 hectares), Greece (50 hectares) and Canada (20-30 hectares) shows that there is certain to be growth in this type of application.

2.3 <u>Greenhouses and large shelters of plastics</u>

Three years ago, in 1976, the total area of plastics greenhouses, heated and not heated, was of the order of 60,000 hectares.

Now the area is probably more than 80,000 hectares. After the countries that used plastics greenhouses as a decisive tool for agricultural development, that is to say, Japan (30,000 hectares), Italy (20,000 hectares) and Spain (11,000 hectares), more and more countries are recognizing the often unrivalled effectiveness of plastics greenhouses in raising their horticultural and market gardening output. The example of Jordan (less than 1 hectare in 1974, 110 hectares in 1980) is particularly significant, but participants will report on many other cases of spectacular development, often due to a combination of the will of persons in authority locally and the assistance of international organizations.

This spread of greenhouse cultivation beyond the traditional Nordic areas towards sunny countries is accompanied, incidentally, by some reappraisal of the function of greenhouses. It is in fact not enough for them merely to be heat traps. In the arid countries they must act as screens against dry winds and excessive sunlight. In the tropical countries, they must protect young seedlings against torrential rain. Incidentally, they can also be used for drying tobacco (1,200 hectares in Greece).

Polyethylene is still by far the commonest material for covering these greenhouses and shelters; it is used in the form of "long life" films, "infrared" PE, EVA, and also, too often, in the form of ordinary film. Plastified PVC is still preferred by Japanese greenhouse operators and is also found in Italian and Greek greenhouses, but in a very small proportion: in Greece, 17 hectares as against 2,000 hectares of greenhouses covered with polyethylene. Plastics panels are arousing renewed interest: polyester reinforced (and protected) with fibreglass in the Near East for reasons of durability, double-wall panels of methyl polymethacrylate or polycarbonate in Western Europe for thermal reasons.

2.4 Grilles and nets

Experience particularly in Kuwait and Abu Dhabi shows that the mere provision of artificial shade makes it possible to extend the harvest from spring to early summer, and then to recommence cultivation at least one month sooner than in the open air. It is therefore not surprising that this type of shelter is spreading quite rapidly from the Near to the Middle East. The Lebanon, with 10 hectares under artificial shade and 50 hectares of plastics greenhouses well illustrates the complementarity of the two methods.

Plastics grilles have many other uses:

Wind breaks: 200,000 m^2 annually in France to intensify both milk and tomato production;

Anti-frost nets (Italy) and bird nets (Swiss, German and Austrian vineyards),

Fruit harvesting: to harvest olives, Greece uses 30 to 45 m^2 of nets per year and Italy 1,200 tonnes of polypropylene.

2.5 Storage and preservation of harvests

In the industrialized countries, millions of tonnes of plastics are used for wine vats, milk tanks and rigid silos.

In Western Europe it seems that the ensilage of fodder under plastic film has, so to speak, reached "cruising level", with a tonnage that scarcely alters with the introduction of new techniques (such as that of large round bales): 25,000 tonnes annually in the Federal Republic of Germany, the same amount in France and 8,000 to 10,000 tonnes in the United Kingdom. However, the storage of grain in plastics silos should develop considerably in countries like India that are suddenly confronted with the problem of storing the abundant harvests that result from the "green revolution" in a manner that is both efficient and economic.

2.6 Irrigation

Even in those countries that are apparently best off for water supply, sharp competition for water has sprung up between households, industries and agriculture. The water consumption of ten persons in a luxury hotel absorbs more water in a year than a hectare of cotton under irrigation.

For that reason, in the whole world, the accent is placed on better management of water, and on the development of water reserves and irrigation networks. However well watered it may be, the United Kingdom uses 7,000 tonnes of plastics a year for this purpose. Because of sunlight, exactly twice as much (14,000 tonnes) is consumed in Italy for the same use. Further southwards, plastics prove to be even more clearly indispensable either for the economic lining of canals and reservoirs (India) or for the optimum use of available water in drip or fine-spray irrigation systems. In South Africa, the areas treated in this way rose between 1976 and 1979 from less than 9,000 hectares to 23,000 hectares; Cyprus predicts that its present equipment covering 6,500 hectares should reach the level of 10,000 hectares in the space of two years.

One should also note the rapid development, particularly in greenhouses, of fertilizing irrigation, which is after all the almost inevitable corollary of micro irrigation techniques and often leads to more sophisticated techniques of soilless cultivation; here also, plastics play an irreplaceable role.

2.7 Drainage

However, it is not enough to supply water. It is also necessary to remove excess water, and treat soil that is periodically waterlogged or threatened with salinity. FAO estimated in 1975 that out of the 223 million hectares then under irrigation in the world, 52 million needed drainage.

The Netherlands has already drained 66 per cent of its agricultural land, the United Kingdom 61 per cent and the Federal Republic of Germany 37 per cent. France is endeavouring to make up its leeway: the use of PVC pipes with ring reinforcements, which facilitate and accelerate mechanized pipe laying, made it possible to drain 78,000 hectares in France in 1979 as against 32,000 in 1974 and less than 10,000 in 1970. Although it has an abundance of virgin land, Canada still carries out drainage operations: 30,000 hectares in Quebec and 25,000 hectares in Ontario in 1978. The reason is that drainage gives obvious benefits (figure III).

Unfortunately, there is still a pronounced gap between the industrialized and the developing countries. In the latter, aridity doubtless tends to force this aspect of water control into the background, however essential it may be. A salutary reaction is emerging in certain development projects, particularly in Egypt.

2.8 Miscellaneous applications

There are few branches of agriculture, whether arable operations or stock raising (including fish farming and hydroponics) which in one way or another do not utilize the characteristics of plastics:

Horticultural ware: Denmark alone manufactures 150 million pots and containers a year;

Harvesting and handling containers;

Agricultural twine:

Elements for agricultural buildings: almost 5,000 tonnes in Hungary;

Parts for agricultural machinery (corrosion resistance);

Foam for the physical improvement of soils;

Protective sheaths for bunches of bananas, sheets for drying cocoa beans, etc.

3. CONCLUSIONS

3.0 This brief review of recent developments in the use of plastics in agriculture has revealed several tendencies:

The continued advance of cultivation under shelter;

The rapid growth of applications with regard to water management;

The progressive transition from mulching and semi-forcing under floating canopies in intensive market gardening to more extensive vegetable cultivation and even large-scale cultivation, thanks to the development not only of new plastics materials but also of suitable machines.

For completeness, three general remarks should be added.

3.1 <u>The agricultural use of plastics and energy</u>

What is usually referred to as the "energy shock" had the merit of highlighting a phenomenon that had too often been ignored in the past, namely, that an increase in agricultural productivity must, at least in the present state of technology, be achieved by means of an increase in the consumption of fossile energy in various forms: mechanization, fertilizers, pesticides and plastics.

For example, mulching strawberry plants makes it possible to increase output by 25 to 45 per cent. But black polyethylene film with a thickness of 50 microns, used at the rate of 350-400 kg/hectares, corresponds to approximately 0.8 TPE.

Should agriculture, and particularly the agricultural use of plastics be accused of wasting fossile energy?

First of all, it should be pointed out that the share of agriculture in world energy consumption is relatively small, namely 3 to 4 per cent.

A closer look at the question will soon show an unsuspected disproportion between energy consumption linked to agricultural production proper and downstream consumption (figure IV). In passing one should note the importance of the item "consumption preparation". It is already a major item in a country as industrialized as the United States but becomes dramatic in the third world. It explains deforestation in Nepal and the Sahel; as a result, the rapid and widespread introduction of easily operated rural digesters for the generation of biogas by family units is justified. Here also, plastics have a role to play.

In the industrialized countries, the cost and sometimes the rationing of traditional fuels have nevertheless forced greenhouse operators to make a serious effort to change their methods, mainly in two ways:

(1) The reduction of heat losses by means of double walls, linings and thermal screens;

(2) The use of energy sources that had so far been neglected, for example, waste heat from industry, which is beginning to be used in the United Kingdom, the Federal Republic of Germany, France and the USSR, and hot springs, which are already being used on a large scale for the heating of greenhouses in Hungary.

Several conference papers will show that in these two uses, plastics have provided at once the most effective and the most economic solutions, thus furnishing additional evidence of the efficient use of energy represented by the utilization of plastics in agriculture and horticulture. Moreover, that explains why the "energy shocks" have in no way slowed down the progress of plastics in agriculture, quite the reverse.

3.2 Plastics and family gardens

Production in family gardens belongs to the non-registered sector and is thus not reflected in statistics. However, it is far from negligible (accounting for 20 per cent of vegetables produced in the United Kingdom) and absorbs considerable quantities of plastics (7,000 tonnes of watering hoses in France).

Several factors contribute to intensifying this phenomenon in the industrialized countries: economic difficulties, the increase in leisure time, and a fashionable "ecological" trend. In the distant French Department of Saint-Pierre-et-Miquelon, off Newfoundland, the increase in the number of plastics family greenhouses meets an immediate need, namely, to obtain fresh vegetables at a latitude where the mean annual temperature is only 5.5° C. For the same reason an attempt is being made to install small individual greenhouses for the benefit of workers in James Bay, in Canada.

The use of plastics in family gardens could doubtless make a valuable contribution to the welfare of the peoples of developing countries; a programme that has been launched in Morocco is an attempt to prove this.

3.3 Agricultural uses of plastics in the developing countries

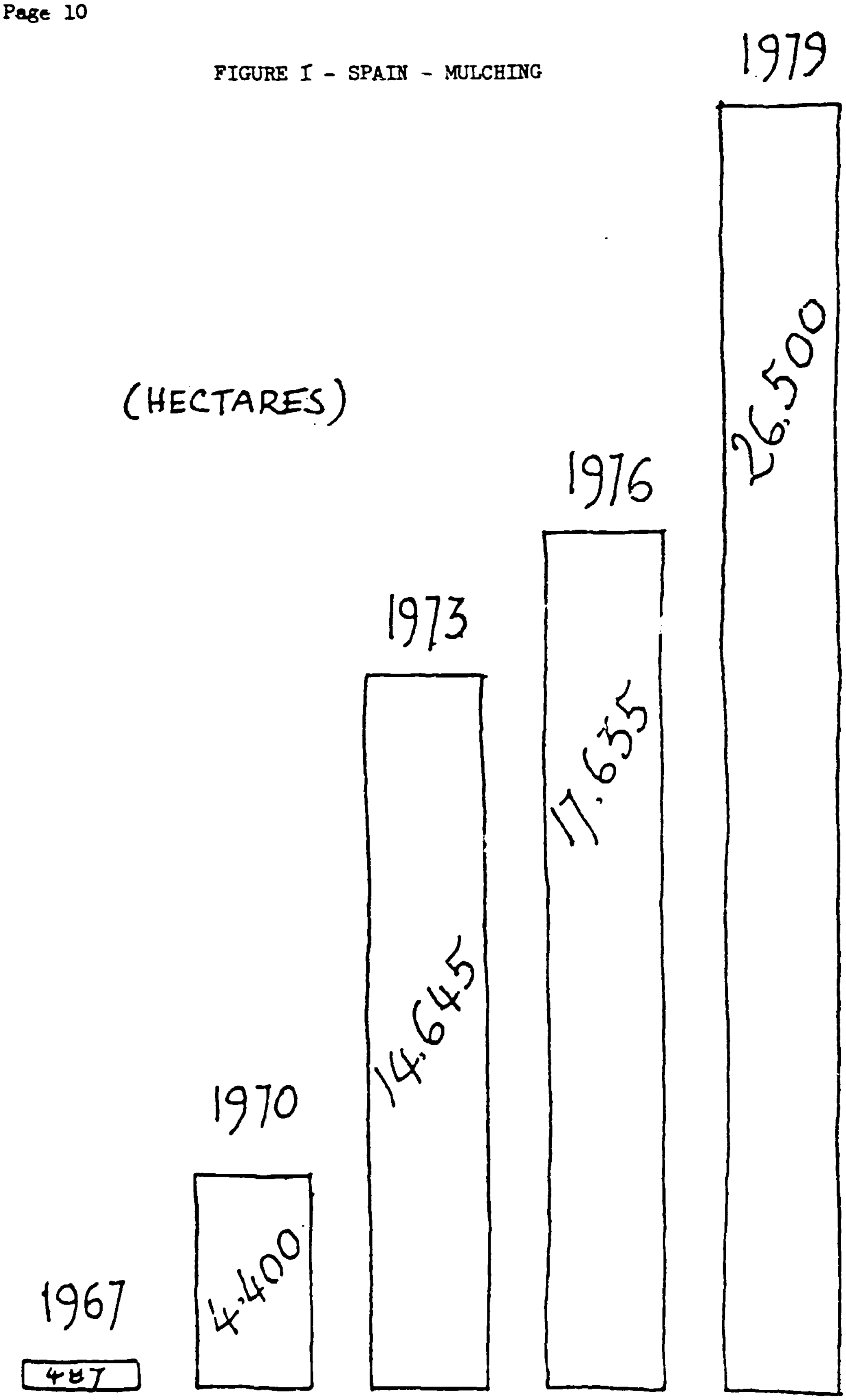
It must be noted that the developing countries, taken all together, have only a very small share in progress in the agricultural use of plastics throughout the world.

Certainly there are exceptions, successful initiatives both in the field of the plastics industry and agricultural productivity which give us reason to hope.

Nevertheless, the over-all results are still disappointing and in any case the targets fixed by international conferences have not nearly been reached. We are here to look for solutions, to analyse the obstacles in the way of more rapid modernization, to compare and contrast points of view and above all to exchange the fruits of our experience.

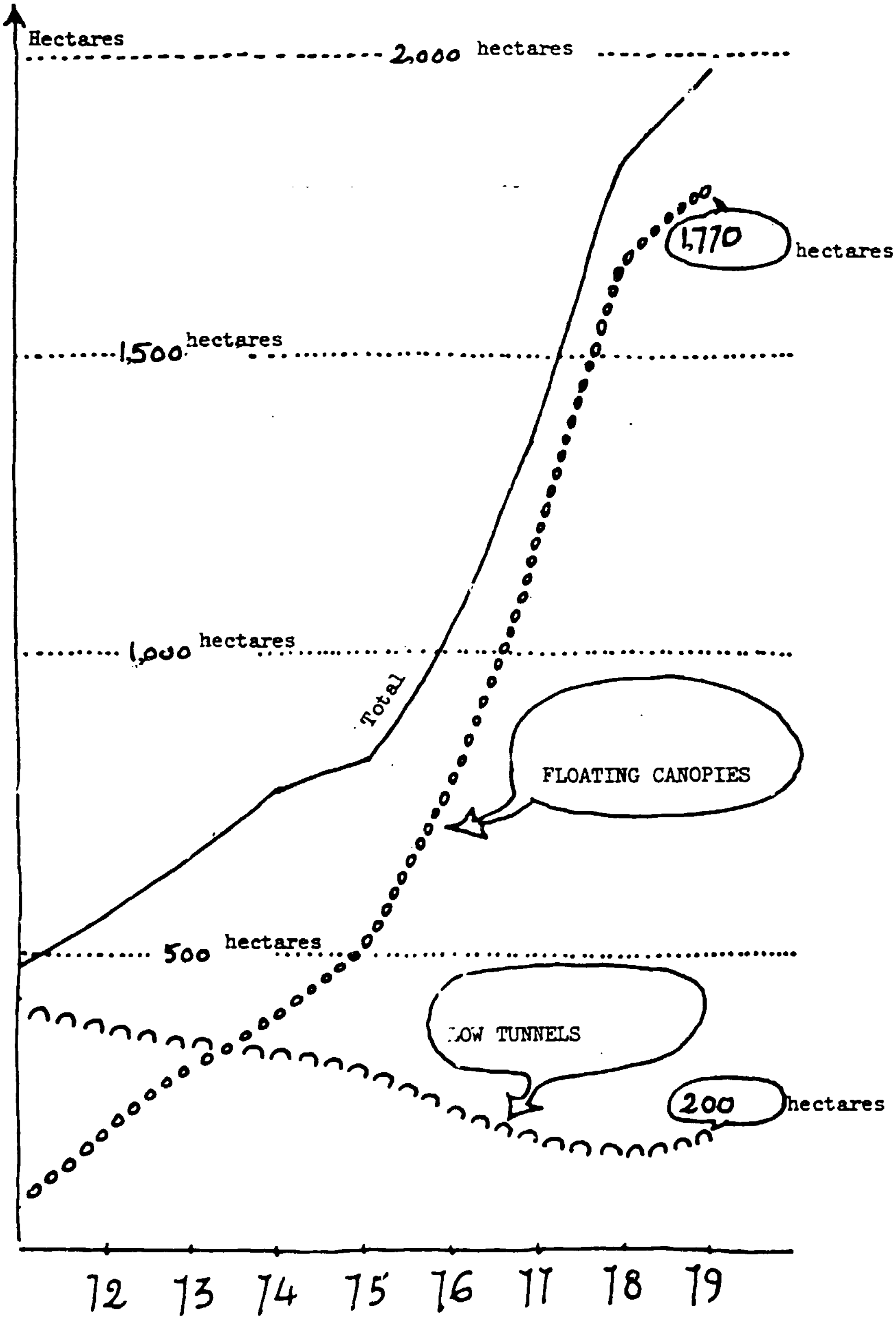
It is precisely the priority objective of CIPA to organise a permanent exchange of information amongst all those who see the rational use of plastics in agriculture as an effective way of ensuring better nutrition for all and for constructing new agro-industrial relationships on solid foundations and later on the basis of solidarity.

FIGURE I - SPAIN - MULCHING



Source: CEPLA

FIGURE 11 - FEDERAL REPUBLIC OF GERMANY - SEMI-FORCING



Source: BASF AG

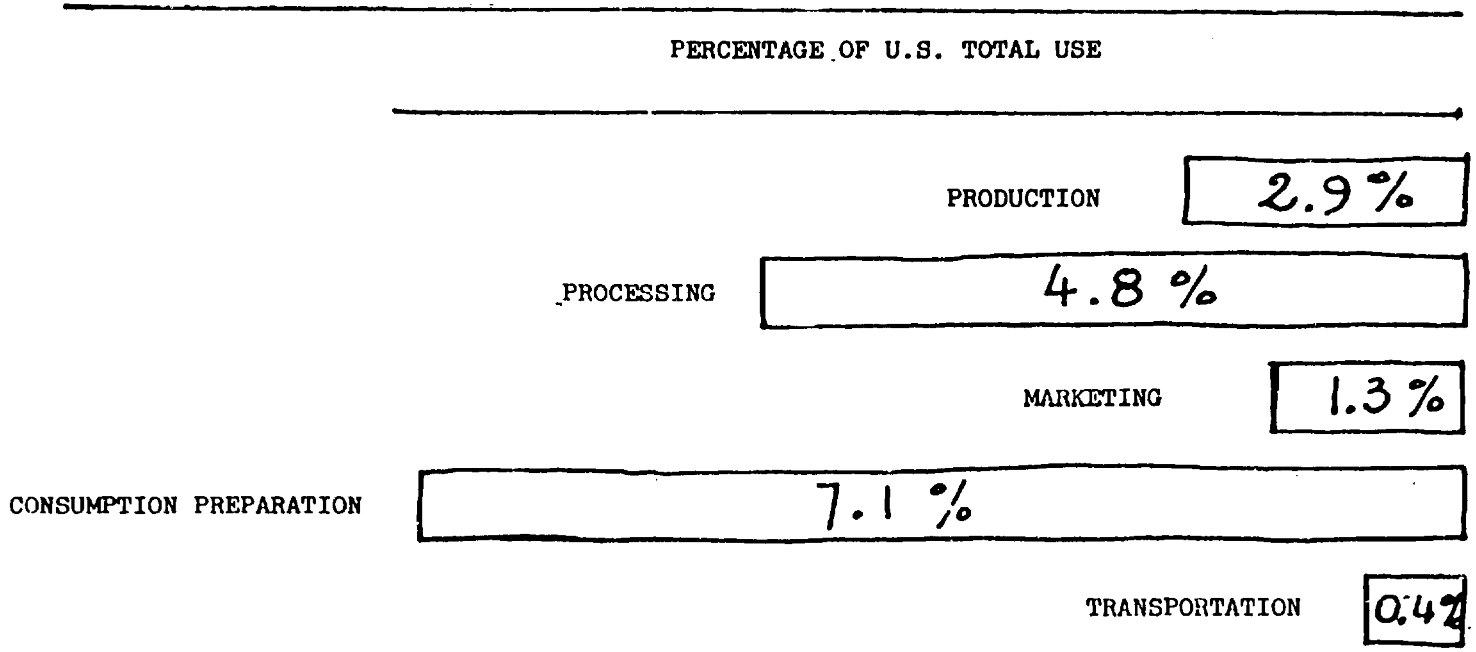
FIGURE III

BEFORE DRAINAGE		AFTER DRAINAGE 30% AGRICULTURAL LAND
1.45	NUMBER COWS/HECTARE	1.76
3.600 ℓ	MILK/COW/YEAR	4.200 ℓ
4.5 t	WHEAT/HECTARE	5.1 t
	FERTILIZERS	-10 %
100	NET INCOME/HECTARE	166

Source: FNCUMA, France

FIGURE IV

ENERGY USE IN THE U.S. FOOD SYSTEM



Source: U.S. Economic Research Service

TOTAL: 16.5%