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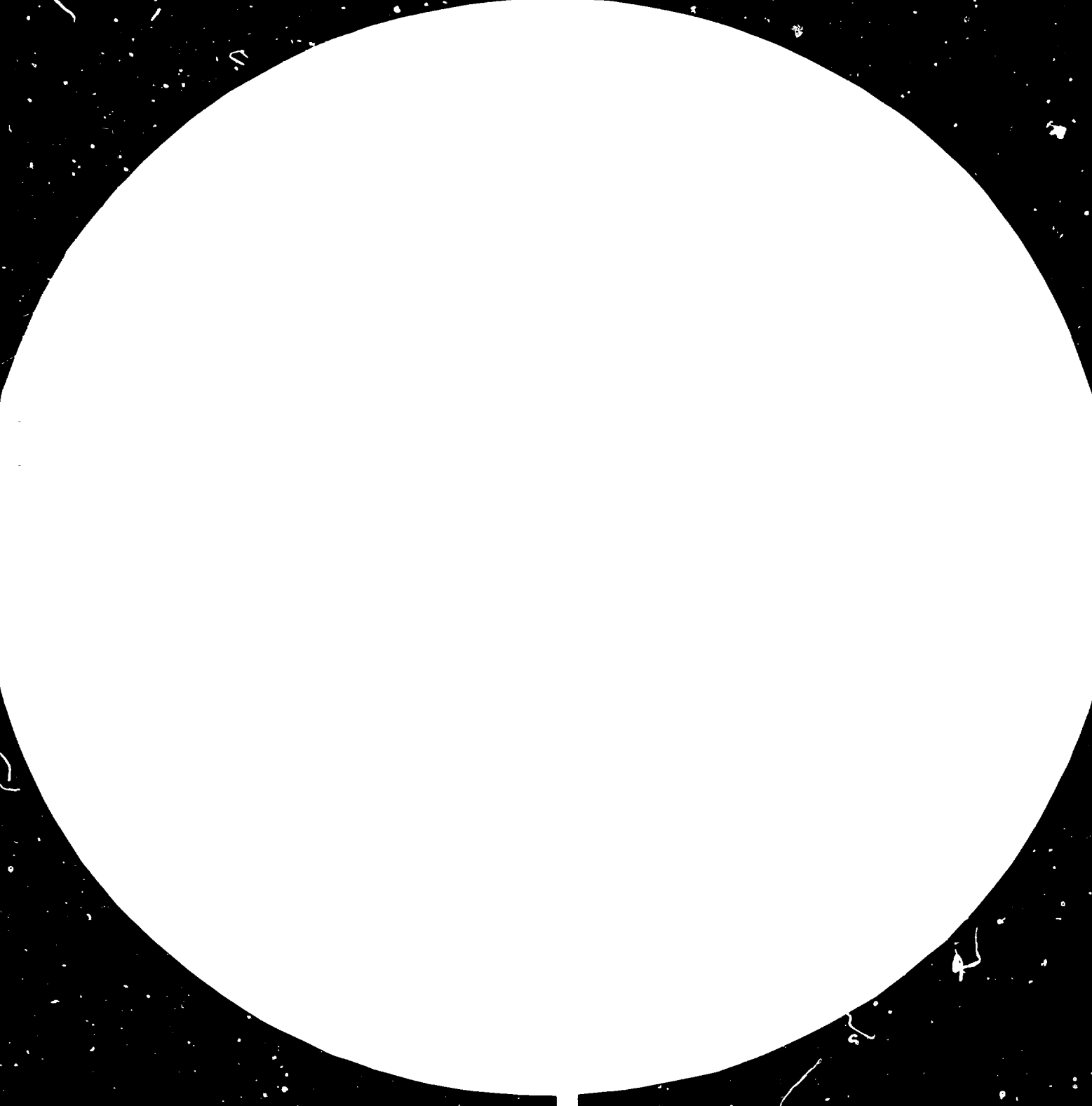

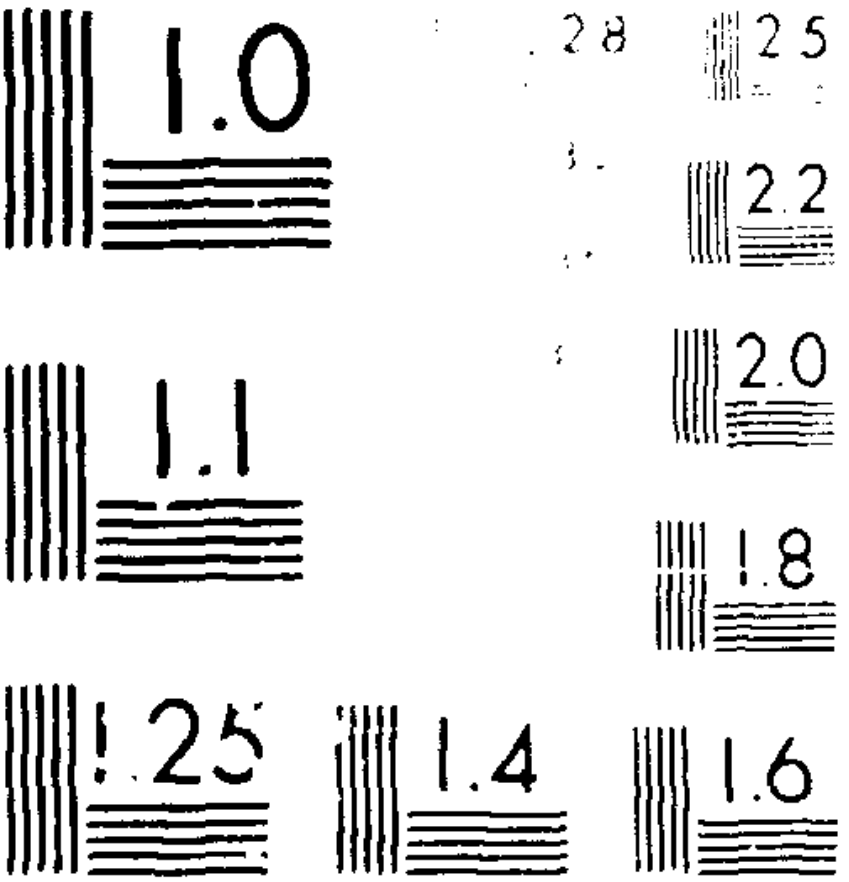
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THE USE OF PLASTICS IN THE AGRICULTURAL DEVELOPMENT OF THE ARGENTINE REPUBLIC*

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 UNIDO Secretariat. The original document of which this is a translation was reproduced without formal editing.

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It is customary for general reports to present an optimistic picture of the state of a technology in its country of origin. In our paper there will be no departure from this rule, since, despite the vicissitudes to which the technical-economic structure of every nation is subject, technology advances and with it the image that it presents.

The use of plastics in agriculture, or as it is sometimes called, plasticulture,[1/] has not expanded in Argentina in recent years to the extent that might have been expected on the basis of the know-how of the country's technicians or the advanced state of its industry. Rather, external and internal factors have conspired to check the constant growth that had been in progress since the introduction of this technique and which had in fact taken on the characteristics of a veritable boom.

The external factors certainly included the oil crisis, in view of the fact that, although Argentina is only minimally dependent on imported oil, the total industrialization of petroleum derivatives has not yet been completed. As a result, the situation affecting raw-material producers abroad did not go unfelt in our country. The coming on line of a number of rudimentary raw-material production units was not sufficient to satisfy all the requirements of the domestic market, with the consequence that supplies had to be imported. The oil crisis brought with it not only an increase in price, but shortages as well.

Once this critical phase had been overcome, the country passed through a period of internal problems which had a severe impact on the agricultural sector by arresting technological progress, a development that could not but affect plasticulture, which is naturally a part of the total technological package. This is the internal factor which we shall be analysing in this paper.

1/ Translator's note: It seems permissible to use this term, in the sense indicated, in this translation, particularly as it is used in original English-language writing on this subject.

It might be well at this point to recall a few facts about the geography of Argentina. The national territory consists of the extreme south-eastern portion of the South American continent, a number of islands in the Atlantic Ocean, and the Antarctic region. The continental part lies between 22 and 55 degrees south latitude and covers an area of 2,778,763 km^2, which together with the island possessions and the Argentine Antarctic makes a total of some four million square kilometres.

Regarding the geography of the country, Professor Federico Daus writes in his book Fisionomía Regional Argentina: "The vastness of its territory is a fundamental feature of the geography of the country in that it is the source of one of its essential characteristics - regional diversity. In turn, climate is the key to regional diversity. The location of the country is such that the middle latitudes predominate, since 44.85 per cent of the total (continental) area lies between 30 and 40 degrees south latitude. Because of this fact and the extention of the country into other latitudes as well, the territory is characterized by a great variety of climatic patterns, the latitudes constituting a kind of moving boundary between the masses of tropical and sub-antarctic air which by alternately advancing and retreating bring about changes in the weather. The advance of these fronts generally results in rain and abrupt falls in temperature in the eastern part of the country." In another place in his book the author writes: "No aspect of human life in the various geographic settings of the country can be properly understood from other than the perspective of regional geography."

As Professor Papadakis has correctly noted, one of the country's climatic characteristics is the abrupt changeability of the temperature. The absence in South America, he points out, of a mountain chain running from east to west makes it possible for the winds to circulate freely from the equatorial zone to the polar and in the opposite direction, the result being a high frequency of late and early frosts. Professor Papadakis rightly argues that a region's climate is more accurately described by its maximum and minimum temperatures than by its average temperature.

These remarks pertain to the area of physical geography. It must also be kept in mind, however, that despite its vast size and propitious conditions for

a greatly expanded agricultural use of plastics, Argentina is a country whose totally atypical demographic distribution is one of the factors which have influenced the growth of this technology.

The current population of Argentina is nearly 27 million inhabitants, more than a third of whom occupy an area no larger than 4,000 km^2. This distribution has created a market whose requirements must be satisfied in every area and at every economic level - food, housing, transport, etc., in effect, in every sector of the basic production and commercial infrastructure.

Although it is very often used, infrastructure is a word which is rarely analysed for its full range of meaning. Its implications extend to geography, economics, population, methods of production, environmentally appropriate technology, storage and transport facilities, distribution systems, commercial channels, and beyond.

We make this point because, while it is true that our country offers exceptionally favourable conditions for plasticulture, the application of this, like any other technology, must respond to economic considerations if it is to avoid becoming a purely speculative undertaking.

When first introduced, and even now to a large degree, plasticulture gained general acceptance as a tool for use in protected cultivation, particularly among flower-growers who, accustomed as they were to working with greenhouses, were quick to capitalize on the economic advantages inherent in the use of plastics. Practical experience, gained over the years, was adapted on the basis of domestic and foreign studies to local conditions.

In a similar way, the tunnel cultivation system replaced the traditional glasshouse as a means of protecting tree seedlings and of achieving early crops, especially in the vicinity of large vegetable-consuming centres. In a number of cases, tunnels within greenhouses are used to protect seedlings (particularly tomatoes and peppers), this being a technique adopted by a number of growers more than 15 years ago.

From 1975 until the present, the country has been in the grip of a major inflationary cycle, which, although now gradually abating, has made itself felt in every sector of the economy, including agriculture, where it has driven up sharply the prices of all inputs. Plasticulture has also, and especially, been affected by this development, as all over the world the price of petroleum products has begun to rise.

In the face of the much higher costs of the materials used to build greenhouses and tunnels, mainly wood and metals, it has become necessary to recommend the use of locally available low-cost materials - cane, stakes, etc. - which, although often far from ideal, nevertheless provide adequate protection, even if they necessarily require greater care. This has led to the building of larger tunnels, something similar to what in France are known as "abri-serre", in which some mechanization of work is possible.

In parallel with these broad-based applications, producers with greater technical and economic means - especially the growers of flowers and house plants, who require sound training in the management of the factors that make for successful and profitable operation - base their evaluations and planning on market conditions, using commercially available supplies and materials, with an eye not so much to immediate economic considerations as to the potential for future expansion. The result is that, with the rising technical competence of the flower-growers, whose number had increased under the initial stimulus of the low cost of the installations and the public's greater purchasing power, greenhouse area has remained stagnant and has even declined with respect to 1965-1973 levels.

Vegetable production, while growing only minimally in terms of volume, has been extended to the southernmost regions of the country. In this connexion, mention should be made of the studies and analyses which have been carried out by José Lesjak, an agronomist of the Experimental Agricultural Station of the National Institute of Agricultural Technology at San Carlos de Bariloche, into the effectiveness of tall cultivation tunnels, and which were described in a paper presented to the Sixth International Congress held in Buenos Aires. These studies, it should be mentioned, were conducted with tomato and pepper seedbeds at Sarmiento, an area with a continental microclimate located at approximately 46 degrees south latitude.

It may be of interest to call particular attention to two aspects of this work. First, there is the technical aspect, reflected in the author's observation to the effect that the use of plastic films is not very widespread, since invariably growers are principally interested in protection against low temperatures, whereas these films are in fact not particularly effective against

intense cold, their most useful feature being their ability to provide protection against the chill winds that are so frequent in Patagonia. Secondly, there is the economic aspect to which the author alludes when he refers to the unfavourable commercial impact of having crops mature in so short a period that the market is glutted with produce. This has prompted efforts to achieve earlier maturity with tomatoes and peppers in seedbeds covered with plastic film. Lesjak also speaks of the use of tall tunnels in San Carlos de Bariloche for the raising of vegetables. Because of its considerably high altitude (800 m above sea level), this area has an extremely severe climate, comparable with that of Río Gallegos or Tierra del Fuego at the southernmost end of the continent.

At the present time, seedbeds are producing under these conditions in the Tierra del Fuego region.

In all of our work we have tried to emphasize that the principal effect of both tunnels and greenhouses on crop development derives essentially from their wind-breaking function. In experiments conducted by the author of this paper, forest plantings required as a preliminary measure the setting up of a protective fence, using materials of any kind capable of shielding the crops until they were securely rooted.

The bulk of large-scale vegetable production, especially for the supply of Buenos Aires and other cities, is located in areas where there is less climatic risk (in some cases as much as 1,700 km away from the consumers), although there have been years when even these zones have been struck by frosts damaging production regions in Argentina and Brazil.

There is no doubt that, even without seeking to extend protection to all crop-growing in this zone, there is still room for the expansion of these techniques as a means of ensuring successful harvests and, to an even greater degree, larger yields, as has already been demonstrated by the agronomist José Ploper in his work as director of the Tucumán Province Experimental Agricultural Station, the conclusions of which he presented to the First National Congress on the Use of Plastics in Agriculture convened in Buenos Aires in 1970.

There are a number of economic factors working in favour of a larger role for plasticulture, especially in the marketing of vegetable products. The increasing cost of inputs (among which we include everything passed on from the

producer to the consumer as the two terminal points of a long chain) is forcing the former to reduce to a minimum everything he is not certain of recovering in the price paid for his products. It is important to keep in mind that producers normally have their sights set on the mass market of Greater Buenos Aires, where there is greater purchasing power. Precisely because of the great diversity of climates, or more accurately microclimates, as pointed out above, an early harvest achieved in one zone, through the corresponding economic effort, may in another zone represent routine production using conventional methods, so that the first zone is obliged to compete at a disadvantage.

Additional problems include the lack of a sufficient processing capacity to absorb surplus production and the highly decentralized nature of the marketing system, which is a direct consequence of the vegetable growers' highly individualistic approach to their business, something that puts them at a clear disadvantage vis-à-vis the buyer.

So far, the price of land has been steadily rising and there are no reasons to believe that there will be a reversal of this trend, as a consequence of which it may be expected that the land itself will be developed to the fullest extent possible.

One factor which may affect this situation is the constantly rising costs of fuel, something which is focusing attention on the transport sector and which may have the effect of bringing the growing areas closer to consumer centres, resulting in a greater need for crop-protection measures.

With respect to the other kinds of crops grown under protection, it should be noted that in the country's tobacco-growing areas the plastic-covered tunnel is the almost exclusive method of protecting the seedlings and that it is quite likely that these same tunnels will in future be employed more extensively in the drying of the tobacco leaves as well.

Ground covers

Progress in this area has been slow, despite the demonstrated advantages of this technique in the growing of vegetables, vines, and forest plants and trees, as certified by the National Institute of Agricultural Technology. In all cases, the results observed were specific and favourable in both economic and technical terms. Accordingly, it would certainly appear that over the short and medium term this method will develop in line with economic considerations, which alone might prevent it from becoming a technological tool for producing more abundant and better yields.

We shall say nothing in this paper about the thickness or colours of the plastic films employed as ground covers. The fact is that a great deal of research has already been done on this subject, and that the question of film thickness and colour must be considered in agricultural planning and specifically studied for each individual crop, zone, and climate. No generalizations are possible, and selections must ultimately depend on the particular conditions in each country and in each region within the country.

Preservation of grains and forrage

We shall not at this point speculate on the world's current and future food requirements, except to note that, apart from unforeseen developments, world population at the end of this century will total some eight billion inhabitants and that food production will have to be intensified to meet the increased demand. In this connexion, the agricultural use of plastics is not a panacea, but part of a large and varied technological package to which it must make its maximum contribution. Farmers and growers must develop an awareness of this fact, a point which is at the heart of the possible differences between the developed and the developing countries.

Since the end of the second world war, technology exchanges within the European Common Market and among neighbouring countries led to rapid recovery and, beyond that, to an intensification of these nations' agricultural sector, which was able to expand on the basis of an industrial infrastructure and a secure and extensive market within a relatively limited geographic region with tested structures and a population enjoying a steadily improving standard of living. All this made it possible to widen the application of technology, and even led to a narrowing of the celebrated "technology gap" to which Servan Schreiber referred in his book The American Challenge as part of his analysis of Europe and the United States.

The Argentine producer enjoys the finest climatic conditions for the development of agriculture and stock raising. It is no boast to say that the country has a large number of top-flight producers and technicians, but these people are unwilling to accept new technologies unless they can be certain that, in the final analysis, their efforts will be rewarded in the form of a commensurate return.

The export of agricultural products is still the country's main source of revenue. With every passing day, agriculture and stock raising are increasingly acquiring the characteristics of an enterprise, requiring the application of the best knowledge and effective resource planning.

In this context, one needs to remember that in seeking to express their views, defend their interests, market their products, and the like, the producers tend to band together in the form of associations, co-operatives, granges, technical advisory groups, etc., and to avail themselves of the services and guidance made available by the National Institute of Agricultural Technology.

Against its annual production figure of about 30 million tonnes of grains and oil seeds, Argentina has a public and private storage capacity of about 50 per cent. In tests supervised by the National Grain Board, plastic films have demonstrated their technical suitability for use on small farms in the storage of wheat and sorghum seeds with no loss in yield or germination.

So far, two factors have been largely responsible for the poor acceptance of this and other equally effective techniques: 1. the producer's desire for rapid marketing; 2. the distrust that sometimes arises at the mention of the word "plastics" and that continues in many cases to pose an obstacle.

With respect to the protection of fodder, a distinction must be made between the two methods of preservation designed to retain its food value: ensilage and haymaking.

We shall not, at this point, for obvious reasons, discuss in detail either of these two procedures, whose purpose is to make use of the fodder when it is at the height of its development, but we shall turn our attention instead to the opportunities they afford for the use of plastics.

Ensilage

Providing that all the necessary precautions have been taken to prepare the ensilage properly, a covering of plastic film, laid down once the fermentation process has ended, provides a genuine insulating screen which not only prevents the penetration of rain or moisture, the restarting of harmful

fermentation, and such, but also makes it possible to reduce the thickness of the layer of earth to be spread above the ensilage. Normally, when no plastic protection is used, this layer must be at least 60-80 mm deep; by using plastic film, on the other hand, this thickness may be reduced by much more than half or the layer may even be done away with altogether, provided precautions are taken to prevent the film from being damaged mechanically or by animals.

Tests conducted in Argentina, for which for various reasons there are no statistical data, have demonstrated the advantages of covered ensilage.

Allowing for slight variations, the conditions over much of the territory of Argentina are suitable for agricultural and stock-raising activities. The decision as to whether to farm or raise stock depends on economic factors, and in particular the export market, with the result that there is a kind of pendulum effect from one to the other of these activities.

The so-called "wet pampa" represents the largest area where natural conditions, soil, and climate are suitable for agriculture and animal husbandry, where stock can be raised in the open without the need for stabling (except for an occasional year of drought), and where there are separate zones for raising and for fattening. It should be pointed out that the term "wet pampa" does not relate specifically to climate, but rather indicates an area of ideal conditions for the raising and slaughtering of the stock, where the animals are able to grow and complete their life cycle in the same location.

Although there are pasture land programmes - that is, the preparation of the ground and the sowing of special mixtures to provide permanent fodder - they have recently been curtailed because of very high prices.

From the point of view of our efforts to promote the more extensive use of plastics, it must be recognized that ensilage has not expanded in the way anticipated, the reason lying in the increased costs of the inputs and in the other factors which have effected the country's over-all economic development and, hence, the agricultural and stock-raising sector as well. Accordingly, we foresee that, as the situation in this sector gradually improves, the need for better technology (in which we include ensilage and the acquisition of the required machinery) will lead to a greater use of plastics.

Haymaking

Haymaking is a practice with a long history in Argentina, especially in areas where, because of propitious climatic conditions, drying takes place rapidly so that there is a minimal loss in the nutritional value of the fodder. The general practice is to produce bales of 45 x 55 cm and 90 cm long, weighing approximately 30 kg. each. These bales are stacked one on top of the other and represent feed reserves to be used when, for reasons of weather, the fields lack natural pasturage. In turn, these stacks are stored in layers and measure 4-5 m in height, the number of bales varying depending on the kind of farming in question. Normally, from 1,000 to 2,000 bales are produced, although the more customary figure is 1,000-1,200.

Plastic film has amply demonstrated its ability to protect these bales against rain, moisture, dew, etc., thereby preventing the damage these factors cause, especially to the bales at the top of the stack. The relationship between the cost of the protection and the material protected is directly proportional to the extent of the damage which the bales exposed to the weather may suffer. By refining the analysis even further, one could calculate the loss in kilograms of meat as a result of the loss in the food value of the bale.

This process of protection involves the same factors already mentioned in the discussion of ensilage.

Plastics in the management and conservation of water

The last few decades have certainly taught us a great deal about the need to save water, which - abundant in some areas, scarce or altogether lacking in others - is not only a limiting factor in cultivation, but must also be used with intelligence and rationality.

In referring to the need for intelligent and rational water management, we are thinking not only of the latest technical advances in this area, but primarily of the importance of analysing the conditions, advantageous and disadvantageous, of each country and even of each region within each country.

Some 30 years ago, Horacio Castro Zinny, an agronomist, published a study entitled Irrigation, Population, and Wealth in which he divided the continental territory of the Republic of Argentina into two parts, referred to as part A and part B.

Part A is the wet part of the country, with an area of 743,552 km^2 (30 per cent of the total), while part B accounts for the remaining 70 per cent or 1,999,161 km^2. In part A, the distribution of rainfall is in harmony with the requirements of the crops that produce the greatest financial return, the annual average falling between 700 and 1,700 mm. In part B, the annual average is 700 mm and less, with the exception of a few areas, but even there artificial irrigation is required because of the irregularity of the rainfall.

Despite major advances in the area of technology, many of the author's concepts remain valid. The introduction of irrigation and the emergence of new materials and systems which can today be used to provide new solutions have so altered the situation that it is no longer possible to divide the problem in the same sweeping manner. But even as long ago as the publication of this study, when today's tools were not available, Zinny was calling for a change in attitude and for a more rational use of water.

Irrigation systems have evolved, although they have not reached every area and there are still many growers who lack the awareness that the earth is a resource to be used and not abused.

Even producers working land that is not artifically irrigated recognize the need for the rational management and maximally effective use of water if they are to be able to face successfully periods of drought that can upset even the best laid plans.

Plastics are today part of a technology through which the use of water can be placed on a rational basis. The problem is that of all the possible technical options to this end, the one to be selected must be most cost-effective in terms of over-all operation. The plastic materials in question - films, rigid and semi-rigid piping, irrigation devices, etc. - are used in the conservation of water to manage such factors as infiltration and subsequent loss, evaporation, conveyance, drainage, distribution, maximum usefulness to the crop, soil protection against waterlogging and ultimate loss, and others.

In our country, where the great variety of climatic and micro-climatic conditions and soil types makes it possible to select different operating modes, this is a subject of engrossing interest.

On the basis of the experience that has already been gained in such areas as the water-proofing (sealing) of dams and weirs of various sizes and of the so-called "Australian" tanks (requiring a special technology), the lining of channels, and the use of irrigation hose and rigid and semi-rigid piping, it is possible to anticipate that, with the organization of production, a falling rate of inflation, and the assurance of a reasonable financial return, the plasticulture sector will continue to grow as it moves into many new areas requiring more advanced methods backed by appropriate economic, financial, commercial, and other structures.

In line with these concepts, irrigation by sprinkling is well understood and widespread, while trickle irrigation, a technique of undoubted value, is under study. Here again, it must be repeated that the factor of financial return always remains the decisive consideration.

Plastics used in agriculture

Before discussing in any detail the plastic materials that have thus far found their way into Argentine agriculture, we should perhaps establish an almost linear classification consisting of films, rigid materials, and piping and netting.

Films

To date, the most widely used film material has been low-density polyethylene. During the first few years following the development of this product, when it was employed as a replacement material, transparent, practically colourless PE was primarily used as a short-life tunnel and greenhouse covering, especially when installed during the autumn-winter or spring-summer period. There was some degree of variation in each case, but its durability was always inversely proportional to the length of the day, since this durability depends primarily on the effect of the ultraviolet radiation and, to a lesser degree, on additional factors, such as the system of installation, winds, site topography, natural protection, and others with a bearing on the durability.

Another important aspect in this connexion is the fact that with the development of raw materials better suited to each application (in respect of durability and weather-resistance), the film-manufacturing industry was faced with the task of introducing some kind of system into the use of the plastics, in the light of the absence of any generally accepted standards for the protection of the growers. The industry had also, in collaboration with the growers, to establish standards and thicknesses for various uses, a step which not only led to more effective co-ordination within the industry itself, but resulted in savings of time and money for the agriculturalists.

For some years now, the manufacturers have been adding to the formulation of their polyethylene certain ultraviolet absorbing agents, which make the material more resistant and stable in the face of weather. The film ranges in thickness from 100 to 200 microns. For early-harvest vegetable tunnels in temperate zones 30-to-40-micron PE film is used, and in the tobacco nurseries, which are of considerable volume, 50-to-70-micron film. For the large tunnels referred to above the recommended thickness is 150 microns, which should be increased to 200 microns in cold regions, particularly where there are high and steady winds.

One technique which has been gaining in popularity in both greenhouses and tunnels involves the use of an inner lining, fashioned from finer film using a variety of methods, for the primary purpose, among others, of cutting heating costs.

Black film as a horticultural ground cover is used only in certain situations in our country, especially in the growing of strawberries. The film used has a width of 30-40 microns, a figure which has so far been found to be cost-effective in terms of harvest yields. With the development of more technologically sophisticated growing techniques, the use of tunnels and greenhouses, and the skilful selection of specific varieties according to growing area (strawberries being a crop with a demonstrated ability to adapt itself to a wide range of climatic conditions), even greater advances can be expected in the various plasticulture applications.

In the area of vine-growing and afforestation, work with ground covers of black PE film, 80-100 microns in thickness, have confirmed the successful experimental results achieved abroad.

Rigid sheet

The rigid sheeting in general use in Argentina for crop protection consists of fibreglass-reinforced polyester. Today's domestically produced material is of excellent quality and is intended for products which, like flowers and house plants, yield a very high return.

We have already discussed the economic factors which have an effect on the profitability of farming and stock raising, along with the elements which contribute to the rapid amortization of all inputs in order that an investment recovered and producing revenue in the form of harvest profit may be expressed in the price obtained. Inflation and marketing considerations make it necessary for the agricultural producer to proceed cautiously in his investments. This explains why, despite the outstanding advantages they afford, plastic films are limited in use by the high related investment costs for structures and coverings.

Netting

There are a number of agricultural applications for plastic netting. We deliberately refer to plastics in general, without specifying the particular material, for the reason that netting is produced, with varying results, from low-, medium-, and high-density polyethylene. The first raw material used was polyvinyl chloride and it unquestionably performed very well. At the same time, what is known as "half-shade" netting has found and continues to find very wide application, especially in floriculture, where it has shown itself to be highly effective. The other uses of netting, as for example in wind-breakers, hail screens, etc., with the exception of it use in the enclosing of poultry sheds, are subject to the same financial constraints that we have already discussed.

Piping

Plastic piping and tubing has gained very wide use in all areas of application, including agriculture, where the principal raw materials employed are PVC and polyethylene. Polypropylene is used to a lesser extent.

For water-conveyance systems operating without special irrigation methods the piping used is semirigid low-density polyethylene and also rigid PVC.

Because of their technical characteristics, which we shall not analyse in detail in this general paper, plastics are more competitive with traditional materials in the development of advanced irrigation systems. In the light of what has already been said of the importance of the conservation and rational management of water, the prospects of expansion in this area require no comment, the fact being that because of its great usefulness in intensive and extensive farming, there is a need for the massive use of plastic piping on a par with, and perhaps to an even greater degree that, other materials.

Conclusions

Just as the other elements which comprise the technology of agriculture and stock breeding, such as herbicides, pesticides, fertilizers, and the like, plastics have come of age in a range of agricultural applications. The efforts that have been and are being made in this direction have not only already led to some degree of familiarity with plasticulture techniques, but are creating a body of trained technicians whose responsibilities must go beyond the mere demonstration of the advantages of plasticulture as a technical discipline to the study of its economic implications in all areas - geography, demography, production, processing, and marketing - in a country with the characteristics of Argentina.

We consider necessary and therefore advocate closer ties between industry, university circles, and the public and private organizations connected with agriculture for the purpose of awakening a keener awareness that the agricultural use of plastics is a technology which has relevance to many applications and which, above all, can contribute to the preservation of the most precious resources of an increasingly more populated world - soil and water.

Consumption of plastics in agriculture

In recent years, the statistical evaluation of the consumption of plastics in agriculture has become extremely difficult because of two quite dissimilar circumstances:

1. The improvement of polyethylene film, which enjoys a virtual monopoly as the covering material for greenhouses and large tunnels, through the addition of ultraviolet absorbents has led to longer use and, as a consequence (since there has been no increase in the area covered) to a decrease in the volume of film specifically produced for agriculture.

2. It is difficult to account for the material which, although not specifically produced for agriculture, is put to agricultural use, especially in the internal lining of greenhouses.

To this should be added, as we have pointed out in the discussion of horticultural producers, the curtailment of inputs which do provide a reliable guarantee of greater profitability, and of other aspects which relate not to production, but to marketing.

With regard to the use of black plastic film, especially black polyethylene, the operative factors are similar, in the light of the controversy which has arisen regarding the economic effectiveness of this material in agriculture, especially stock raising, and which has affected its uses in all areas.

Successful experimentation in the mulching of vines and plants of the Salicaceae family suggests expanding applications in this area.

We take the view that in demographically atypical countries such as ours, consumption per-capita ratios are neither valid nor meaningful.

Application	Year: 1979	Consumption in tonnes
Greenhouses and tunnels, large and traditional		1,100
Piping (PVC and low-density PE)		4,000
Stacking, storage, reservoirs, irrigation hose		1,200
Containers		3,000
Mesh and netting		450
Total		9,750

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Note: The maps are the work of Professor Juan Papadakis and are taken from his work mentioned above.

The map of the horticultural regions, published in the work of the Instituto de Ciencias Agrícolas, shows specific regions. Nevertheless, there are many other local zones which offer good conditions for the expanded use of plastics in agriculture, a use which has, however, remained limited because of the reasons discussed in this paper.[1/]

1/ Translator's note. Because time did not permit their inclusions the maps referred to have been omitted from this translation.