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AGRICULTURE AND ENERGY: CURRENT PROBLEMS AND FUTURE OUTLOOK

A separate chapter of the Commission's Report on "The agricultural situation in the Community" (1) in 1982 is devoted to "Agriculture and energy: current problems and future outlook". In view of their economic importance we are reprinting the complete text in question in this issue of "Green Europe".

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Agriculture and energy: current problems and future outlook

High energy consumption — high productivity of labour: agriculture as a consumer of energy

The situation in Europe

European agriculture, or at least most Community agriculture, is frequently described as 'modern', 'intensive' or even 'industrial'. The amazing increase in the productivity of agricultural labour and farmland has been, above all, attributable to far-reaching specialization and intensification of agricultural production, accompanied by substantial structural changes (decrease in the numbers employed, increase in the average size of farm).

Since the energy crisis of the 1970s, however, it has become increasingly clear that there is also a negative side to such developments. More and more energy is required for agricultural production, both directly and indirectly. The high degree of mechanization, the intensive application of fertilizers and plant protection products, the use of specially bred and selected seeds and plants and the rearing of livestock on concentrated feeds are all clear indications of the growing consumption of commercial energy. Until now, this commercial energy has been almost exclusively of fossil origin, that is, petroleum or natural gas in most cases.

The situation is worldwide

Comparative studies show that this problem is by no means uniquely European. In all parts of the world where intensive farming is practised and where the yields per hectare are correspondingly high, a heavy energy input is required.

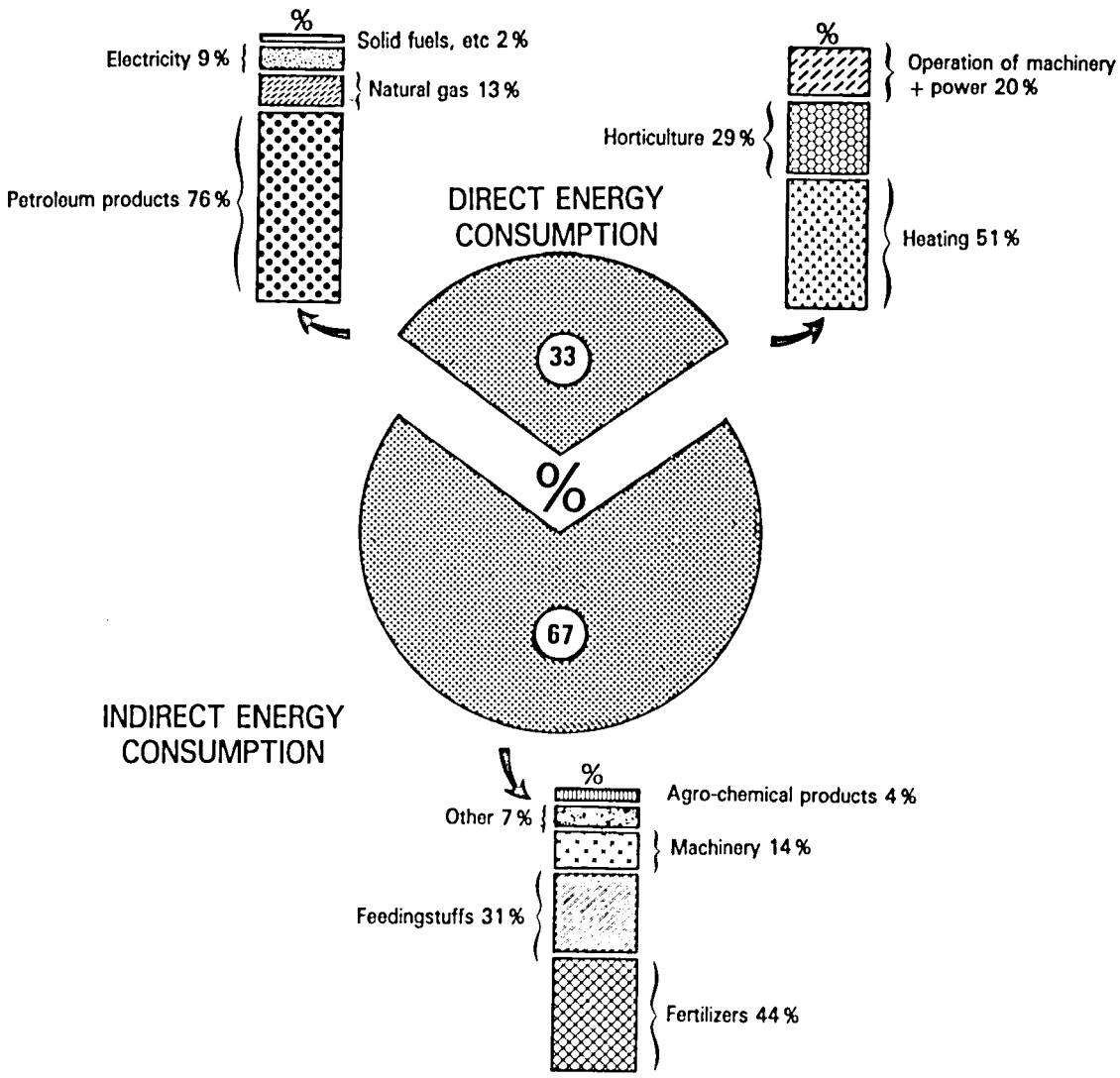
Some countries with a low population density (e.g. Argentina, Australia, large regions of Canada or New Zealand) can, however, grow cereals and rear cattle or sheep on vast areas, practising relatively extensive forms of production. To produce a given quantity, they use more land but less energy than other countries where more intensive means of production are employed.

Intensive production — why?

In the past, European farmers (and farmers in other economically advanced countries) had a number of cogent economic and social reasons for intensifying production. For one thing, there was only a restricted area of farmland to supply the food for a growing population. The area available was being further reduced by the allocation of land for residential and industrial development. In the 1960s and the early 1970s the Community experienced an unprecedented economic boom which led to rising incomes in all sectors and caused many agricultural workers to transfer to other more attractive jobs. With increasing prosperity there came a greater demand for high-quality protein foods such as meat. For the production of one calorie of meat, however, up to 10 times as much land is required as for the production of one calorie of cereal, all other things being equal. The growing demand for land, which stemmed partly from requirements in other sectors and partly from speculative pressure, also led to a considerable rise in the cost of 'soil' as a factor of production.

In the post-war era these various factors have combined to provide a strong economic incentive for the intensification and mechanization of agricultural production. Intensive use of the soil and labour-saving production methods have offered advantages both as regards security of supply for the population and as regards the competitiveness of individual farms. Inevitably, however, they have also entailed the ever-increasing energy requirements of European agriculture. Farmers did not see this as any great problem as long as the energy costs of more intensive production were more than offset by increased yields.

STRUCTURE OF ENERGY CONSUMPTION BY COMMUNITY AGRICULTURE IN 1977/78 (EUR 9)



Source: The Economist Intelligence Unit Ltd: Consumption of energy in agriculture in the European Community, a study carried out for the Directorate-General for Agriculture (Brussels 1981).

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Structure of agricultural energy consumption

Graph 2 shows the quantitative structure of energy consumption by Community agriculture in 1977/78 (EUR 9). The figures are based partly on estimates and can therefore be taken only as a rough guide.

Direct use accounts for just under one-third of all the energy consumed by agriculture. Roughly half is used for the operation of machinery and the other half is mainly used for the heating of glasshouses, for the heating and ventilation of livestock housing and for the drying of crops. Petroleum products supply over three-quarters of this energy for direct use, with the remainder coming from natural gas, electricity and (to a much lesser extent) solid fuels.

The sole outstanding exception is found in the Netherlands, where some 80% of the energy for direct use is consumed by horticulture and only 12% by the operation of machinery. Again in the Netherlands, over 80% of the directly-used energy is supplied in the form of natural gas and only 15% in the form of petroleum products.

The indirect consumption of energy by European agriculture is mainly accounted for by mineral fertilizers, feedingstuffs, machinery and agro-chemical products (plant protection products, herbicides, pharmaceuticals, etc.), which represent over 90% of this category of consumption. The manufacture of all such products requires energy, which is thus indirectly used for the purposes of agricultural production. It is estimated that two-thirds of all the energy used in agriculture is consumed in this way.

A modest percentage of overall energy consumption

Although the energy used by agriculture is on the increase, it still accounts for a very modest share of overall consumption of commercial energy supplies. It is estimated at between 4% and 5% in the Community and between 3% and 4%

worldwide. Comparisons between the main regions of the world may be made on the basis of Table 1. This table is based on calculations and estimates made by the Food and Agriculture Organization of the United Nations (FAO) for 1972/73 and the figures which it contains should be seen as orders of magnitude. Since agriculture's share of worldwide energy consumption is so small, even a further increase in the energy requirements of farmers will have only a very limited effect on the overall demand for energy.

TABLE 1

Estimated world consumption of commercial energy in 1972/73 (total consumption and agricultural consumption)

Region	Consumption in million toe		% in agri-culture	Consumption in million toe	
	Total	Agri-culture		Per capita	Per person engaged in agriculture
Developed countries	3 247.7	110.8	3.5	4.4	2.6
North America	1 838.7	51.1	2.8	8.0	13.3
Western Europe	1 025.6	50.5	4.9	2.8	2.0
Oceania	58.3	3.3	5.6	3.7	5.9
Other developed countries	320	5.8	1.8	2.4	0.5
Developing countries	461.7	21.9	4.8	0.3	0.05
Africa	37.5	1.6	4.5	0.1	0.02
Latin America	194.7	7.4	3.8	0.7	0.21
Near East	63	4	6.4	0.6	0.11
Far East	166.4	8.8	5.3	0.1	0.03
Countries with planned economies	1 531.7	48.9	3.2	1.3	0.2
World	5 236.1	181.8	3.5	1.4	0.24

Source: FAO, *The state of food and agriculture*, 1976, Rome 1977.

An ever-heavier burden: increases in energy prices

On the other hand, any increase in the energy requirements of agriculture in the present circumstances means greater dependence on petroleum and natural gas

products as well as vulnerability to price rises. The prices for products in turn are heavily influenced by the increases in crude-oil prices over the past 10 years.

Initially, however, these price increases had a very limited effect on agriculture as compared with other sectors, since the percentage of total agricultural production costs accounted for by direct energy consumption is very small (less than 6% on average). Thus, during the first phase, the effects were mainly felt in those forms of production which were energy-intensive (e.g. glasshouse horticulture) or heavily dependent on transport (problem of transport costs).

Gradually, however, the increases in energy prices were reflected in the prices for other agricultural inputs which required large quantities of commercial energy for their manufacture and distribution (fertilizers, machinery, feedingstuffs, etc.). Since the sharp new increases in petroleum prices in 1979/80, the negative effects of the energy crisis on the economic position of farmers have been much more noticeable throughout Europe. The prices for directly-used energy (fuels, electricity, etc.) and for fertilizers, plant protection products and machinery have risen much more steeply than agricultural producer prices. Graph 3 shows this divergence between the prices for agricultural products (producer prices), on the one hand, and the prices for means of production (inputs) with a high energy component, on the other. All prices in the graph are shown as relative to the overall average for input prices, which are taken as constant (= 100).

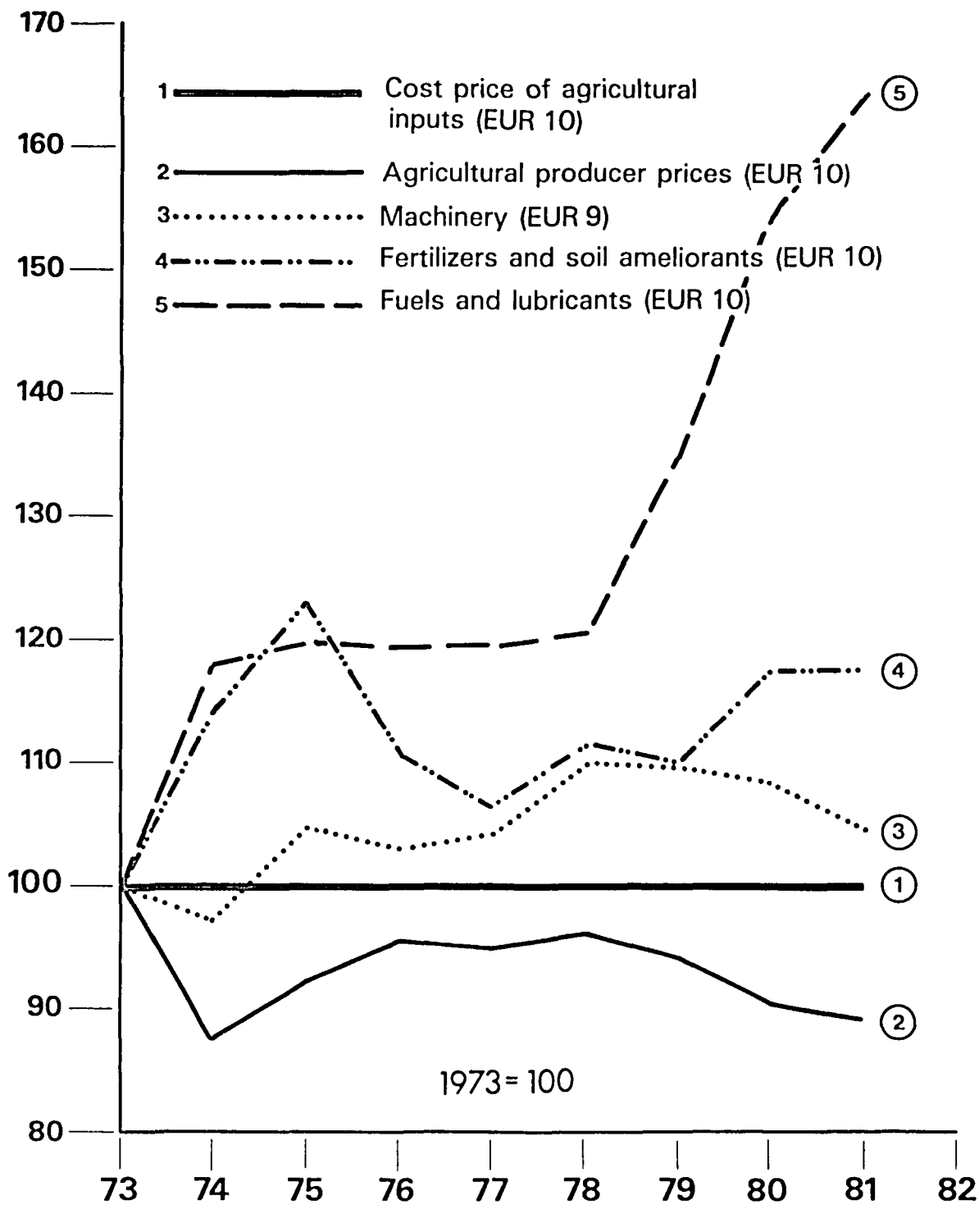
Until 1972, the price relationship had, generally speaking, been somewhat in the farmers' favour. After 1973/74, however, agricultural producer prices lagged behind the prices for energy (used directly or indirectly) and although the situation improved in 1975 and 1976, this was only a limited and temporary improvement.

The widening of the 'price gap' (see Graph 3) clearly illustrates the effects of the energy crisis on agriculture. It should also be remembered that agricultural energy consumption has increased still further over the period in question, that is, in economic terms agriculture has become even more sensitive to developments in the energy sector.

Agriculture and the crisis: possible responses

Given the energy situation facing European farmers, various questions arise. Can the Community afford to continue producing food by more and more energy-

Trends in the EC indices for fuel and lubricant prices, fertilizer and soil-ameliorant prices, capital cost of machinery and agricultural producer prices, in relation to the index for the cost price for agricultural inputs as a whole (= 100)



intensive methods? Can any strategies be worked out which would represent a reasonable alternative in terms of energy and agriculture? For example, would it be a solution to import larger quantities of certain foods from countries which produce them by extensive means, that is, with a low level of energy input? Or, if the need for more intensive production in Europe is acknowledged, would it not be possible to cut back agricultural energy consumption by appropriate energy-saving measures? Could the farmers themselves not produce some of the energy which they require?

On the following pages an attempt will be made to examine these questions, although it is hardly possible at this stage to give any definite answers. Thus, the following remarks are mainly intended as a basis for further discussion.

The 'external alternative': save energy by importing?

In any assessment of the energy savings which might be achieved by importing products from countries using extensive methods of farming, two considerations should be particularly borne in mind:

(i) Where extensive methods of production are practised, the input of commercial energy per hectare is lower but the yields per hectare are also lower. Thus, any comparison must be based on the energy input per unit of yield (e.g. energy consumption per tonne of wheat, beef, etc.).

(ii) Most of the countries which employ extensive methods of production and which would export to the Community are overseas and very remote. The transportation of products from the producing country to the Community would therefore consume considerable quantities of energy which would have to be included in any comparison.

Sectoral differences

A comparative study which took account of these considerations was carried out under the 1980/81 study programme of the Directorate-General for Agriculture.

Its final results for certain important products are shown in Table 2. These results represent a generalization inasmuch as they are based on calculations or estimates of 'average', 'most frequent' or 'typical' values. In practice, the degree of intensive production and, consequently, energy input varies greatly within each country producing a given product.

Some general conclusions may be drawn, however. As a rule, less energy is consumed when beef, veal, sheepmeat and derived products are imported from North America, South America, Australia or New Zealand than when they are produced in Europe. The same applies (with the exception of imports from the USA) to wheat, but here the energy saving is much smaller. When the energy consumed by transportation is taken into account, there is no advantage whatever in importing the other types of cereal. The same applies to milk products, which are actually cheaper to make in Europe in terms of energy consumption. Similarly, it requires less energy to grow vegetables (exception: tomatoes) or to manufacture sugar in the Community than it would to import these products from overseas.

TABLE 2

Energy saved by importation from overseas as compared with production in Europe in the case of some important agricultural products (including energy required for transportation to Community frontiers)

Product	Energy saving if imported					Product	Energy saving if imported				
	++	+	0	−	−−		++	+	0	−	−−
Beef and veal	×					Maize			×		
Sheepmeat	×					Barley			×		
Pigmeat					×	Rye				×	
Poultrymeat				×		Beans					×
Butter				×		Potatoes					×
Wheat		×				Tomatoes	×				
						Sugar (refined)					×

Source: Slesser, M.; Wallace, F.: 'Consumption of energy in agriculture, at world level, available to the European Community'. Study for the Directorate-General for Agriculture, Brussels 1981.
Note: ++ = considerable energy saving if imported; + = small energy saving if imported; 0 = practically no saving; − = slight energy saving if produced in the Community; −− = considerable energy saving if produced in the Community.

Energy savings doubtful in the long run

Table 2 gives a picture of the situation at a given time. It is based on a (rough) comparison of levels of energy consumption in the latter half of the 1970s. The situation would be different if the Community were to go over to an external strategy and import a substantial proportion of its requirements for products such as beef or wheat from those countries which save energy by their extensive methods of production. To satisfy the considerable increase in demand which would follow, these countries would either have to release more land for the production of the quantities required or would themselves have to adopt more intensive methods, that is, increase their energy consumption. As farming became more intensive, however, the point would eventually be reached where imports from overseas (including energy consumption for transportation purposes) would cease to enjoy any advantage over Community products in terms of energy input. This limit is reached sooner or later, depending on the product and the circumstances surrounding production (both inside and outside the Community). In the case of beef, veal and sheepmeat, therefore, the scope for energy savings is probably greater than in the case of wheat.

In this connection, another important consideration should be mentioned: as the world population increases, there is a corresponding increase in the world's food requirements. In the foreseeable future it is highly probable that these requirements can only be covered if the countries now producing food by extensive and low-productivity methods of farming change over to more intensive methods of production. In the long term, this alone would tend to offset any energy-saving advantages enjoyed by one production system as compared to another, so that in terms of energy-saving the long-term success of any Community import strategy would appear doubtful.

Undesirable side-effects

Apart from making the Community more dependent on other countries for its supplies in order to achieve energy savings which are doubtful in the long term,

an import strategy would create employment problems in European agriculture. According to the agricultural structures survey of 1975, over 400 000 farms were mainly engaged in the production of cereals, 246 000 in the rearing and fattening of cattle and 240 000 in mixed cattle-farming (meat/milk). (1) If the Community's requirements for these products were wholly or largely covered by imports, considerable structural adjustments would be inevitable in these sectors.

Given the generally unfavourable economic situation, this would obviously give rise to the question of alternative employment for the farmers concerned.

To save energy, one possible alternative would be for these farmers to change over to those products which cost less, in energy terms, to produce in the Community. These products would then be exported to other countries where farming conditions were less favourable. This would ultimately mean far-reaching changes in the division of labour in agriculture throughout the world, on the basis of energy-saving criteria. Unfortunately, it would require highly complicated and lengthy negotiations, the outcome of which would be quite unpredictable.

Conclusion: an imperfect solution

Thus, the 'external alternative' would, all things considered, represent only an imperfect solution to the energy problems of European agriculture; it would create more problems than it would solve. Energy would be saved only in the case of a few products. In the short and medium term, it would lead to considerable problems of structural adjustment in Community agriculture. In the long term, there is every probability that the energy saving would become gradually smaller or even disappear altogether. At any event, the Community would become considerably more dependent on external sources for its supplies of basic foodstuffs.

(1) See Agricultural Report 1982, point 204.

Internal adjustment: necessity and opportunity

Energy savings are sensible and feasible

Since the external alternative offers only limited scope for improvement and is bound up with a number of problems and risks, the question arises as to what internal adjustments can be made within European agriculture itself. Here, as in other sectors, one's thoughts turn first of all to possible ways of saving energy.

Various experts take the view that the current level of agricultural energy consumption could be reduced by 15% to 10% by means of specific economy measures. These would include the following:

(i) use of fertilizers and plant protection products strictly according to requirements, wider use of 'integrated' plant protection methods; development of energy-saving methods for the manufacture of fertilizers; replacement of chemical fertilizers by 'biological' fertilizers derived from waste matter;

(ii) rational choice and use of machinery;

(iii) systematic use of thermal insulation techniques;

(iv) recovery of heat arising as a by-product of certain types of farming (dairy farming, stock-farming);

(v) recovery of waste heat from non-agricultural activities (e.g. generation of electricity, manufacture of foodstuffs, etc.).

There is also another interesting possibility. Consideration could be given to some changes in the agricultural division of labour within the Community, so that optimum use could be made of the energy-saving advantages offered by production in certain regions. Any such relocation of production could only be achieved gradually, of course. In the long term, however, it could be the trump card which would enable European agriculture to adapt to a possible future deterioration in the energy situation.

Challenge and opportunity: agriculture as an energy producer

Energy saving is not the only strategy whereby agriculture could adjust to the energy crisis. A proportion of the biomass (1) produced by farming could be used as a renewable source of energy and thus replace to some extent the non-renewable fossil fuels. Agriculture itself would then become an energy producer.

Considerable potential

Initially, use could be made of agricultural waste to produce energy in the form of heat (e.g. burning of waste) or gas (by fermentation or gasification). Such energy could be used directly on the farm or at village level to reduce transport costs wherever possible.

Recent studies have shown that between 30 and 40 million tonnes of oil equivalent (toe) per year could be recovered from agricultural and forestry waste for use in the Community. This would represent between 2.5% and 3% of the total estimated Community energy consumption for 1985.

The second stage, which would go much further, would be to plan how agriculture could make a positive net contribution towards covering Community energy requirements by large-scale production of biomass for energy purposes. Use could be made of familiar crops such as beet, maize or colza, but 'new' types of plant could also be developed and tested if they seemed promising as raw materials for energy production (e.g. giant reeds, fast-growing ligneous plants and certain species of euphorbia).

Various scenarios have been envisaged for energy production from crops in Europe. According to the more cautious estimates (allocation of between 7 and 8 million ha for energy crops), between 35 and 40 million toe could be produced by the year 2000. This would cover about 3% of estimated Community energy consumption in 1985 and probably 2.5% of consumption in the year 2000, without any adverse effect on the Community's security of supply or its external commitments, e.g. in the food aid context.

(1) Biomass is the term for all organic matter (animal and vegetable) ultimately derived from photosynthesis. Using solar energy, plants assimilate carbon which they absorb via the chlorophyll in their leaves.

Questions still unanswered

The extraction of energy from biomass is like any other new activity in that it is very difficult to predict the level of production and marketing costs, the possible market outlets and the degree of interdependence with other markets, both for the raw material and for the end product.

There are several indications, however, that the extraction of energy from agricultural and forestry waste could already be economically worthwhile at farm or village level. Some of the energy consumed by agriculture would be cheaper to supply in this way than from traditional sources. On the other hand, 'energy crops' are still mostly at the experimental stage in the Community and in the majority of cases their profitability cannot yet be guaranteed. Much technological progress will still be needed, to improve economic balances as well as, in some cases at least, energy balances.

The large-scale planting of energy crops would also give rise to a number of other basic questions in this context. Essentially, these problems would be the competition between the use of biomass as a source of energy and its use for other purposes (principally for the manufacture of foodstuffs), the competition for the use of the land, the interdependence of markets and security of supply (both in food and in energy), the consequences for agricultural production structures and the possible risks to the environment.

A new direction for the common agricultural policy?

The extraction of energy from biomass is one of the various possible ways of meeting the challenge of the energy crisis. Like the other possible responses, it would require a substantial level of investment. Since the financial resources are limited, a political decision would be needed to decide which solution should take precedence over another.

Where the use of agricultural and forestry biomass is concerned, such a decision would be taken in the context of the general debate concerning the future of the common agricultural policy. Central to this debate are the structural surpluses of certain agricultural products. Thus, the question arises as to whether a 'biomass energy strategy' could not help to solve both the surplus problem and the energy problem.

Clearly, the production of surplus food which is then transformed into energy cannot be justified, either in economic terms or in terms of energy consumption. On the other hand, careful consideration should be given to any solution whereby some of the land now being used for surplus food production would instead be used to produce self-reproducing raw materials (biomass) as a source of fuel.

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