CCP:OF 97/2

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October 1997

منظمة الأغذية والزراعة للأمم المتحدة | 联合国粮食及农业组织 | Food and Agriculture Organization of the United Nations | Organisation des Nations Unies pour l'alimentation et l'agriculture | Organización de las Naciones Unidas para la Agricultura y la Alimentación

Item II.B of the Provisonal Agenda

COMMITTEE ON COMMODITY PROBLEMS

INTERGOVERNMENTAL GROUP ON OILSEEDS, OILS AND FATS

28th Session

Rome, 10-12 December 1997

POSSIBLE IMPACT OF ENVIRONMENTAL REGULATIONS ON THE CULTIVATION, PROCESSING AND TRADE IN THE TWO MAJOR ANNUAL AND PERENNIAL OIL CROPS

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The Group decision as reflected in the Report of the 28th Session (Document CCP:99/5 - CCP:OF 97/8) on this agenda item

The Group reviewed this item with the help of document CCP:OF 97/2. The representatives of several major soybean and oil palm producing and processing countries pointed to the important positive impact that the application of modern techniques and practices in the cultivation and processing of soybeans and oil palm has had for the protection of the environment. They informed the meeting of the pollution control measures and regulations put into force in their countries and of their positive effects on the environment. In this regard, they stressed the negative impact on the environment of governmental subsidies on fertilisers, pesticides and herbicides where this encouraged their over-use. The Group noted that, although pollution control measures currently applied to the cultivation and processing of the major oil crops did not significantly affect their competitiveness, the fuller internalization of environmental protection costs could change that situation in the future.

A. INTRODUCTION

1. At its 27th session in May 1995, the Intergovernmental Group on Oilseeds, Oils and Fats undertook a preliminary review of the environmental issues facing the world oilseeds economy and concluded that the analytical approach adopted by the Secretariat could be extremely useful in assessing links between the environment and the competitiveness and trade of the various oil crops, as well as in contributing to building an international consensus on environment practices and policies. The Group requested that the Secretariat focus its further work, *inter alia*, on the analysis of the impact on trade arising from possible changes in the competitive positions of annual versus perennial oil crops, as a result of prospective national and international environmental regulations.

B. ENVIRONMENTAL IMPACT OF SOYBEAN AND OIL PALM CULTIVATION AND PROCESSING

Cultivation

2. Over 73 million hectares are under soybean and oil palm cultivation worldwide, yielding about 41 percent of the world output of oils and fats and 56 percent of the global output of protein meals. Cultivation of these two crops is therefore of utmost importance in meeting world demand for of oils and fats for direct nutrition, processing to food and industrial products, as well as for covering the demand for protein ingredients for animal feeding. The application of appropriate farming practices and cultivation methods have been proven to avoid to a very great extent the damage to the environment. Nevertheless, a number of activities associated with soybean and oil palm cultivation can have a negative impact on the environment, ranging from the replacement of the natural forest with plantations of oil palm to pollution caused by inappropriate and excessive application of fertilisers, pesticides and herbicides. The quantitative analysis of these environmental impacts is complex. The diffuse nature of agricultural pollution, as well as its close association with specific farming systems and techniques, make it difficult to determine the contribution of individual activities to the overall environmental effect. The identification of environmental effects is made even more difficult by the complexity of ecosystems, as differences in endowments of key environmental factors (e.g. soil type, geology, hydrology) can mean that a certain farming practice may pollute in one place, but not in another. The impact also depends on natural factors, such as wind, rainfall and temperature, the effects of which can often be perceived only after years. Moreover, the same pollution concentrated in a short period of time can have much more serious effects on human health and ecosystems than if arising gradually over a longer period.

3. It is widely acknowledged that the increasingly intensive soybean or oil palm cultivation methods applied over the last 20 years have contributed significantly to an array of pollution problems, although our understanding of the specific impact of each of them on the environment is poor. The main categories of environmental impacts related to the cultivation of soybeans and oil palms include:

- human health effects of fertilisers, pesticides, herbicides and heavy metals, through the contamination of water and food products and the acid deposition from ammonia emissions by fertiliser,
- soil erosion and consequent sedimentation in coastal and surface water resulting in infrastructure and property damage, increased risk of flooding and higher costs of navigation, water storage and treatment;
- on- site losses of soil productivity from erosion, salinization, compaction, waterlogging and chemical pollution;
- loss of wildlife, biological diversity and damage to ecosystem equilibrium and resilience due to degradation of soil; contamination of coastal, surface, and ground waters from

chemical fertilisers and pesticides; and conversion of forest, wetland, and other natural features (such as streams) to farmland and plantation uses.

4. The potential for fertilisers and pesticides used in the cultivation of oil crops, including **soybeans,** to accumulate in water bodies depends on inherent leachibility of the former and on specific site characteristics, such as climate, topography and type of soil, depth to groundwater and other hydro-geologic factors. However, farm practices and the use of chemical inputs can vary greatly with the geographic location, depending on specific ecological, climatic and economic conditions. For example, pesticides use is more important in tropical and subtropical environments where diseases tend to be severe because of high temperatures and of heavy and frequent rainfall. Moreover, soils in tropical regions are more susceptible to erosion, especially when they are intensely cultivated. The use of fertilisers and pesticides is weighted by an index that reflects the inherent leachibility of their chemical compounds.

5. A study ranking annual crops according to their contribution to land erosion and the average fertilisers and pesticides use in their cultivation in the United States showed that, relative to other major agricultural commodities, soybean cultivation is highly erosive, low in nitrogen application per unit area and moderate in terms of pesticide application (see Table 1).

Table 1. Pollution "intensity" of selected crops in the United States.

Soil erosion (kg / acre)		Use of nitrogen fertilizers (kg /acre)		Use (kg/acre) weighted by leaching vulnerability)	Use of pesticides weighted by the leaching vulnerability (ordinal ranking)
soybeans	**7.1**	maize	122	46	Groundnuts
maize	6.6	groundnuts	83	40	maize
groundnuts	6.4	cotton	73	27	**soybeans**
cotton	3.7	wheat	61	20	cotton
wheat	3.2	**soybeans**	**19**	**7**	wheat

Source: J.A. Tobey: "The soybean sector and the environment: Implications for the competitiveness and trade", September 1996

6. Brazil has the largest areas under soybean cultivation in the tropics and subtropics and soil erosion in these areas is a serious problem. Most of the soybean production takes place in the subtropical South and Southeast savannah regions, which are also the most affected by agricultural pollution. The increased monoculture cultivation of soybeans leads to high demand for pesticides, and the climate in the savannah region makes the use of herbicides crucial for the production of soybeans. The use of chemical fertilisers has increased from 27 to 53 kg/ha over the period 1979 to 1991, but has been decreasing since. Environmental problems in these regions include soil contamination, reduced soil fertility, chemical residues in water supplies, and some problems of pest immunity. Also, irrigation often increases the salinization problems and facilitates the leaching of chemicals into water supplies.

7. Most of the soybean land in Argentina is rich and fertile. Fertiliser application per hectare is very low, e.g. during the 1990/91 growing season it averaged 6.1 kilograms per hectare, compared to ratios of 63 kilograms per hectare in Mexico, 295 kg in France, and 383 kg in

Germany. The main environmental problems associated with soybean production in Argentina are the deforestation and the degradation of soil in the Northwest provinces. As a consequence, erosion and flooding potential in its Northwest region have become serious problems.

8. Chemical fertilisers are probably the most important of all the inputs leading to higher soybean production in China. Total fertiliser use increased from about 1 kilogram per hectare in 1961 to 60 kilograms per hectare in 1992 resulting in the build-up of heavy metals and acidification, and pollution of water supplies.

9. **Oil palm** cultivation has an impact on the natural rain forest environment. The replacement of a natural rain forests with agricultural production systems changes the species composition of both plant and animal populations[1] and reduces bio-diversity. The replacement of secondary forests with plantations has, however, no drastic effects on bio-diversity. Recent studies have shown that the number of plant and animal species and their populations in oil palm and rubber-type plantations are similar to that found in secondary forests. These studies also suggest that replacing natural rain forests with oil palm plantations has no appreciable impact on rainfall patterns. This may have several possible reasons: (i) other factors than the forest cover are more important in determining the level of precipitation; (ii) the area of forest land substituted by oil palm plantation is too small to have a real impact on rainfall patterns; (iii) the effects on rainfall patterns are reduced on land areas surrounded by sea, such as the Malay archipelago.

10. Oil palm cultivation has an impact on climate through the fixation of carbon dioxide. Well managed oil palm plantation on best soils may accumulate at maturity up to 100-120 tonnes dry weight of biomass per hectare. This biomass is largely dissipated when the palms are cleared for replanting. The Malaysian experience has proven that the increased adoption of the zero-burning technique during replanting, i.e the felling of old stands of palms and the mechanical shredding of the tissues which is left for decomposition in situ, minimises the carbon loss, by returning most of the organic matter to the soil. Apart from being an agronomically sound and environmentally friendly technique of replanting, this technique also offers considerable cost savings, compared with the traditional open burning method of land preparation. (Nutrient losses of the readily soluble forms of nitrogen and potassium in oil palm plantations can be also caused by leaching; however, the losses are insignificant, accounting for less than 6-11 percent of the applied nutrients).

11. Many studies have shown that forest clearance for oil palm planting disturbs the natural hydrological cycle. The water table rises because of reduced evapo-transpiration and a greater volume of water would be lost, partly due to decreased infiltration rates, higher stream flows at peak periods and greater seasonal fluctuations in flow. Because of increased soil erosion, both solute and suspended sediment loads in stream waters increase, resulting in downstream silt deposition, causing blockages and promoting floods. However, proper oil palm plantation and cultivation techniques can mitigate many of these adverse environmental effects. Various measures to control erosion include the early establishment of cover crop, terracing, construction of silt pits and mulching with empty fruit bunches.

12. About 72 percent of the mature plantations of palm are found in Malaysia and Indonesia[2]. Under the current practice in Malaysia, about 10 tonnes of pruned fronds are annually produced per hectare of oil palm, containing an equivalent of 7.5 kg nitrogen, 1.6 kg phosphorus, 9.8 kg potassium and 2.79 kg magnesium. These substances are recycled to the field, reducing the need for

[1] The number of mammal species of a primary rain forest is reduced by about a half when the transition is made to a disturbed natural forest system and by less than 15 percent when it is passed from a disturbed natural forest to a secondary forest.

[2] About 45 percent of the world area under mature oil palm plantations (amounting to 5.3 million hectares) is found in Malaysia and 26 percent in Indonesia.

additional mineral fertiliser. In case additional fertilisers are necessary, computer programmes allow the calculation of inputs to reach optimum oil palm yields, taking into account the specific soil, plant and other environmental factors.

13. The adoption of integrated pest management practices[3], combining both biological and farming approaches, make possible the low usage of insecticides, fungicides, herbicides and rodenticides in oil palm cultivation. Thus, on balance, the chemical input requirements in oil palm cultivation, as well as the polluting emissions to soil and water are minimal, while emissions to air (sulphur, nitrogen, oxides and carbon dioxide, pesticides and herbicides) are either comparable, or somewhat lower than in producing annual crops, soybeans in particular[4].

14. The technical efficiency of crop cultivation is also measured by its energy balance. From an annual energy input of 19.2 Giga Joules (GJ) per hectare, oil palm yield products with a total energy of 182.1 GJ per hectare, showing an output-input energy ratio of 9.5, achieved by only few other agricultural systems (see table 2). This may be attributed to the recycling of biomass, which reduces the requirements of inorganic fertilisers and to the low usage of pesticides made possible by the adoption of integrated pest management practices. Soybeans, on the contrary, have relatively low output-input energy ratios: from a total annual input energy of 20 Gija-joules per hectare, soybeans yield products with a total energy of 50 Giga-joules per hectare, i.e an output-input ratio of 2.5.

Table 2. Input-output energy ratios for selected oil crops

Farming System	**Annual Energy Value, Gj/ha[5]**		
	Input	**Output**	**Output-Input Ratio**
Oil Palm (Malaysia)	19.2	182.1	9.5
Oilseed Rape (UK)	23.0	70.0	3.0
Maize (USA)	30.0	84.5	2.8
Soybeans (USA)	20.0	50.0	2.5
Wheat (India)	6.6	11.2	1.7
Rice (USA)	65.5	84.1	1.3
Sugar beet (UK)	124.4	82.9	0.7

Source: Wood and Corley "The energy balance of oil palm cultivation" (1991)

[3] Typical examples include the use of sheep to control weeds, biological control of insect pests with predators and parasitoids, rat control with barn owls, and also the practice of allowing non-competitive weeds to thrive in the plantations.

[4] Table 1, on page 3 of document CCP:OF 95/3, shows an input-output analysis of intensive cultivation of soybean, oil palm, sunflower and rapeseed.

[5] Giga-Joule is the standard energy measure, equivalent to 1.4x10 Kilogrammeter.

Extraction and processing of soybean and palm oils

15. The world's major processors and exporters of **soybean oil** are Europe,[6] Brazil, Argentina and the United States. Together, they account for 95 and 87 percent of the soybean oil and cake export market, respectively. The major environmental concerns at the oil extraction stage are emissions of residual solvents and air pollution from the use of fossil fuels. Most modern mills use hexane extraction (rather than hydraulic or screw presses). The crude soybean oil obtained is further refined through processes, including degumming, neutralisation, bleaching, deodoration and hydrogenation. As crude oil extraction in modern mills is usually done with high-performance, standard equipment provided by only a few suppliers in the world, there is little variation in the use of hexane and losses are minimal. However, where equipment is out-dated or plants are small (i.e. capacities of less than 1000 tons/day) the use and losses of hexane may be higher. In general, however, the environmental damage related to soybean cultivation is much greater than that related to processing[7].

16. Malaysia and Indonesia are the major producers and exporters of **palm oil**, accounting together for eighty four percent of current world exports. Crude palm oil is extracted by mechanical pressing at high temperature, which generates palm oil mill effluent (POME), empty fruit bunches and mesocarp fibre and shell. The fibre and shell are used as fuel, providing energy for the mill. The main pollutant connected with the processing of palm fruit is the mill effluent, containing organic matter. In 1989, when crude palm oil production in Malaysia amounted to about 6 million tons, total POME produced amounted to about 15.2 million tons, equivalent to domestic sewage generated by 22.3 million people. If left untreated, such enormous quantities of organic matter would have serious repercussions on the environment. However, different treatment technologies (pounding systems, open and close tank digesters, land application, etc) reduce pollution with palm oil effluents significantly. Nevertheless, in contrast to soybean oil, the environmental damage related to processing of palm oil is higher than that related to the cultivation of the crop.

17. Wastewater effluents are also generated in the physical and chemical refining of the crude palm oil, although in much smaller volumes and considerably less polluting than in primary processing. The installation of effluent treatment systems and the promulgation and enforcement of governmental regulatory standards, in Malaysia in particular, have led to significant reductions in pollutants and to improvements of waterways in peninsular Malaysia.

18. Exhaust fumes from incinerators are another source of pollution in palm oil mills, resulting from the traditional burning of empty fruit bunches after sterilisation and from stripping. Improperly operated, such incinerators emit a lot of smoke and other polluting particles. Plantation companies have, therefore, increasingly adopted the practice of recycling the empty fruit bunches to the plantation as mulch and, thereby, improved the yields of fresh fruit bunches by over twenty percent.

C. ENVIRONMENTAL REGULATIONS : MAJOR FACTORS AFFECTING THEIR APPLICATION AND THEIR IMPACT ON TRADE COMPETITIVENESS OF MAJOR OIL CROPS

[6] Soybean oil and cake are, to a large extent, produced and exported in Europe through crushing very large quantities of imported soybeans.

[7] Table 2, on page 4 of document CCP:OF 95/3, shows the input-output analysis of processing soybean, sunflower, rapeseed and oil palm fruit to vegetable oils and meals.

Influence of property rights and of political considerations on the application of pollution control measures and the internalisation of environmental costs

19. Environmental control in most industrial countries in the 1970's was focused principally on large industrial and municipal sources of polluting emissions, with considerable success in cleaning up this so-called "point", or "first generation" type of pollution. The diffuse, "second generation" pollution problems are more difficult and often more costly to control. Agricultural pollution is a "second generation" pollution problem, raising particular environmental management difficulties. Some of these difficulties are of a technical nature, while others are related to existing rights and obligations associated with ownership and user rights of existing resources, as well as with economic, political and social considerations.

20. The effective internalisation of environmental costs is determined, to a certain degree, by legal and constitutional property rights to natural resources, which do not allow extensive interference in landowners' use of their land. The degree of application of the environmental control regulations in agriculture and the internalisation of environmental costs is also determined by political considerations. In most industrial countries, the specific political status of farmers has determined the reluctance to impose additional financial burdens on agriculture that might adversely affect their output and income.

21. The difficulty of imposing stringent environmental regulations in many developing countries is largely due to the dilemma faced by Governments between their enforcement and the need to cope the reduction of poverty, meeting food demand and promoting economic development. Nevertheless, developing countries which are large producers of soybean and oil palm, such as Argentina, Brazil, China, Malaysia and to a lesser extent Indonesia, have issued important environmental protection and pollution control regulations in the oilseed-based product sector. Environmental consciousness and the capacity to manage the environment has grown considerably in the last decade in these countries. The lack of technical, financial and institutional infrastructure has delayed, however, the practical enforcement of environmental laws and regulations and the more extensive internalisation of environmental costs.

The impact of environmental regulations on the trade competitiveness of major oils

22. The introduction of environmental regulations and pollution control measures in agriculture raises concern over the impact on trade competitiveness of different products and producing countries, because protection measures with different stringency could result in an uneven trade "playing field". At present, the costs associated with conforming with the pollution control measures enforced in the major producing and exporting countries appear to be relatively small, averaging $18, $15, $11, and $6 for producing and processing, respectively, soybean, sunflower, palm, and rapeseed oils (FAO, CCP:OF 95/3, page 8, Table 4). Thus, environmental costs related to the implementation of pollution control policies in the oilseeds sector would add at present between 0.5 and 5 percent to production costs of the major annual and perennial oil crops.

23. Although existing pollution control measures applied in the cultivation and processing of the major oil crops do not significantly affect their competitiveness at present, more stringent regulations leading to a fuller internalisation of environmental costs of cultivation and processing could change the relative competitiveness of major oils, as well as the competitiveness between the major producing/exporting countries. Soybean cultivation and processing have the largest pollution potential, and the costs of a comprehensive package of environment protection measures could add 24 to 27 percent to current production costs of soybean oil. By contrast, the full costs of controlling pollution in oil palm cultivation and processing would add 10 to 15 percent to the current production costs of palm oil.

24. The shift in competitiveness between soybean oil and palm oil would, moreover, be determined by the focus of the pollution control regulations. If the environmental costs of *cultivation* have to be internalised, palm oil producers and exporters in Malaysia, Indonesia and Pacific Region would greatly benefit. If the cost burden is more geared at reducing environmental damage due to *processing*, this would be mainly to the advantage of soybean oil, producers/exporters in North and South America.

D. CONCLUSIONS AND RECOMMENDATIONS

25. If poorly managed, the expected growth in soybean and oil palm production and processing could result in increased pressure on, or damage to the environment, caused by land conversion and environmentally un-sustainable farming practices, as well as by environmentally inadequate processing technologies. The negative environmental effects of agricultural growth in both developing and developed countries can only be avoided if progress continues to be made toward the enforcement and the extended application of environmental policies and of protective measures against environmentally unsustainable agricultural practices. Thus, pesticide and fertiliser subsidies geared at encouraging the adoption of more intensive cultivation and farming in areas where such applications are already high, are questionable. Likewise, incentives for land clearing and conversion to agriculture can have negative effects on the environment. Income tax and capital market policies can have also important environmental implications, as they may accelerate the pace of settlement in virgin areas, the rate of deforestation for the cultivation of crops, including soybeans and oil palm, and thereby contribute to the unsustainable use of the land.

26. Governments around the world have been hesitant to impose stringent and costly environmental policies on the oilseeds sector. Current pollution abatement costs at 0.5 percent are lowest in palm oil cultivation and processing. Although in soybean production and processing they reach 5 percent, the difference in the currently applied pollution abatement costs of these two major annual and perennial crops is minor and has not had an impact on their competitiveness todate, nor had it altered the patterns of trade to any notable degree. The further strengthening of environmental regulations and a gradual extension of the internalisation of aggregated pollution control costs of cultivation and processing would, however, result in the long term in more marked increases of production costs of the major producers and exporters and affect their relative competitiveness and international market shares. In these circumstances, the competitiveness of exports of soybean-based products (oil and meal) from the USA, Brazil and Argentina could decrease, while palm oil from Asian and Pacific countries could possibly increase its shares in the world trade in vegetable oils. Moreover, a greater focusing on the internalisation of pollution control in cultivation would confer a competitive advantage to Asian and Pacific exporters of palm oil, while the focus on controlling pollution from industrial processing of oils would benefit mainly North and South American exporters of soybean-based products.

27. In the light of the above, the Group may wish to recommend to the Secretariat to concentrate its work on the following issues:

- *Promotion of "environmental-friendly" oilseed-based products.* The Secretariat is recommended to undertake, within the limit of available resources, an assessment of the implications of promoting "environmental-friendly" products on the production and trade in lauric oils, in particular coconut oil.

- *Country case studies*. The Secretariat is recommended to undertake case studies, in order to assess the existing situation and to quantify the environmental effects of production of oilseed-based products and the likely costs and benefits of the environmental policies.