# IENICA

Interactive European Network for Industrial Crops and their Applications

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# REPORT FROM THE STATE OF GREECE

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# METHODOLOGY

The preparation of this report was based on the methodological approach already used in our earlier IENICA report since 1999 (for more details, see N. Diamantidis, PhD Thesis, NTUA, Athens, 2000), in conjunction with the more recent literature and other related activities.

Prominent among the latter is the ongoing exercise "Technology Foresight in Greece" (2001-2021), and particularly the progress of its more relevant panels (Agriculture, Biotechnologies, Environment).

Main Data Sources:

- FAO, Agricultural Statistics, 1995-2003.
- National Statistical Service of Greece, Agricultural Production Data, 1995-2003.
- Technology Foresight in Greece (www.foresight-gsrt.gr).
- Proceedings on the Integrated Management of Oil Wastes, Athens, January 2004.

# EXECUTIVE SUMMARY

**UPDATE OF THE GREEK REPORT**
**(1995-2003)**

This report is an update of the previous IENICA Report from the State of Greece (1999), and therefore should be read in conjunction with that relatively longer and more detailed document (see www.ienica.net). The main purpose of this update is to provide more recent data on the Greek industrial crops (in the form of the following Tables), together with some information on their products, as well as a brief review the main arguments put forward by the previous report.

The conclusion of the present document is that, although the current industrial use of Greek agricultural crops and products is limited to rather conventional food outlets, there exist both significant potential as well as scope for many-fold increase of this sector aiming at mega-targets such as national and regional development. A main obstacle for a successful deployment along that pathway consists in the present use of the CAP by Greek farmers, their Unions and the National State.

# OIL CROPS

Oil crops were not included in the original IENICA report for Greece, mainly due to the predominantly food uses of their products. Nevertheless, both the importance of these crops for the dynamics of Greek agriculture, especially in a post-CAP era, along with the significant potential of some non-food uses in the near future, have resulted in their consideration here.

The annual production figures of sunflower seeds (Table 1) vary considerably between 20,000 and 60,000 tonnes. Being a crop of regional importance (in the northern areas), they are grown specifically as edible, vegetable-oil sources, although their future use for biodiesel production might push their production up, and thus open the way for other industrial uses, such as biolubricants and oleo-chemistry-based speciality products.

**Table 1 – Sunflower seeds (industrial use for edible oil production)**

| Year | Area Harvested (ha) | Production (t) | Yield (t/ha) |
|---|---|---|---|
| **2002** | 17,076 | 20,000 | 1.171 |
| **2001** | 17,457 | 22,808 | 1.307 |
| **2000** | 24,780 | 34,950 | 1.410 |
| **1999** | 34,600 | 55,500 | 1.604 |
| **1998** | 31,336 | 40,413 | 1.290 |
| **1997** | 26,886 | 36,000 | 1.339 |
| **1996** | 23,261 | 31,234 | 1.343 |

Olives for oil (Table 2) constitute one of the main national crops, with a recent annual production higher than 2 million tonnes.

**Table 2 - Olives for oil (followed by industrial extraction of kernel oil)**

| Year | Area Harvested (ha) | Production (t) | Yield (t/ha) |
|---|---|---|---|
| **2002** | 765,000 | 2,000,000 | 2.614 |
| **2001** | 767,144 | 2,249,430 | 2.932 |
| **2000** | 765,151 | 2,273,836 | 2.972 |
| **1999** | 757,600 | 2,196,615 | 2.899 |
| **1998** | 738,582 | 2,068,167 | 2.800 |
| **1997** | 728,735 | 2,087,165 | 2.864 |
| **1996** | 717,383 | 2,131,000 | 2.971 |

Olive oil is still prohibitively expensive as an industrial non-food feedstock, but one of the uses of olive kernel oil which is actually being extracted from the pressed olive cakes is in soap making in local factories (linked to the kernel oil extraction units) – 1-2 kt/year. We should also mention the significant national R&D activities on topics of olive residues and wastes utilisation, with ongoing research in directions including the production of biofertilisers (NTUA) and biofuels (various actors), as well as notably the fractionation of high value-added polyphenols from olive mill effluents (Athens U., Pharmacy School).

Cotton seed oil represents another case of low industrial value vegetable oil, being produced from a main national crop (Table 3). Its strong animal feeding limitations (e.g. gossypol) could act as a positive factor for pushing other industrial uses, should the technologies and markets be in place. Nevertheless, the presently extracted limited quantities of cotton-seed oil are of low quality and thus find only low-grade uses (e.g. as paint solvent) – in very limited amounts – and as a fuel (crude bio-diesel) in more substantial amounts (20-30 kt/year), processed through combustion at the crushing/pressing/extraction plants.

**Table 3 - Cotton seed + fibre (cotton seed oil is industrially extracted)**

| Year | Area Harvested (ha) | Production (t) | Yield (t/ha) |
|---|---|---|---|
| **2002** | 388,339 | 1,080,000 | 2.781 |
| **2001** | 403,140 | 1,326,458 | 3.290 |
| **2000** | 413,600 | 1,259,628 | 3.046 |
| **1999** | 424,260 | 1,367,000 | 3.222 |
| **1998** | 423,439 | 1,186,682 | 2.802 |
| **1997** | 407,600 | 1,126,674 | 2.764 |
| **1996** | 417,000 | 1,276,000 | 3.060 |

Overall, the oil crop situation in Greece leads to the conclusion that as long as the present EU subsidies regime persists no major change to the above summarised pseudi-equilibrium will take place, with minor developments in the areas of by-products and wastes. If, however, the Brussels subsidy scheme shifts to more ‘green’ targets and/or tends to lower its contributions, then the whole oil crop balance could move towards more industrial uses incorparating non-food applications.

# FIBRE CROPS

As already shown in the 1999 report, the cotton cultivation areas have tripled from a pre-EU (before 1980) 140,000 ha to the present ca. 400,000 ha (Table 4). This development, clearly promoted by CAP, leads to the yearly production of 1.3 million tonnes of seed + fibre (the fibre mass being about one third of the crop). Although the present high production costs do not make this crop really competitive on the international markets, there are specific technical and quality aspects that could be of great industrial value should the actual CAP support even start to shift (see also above the general comment on oil crops).

**Table 4 - Cotton seeds + fibre**

| Year | Area Harvested (ha) | Production (t) | Yield (t/ha) |
|---|---|---|---|
| **2002** | 388,339 | 1,080,000 | 2.781 |
| **2001** | 403,140 | 1,326,458 | 3.290 |
| **2000** | 413,600 | 1,259,628 | 3.046 |
| **1999** | 424,260 | 1,367,000 | 3.222 |
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| **1996** | 417,000 | 1,276,000 | 3.060 |

The case of sorghum is totally different: as already presented in the previous report, the traditional "sorgho" production area (North regions) has shrunk in the EU era by almost ten times, i.e. from 9,000 ha (1970) down to the present quasi-stabilised area of 1,000 ha (Table 5), obviously been replaced by heavily subsidised competitors. With the advent of the 'new' industrial/energy sorghum plantations (see the previous report), the fibre potential of the crop could be recognised again, although not in the same regions, and – more significantly - in a high value-added context, as far as the products are concerned (see R&D by BTU/NTUA).

**Table 5 - Sorghum**

| Year | Area Harvested (ha) | Production (t) | Yield (t/ha) |
|---|---|---|---|
| **2002** | 1,000 | 2,000 | 2.000 |
| **2001** | 1,000 | 2,000 | 2.000 |
| **2000** | 1,000 | 2,000 | 2.000 |
| **1999** | 1,000 | 2,000 | 2.000 |
| **1998** | 1,000 | 2,000 | 2.000 |
| **1997** | 1,000 | 2,000 | 2.000 |
| **1996** | 1,000 | 2,000 | 2.000 |

# CARBOHYDRATE CROPS

Two food crops dominate the sector - wheat and maize. In the period examined, wheat (Table 6) growing areas have remained rather constant at less than 900,000 ha, yielding more than 2 million tonnes per year of grain, at a rather mediocre average yield factor (2.3 t/ha). At the same time, with one quarter of the area – also close to stable – maize (Table 7) yields about the same level of grain production, i.e. 2 million tonnes per year, due to the record high average yields of the crop (close to 10 t/ha! – see also the previous report). The only use of the ca. 3 million tonnes/year of the carbohydrates generated by the two crops is that of the food chain, through the milling and the animal feed pathways. The predominant use of the protein and oil components is also for food, with limited industrial production of corn oil and the various by-products and residues. Corn starch production is limited to food uses, as a side activity to oil extraction. All industrial starch requirements are covered by imports.

Among the new potential introductions of carbohydrate crops, sweet sorghum occupies a key position (see previous report, and the general comment on oil crops).

**Table 6 - Wheat (for grain)**

| Year | Area Harvested (ha) | Production (t) | Yield (t/ha) |
|---|---|---|---|
| **2002** | 876,389 | 2,033,000 | 2.320 |
| **2001** | 869,130 | 2,084,400 | 2.398 |
| **2000** | 859,780 | 2,183,360 | 2.539 |
| **1999** | 837,900 | 2,063,990 | 2.463 |
| **1998** | 855,422 | 1,880,000 | 2.198 |
| **1997** | 859,813 | 1,990,803 | 2.315 |
| **1996** | 864,854 | 1,882,488 | 2.177 |

**Table 7 - Maize (for grain)**

| Year | Area Harvested (ha) | Production (t) | Yield (t/ha) |
|---|---|---|---|
| **2002** | 220,301 | 2,014,000 | 9.142 |
| **2001** | 210,296 | 2,034,766 | 9.676 |
| **2000** | 215,000 | 2,307,500 | 10.733 |
| **1999** | 209,800 | 1,949,920 | 9.294 |
| **1998** | 213,938 | 1,816,441 | 8.491 |
| **1997** | 210,645 | 2,025,281 | 9.615 |
| **1996** | 213,000 | 2,110,000 | 9.906 |

# SPECIALITY CROPS

In this category, we have included the traditional production of tobacco leaves (Table 8), which from ca. 100,00 ha of the pre-EU era has shrunk down to 60,000 ha, with a tendency of further decrease. Nevertheless, due to an overall yield improvement (from 0.9 to 2.2 t/ha in the same period), production levels have actually increased to a stable 130,000 tonnes/year. Moreover, as 50% of this former 'cash-crop' production takes place in less favoured areas (with 13% in mountain areas - see Table 10), this trend could jeopardize some regional and local economies, unless some good alternative crops are been proposed; thus a potential 'window' for new industrial crops, capitalising on the technical and quality skills and successes of the tobacco sub-sector.

Carob beans (Table 9) represent a class of Mediterranean tree-crops left outside the CAP effects. The present 20,000 tonnes/year are not an indication of the real potential, which depends upon the demand of particular industrial uses, such as that of roasted beans as cocoa substitute, and carob sugars as substrate of innovative bio-processes. Given the abundance of the crop around the Mediterranean basin, a carob-based technology could have a wider impact on the regional economies concerned.

**Table 8 - Tobacco Leaves**

| Year | Area Harvested (ha) | Production (t) | Yield (t/ha) |
|---|---|---|---|
| **2002** | 59,534 | 123,700 | 2.078 |
| **2001** | 60,917 | 136,490 | 2.241 |
| **2000** | 62,917 | 136,593 | 2.171 |
| **1999** | 64,963 | 139,791 | 2.152 |
| **1998** | 67,230 | 137,114 | 2.039 |
| **1997** | 65,889 | 136,977 | 2.079 |
| **1996** | 64,842 | 133,750 | 2.063 |

**Table 9 - Carobs**

| Year | Area Harvested (ha) | Production (t) | Yield (t/ha) |
|---|---|---|---|
| **2002** | 12,600 | 19,000 | 1.508 |
| **2001** | 12,600 | 19,000 | 1.508 |
| **2000** | 12,600 | 19,000 | 1.508 |
| **1999** | 12,600 | 19,000 | 1.508 |
| **1998** | 12,600 | 18,494 | 1.468 |
| **1997** | 12,600 | 19,134 | 1.519 |
| **1996** | 12,600 | 17,034 | 1.352 |

# OPPORTUNITIES AND CONSTRAINTS REVISITED

The following diagramme of the time change of the main industrial crops production level summarises rather efficiently the present 'stagnated' situation of the sector in Greece: with the only exception of the sunflower variability by 100% in 5 years, all crops examined appear stabilised. This indicator clearly reflects a stability/stagnation in the overall dynamics, as on the one hand the two constraining factors of change identified in the 1999 report, i.e. legislation (CAP) and economics, retain their position and strength, whereas, on the other hand, the two driving factors of change, also defined in the same report, i.e. S&T and the environment, have not increased theirs. In some aspects, agro-industrial research of this kind has actually suffered by a combination of reduced opportunities for funding from both EU (new FP structure and priorities) and national (new business-oriented GSRT targets) sources.

Obviously, any indication of serious CAP shift towards environment-friendly and alternative/innovative solutions as well as rural development could dramatically speed up the presently blocked dynamics of change. As for the national priorities, there are encouraging indications that the ongoing, first ever, National Technology Foresight Programme (2001-2021), and particularly its Agriculture, Environment, Energy and Biotech panels, will converge in focusing their strategic recommendations on industrial/non-food crop use as a lever for regional development and a possible 'flag' sector within a broader wave towards a '2$^{nd}$ Greek Revolution', some 200 later than the first (1821)!

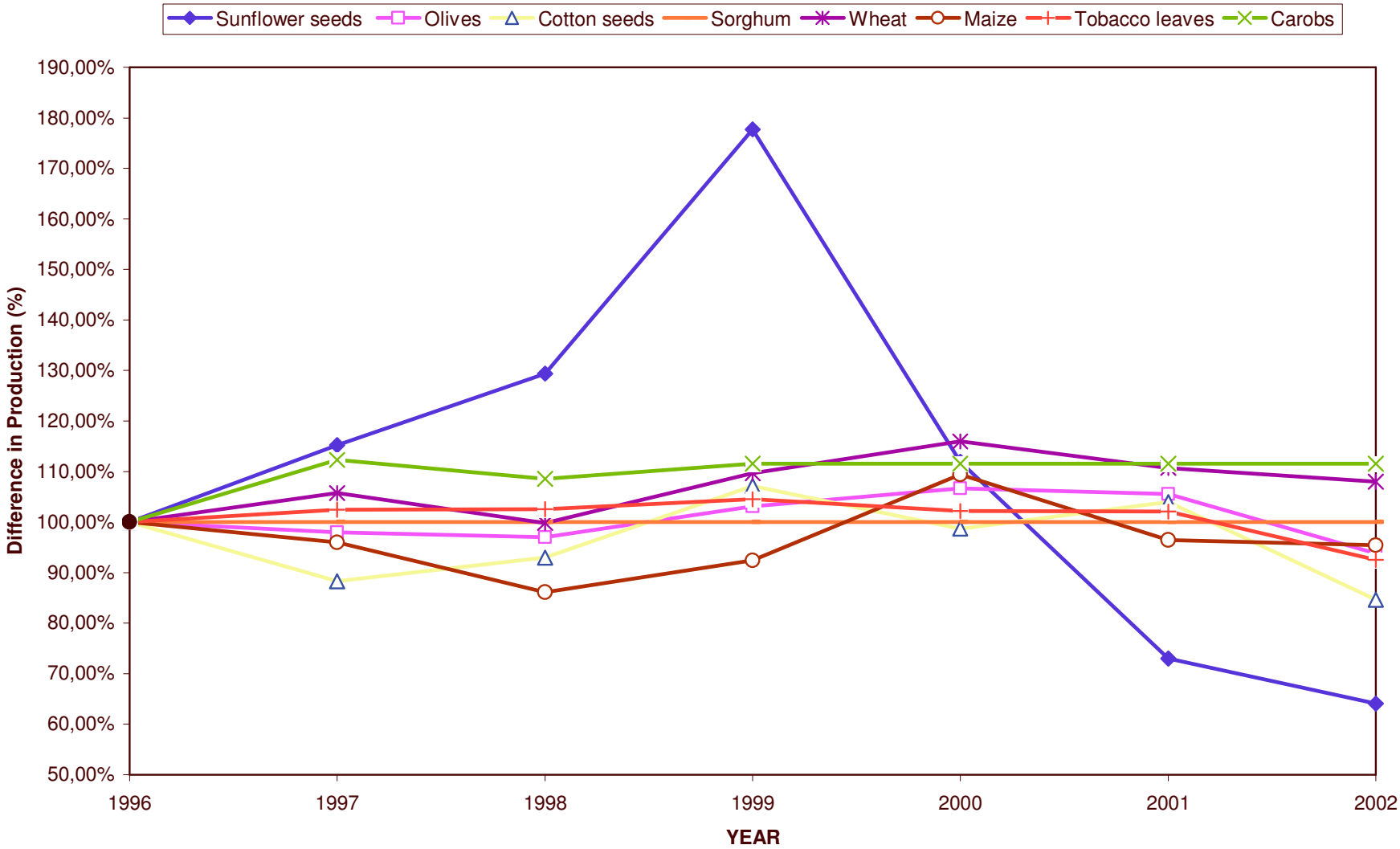
Sunflower seeds
Olives
Cotton seeds
Sorghum
Wheat
Maize
Tobacco leaves
Carobs
190,00%
180,00%
170,00%
160,00%
150,00%
140,00%
130,00%
120,00%
110,00%
100,00%
90,00%
80,00%
70,00%
60,00%
50,00%
Difference in Production (%)
1996
1997
1998
1999
2000
2001
2002
YEAR

**Table 10 - Distribution of the main industrial crop production in Greece by land type**

| Crops | Land Type | | | Total (%) |
|---|---|---|---|---|
| | Plains (%) | Hills (%) | Mountains (%) | |
| Wheat | 66.6 | 25.0 | 8.4 | 100.0 |
| Maize | 72.7 | 20.0 | 7.3 | 100.0 |
| Tobacco seeds | 50.0 | 36.7 | 13.3 | 100.0 |
| Cotton seeds | 80.8 | 18.7 | 0.5 | 100.0 |
| Sunflower seeds | 77.4 | 17.1 | 5.5 | 100.0 |
| Sorghum | 72.3 | 18.0 | 10.7 | 100.0 |