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Rice production and research in Greece

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Résumé. *En Grèce, en 1995, la superficie consacrée à la riziculture couvrait 25 500 ha, avec un rendement moyen de 8,11 t/ha, une production rizicole de 206 900 tonnes et une consommation de 5,9 kg par personne. Pendant la période 1981-1995, le rendement a augmenté en moyenne de 3,5%, la production de 2,5% et la consommation de 0,8%. Les prix en valeur réelle du riz paddy ont progressé de 13% en moyenne entre 1988 et 1990, de 1,5% entre 1982 et 1987 et de 4% pendant la période 1991-95, par rapport au niveau de 1981. La Grèce est devenue autosuffisante en riz au cours des quatre dernières années et exporte du riz Indica. Les principales variétés cultivées son: Thaibonnet, Macedonian, Axios, Strymonas, Ispanikia, Lido et Roxani. Les principaux facteurs qui limitent la production rizicole sont les suivants : eau d'irrigation insuffisante, salinisation élevée du sol et le problème du riz rouge. Les rendements en riz pourront s'améliorer au cours des cinq prochaines années pour se stabiliser à 8,5 t/ha, de même que la superficie ensemencée qui pourra avoisiner les 30 000 ha. 95% des activités de recherche sur le riz conduites en Grèce relèvent de l'Institut des Céréales de Thessalonique. Dans ce domaine, les principaux résultats obtenus ont été : la mise en circulation de 18 variétés de riz au cours des quarante dernières années et l'obtention de données de recherche pour une fumure correcte, une lutte efficace contre les mauvaises herbes, des systèmes d'irrigation appropriés, la détermination du moment propice à la récolte, etc. Sept programmes de recherche sont en cours actuellement. La politique suivie en matière de production rizicole recherche un équilibre entre les types Indica et Japonica pour une production suffisante et une amélioration stable de la qualité du riz.*

Abstract. In 1995, the rice growing area in Greece was 25 500 ha, the average yield was 8.11 t/ha, rice production 206 900 tons and consumption 5.9 kg per capita. Rice yield had an average increase of 3.5%, production 2.5% and consumption 0.8% during the period 1981-1995. The deflated prices of paddy rice were increased by an average of 13% during the period 1988-1990, 1.5% during the six-year period 1982-1987 and 4% during the five-year period 1991-1995, in comparison to the prices in 1981. Greece has become self-sufficient in rice over the last four years and exports the indica type. The principal cultivated varieties are: Thaibonnet, Macedonian, Axios, Strymonas, Ispanikia, Lido and Roxani. The most serious constraints of rice production are: the shortage of irrigation water, high salination of soils and the need for red rice. The rice yields can be increased and can be stabilized at 8.5 t/ha over the next five years while the rice area can approach 30 000 ha. The Cereal Institute of Thessaloniki carries out 95% of the research on rice in Greece. The most important achievements in rice research were: the releasing of 18 rice varieties during the last 40 years and obtaining research data for correct fertilization, weed control, methods of irrigation, harvesting time, etc. Now the actual research programmes are seven. The rice production policy is a production balance between the types indica and japonica for achieving their sufficiency and the stable improvement of rice quality.

I – General information

Rice is not a very important crop in Greece. The rice area in 1995 was 25,500 ha, i.e. 0.04% of the cultivable area which is 4.01 million ha, while the total land area is 13.19 million ha.

II – Rice production, consumption and area

Rice production and consumption since 1981 to present appear in Table 1.

Table 1. Rice production and consumption

Year	Production (paddy)		Consumption (milled rice)		Consumption
	(1000 tons)	**Index** (%)	**Milled rice**	**Index** (%)	(kg per capita)
1981	87.00	100	54.96	100	5.33
1982	83.38	96	56.69	103	5.50
1983	82.20	95	55.64	101	5.40
1984	89.84	103	53.25	97	5.17
1985	106.41	122	65.84	120	6.39
1986	119.34	137	60.57	111	5.88
1987	130.01	149	64.40	117	6.25
1988	114.10	131	63.42	115	6.16
1989	99.84	115	48.34	88	4.69
1990	95.98	110	61.79	112	6.00
1991	89.00	102	47.43	86	4.65
1992	109.51	126	69.58	127	6.76
1993	141.80	103	73.12	133	7.10
1994	174.42	200	69.17	126	6.72
1995	206.90	238	60.74	111	5.90
1996*	220.00	253			

* estimated

Rice production increased at an average of 2.5% annually for the period 1981-1995, while the consumption of milled rice increased at an average of 0.8% during the same period.

Rice production prices from 1981 through 1995 appear in Table 2.

Table 2. Price evolution for rice introduction

Year	Average prices of paddy rice (Drachmas/kg)	Deflated prices of paddy rice (Drachmas/kg)
1981	15.94	15.94
1982	19.44	16.76
1983	23.68	16.68
1984	28.44	16.73
1985	32.16	16.16
1986	36.66	15.53
1987	40.32	15.27
1988	50.10	17.16
1989	64.21	19.58
1990	67.86	17.44
1991	73.78	15.97
1992	87.63	16.76
1993	98.35	16.73
1994	109.50	16.95
1995	116.00	16.74

For the indica type, rice prices were about 20% higher than for the japonica type until 1987. This difference decreased the following years. In 1994, the price of the indica type was only 4% higher than that of the japonica type while, in 1995, the price of the indica type was 8% lower than that of the japonica type. The prices of the japonica type rice differed according to the rice category. So the prices of the medium grain category were 5-6% higher than those of the short grain category, while they were lower by about the same percentage than those of the long grain category.

The deflated prices of paddy rice increased at an average of 13% for the three-year period 1988-1990 in comparison with the prices of 1981. This period was characterized by dry weather conditions, shortage of irrigation water and decrease of yields. These prices increased at an average of only 1.5% for the six-year period 1982-1987 and of 4% for the five-year period 1991-1995 in comparison with the prices of 1981.

Rice imports and exports from 1981 through 1994 appear in Table 3.

Table 3. Rice import and export evolution

Year	Imports		Exports	
	(1000 t) **	Value (million $US)	(1000 t)	Value (million $US)
1981	2.5	1.96	4.95	1.37
1982	8.3	5.15	4.43	1.01
1983	7.8	5.35	4.39	0.83
1984	9.5	6.30	17.39	8.13
1985	7.4	5.58	12.53	3.92
1986	5.7	5.78	31.89	12.00
1987	5.2	5.74	36.18	15.38
1988	6.1	7.95	22.65	12.58
1989	4.5	7.05	29.94	14.20
1990	4.7	8.73	5.59	1.81
1991	6.3	8.93	22.29	9.35
1992	7.4	10.39	9.85	4.29
1993	7.0	9.16	36.36	23.03
1994	6.5	8.32	50.68	33.77
1995*	6.0	8.00	79.75	57.44

* estimated; ** Rice = Paddy x 65%, brown, milled, broken, flour

Greece has been self-sufficient in rice since 1984, with the exception of 1985, 1990 and 1992 for which the import-export balance showed a deficit. The rice imported was usually milled rice of indica type while the rice exported was paddy and broken rice of both types.

For rice areas and yields per region in 1995, see Table 4 and map.

Table 4. Rice area and yield in 1995

Region	Rice area (1000 ha)	Yield (t/ha)
Thessaloniki	16.38	8.78
Serres	4.57	5.89
Imathia	2.04	9.91
Fthiotida	0.93	6.45
Pieria	0.63	6.79
Rest	0.95	6.00
Total	**25.50**	**8.11**

There is a significant difference in yields according to various regions of rice cultivation due to incomplete information of rice growers in some regions.

The main cultivated rice varieties for each region appear in Table 5.

Table 5. Main cultivated varieties in each region

Region	Cultivated varieties
Thessaloniki	Thaibonnet, Makedonia, Ispaniki A
Serres	Axios, Lido
Imathia	Thaibonnet
Fthiotida	Strymonas, Roxani
Pieria	Thaibonnet

III – Constraints and potential of rice production

1. Constraints

❑ **Climate.** Rice areas require a Mediterranean type of climate, with rainfall during the autumn, winter and spring and drought accompanied by high temperatures in the summer. Tables 1 and 2 give the meteorological data on 75% of the rice area in Greece (regions of Thessaloniki, Imathia and Pieria).

Table 6. Mean temperatures for Thessaloniki, 1991-1995

Month	Temperatures (°C)														
	Maximum					*Minimum*					*Mean*				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
May	24.5	25.4	25.2	25.5	24.5	13.2	13.0	12.7	13.4	12.0	18.3	19.2	18.5	19.4	17.9
June	32.0	31.8	31.5	32.2	30.0	17.6	16.9	16.2	17.1	17.8	25.3	24.9	24.4	25.6	23.6
July	33.4	33.2	32.9	33.6	31.3	18.8	18.2	17.2	18.5	19.2	26.1	25.7	24.9	26.3	25.8
August	33.9	34.1	33.2	34.2	32.3	18.9	18.3	18.0	18.8	17.6	26.4	26.0	25.6	26.5	24.8
Septemb.	26.1	27.1	28.3	27.4	26.0	13.5	13.4	12.8	13.6	13.8	20.9	20.0	20.5	20.8	20.2
October	22.2	22.3	23.8	23.7	22.1	11.5	11.5	11.7	11.8	11.6	17.2	16.7	17.5	17.3	17.3

Table 7. Mean rainfall and wind for Thessaloniki, 1991-1995

Month	Rainfall (mm)					Wind speed (m/sec)				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
May	29	35	85	54	39	0.8	0.7	0.8	0.6	0.7
June	41	61	9	3	6	1.2	1.1	1.2	1.0	1.0
July	63	38	-	38	67	1.1	1.0	1.3	0.6	0.8
August	70	-	-	24	33	1.0	0.9	1.1	0.6	0.7
Septemb.	44	2	3	-	17	0.7	0.8	0.8	0.5	0.6
October	13	90	9	92	19	0.6	0.4	0.6	0.4	0.5

Though temperatures are generally favourable for rice cultivation, rainfall is insufficient during the summer. Moreover, very strong and cold winds usually prevail during the summer in the region of Thessaloniki.

❒ **Soils.** Ninety percent of the cultivated rice area is characterized by pathogenic soils with high salinity. Therefore, leaching the soil salts especially at the first stages of the rice plants and also for application of acid fertilizers is absolutely necessary. An ideal system of rotation is very difficult to be applied because of very high salinity. In addition, there is a significant area (80%) where a 3-year rotation (rice and one year corn, sugarbeet and cotton) is applied.

❒ **Water and Irrigation**. The shortage of irrigation water is the most restrictive factor for the expansion of the rice crop. The laser technique for land levelling, besides allowing significant irrigation water saving, has not only maintained the cultivated rice areas but also increased them.

❒ **Diseases**. Recently, attacks of rice plants by *Pyricularia oryzae* or other diseases have not been recorded.

❒ **Insects.** The stemborer *Sesamia* inference attacks rice plants and causes damages up to about 10 % of late cultivars (*Thaibonnet* and *Ispaniki A*). Insects as *Hydrelia Sp.* and *Ephydra attica* do not cause any damages to rice plants.

❒ **Weeds.** The most serious weeds affecting the rice crop with a consequence on yield and quality are *Echinochloa crus galli* and red rice. The former is being hardly controlled these last years as it has developed resistant biotypes subsequent to the application of herbicides (molinate and propanil) since 30 years. Moreover, the failure of the newer rice varieties to overcome the above weeds prevents their

control. Red rice can be partly controlled by using certified seeds, mechanical means for ploughing and harrowing for example, as well as through rotation.

2. The potentials

❒ **Increase of rice yields.** Rice yields is likely to increase within the next 5 years and to be stabilized at 8.5 tons/ha. This expected increase in yields will result from the substitution of some cultivated varieties by new Greek varieties. Increase in yields will be achieved through the adoption of new techniques of rice cultivation by some rice growers.

❒ **Increase of the rice area.** The rice area has been fluctuating between 14,000 to 25,000 ha annually for the last 40 years. In 1996, this area was of 28,000 ha and cannot attain more than 30,000 ha for the time being because of the shortage of irrigation water.

IV – The rice research network

Institutes implicated on rice research and production are:

1. Cereal Institute, 57001 Thermi-Thessaloniki
2. Soil Science Institute, 57001 Thermi-Thessaloniki
3. Plant Protection Institute, 57001 Thermi-Thessaloniki
4. Land Reclamation Institute, 57400 Sindos-Thessaloniki
5. Gene Bank, 57001 Thermi-Thessaloniki

These institutes belong to NAGREF (National Agricultural Research Foundation) which pertains to the Ministry of Agriculture.

The **Cereal Institute** closely collaborates with the Aristotle University of Thessaloniki (Departments of Breeding, Agronomy and Agricultural Economics). It carries out 95% of the research work on rice in Greece. A 50 ha farm situated near the village of Kalochori, at a distance of about 10 km from Thessaloniki (geographic latitude 40°33'), equiped with the necessary facilities, is being used for experimentation. The personnel consists of one researcher (breeder), one agriculturist, one technician and five temporary field workers, spending 80% of their time working for breeding programmes and the rest for agronomy programmes. There is also one researcher working partly on rice quality. The principal research themes of this Institute are: breeding, weed control and fertilisation.

The **Soil Science, Plant Protection, Land Reclamation** institutes and the **Gene Bank** cooperate closely with the Cereal Institute, the first institute in the programme of rice fertilisation, the second in the programme of rice protection against insects, the third in the programme of water management and the fourth in the programme of conservation of genetic material. One researcher from each of the above institutes is partly working in the corresponding programme.

1. Most important achievements in rice research

❒ Eighteen rice varieties have been released during the 40 years of research by the Cereal Institute. Sixteen of them have been released by the application of the classical pedigree method and two by the Honeycomb pedigree method. Seven varieties of them are cultivated now. After about 10 years of experimentation we have found out that the honeycomb pedigree method of selecting genetic material is more effective for yield and quality than the methods of classical pedigree and single panicle descent.

❒ Study of the Minimum Tillage in the 1980 decade had as a result deeper knowledge for saving rice production cost, energy and machinery.

❒ The research of the last years led to the conclusion that seed quantity for seeding fluctuates between 170-230 kg/ha and it depends on the seed size, variety type (japonica or indica) and the seed quality.

❒ Study has been realised on sexual trapping with pheromones in order to evaluate the population of the insect Sesame inference. Then, the rice growers can be informed about the size of the insect population.

❒ Study of the competitiveness of the rice varieties with the weed *Echinochloa crus galli* has led to the conclusion that indica type varieties are less competitive to this weed than those of japonica type varieties. Also varieties with higher plant height and greater grain size are more competitive than those with lower plant height and smaller grain size.

The herbicides molinate, propanil, pretilachlor and quinclorac, have been studied in different times, doses and techniques of application and we have found their right time of application, their proper doses and techniques. So we succeeded an increase of the yield and quality, low cost and smaller aggravation of the environment. Very satisfactory is the effectiveness of the new herbicide DE 537 (*Cyhalafop*) for controlling the *Echinochloa crus galli*.

❒ Intensive research has been done on the fertilization of the rice crop. Studies were realized on the reduction of nitrogen losses in the rice fields and on N, P and K response of new cultivars. It has been found that the fertilization rates which the rice crop needs are: N 140-160 kg/ha, P205 40-60 kg/ha and K2O 60-100 kg/ha. Nitrogen must be applied at three times: 40% before seeding, 35% during the tillering and the rest at the panicle initiation. Phosphorus and potassium must be applied before seeding.

❒ Research has been done on the irrigation methods and on the water requirements of the rice cultivation. The adoption of the results of this research by the rice growers had as result a significant water economy.

❒ Study has shown that the highest total milling yield is obtained at that harvest time when the grain moisture content is about 18%, while the lower grain breakage at that harvest time when the grain moisture content is about 22%. The partial improvement of rice quality is based on the above research data. All the above achievements increased and improved the rice production in Greece. The yield had an average annual increase of 3.5% for the period 1981-1995, while the rice product was more exportable due to the significant improvement of its quality.

2. Actual programmes

The actual programmes are the following:

1) Breeding programme: Emphasis is given to the releasing of indica type varieties.
2) Weed control programme: Study of the competition of the rice cultivars with the weed *Echinochloa crus galli* and evaluation of new herbicides for controlling the above weed.
3) Fertilisation programme: Evaluation of the new cultivars on the nitrogen response.
4) Programme of study of the insects biology Sesame inference and *Ephydra attica*.
5) Programme FAO "Interregional cooperative rice research network on the Mediterranean climate" (Groups: Breeding, Agronomy and Processing).
6) European Union programme "Quality and competitiveness of European rices". Concerted action, 1995-1997.
7) European Union programme "Rice Genetic Resources for Europe". Shared cost, 1996-1999.

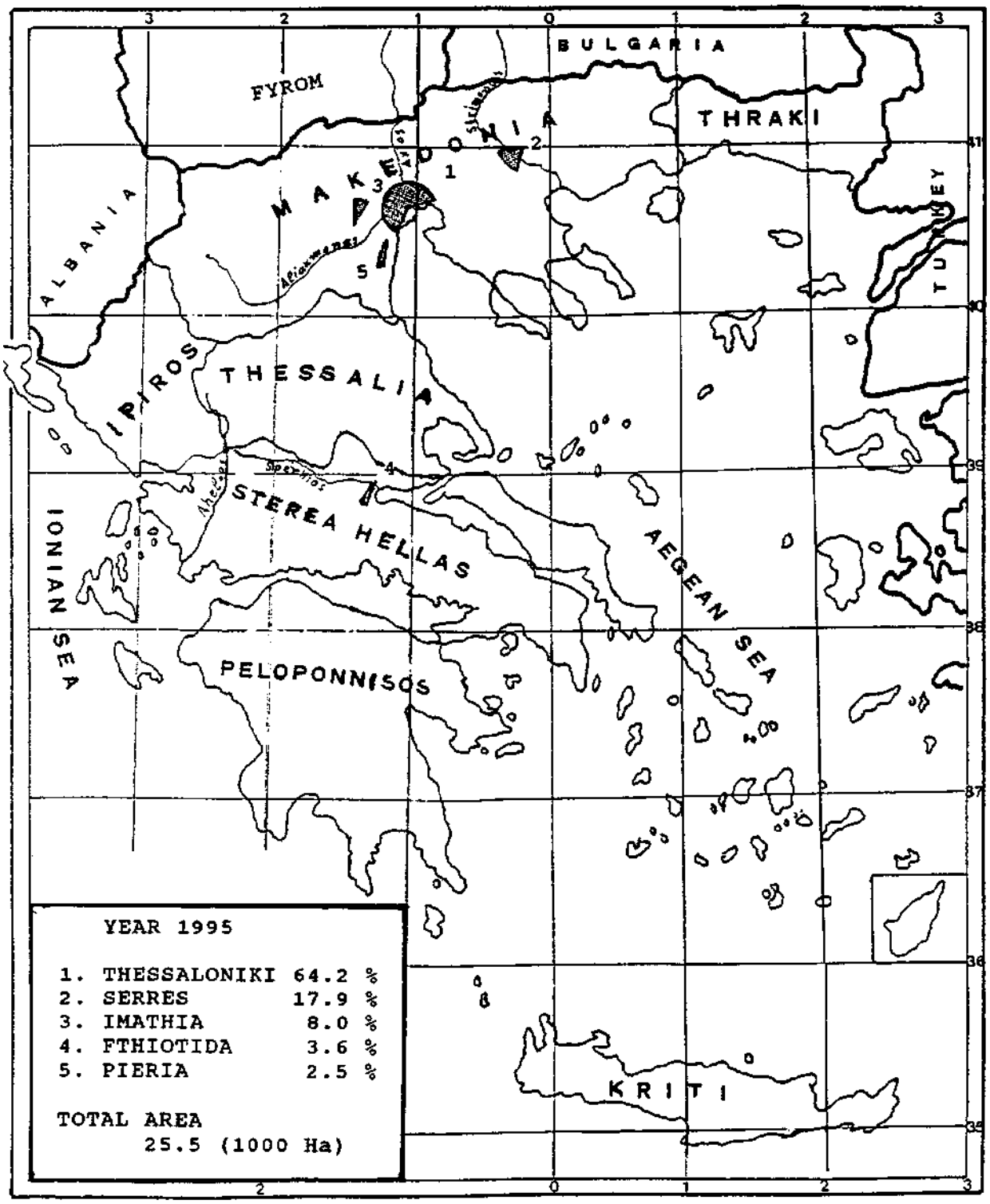
3. The constraints of rice research

The constraints of rice research are the following:
1) Little support by the State
2) The unhealthy environment of rice fields do not attract new scientists, technicians and field workers in the rice crop.

V – Rice production policy

For the indica type, Greek's rice production is equivalent to twice its consumption needs, while there is a deficit of 10% for the japonica type. The objective is to achieve sufficiency through a well balanced production of the two types. Another objective is the stable improvement of rice quality so that it will be more competitive in the European market.

Rice cropping area in Greece



Rice cropping area in Greece