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SECTORAL STUDY

Apiculture

Coordinator: Paschalis Harizanis
Researchers: Athanasios Antonopoulos, Dimitra Mougopetrou,
Athina Gratsani, Konstantinos Kompotheklas, Vasileios Alexandratos

PLANNING AND IMPLEMENTATION :
AGRICULTURAL UNIVERSITY OF ATHENS

The program **NEW AGRICULTURE FOR A NEW GENERATION** is

Led by:
RUTGERS
School of Environmental and Biological Sciences

In partnership with:
AGRICULTURAL UNIVERSITY OF ATHENS
AMERICAN FARM SCHOOL

Implemented through an exclusive grant by:
ΙΣΝ/SNF ΙΔΡΥΜΑ ΣΤΑΥΡΟΣ ΝΙΑΡΧΟΣ
STAVROS NIARCHOS FOUNDATION

«Recharging Greek Youth to Revitalize the Agriculture and Food Sector of the Greek Economy»

Final Report

Sectoral Study 8
Apiculture

Athens, December 2015

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SUMMARY

Apiculture is a very important sector of agriculture, providing the farmer with unique products like honey, wax, pollen, royal jelly, propolis and bee venom. The greatest benefit comes from pollination that the honey bee performs thus increasing crop production and environmental diversity.

In Greece there are approximately 1,700,000 colonies (second in the E.U.) with a hive density of 12.4 colonies per. There are more than 20.000 beekeeping operations that produce every year about 15.000 tons of honey. A total of 60% of Greek honey is from honey dew. Due to the dry climate and the diverse honey flora, the produced honey is of special aroma and taste.

Every enterprise of the food chain that is functioning within the European Union must apply a HACCP system. Risk factors must be examined and avoided. The beekeeping building, the store room and honey processing rooms must be constructed according to the HACCP system.

The market for honey includes the foodservice sector, tourist sites and as a domestic consumption. About 70% of the total honey production in Greece is available directly from producers and only 30% through distribution channels. Pollen and royal jelly usually are available directly from producers as well as from healthy food stores.

Agrotourism (agrorural tourism) can provide excellent communication between producers and consumers. In the field of beekeeping 5 to 10 colonies are provided so visitors can perform

inspections for acquaintance and have direct contact with honey production. Also, a small building for storage and for preparation of beekeeping materials and honey processing is provided. The farm must have a series of different types of pure Greek honeys to perform honey pollen and royal jelly tasting.

In the business plan, a beekeeping operation is analyzed starting with five colonies (beginners) and over a six year period of building, an operation with 240 colonies is created. All possible economic factors are taken into consideration and a complete analysis is made for a small size (30 colonies) a medium size (120 colonies) and a large size (240 colonies) beekeeping operation.

Beekeeping is one of the most attractive sectors for young farmers. There are specific information that are given and certain steps that must be followed in order to succeed as a beekeeper. Several seminars are necessary which will provide knowledge and experience. A model center is established in order to educate young beekeepers, to support them as well as other beekeepers on different problems and inform them on new technologies. For the support center, a modern apiary with 20 to 30 colonies is needed with the necessary equipment and a lab with the basic equipment and specialized personnel. Alternatively the centre can be located at the university at the corresponding laboratory.

ATTRACTIVENESS OF APICULTURE BY YOUNG PEOPLE

History of Apiculture

The art of beekeeping is known from ancient times. The oldest mythical person that is recorded as a beekeeper is Aristaios. We also have reports from the epics of Homer regarding honey as one of the main foods. Finally at excavations in Phaistos clay hives were found, dating back to the Minoan era (Nicolaides, 1979).

Previously those who were dealing with beekeeping were mainly naturalists, farmers and some amateurs. But from the year 1852 onwards using the Langstroth hives and Hoffman frames beekeeping gradually took its current form as many American beekeepers evolved from amateur or farmers to professional beekeepers. (Nicolaides, 1979)

In Greece the first move for the development of beekeeping was made by the Greek Agricultural Society in 1903 at the beginning very slowly with 412 Langstroth hives in 1903, reaching 3.000 in 1912 while the same year there were 250,000 oldstyle hives. Then because of the Balkan war and World War I the development of beekeeping stopped until refugees of the Asia Minor disaster contributed to the development between 1926 and 1928. In 1939 Greece was to have 100,000 Langstroth hives and 600,000 old style hives. After World War II and the Civil War in Greece, the apiculture section of the Ministry of Agriculture and the Agricultural Bank of Greece gave 93,500 hives, 3,100 honey extractors and 3,000,000 wax foundations. Contributing to the postwar development of beekeeping were beekeeping schools and modern books as well as magazines that began to be issued from 1901 onwards (Nicolaides

1979). According to the latest FAO data in Greece in 2008 there were 1.315 million colonies with an average production of 13.5 kg per colony.

Beekeeping is practiced mainly for the production of honey but other products are produced such as pollen, royal jelly, propolis, beeswax and venom.

Beekeeping as a profession

In Greece were unemployment is high due to economic crisis, especially among young people, beekeeping could be a solution as a business opportunity for the new generation by additional income for young people, farmers or not, who are underemployed.

There are advantages and disadvantages in such an endeavor by young people that varies according to the place of residence of the person concerned and whether the person is engaged in agriculture or not. Initially we will analyze the advantages and disadvantages of the inhabitants of the Greek province, who have been dealing with agriculture and then of those living in urban areas, large or small cities, but also in provincial towns or villages that do not have experience in the agriculture sector. At this point it should be noted that someone who is allergic to bee sting cannot work with bees.

Beekeeping for farmers.

For farmers there are already some positive elements in dealing with beekeeping. Firstly easy access to the apiary and knowledge of the bee plants in the area. Secondly it is possible to exploit untapped building as warehouses and exploit their truck to transport the hives. The time allocated to beekeeping can be defined by the person concerned in combination with other agricultural operations. Key benefits are the additional income that might arise from his involvement with the beekeeping as well as pollination of crops that improving the quality and quantity of the product (Tables 1, 2 and 3).

A close relationship of interdependence is created among the various plants and their insect pollinators through evolutionary mechanisms after thousands of years of coexistence. This relationship ensures the plants transfer their gametes and therefore fertilization and their perpetuation is ensured. Pollinators provide food and shelter (Thrasivoulou, 1989). The common bee (*Apis mellifera*) plays an important role in plant pollination. Tables 1, 2 and 3 show the requirements for bees for the main crops.

Table 1. Fruit trees orchards and colony requirements for pollination (Thrasivoulou, 1989).

Fruit trees	Requirements of bees
Apple tree	1 colony/ hectare
Pear tree	1 colony/ hectare. The common bee is the main pollinator
Quince	1 colony/ hectare. The common bee is the main pollinator
Apricot	1 colony/ hectare

Cherry - Sour cherry tree.	1 colony/hectare
Damson	2.5 colonies/ hectare. Colonies must be transferred when 1/3 of the flower has opened
Almond	4.5- 9 colonies/ hectare 160-400 m distances between them. Pollination almost exclusively by common bee
Kiwi	7- 12 colonies/ hectare ensure adequate pollination. They should be fed with syrup 1: 1 to maintain the ability of the queen to lay eggs because the flowers do not give nectar.

Table 2. Field crops and colony requirements for pollination (Thrasivoulou, 1989).

Industrial plants	Requirements bees
Sunflower	Bee is the main pollinator/ 8-10 visits per flower. Colonies should be transferred when the first flowers open
Cotton	Bees are the best pollinators / protect the plant from aphids because they collect honey dew

Table 3. Vegetable crops and colony requirements for pollination (Thrasivoulou, 1989).

Vegetables	requirements of bees
Cucumbers	2.5 colonies/ hectare. 2.5- 7 hives/ hectare in varieties with more female flowers.
Pumpkin	2.5 colonies/ hectare
Watermelon	2.5- 12 colonies /hectare. Exclusive pollination from the common bee.
Mellon	2.5- 12 colonies/ hectare
Carrot	2 colonies/ hectare
Strawberry	The flower must accept 16-25 bee visits but bees ignore strawberry if other plants are in the region.
Artichoke	Bees carry pollen.
Onion	Bees carry pollen.

In addition to the advantages, disadvantages also exist, many of which can be overcome for a farmer who wants to deal with beekeeping. The main disadvantage but also one that is easier to overcome is the lack of beekeeping knowledge. Nowadays however, there are more than 70 beekeeping associations in various regions of Greece, there are also government agencies, universities and institutes, dealing with beekeeping and finally a number of published

beekeeping books circulating. The remaining shortcomings concern the purchase of hives, bees and equipment needed by a new beekeeper which contributes to financial costs and of course more working hours, but if combined with other agricultural activities, as mentioned above, it is in the interest of the farmer.

Beekeeping for young people who have not been engaged in agricultural production.

After the financial crisis of 2010, there is an interest in switching to the primary production sector by young people who have not work in this sector in the past. This is primarily for reasons of unemployment, underemployment and less for interest in beekeeping. Beekeeping is very attractive in this world and a false impression has been created that beekeeping offers a large income with low cost and minimal work. But a more careful and objective approach reveals that in many cases the reality and estimation is not the same thing.

In this category of people beekeeping could be a solution for unemployment provided that they reside in areas that have easy access to areas suitable to place colonies, whereas if they are urban area residents and there is difficult access to such areas this can be a limiting factor. In general for residents of small towns and villages it is easier to deal with beekeeping compared with residents of large cities. Also a point of attraction for someone to start beekeeping is the occupation with nature.

The main negative, as in the previous category of people is the lack of education. Purchase costs of equipment here are greater and there are transportation requirements, so apart from the rest of the equipment a car and trailer must be purchased. Finally it takes time until beekeeping can become a person main occupation, which means that for some years in the beginning should be combined with something else.

Area selection

For these two categories of people mentioned above it is very important to choose one suitable area in which hives can produce honey. According to Xydias (1965) beekeeping productivity of an area is indicated by the average number of colonies per square kilometer and of the type of beekeeping handlings, not only by the number of colonies. The bees must be in hives with frames, the diseases must be controlled, hives must be transferred to other regions and intensive exploitation must be applied.

CONSUMER HABITS AND GROWTH POTENTIAL, AS WELL AS EXPORT POTENTIAL

In the years 2008-2012, the continent with the highest production of honey in the world is Asia, followed by Europe and America (Table 4). China is the world's largest exporter, followed by Argentina (Table 10), while the European Union (EU) is the largest importer (Table 11). The global production of honey amounted to 1,592,701 tons for 2012 (FAO).

Table 4. World honey production by continent in tons (source: FAO).

Continent	2008	2009	2010	2011	2012	Average	%
Asia	664391	673729	682414	729877	737482	697578,6	45,04%
Europe	351809	353877	348603	337211	348413	347982,6	22,47%
America	315177	298832	319428	331361	320807	317121	20,47%
Africa	158414	153810	167211	154261	164239	159587	10,30%
Oceania	31165	30074	29561	20318	21760	26575,6	1,72%
World	1.520.956	1.510.322	1.547.217	1.573.028	1.592.701	1.548.844,80	100,00%

Since 2004, as a consequence of the enlargement of the EU with the inclusion of 10 new Member States, the EU has become the second largest producer in the world. In 2012 the EU produced 348,413 tons of honey, (22% of world production), while China stabilized its position as the largest producer worldwide with a production amounting to 436,000 tons (Table 5). The other major producers are Turkey and Argentina with their production amounting to 88,162 and 75,500 tons respectively (Table 5).

Table 5. The 10 countries with the largest honey production for the year 2012 (source: FAO)

	Country	Production (tons)
1	China	436000
2	Turkey	88162
3	Argentina	75500
4	Ukraine	70134
5	USA	66720
6	Russia	64898
7	India	61000
8	Mexico	58602
9	Iran	48000
10	Ethiopia	45905

Greece is produced 14,800 tons per year (Table 8) and is in 23th position in honey production in the world (appendix, page 63) and 7th in Europe (Tables 7). In Europe, the countries with the highest production are Ukraine, Russia and Spain (Table 7).

Table 6. Number of colonies per country (in size order) and the colony density in the EU- 27 (European Commission, 2007).

	Country	Number of colonies	E.U percent	km^2	Colonies per km^2
	Spain (ES)	2.320.949	17,1	504.030	4,6
	Greece (EL)	1.467.690	10,8	131.990	11,1
	France (FR)	1.360.973	10,0	547.030	2,5
	Italy (IT)	1.157.333	8,5	301.338	3,8
	Poland (PL)	1.091.930	8,0	312.679	3,5
	Romania (RO)	975.062	7,2	238.391	4,1
	Hungary (HU)	900.000	6,6	93.030	9,7
	Germany (DE)	751.000	5,5	357.021	2,1
	Bulgaria (BG)	671.674	4,9	110.910	6,1
0	Portugal (PT)	555.049	4,1	92.345	6,0
1	Czech (CZ)	525.560	3,9	78.866	6,7
2	Austria (AT)	311.000	2,3	83.872	3,7
3	G.Britain (UK)	274.000	2,0	244.820	1,1
4	Slovakia (SK)	246.259	1,8	49.035	5,0
5	Slovenia (SL)	170.682	1,3	20.273	8,4
6	Denmark (DK)	170.000	1,2	43.098	3,9
7	Sweden (SE)	150.000	1,1	449.964	0,3
8	Belgium (BE)	110.000	0,8	32.528	3,4
9	Lithuania (LT)	85.015	0,6	65.200	1,3

0	Netherland (NL)	80.000	0,6	41.526	1,9
	Latvia (LV)	62.200	0,5	64.589	1,0
1					
2	Finland (FI)	56.000	0,4	338.145	0,2
3	Cyprus (CY)	44.338	0,3	9.251	4,8
4	Estonia (EE)	33.000	0,2	45.228	0,7
5	Ireland (IE)	22.000	0,2	70.273	0,3
6	Luxemburg (LU)	9.267	0,1	2.586	3,6
7	Malta (MT)	1.938	0,01	316	6,1
	Total	13.602.719			

Table 7. Ten European countries with the largest honey production for the year 2012 (source: FAO)

	Country	Production (tons)
1	Ukraine	70134
2	Russia	64898
3	Spain	29735
4	Romania	23062
5	Hungary	17000
6	Germany	15699
7	Greece	14800
8	Poland	12176
9	France	11809
10	Italy	9550

The total number of beekeepers in the EU stands at 593,000, of whom 17,986 are considered professionals (at least 150 colonies). Of the total number of colonies (13,602,719), 4,321,901 belong to the professional beekeepers. Approximately 3 % of the professional beekeepers possess 32 % of the total apiaries (Table 6).

Table 8. Honey production in Greece for the years 2008-2012 (source: FAO)

Year	Production (tons)
2012	14800
2011	14500
2010	14300
2009	16000
2008	15682

According to FAO, Greece imported 2,167 tons of honey for the year 2011(Table 13) and exported 785 tons (Table 14). The average import price is $ 4.1 and the average export price of $ 7.5. From these data it is evident that imports are cheap and the Greek honey is exported at high prices. These figures show the high production costs of Greek honey and high quality.

Honey consumption per capita is calculated by comparing the annual production, imports and exports. So the consumption of honey, according to the population census of 2011 conducted by the Greek Statistics Authority is 1468 grams per capita. Table 9 shows honey consumption for several countries.

Table 9. Honey consumption per capita for different countries for the year 2011(source: FAO).

Country	Honey consumption per capita
Greece	1468 gram
Germany	1010 gram
USA	620 gram
Ethiopia	430 gram
India	30 gram

Trade

World trade represents about a quarter of the total honey production. World honey exports amounted to 492,708 tons in 2011. China is the largest exporter and exported 99,988 tons in 2011 which

corresponds to 20% of world trade. Table 10 shows countries with the largest honey exports.

Table 10. Ten countries with the largest honey exports for 2011 (Source: FAO).

n	Country	Tons
1	China	99988
2	Argentina	72356
3	India	28940
4	Vietnam	28032
5	Mexico	26888
6	Brazil	22399
7	Germany	18946
8	Spain	18771
9	Belgium	16833
10	Uruguay	15243

The main import market is still the EU market which absorbed over 50% of the imported honey in the world in 2011 (265,883 tons). America is the other major importer with 134,523 tons (Table 11). Germany and United Kingdom absorbed about 42% of total the EU imports in 2011 (Table 12).

Table 11. The honey imports in 2011 by continent (Source FAO).

Continent	Imports (tons)
Asia	87336
Europe	265883
America	134523
Africa	6274
Oceania	3186

Table 12. Ten countries with the largest honey imports for 2011 (Source: FAO).

n	Country	Imports (Tons)
1	USA	130495
2	Germany	77361
3	Japan	40584
4	United Kingdom	35644
5	France	27153
6	Belgium	21055
7	Spain	20655
8	Italy	15155
9	Saudi Arabia	14007
10	Poland	13609

Global imports have been growing normally since the late 70s due to increased consumption of natural and dietary products, as well as the efforts of some dynamic entrepreneurs to promote their special or cheap honey, usually with the form of blends, and due to the increased production of industrial honey. Greece imports honey mostly from Bulgaria, Germany and Spain (Table 13), while exports to Germany, Cyprus and Canada (Table 14).

Table 13. Imports of honey in Greece from 2009 to 2011, five countries from which the largest quantity was imported (Source: FAO).

	2009		2010		2011	
	Quantity (tons)	Values (1000$)	Quantity (tons)	Values (1000$)	Quantity (tons)	Values (1000$)
Bulgaria	879	2738	733	2204	645	2113
Germany	408	2322	391	2157	642	2629
Spain	647	2339	574	2497	627	2314
Netherlands	126	674	64	352	133	800
Belgium	85	922	48	749	51	622

Table 14. Exports of honey from Greece for the years 2009-2011, five countries to which the largest amount was exported (Source: FAO).

	2009		2010		2011	
	Quantity (tons)	Values (1000$)	Quantity (tons)	Values (1000$)	Quantity (tons)	Values (1000$)
Germany	147	1274	291	1978	308	2295
Cyprus	153	890	114	754	138	856
Canada	43	390	74	549	120	640

United Kingdom	68	547	86	648	56	399
France	37	393	66	580	35	384
USA	39	383	49	539	33	370

Supply Balances

The EU has a deficit as regards to honey and is forced to import one third of the honey consumed. During the year 2011, the EU produced 337,211 tons and consumed 475,995 tons and noted self-sufficiency of 71%. The degree of EU selfsufficiency has improved after its enlargement to 25 members, since before enlargement self-sufficiency was 45%. Greece had a 91% degree of self-sufficiency, in 2011 (FAO) produced 14,500 tons and consumed 15,883 tons. For more details see appendix, (page 62-65).

Conclusions

It is concluded that Greece consumed large quantities of honey. In Greece and in Europe the honey is an attractive product. The increase in production should be done in order to reduce production costs and imports of lower quality honeys from third world countries. The Greek State must play a catalytic role in order to improve control mechanisms for the quality honey and to advice of the proper methods of beekeeping management.

SYNERGIES WITH OTHER SECTORS AND SECTORAL STUDIES TO THE BEST OF THE RESEARCHER'S ABILITY

The next eight flow charts show the general picture of honey bee products and services. In a next study all these charts will be described in detail.

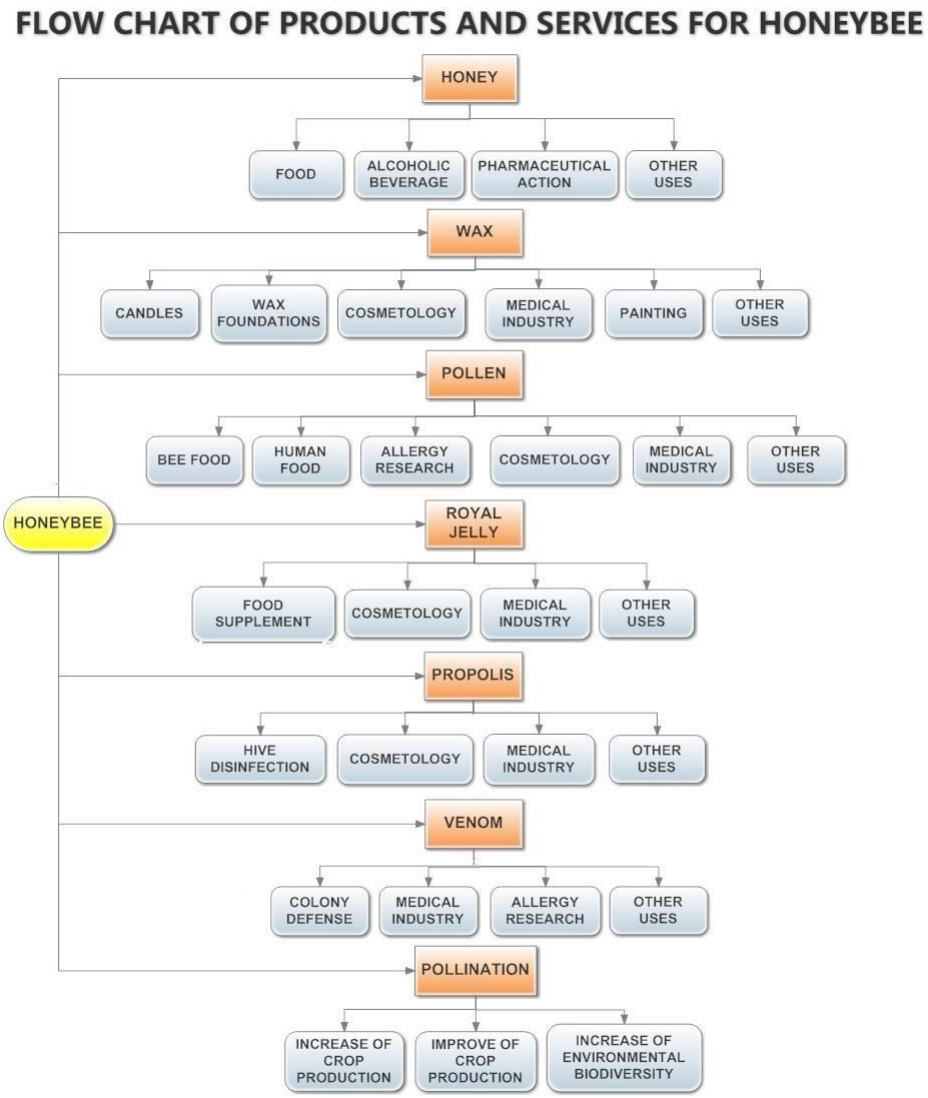

Figure 1. Flow chart of products and services for honeybee.

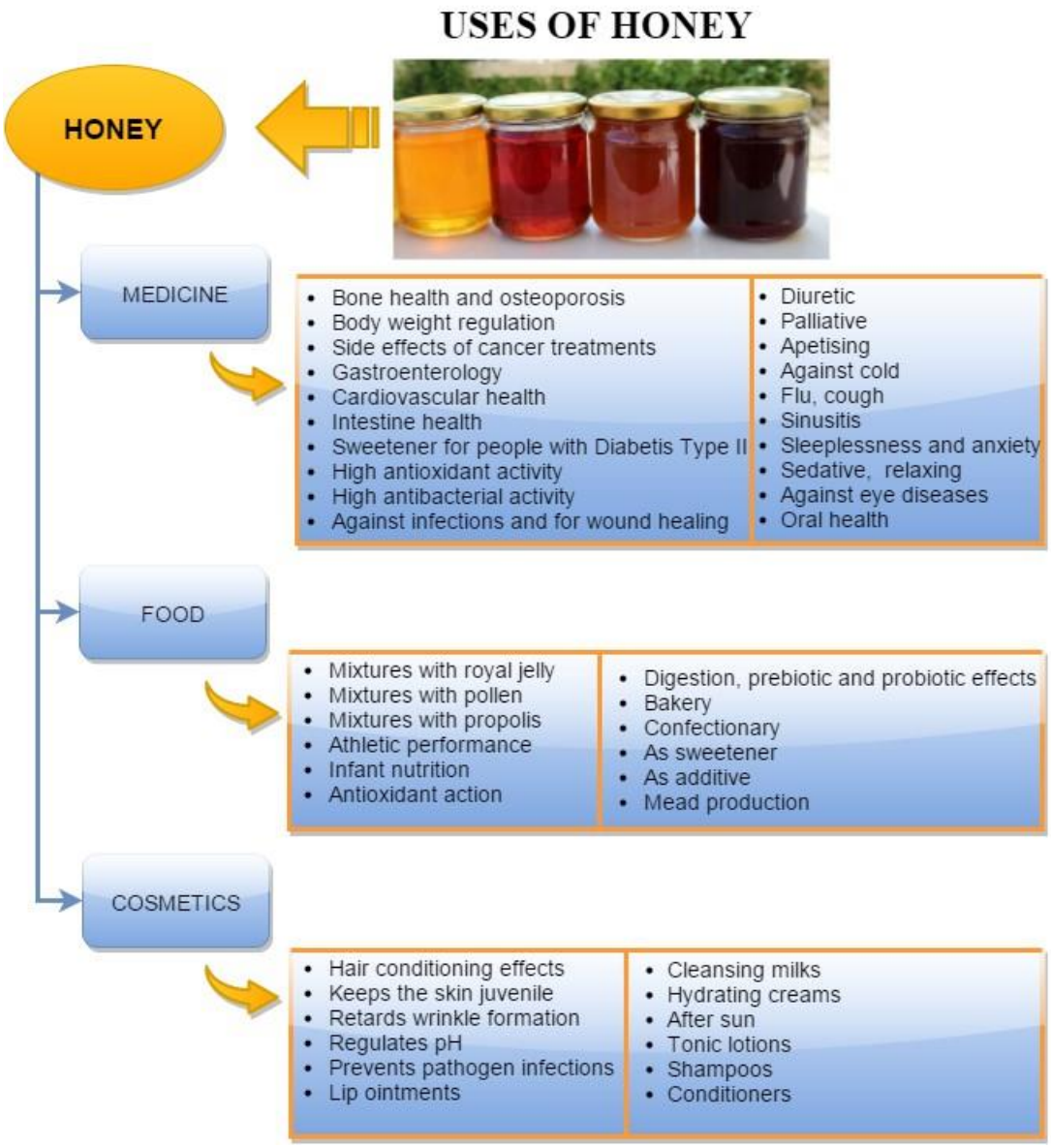

Figure 2. Flow chart of the uses of honey.

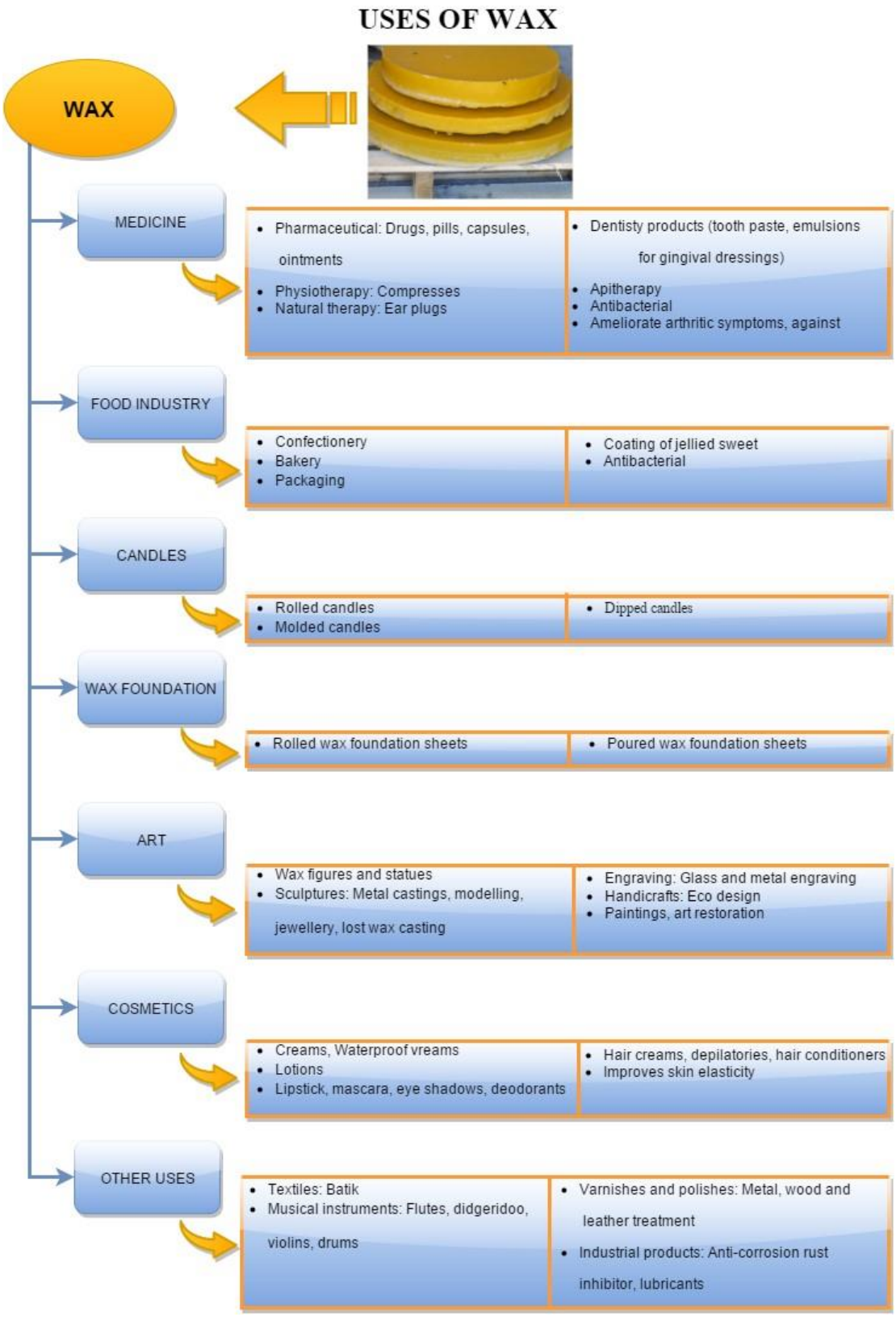

Figure 3. Flow chart of the uses of wax.

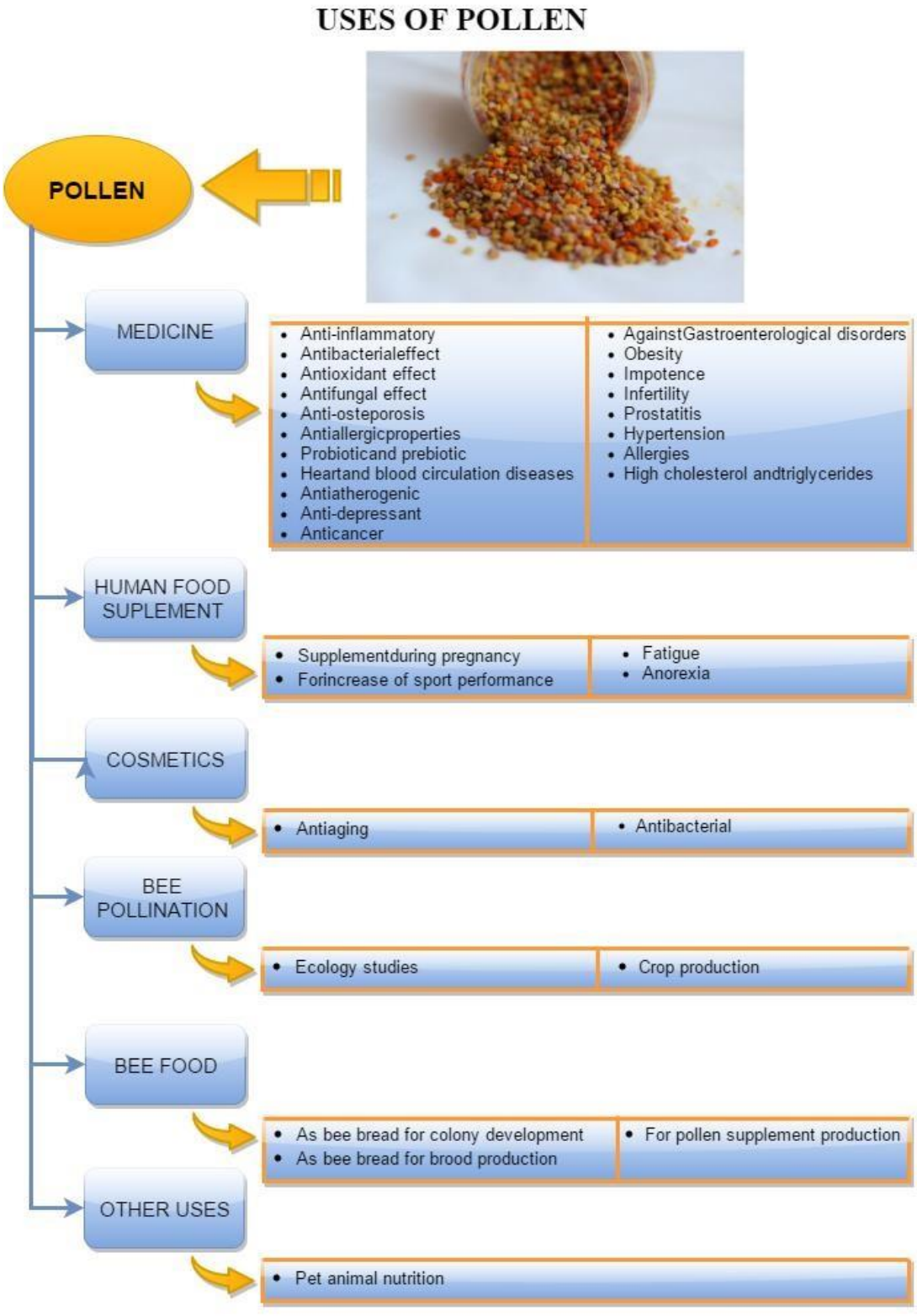

Figure 4. Flow chart of the uses of pollen.

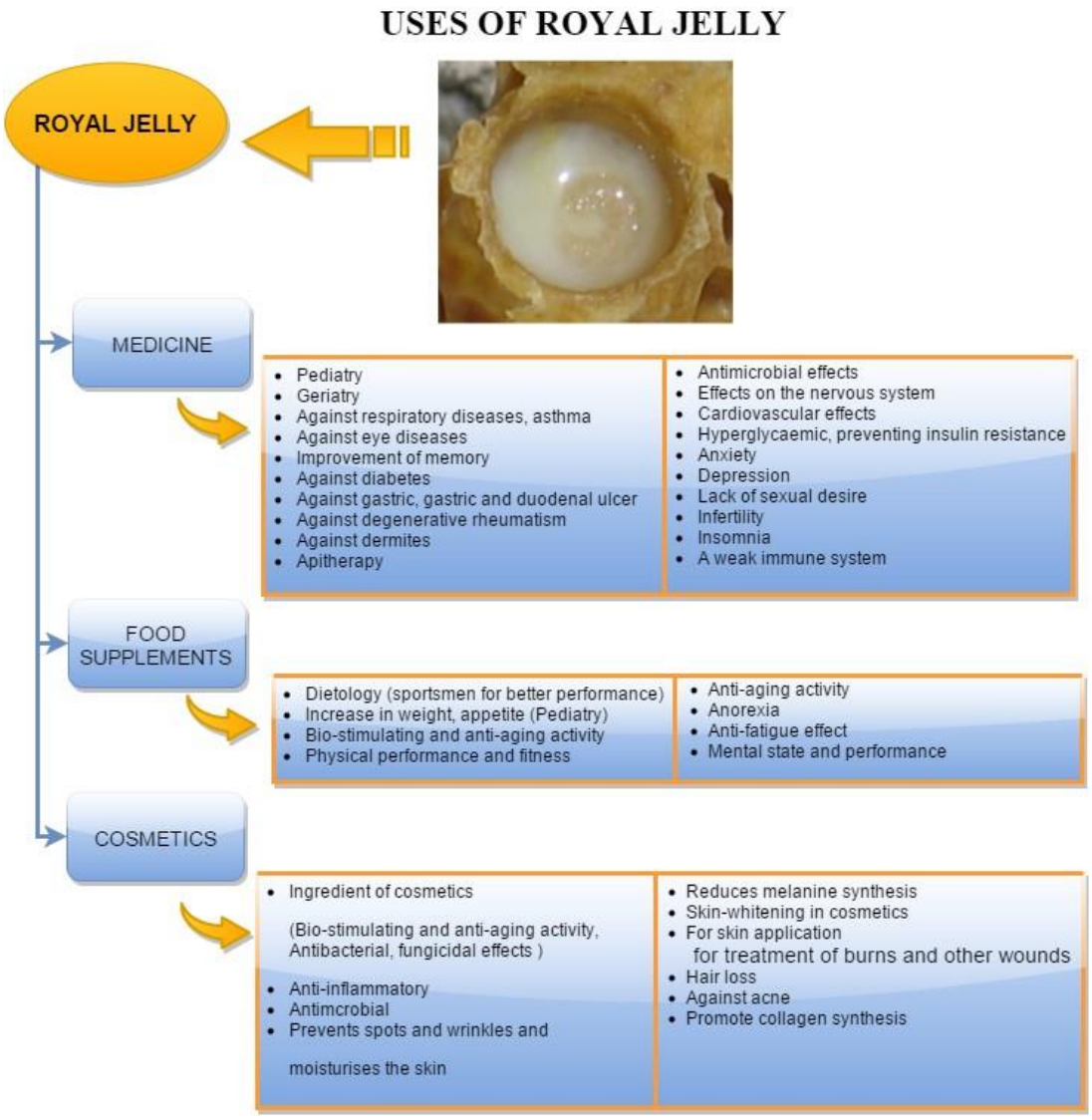

Figure 5. Flow chart of the uses of royal jelly.

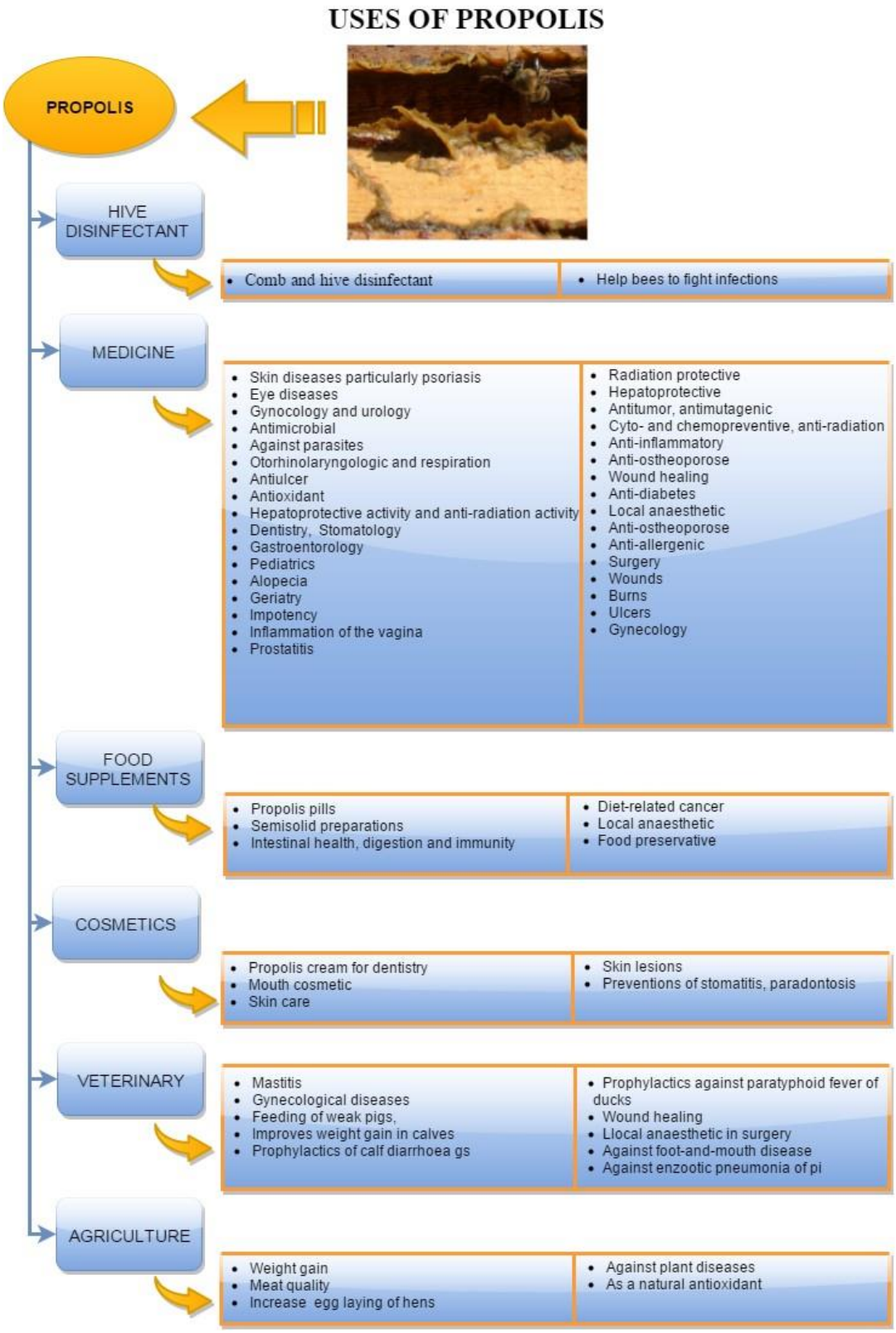

Figure 6. Flow chart of the uses of propolis.

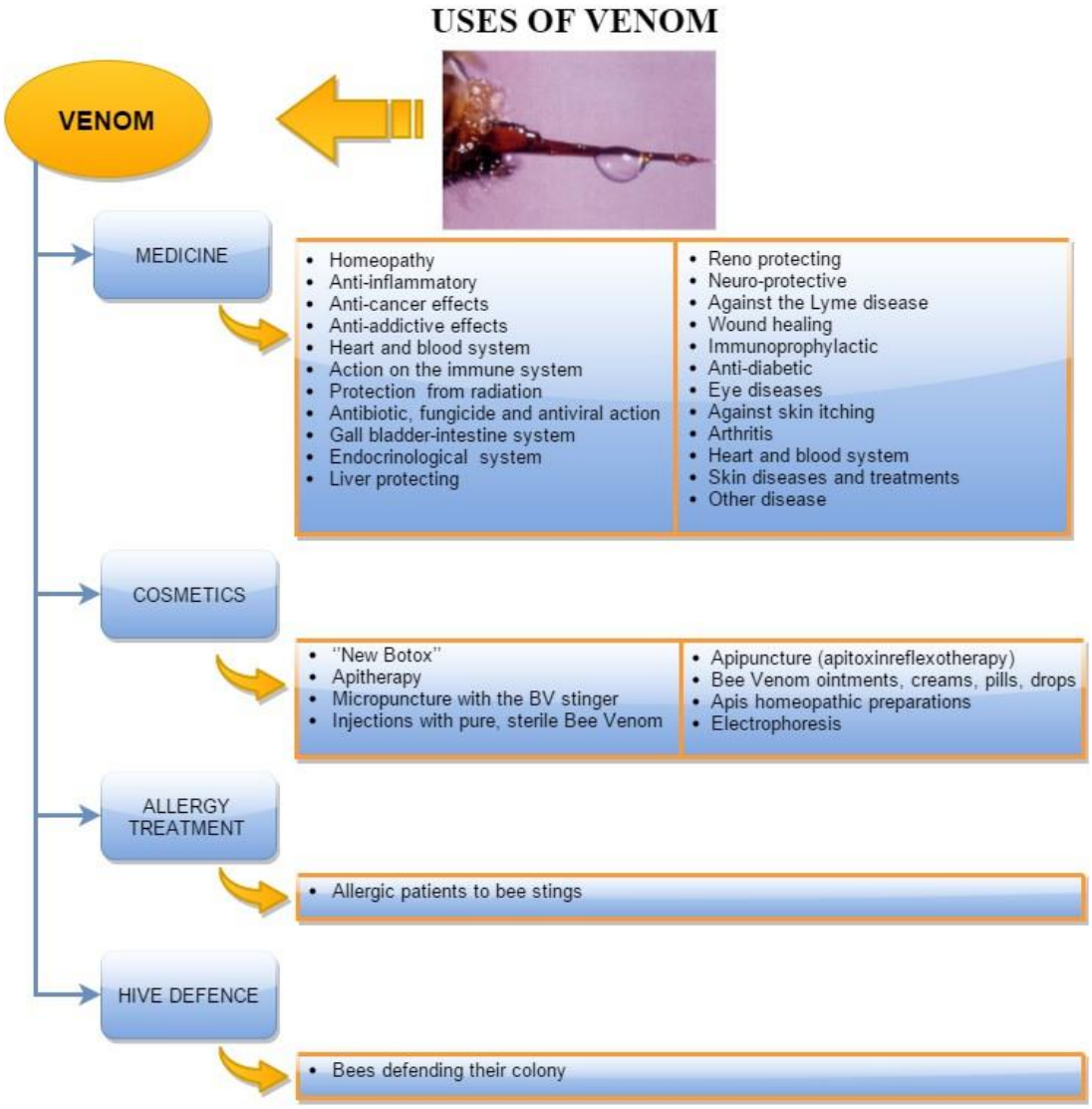

Figure 7. Flow chart of the uses of venom.

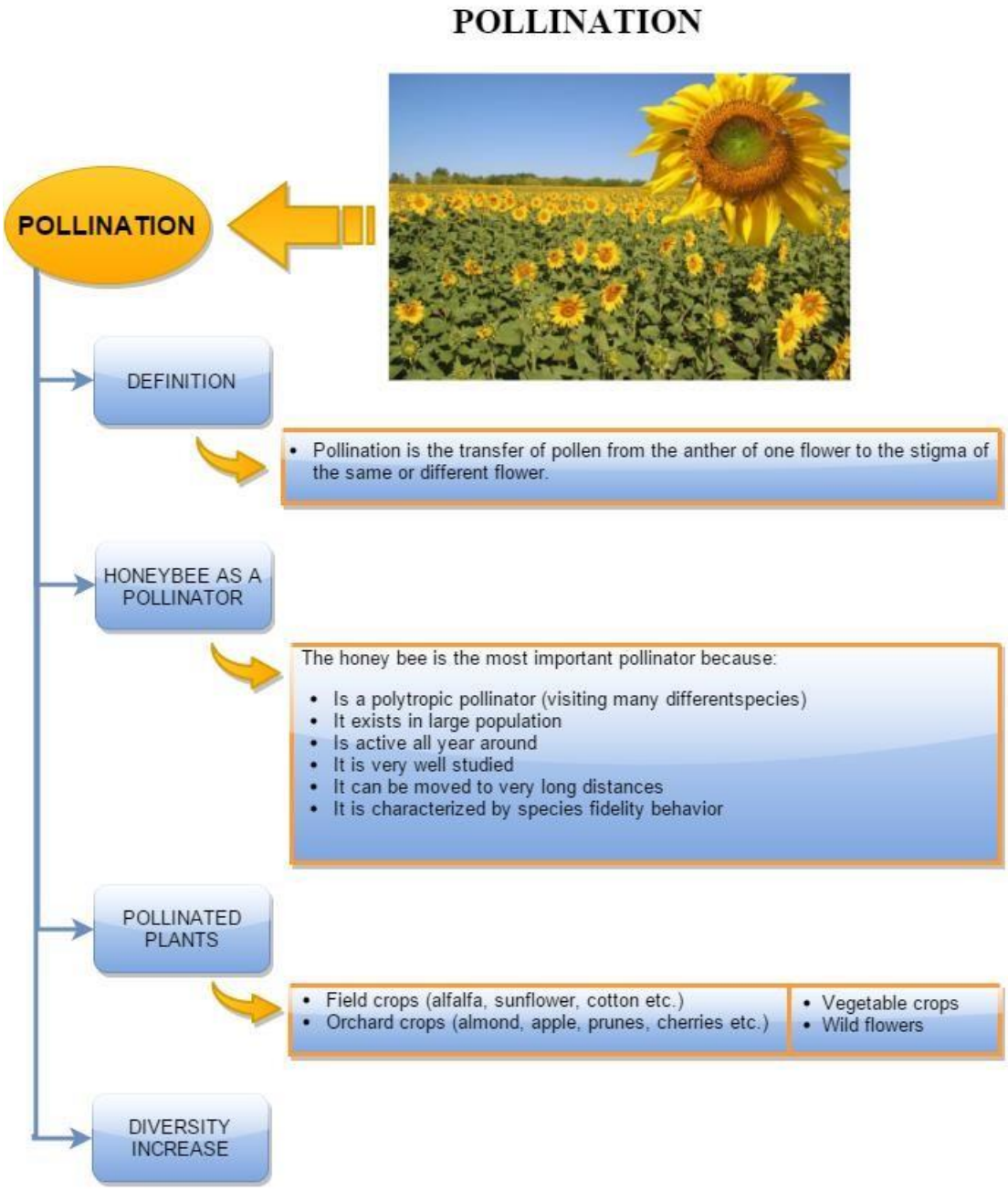

Figure 8. Flow chart of pollination.

ANALYSIS OF IMPORTS AND OPPORTUNITIES FOR GREEK-PRODUCED SUBSTITUTES

Products that can substitute honey in Greece are the following: halva, tahini and jam. These products are produced and consumed in our country without making large imports or exports.

Halva is a sweet which is found in several varieties. The different types of halva are: sesame, semolina, halva Farsala and ketene halva. The raw materials for the production of halva are fats (butter, olive oil, sunflower oil and sesame paste), starch (niseste,

semolina, tahini) and sweeteners (sugar, honey, molasses, glucose, carobsyrop) (Source ICAP).

Table 15. Production, exports and consumption of halva in tons in Greece for the years 2011- 2014 (source ICAP).

Year	Production	Exports	Consumption
2011	12150	2400	9750
2012	11000	2000	9000
2013	12900	2800	10100
2014	13200	2650	10550

Tahini is an oily cream derived from pulping husk free, dried and toasted sesame. The tahini contains many vitamins and proteins because the sesame seeds from which tahini is produced contains high biological proteins 20% with sulfur amino acids, vitamins (B1, B2, B3), carbohydrates and good quality fat (monounsaturated or polyunsaturated fatty acids) (Source ICAP).

Table 16. Production, exports and consumption of tahini in tons in Greece for the years 2011- 2014 (source: ICAP).

Year	Production	Exports	Consumption
2011	8600	2900	5700
2012	8400	3000	5400
2013	9500	3500	6000
2014	10000	3800	6200

Jam is a pulpy sweet, made from cooked fruit and sugar. The preparation of the jam is based on three main substances that are in a certain ratio in water (pectin, which is present as solute substance in all fruit, acid and sugar) (Source ICAP).

Table 17. Production, imports, exports and consumption of jam in tons in Greece for the years 2011 - 2014 (source: ICAP).

Year	Production	Exports	Imports	Consumption
2011	13500	800	2500	11800
2012	12500	550	2800	10250
2013	13000	900	3200	10700
2014	13400	950	3500	10850

Tables 15, 16 and 17 show the productions and consumptions of three basic substitutes of honey. As regards imports, only jam is imported in small quantities while for halva and tahini there are no imports only exports. Table 18 shows consumption per capita of the three substitutes compared to the consumption of honey. All four products have a high consumption rate, honey has the highest.

Table 18. Consumption per capita and type of product in Greece for the year 2011.

Product	Consumption per capita
Honey	1430 gram
Halva	900 gram
Tahini	530 gram
Jam	1091 gram

DISTRIBUTION NETWORKS

The market for honey includes mainly the foodservice sector and tourist sites as well as domestic consumption. The distribution of products is carried out principally through wholesalers and dealers, while supermarkets are the main retail locations.

The majority of domestic production is distributed in bulk, outside the formal distribution networks, given the high number of amateur beekeepers. Nearly 70% of the total honey production in Greece is available directly from producers and only 30% through distribution channels (source: European Commission).

The largest companies in the sector have extensive distribution networks to meet domestic demand, while smaller businesses and cooperatives sell their products as raw material for processing to higher processing and packaging units, to commercial companies / distribution companies, to local merchants and finally direct to shops and distributors.

In the Appendix, (page 117-123), are shown analytically all standardization companies and honey.

AGRORURAL TURISM

Agrorural tourism is a form of tourism where visitors stay on a farm and participate in agricultural activities in order to have direct contact with rural life, crops, nature, flora and fauna. Activities can include the participation in agricultural activities, the observation of the ecosystem, adventure sports, cultural tours and various courses.

In the field of beekeeping 5 to 10 colonies are provided so visitors can perform inspections for acquaintance and have direct contact with honey production. Also, a small building for storage and preparation of beekeeping materials and honey processing is included. The farm must have a series of different types of pure Greek honeys (thyme, pine, fir, orange, chestnut, heather, sunflower, cotton etc) to perform honey tasting as well as other products like pollen and royal jelly.

Agrorural tourism must focus on production issues in relation to food quality and environmental protection. Providing breakfast and other meals with quality products will convince the visitors to stay more time and come back again.

ESTABLISHING A HACCP SYSTEM AT A HONEY PROCESSING FAMILY ENTERPRISE

General

Every enterprise of the food chain that is functioning in the European Union is obliged by Regulations 178/2002/EC and 852/2004/EC to apply a HACCP system. The hazards of honey are classified as biological, chemical and physical, depending on the cause. The most dangerous implication concerns infant botulism as the spores of *Clostridium botulinum* cannot be removed completely from honey. The chemical hazards are also of importance due to chemical substances used in bee keeping.

Depending on its physical properties, such as crystallization and colour the proper beekeeping operations must be applied in order to reflect the physical characteristics that the consumer wants to have on the table.

The yeasts are a common problem in Greek honey, of which 39 strains were isolated when placed in the appropriate storage conditions regarding temperature, humidity and oxygen. The yeasts under these environmental conditions germinate and spread, destroying the final product.

It is a fact that the proper use of chemicals is the best way to reduce chemical contamination for conventional beekeepers. The implementation of organic beekeeping according to Regulations 2092/91 (EC, 1991) and 1804/99 RC (EU, 1999) significantly reduces the problem of chemical residues, but these Community legislations raise questions in their implementation, as there are ambiguities in the Regulations. In addition, drugs are used that have not yet been approved by the National Medicines Agency, except drugs for varroasis. The Regulations 2377/90 (EC, 1990) and 396/2005 (EU, 2005), referred to the presence of residues and establish maximum residue limits (MRLs) for substances detected in honey and give answers to the problems created during wax moth control. But most beekeepers and formulators follow Directive 2001/110 / EC (EU, 2001) which establishes quality criteria for organic and conventional unifloral honey, but mainly qualitative criteria of honeys from the unifloral blends categories.

Hazard factors in honey

Risk factors (hazards) that are observed in honey and will be examined in this study can be categorized into three categories: biological, chemical and physical substances used in beekeeping.

1. Biological risk factors

The main biological agent that concerns the health and safety of honey are the spores of *C. botulinum* and specifically the causative agent of botulism in infants (infant botulism). Infant botulism affects infants under 12 months of age. This type of botulism is caused by the ingestion of *C. botulinum* spores which germinate, colonize and produce a toxin in the intestinal tract of infants. Of the various potential environmental sources such as soil, water tanks, dust and food, honey is an important reservoir for spores of *C. botulinum*. The

Food and Drug Administration (FDA) has recommended avoiding the use of honey and other food, such as corn syrup in the diet of infants.

It has been found that *C. botulinum* spores in honey can be transferred from the digestive tract of bees or may be obtained from the hairy body of the insect, but they probably come from the external environment. Hygiene conditions during the extraction and filtration of honey are important in the infection of the exported honey. Equipping the extraction area with adequate facilities for washing hands is possible to reduce the presence of spores of *C. botulinum* in honey significantly. The use of different shoes indoors by the beekeeper can avoid dust and spores carried in the honey extraction area. Adequate illumination facilitates purification of the extraction space and equipment, reducing in this way the possibility of contamination by dust residues.

2. Chemical risk factors

Chemical risk factors due to consumption of honey can be derived from either natural toxins present in the nectar of plants or from occasionally added chemicals, such as therapeutic interventions in the colony throughout the year in order to address various diseases of the bee as the Varroa mite (*Varroa destructor*). Also therapeutic chemicals are used in order to achieve disinfection of the hive from spores of microorganisms, such as bacterial spores of American foulbrood (*Phaenibacillus larvae*), or spores of protozoan nozemosis (*Nosema apis* and *Nosema cerenae*), or evolutionary stages (eggs, larvae) insect pests of hive, like the great wax moth (*Galleria mellonella*) and minor wax moth (*Achroia grisella*). All drugs used for treatment of bee pests and diseases could potentially leave residues in honey and other hive products. Residues of biocidal formulations used against Varroa should be within the limits set by the Community Regulation 2377/90 (EC, 1990). There is no provision of acceptable concentrations of malathion residues, which is why its use in beekeeping should be stopped. No maximum concentration for fluvalinate and flumethrin is required because the concentrations found in honey is small and poses no risk to human health. According to Regulation 1804/99 (EU, 1999) for the organic livestock production, the only chemical drugs that can be used against varroa, are herbal medicinal products that are not effective, such as the organic acids: formic, lactic, acetic, oxalic and essential oils: menthol, thymol, eucalyptol and camphor.

Residues of antibiotics.

According to Regulation 2377/90 of the EEC (1990), the presence of antibiotic residues in honey is not allowed such as sulfonamides, streptomycin and tetracycline (terramycin) for the treatment of the American and European foulbrood, because they have not established maximum residue limits (MRLs) for the above substances. Honey harvested from apiaries when treated with antibiotics (terramycin, sulfathiazole, fumidil, etc.) should be analyzed for residues before being offered for consumption. Honey contaminated with antibiotics should not be marketed. Another potential source of contamination is the presence of synthetic pesticides used in orchards and groves. Also, another source of contamination in honey is the presence of pesticides in the environment, which the bees collect and transport the hive. There are

a large number of sulfonylurea herbicides of the group such as: Glean, Logran, Granstar, Rush and Milagro, which when disintegrated release sulfonamides.

Toxic honey.

The views on the subject of toxic honey widely vary. For instance, it is often declared that if it is established that honey is toxic, it may be attributed whether the honey is ripe or not. Once combs are sealed then honey is no longer harmful. This may occur with toxic honey from species *Rhododendron*. Some of the aromatic varieties of the genus *Rhododendron* contain in the nectar one of the most deadly poisons worldwide, known as acetylandromedol. This substance, also known as andromedotoxin, is extracted from the nectar of several species Rhododendrons and their hybrids (Olszowy, 1977).

Allergy to honey.

Allergy to honey constitutes approximately 2.3% of all cases of food allergens. During the collection of natural sources of honey, nectar and honeydew, pollen grains and less often fungal spores and parts of bee bodies is mixed in this raw material. Ten grams (10 g) of honey contain: 20,000-100,000 pollen grains coming from over 150 different entomofilous and anemofilous plants. The pollen grains retain their allergenic properties during the ripening of honey. This raw material is further processed in the hive and becomes ripe honey when the rich enzyme secretions from the salivary and hypopharyngeal glands of bee are added. Honey contains also small amounts of wax (<0.05%), but this has no allergenic properties. The honeydew, a product of sucking insects, contains mainly carbohydrates and almost no allergen peptide or protein. (Helbing *et al.*, 1992).

3. Natural risk factors

Natural risk factors that may occur to honey focus on foreign bodies such as glass fragments from the glass jars, wooden transport pallets, wood from hives and the frames and metal fragments from the caps or storage containers.

Characteristics of a good beekeeping building

1. The honey extraction and honey processing room must have floor and walls with tiles and a good drainage system (Fig. 9).
2. The honey extraction room must be supplied with hot and cold water.
3. All the rooms must be supplied with many electrical outlets on the walls.
4. Possibility of controlled temperature in some rooms like office, honey extraction room, room for combs to be extracted and for jars of honey.
5. Room for selling the product.
6. Office with window.
7. A toilet with washbasin, shower and cesspit.

8. Follow all the necessary hygienic rules.

Characteristics of a good beekeeping storeroom

1. Concrete floor with good drainage for storing the beekeeping material.
2. Wide doors for easy entrance of large equipment.
3. Electric supply with the proper grounding.
4. Supply of cold and hot water.
5. Loading deck
6. Door and windows with wire screen (insect and mouse tight).
7. A bee escape (a hole at the roof for bee escaping when they are in the building).
8. Enough height for large capacity.
9. Keep safe from thefts.
10. Many shelves, strong and wide enough to resist heavy loads.
11. To have a proper place for cleaning the propolis and the wax from the bee equipment and tools as well as for their painting.
12. Accessibility to cars and trucks all year around and even under rain.

Problems in the beekeeping building

Even in the best constructed buildings problems may arise. The following problems are characteristic and common to beekeeping buildings.

1. Mice

The beekeeping storeroom is considered a paradise for mice because they can find combs with honey, pollen and dead bees. With this rich and balanced diet and protection from adverse weather conditions they develop and multiply very quickly.

2. Robber bees

Even having doors and windows with wire screens, bees can still enter the building during drought (lack of food for bees) and gather by the hundreds on the windows. Later they die and smell very badly during their decomposition. Good bee tight windows especially when there is honey in the building are very important. Also it is necessary to put bee escapes on the windows and the roof. These escapes are openings for one way traffic for bees. They can go out but cannot enter the building.

3. Other insects

Other insects like wax moth, ants or cockroaches often cause problems. Each insect requires special treatment and cleanness and a good order in the storeroom facilitates their restriction.

4. Fire hazard

Most of the beekeeping tools and materials (wood, wax etc.) are flammable and in case of fire, the extinguishing is very difficult. Fire extinguishers must be placed in well visible places and the electrical supply must be properly grounded.

5. Wax on the floor

No matter how well the building is constructed and how careful you are, you cannot avoid the presence of wax on the floor. We can scrape the wax and wash the floor with hot water. This work can be facilitated if the floor is well constructed (tiles etc.).

6. Honey on the floor

Avoid spilling honey on the floor. Honey is not “dirty” but it is sticky on the shoes and not comfortable for some one that walks on such floor. Moping the floor with hot water solves the problem easily.

7. The smell

The beekeeping storeroom has a characteristic smell which is a blend of wax, propolis, honey, smoke, decomposed bees and old wood. This smell is usual and good ventilation can reduce it.

More details for requirement of hygienic-safety for businesses on packaging honey are described in appendix, (page 66-70).

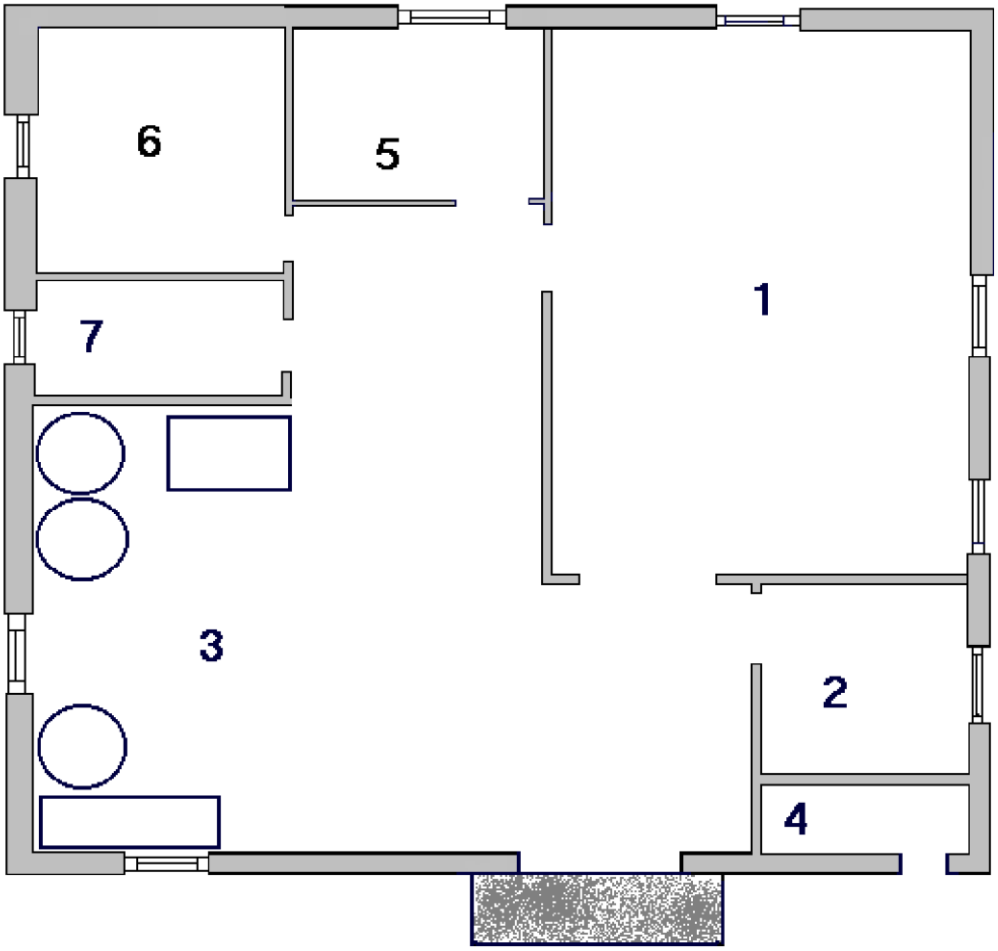

Figure 9. The floor plan (scale 1:200) of a beekeeping building (for about 250 colonies) is shown. The real dimensions can be altered according to the available area. The outside dimensions are 10 X 10 meters.

MEMORANDUM

1. Bee equipment storage
2. Comb honey storage
3. Honey extracting and processing room
4. Electric and heating unit
5. Repairing shop
6. Office
7. WC

Description of the HACCP system

The application of HACCP is about a family processing enterprise of small size and the honey is supplied from this operation. It is a small scale production chain that starts from the hive and ends on the consumer's table. The HACCP system, studied below, includes the ability of the enterprise to receive an amount of honey from beekeepers outside of the family business. The study of HACCP begins with prerequisites that must be applied by the company. Then the analysis of the flow chart is performed which helps in identifying the critical control points (CCPs). To install food safety management system according to the standard ISO 22000: 2005, the company has to implement the prerequisites for monitoring the probability of a risk, entrance for the food, safety for the work environment and the contamination from the product processing environment.

When establishing the prerequisites the following should be considered:

- Construction, building placement and additional buildings
- Spatial Location of facilities, work environment and locker rooms
- Networks support services, waste disposal and sewage
- Suitability of equipment and accessibility for cleaning, repair and preventive maintenance of air, water and energy
- Administration procured materials
- Measures for contamination
- Cleaning and disinfection
- Pest and vermin control
- Personal hygiene

The precautionary measures selected to control the identified risk factors should be categorized either according to their management mode, or prerequisite programs and functional prerequisites, or HACCP plan. The prerequisites programs should be documented for each program to have the following information:

- Risk to food safety is controlled with the program
- Preventive measures
- Procedures for monitoring the proper implementation of the program
- Planned adjustments and corrective actions in case of deviation
- Responsibilities and duties
- Monitoring Files

Table 19 shows the prerequisite program to be followed in the honey business standardization. To disinfect effectively and sufficiently and so that there is no risk of contamination from detergent residues after cleaning, the wall surfaces must be smooth, for easy and thorough cleaning and there should be no gaps and cracks in which microbial load can accumulate. According to the audit program including, the existence of certificates of receipt of packaging materials it is required to certify the suitability of materials for use in the diet. The use of pallets and crates made of plastic reduces the occurrence of foreign particles in the bottling area, such as wood powder and microbial growth in their slits. To confirm the correctness of HACCP, applied to bottling (presence of microorganisms), microbiological analyses must be carried out on samples of honey before it is given to bottling (Table 21). Table 20 summarizes the critical points mentioned and associates them. These

are the specific health rules applicable to the company as an integral part of the prerequisite hygiene programs.

Table 19. Prerequisite Programs (PRPs)

No	PROGRAMME	RISK FACTOR	CONTROL PARAMETER	MONITORING (PROCEDURE, FREQUENCY, PERSON IN CHARGE)	CORRECTIVE ACTION	DOCUMENTATION OF MONITORING
1	CLEANING DISINFECTION	Microbial count. Pollution from residues cleaning after the cleanliness	Checking of residual cargo that cleanliness had been done.	Optical control the point that became maid, according to the program by the responsible monitoring. Auditof residual cargo to swap test every week.	Compliance with the program of cleaning. Repeat cleaning. Staff training.	Cleaning and disinfection programme. Checking cleaning for surface and equipment. Sanitary inspection.
2	PEST CONTROL	Microbial infections of the host. Foreign body of their host (fly, cockroach, rodent droppings)	Those laid down in relevant regulations 852/2004/EC	Monitoring in accordance with the Regulation, the control pests files in each operation. Inspection of their premises daily from the person responsible.	Recording the problem. Recommendation in external partner.	File Control Pests. Sanitary Inspection.
3	STAFF HYGIENE	Microbial contamination from the staff. Foreign body that comes from the staff (hairs, buttons, belongings).	Those laid down in relevant regulations 852/2004/EC	Daily Sanitary Inspection by the person responsible	Staff training	Sanitary Inspection
4	INCOMING CONTROL	Referring to the risk analysis	Those laid down in relevant regulations 852/2004/EC	Monitoring of incoming materials in accordance with the Regulation and fulfillment of these forms by the responsible On each pick.	Commitment non conforming	Specification files of raw materials. Certificate files suitability. Control files of the delivery.
5	PREVENTIVE MAINTENANCE EQUIPMENT AND OUTFIT	Chemical contamination from lubricating materials of equipment. Foreign body from a lack of maintenance equipment	Those laid down in relevant programme	Testing the items defined in the program by the person in charge.	Repairs, replacement	Program of preventive maintenance
6	WATER CONTROL	Chemical or microbial contamination	Those laid down in relevant regulations.	Sampling according to the sampling plan and	Repeat sampling and testing.	Audit files of drinking water

		of the incoming water	Chemical and Microbiological criteria	checking the results by the manager.	Identify and eliminate causes of non-conformity	

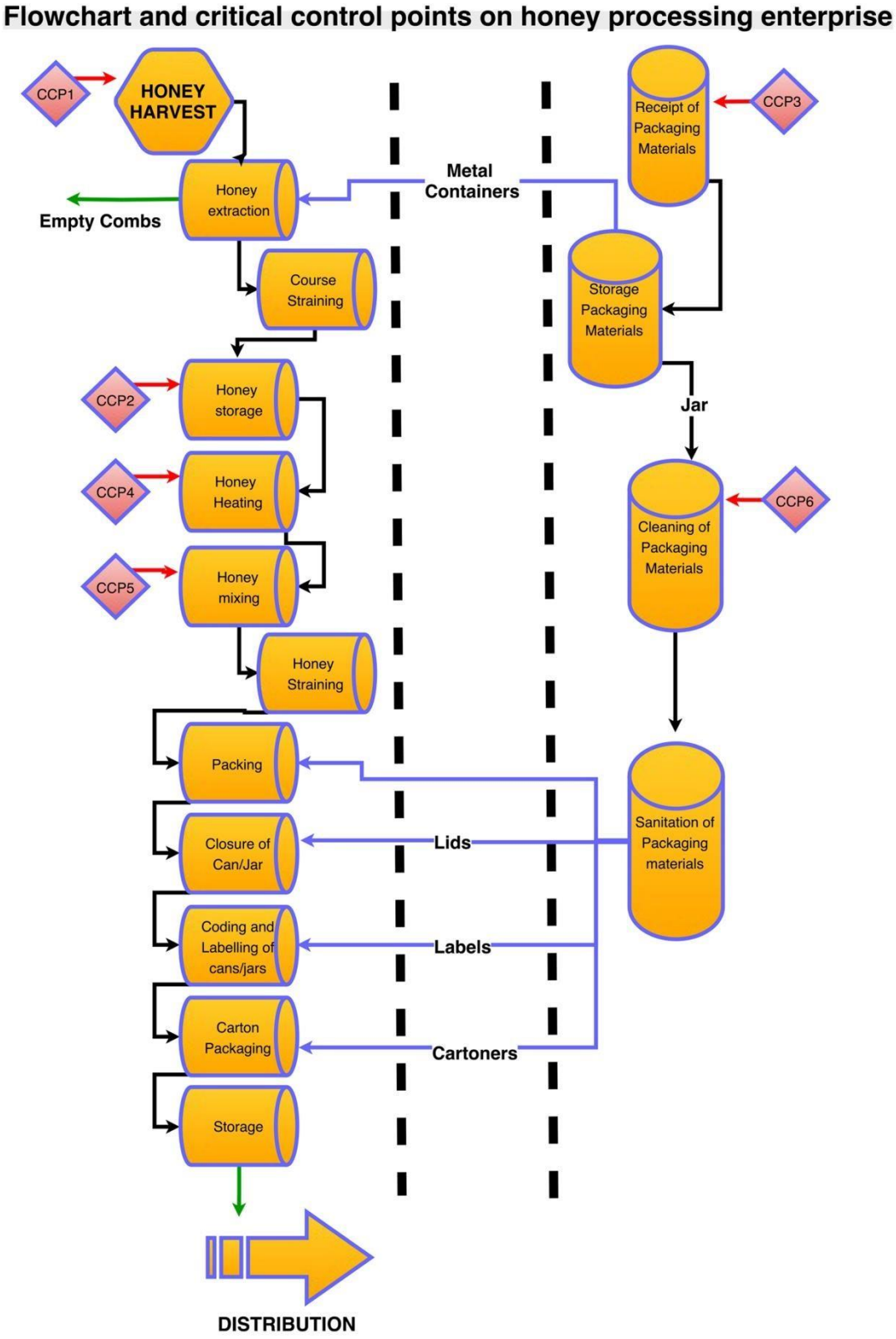

Figure 10. Critical control points on honey processing enterprise.

Table 20. HACCP plan for honey

CCP	STAGE	RISK FACTOR	PREVENTION MEASURES	CRITICAL LIMITS	MONITORING				CORRECTIVE ACTION	records kept
					WHAT	HOW	WHEN	WHO		
CCP1	Receipt of honey	Chemical residues of medicines	Sample analysis	According to Reg. 2377/90	Residues limits	Checking in pick	In each pick	In charge of receipt	Reject batch	Form analysis results and qualitative and quantitative situation in receipt products
CCP2	Storing honey in jars and / or containers	Yeasts	Filling containers up to the surface	Humidity <20%. Optimum 17% depending on the plant origin	Increase of humidity	By refractometer	Upon receipt and before processing	Head of the Laboratory	Heating before storage or Before processing for a year	Batch receipt, control and corrective actions Files
CCP3	Receipt of metal caps and metal jam and containers	Unsafe internal coating. Tinned containers unsuitable for use	Supplier certificates	Absence	Quality of Incoming. Compliance with the standards of supplier	Checking at receipt	In each receipt	In charge of receipt	Reject batch	Files of batch receipt, control and corrective actions
CCP4	Heating honey for mixing	Migration of chemical substances in honey from melted pieces of wax	Control of temperature among 30-40°C, time control	$<45\,^{o}C$	Organ indications	Visual inspection	Every time, every hour	Operator manager	Heat prolongation	Temperature Log Files and application time, batch files
CCP5	Infiltration	Foreign material	Replacementcleaning of the filter	Holes among 100-400 microns, full filter	State of filter	Visual inspection	Before any new mixing	Operator manager	Filter replacement	Form of filter checks
CCP6	Cleaning of jars	Broken glass	Supplier certificates	Absence of fragments	Integrity jars	Visual inspection	Before and after cleaning	In charge of cleaning packaging materials	Rejection	Files of batch receipt, control and corrective actions

Table 21. Reference Test (Test Report) to check presence of coliforms, Salmonella, anaerobic spores, yeasts and fungi in honey sample.

Test	Standard Limits	Testing Method / Confirmation	
		Method	Method / Confirmation
Total Plate count	2,5 x 10^2 cfu*/g	ICMSF	Plate Count Agar (pour plate technique) 30±1°C
Total coliforms	<10 cfu/g	APHA 2001	Violet Red Bile Agar (VRBA) 37±1°C. Confirmation: Brilliant Green Bile Broth (BGBB) 30±1°C.
Salmonella spp.	Absence in 25 g	EN ISO 6579:2002	BPW 37±1°C /RV 42°C, MKTTn 37±1°C,/XLD, BS 37±1°C. Confirmation: Nutr.A 37±1°C, TSI 37±1°C, Urea Agar 37±1°C, LLDM 37±1 °C, β-galactosidase, Test VP, Test indole, Serological confirm.:O, Vi and/or Hantigens.
Anaerobic sporeformers	MPN 0,9/g	RCM/MPN technique (80 °C)	Heat treatment 80°C /10min, Most Probable Number technique, Reinforced Clostridial Medium, 35°C/7-10days
Yeast & Molds	<100 cfu/g	APHA 2001	Plate Count Agar+chloramphenicol (100µg/ml)/25°C /3-5 days
*colony forming units			

SUBSIDIES

Apiculture has been subsidized with 99.406.396 Euros for the years 1998 to 2015, of this amount 81.406.396 Euros has been given for various subsidies (Table 22). The small islands of the Aegean were also subsidized with 18.000.000 euro's for the years 2003 to 2015 for sugar, adapted hybrids, beekeepers training, fairs, honey analysis, brochures, marketing and promotion for the improvement of honey, technology - computers and excursions (source Bagiatis, 2015). Detailed tables are shown in the appendix, (page 72-77).

Table 22. Apiculture subsidies in euro for the years 1998 to 2015 (source Bagiatis, 2015)

Category	Euro
Hive replacements	17.591.569
Apiculture centers	17.186.760
Apicultural Organizations Equipment	6.481.867
Control of Varroa mite	6.247.146
Epizootic study	3.823.528
Research	2.495.837
Training brochures	2.401.801
Hives movements	17.689.824
Honey analyses	2.573.088
Laboratory support	1.161.468
Honey flora enrichment	1.330.773
Technical support program	831.274
Melinet site	661.869
Chemists Community Nikiti, Crete	397.305
Queens' certification	280.000
Excursions	132.287
Predicting honey flows	120.000
Aegean small islands	18.000.000
Sum	99.406.396

Beekeeping Subsidies (legal basis)

The legal basis for aid to the beekeeping governed by the following regulations:

- REGULATION (EU) 2015/1368 OF THE COMMISSION of August 6, 2015 to establish rules for applying Regulation (EU) No. 1308/2013 of the European Parliament and of the Council concerning the aid to the beekeeping sector.
- REGULATION (EU) 2015/1366 OF THE COMMISSION of 11 May 2015 for the completion of Regulation (EC) No.

1308/2013 of the European Parliament and of the Council concerning the aid to the beekeeping sector.

- REGULATION (EU) 1308/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 December 2013 establishing a common organization of agricultural markets and the repeal of Regulations (EEC) No. 922/72, (EEC) No. 234/79, (EC) No. 1037/2001 and (EC) No. 1234/2007 of the Council.

As regards the subsidies that given to Greece on beekeeping for 2014 were the following decisions:

- No. 1568/107208/27.08.2014 "Determination of the total amount and rate of assistance for the beneficiaries of Action 4.1 'analyzes honey' and the amount of aid and the beneficiaries of Action 4.2 'Supporting the establishment the operation of honey analysis laboratories' under the program to improve the

  production and marketing of apiculture products for the year 2014 "
- No. 1567/107207/27.08.2014
- "Determination of the beneficiaries and the amount of aid in the context of implementation of actions 3.1 'Equipment for travel facilitation' and 3.2

  'Financial support of transhumance' for the year 2014"
- No. 1479/102463/11.08.2014
- "Approval of expenditure and define the implementation details of the actions 1.2 'Electronic Network Apiculture – Melinet' and 6.1 'Applied Research within the program to improve conditions for the production and marketing of apiculture products' for the year 2014"
- No. 1267/90608(GG 1942/B/17.07.2014) Modify the no. 956/60312 / 05.08.2014 Ministerial Decision (B 1243) on the establishment the terms and conditions for the implementation of actions 3.1 "Equipment for facilitating movements" and 3.2 "Financial support of nomadic beekeeping ", in the context of implementation of the program to improve conditions for the production and marketing of apiculture products for the years 2014-2016
- No. 1199/83524(GG 1819/B/02.07.2014) Definition of terms, conditions, supporting documents and the way of payment of subsidies with actions 1.2 "Electronic Network Apiculture – Melinet" and 6.1 "Applied Research" within the program to improve conditions for the production and marketing of apiculture products" in 2014-2016
- No. 1200/83526/26.06.2014 "Approval of the training program, of the list of trainers and expenditure for the implementation of Action 1.3" Training Beekeepers "for the year 2014"
- No. 1078/71082/06.06.2014 Determination of the process, the terms, conditions, supporting and strengthening the action of payment 1.3 "Training Beekeepers' under the

program to improve the production and marketing of apiculture products in 2014-2016

- No. 988/63186/19.05.2014 Apiculture centers operation
- No. 956/60312/15.05.2014 Beekeeping movement- replace
- Program to improve conditions for the production and marketing of apiculture programs for the years 2014-2016, regulations 1234/2007, 797/2004 and 917/2004

(Source Ministry of rural development and food) Aegean small islands

For additional subsidies to the Aegean small islands apply the basic EU regulation Reg (Eu) No. 229/2013 of the European Parliament and of the Council laying down specific measures for agriculture in the Aegean small islands. Also the Regulation Reg. (EU) No. 178/2014 supplementing Regulation (EU) No. 229/2013 of the European Parliament and Council of 13 March 2013 and its implementing regulation of the Commission Reg. (EU) No. 181/2014 laying down rules for applying Regulation (EU) No. 229/2013 of the European Parliament and Council of March 13 2013 for specific measures for agriculture in the Aegean small islands. As far as beekeeping is concerned there is the ministry decision 295610/AA 687/24-05-2007 "Additional measures for the implementation of the Community scheme concerning the aid for improving the production and marketing of apiculture products in the Aegean small islands, pursuant to Reg. (EC) 1405/2006 and Reg. (EC) 1914/2006 of the Commission". (Government Gazette B '897 / 06.06.2007), Ministerial Decree 1507/67082/03-06-2013 Modification of the final aid payment date on the No. 295 601 / AA687 / 24.05.2007 Joint Ministerial Decision of the Ministers of Economy and Finance and Rural Development and Food "Complementary measures for the implementation of the Community procedure with regard to aid for improving the production and marketing of apiculture products in the Aegean small islands, pursuant to Reg. (EC) 1405/2006 and Reg (EC) 1914/2006 (Government Gazette B '897) "(Government Gazette B'
1367 / 05.06.2013) and the Joint Ministerial Decree 580/35912/30-03-2015 "Amendment of number. 687/295610 / 24-05-2007 decision of the Ministers of Finance and Agriculture on additional measures for the implementation of the Community scheme concerning the aid for improving the production and marketing of apiculture products in the Aegean small islands. (Government gazette B' 625 / 04.15.2015). (Source: Ministry of Rural Development and Food).

Subsidies from private sector
A beekeeper also can be founded by private sector companies.

BUSINESS PLAN OF BEEKEEPING OPERATION

To study the beekeeping operation a six-year business plan was established in order to develop the exploitation gradually, both in equipment and in know-how. Subsequently the productive phase of the operation is presented in the seventh year. The monetary funds

needed are distributed gradually and increase as time progresses and the investment grows.

The capital increase, as mentioned, is gradual. In the first year after the person has attended the basic training course, buys five nuclei each with five combs of bees and the initial necessary equipment. The purpose is that at the end of the beekeeping period the nuclei will have become colonies with 20 built combs. Over the winter period the colony will be comprised of 10 combs, and the honey chamber with 10 built combs will be stored. At the beginning of the second period a strengthening must be done so that the hives will rapidly regain the honey chambers, and subsequently nuclei with five combs are will be taken from them. At the same time five other nuclei will be bought and with the same process the second period ends with 15 double beehives. In the next years every time beehives will be doubled with the method of creating nuclei and the interested person will be educated by taking part in seminars of beekeeping operations, queen rearing, and enemies and diseases. As a result at the end of the sixth year there will be 240 double hives, all the necessary equipment and the necessary knowledge for the beekeeping operation to be functional

Table 23 shows the increase in the number of hives with colonies from the first until the sixth year. If the person fails to achieve the goals in the first two years it means that the person should not exercise this profession and will have a small loss of money roughly 2500 Euros, this cost is characterized as minimal compared to other farms and business operations.

Detailed analysis of the business plan can be found in the appendix, (page 78-93).

Table 23. Colony increase per Year.

Hives Increase per Year						
COLONIES	1st year		2nd year		3rd Year	
	Begin	End	Begin	End	Begin	End
	5	5	10	15	15	30
	4th Year		5th year		6th Year	
	Begin	End	Begin	End	Begin	End
	30	60	60	120	120	240

Figure 14 shows the total production cost made in equipment purchases and nuclei for each year. Equipment regards everything a beekeeper need for each year with functional beekeeping operation and shown separately in the appendix. In the third year there is a noticeable increase in expenditure due to the purchase of the small truck[1]. In the fifth year the diagram shows the cost of storage on private land and in the sixth year of the purchase of the large truck

[1] According to Chapter III of the OG 707/B/1991, the license of farm truck vehicle with gross weight up to 4000kg is written a confirmation of the Agriculture Directorate which certifies the existence of farming business in the name of the applicant of such size that requires the use truck vehicle.

(8000 kg[1] gross weight). Because of that purchase from the sixth year transport of hives begins and therefore the travel subsidies also begin, according to the latest legislation subsidies for 2014 which amount to 3.59 Euros[2] per hive. In the second year the beekeeping booklet[4] is issued because the operation is now bigger than ten beehives and the subsidies are given through the government directive "equipment to facilitate movement" and concerns the purchase of hives, and is calculated to 18 Euros[3] per hive for 10% of the hives.

The values of sold products are shown in the table 24 and the figure 11. The first year is zero because the goal is for the interested person to learn bee handlings and to build combs. From the second year and after the honey production is calculated at 8 kg per hive (half of the average) due to the procedure of doubling the colonies through the production of nuclei. Also in the sold products a kilo of pollen from each productive colony (not nucleus) is calculated. In the seventh year the situation is stabilized and honey production is estimated at 16.3 kg per colony which is the average production (Papanagiotou, 2010), pollen is still calculated at 1 kg per colony and now there is also the possibility of selling nuclei. Prices are estimated after researchers contacted various beekeepers and beekeeping operations and amounted to 7 Euros per kilo of honey, 20 Euros per kilo for pollen and 50 Euros per nucleus with five build combs.

Regarding the average honey production per hive this may vary a lot, usually professional beekeepers far exceed this value. If one year is good there are reports of producers who reach 30 kg per hive, while if one year is not good production can fall less.

Table 24. Value of sold products for the beekeeping operation

Value of sold products							
	1st year	2nd year	3rd Year	4th Year	5th year	6th Year	7th Year
Honey value	0	320	960	1920	3840	9600	31296

[1] According to the Number Α9/οικ/16954/1248 of OG 696/Β/2000 the grant of authorization of truck with gross weight up to 8000kg for private use in beekeeping business is permitted with the following conditions: The applicant must have beekeeping booklet for three continuous years, holding more than 200 beehives and to be characterized by main occupation farmer.

[2] Ministerial Decision No. 965/60312/05.08.2014 (Β΄1243) establish the terms and conditions for the implementation of actions 3.2 "financial support of transhumance." The total amount for the implementation of the measure 3.2 amounts to 2.665 million and the amount of subsidy per moveable hive to 3.59 Euros. [4] **OG***/Β/642/28-5-2001*

[3] The Ministerial Decision No. 965/60312/05.08.2014 (Β΄1243) establishes the terms and conditions for the implementation of measures 3.1 "equipment for convenience of movement." The total amount for the implementation of the measure 3.1 amounts to 1.429.000 and the subsidy amount for the supply of new hives is set at 18 Euros per hive for the 10% of the hives.

Pollen value	0	100	300	600	1200	2400	4800
Splits value	0	0	0	0	0	0	6000
Total value of sold products	0	420	1260	2520	5040	12000	42096

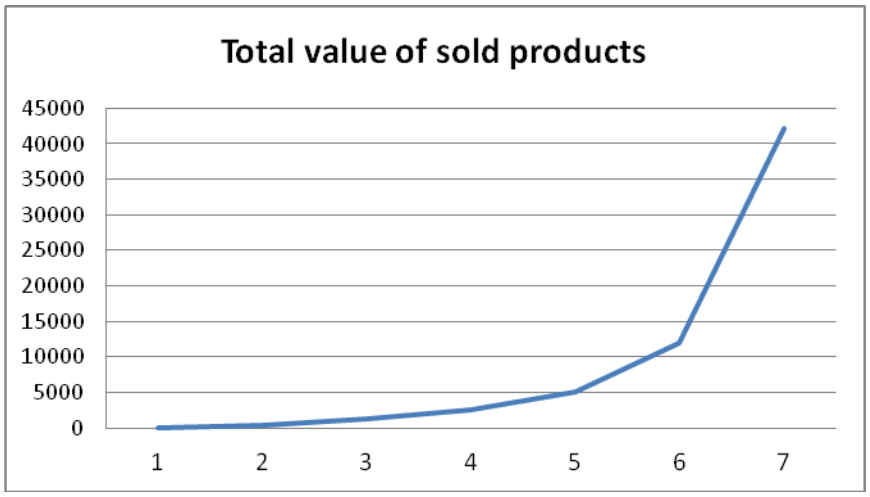

Figure 11. Increase of total sold products compared to time.

Table 25: Calculation of fixed capital of beekeeping operation

Calculation of annual average value of beekeeping operation							
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year
Average value of constructions and equipment (€)	509,6	2367,0	15883,3	16941,3	61467,5	75694,3	71572,6
Average value of colonies (€)	625,0	2125,0	4500,0	9000,0	18000,0	36000,0	48000,0
Average value of constructions and colonies	1134,6	4492,0	20383,3	25941,3	79467,5	111694,3	119572,6

In table 25 the average value of beekeeping operation is calculated for each year separately. It seems that the depreciation contributes significantly to the value of the capital in the end of the year. Up to the fifth-sixth year, the value of assets at the end of the year is very high because the beekeeper is in the investment stage of his activity.

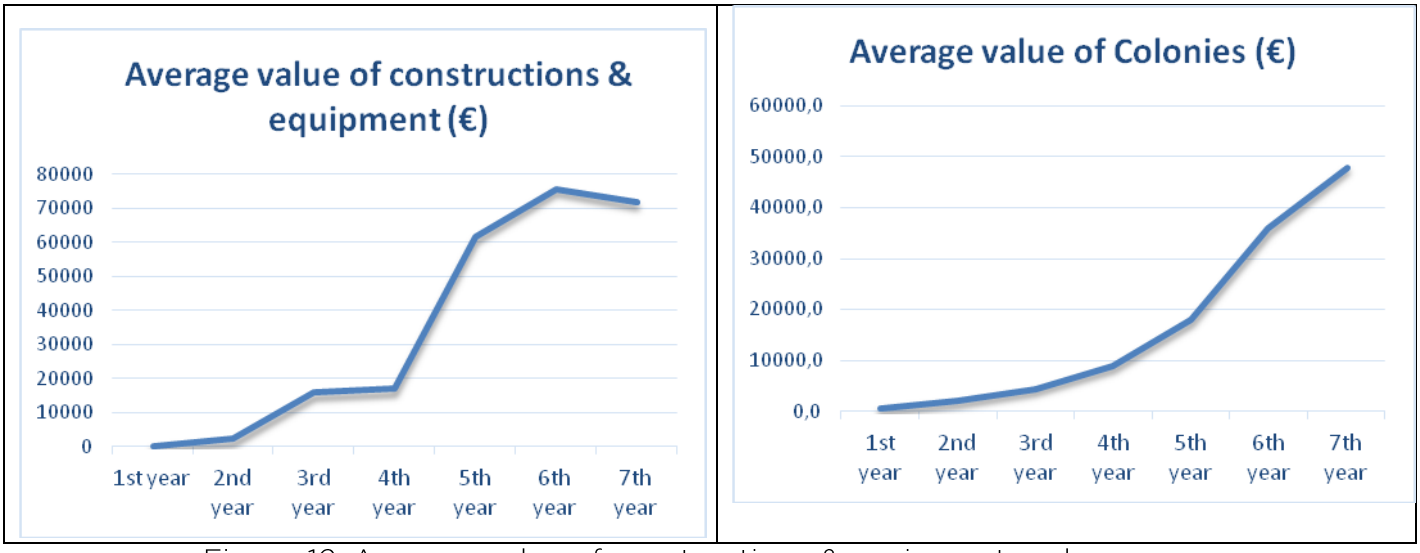

Figure 12. Average value of constructions & equipment and average value of colonies

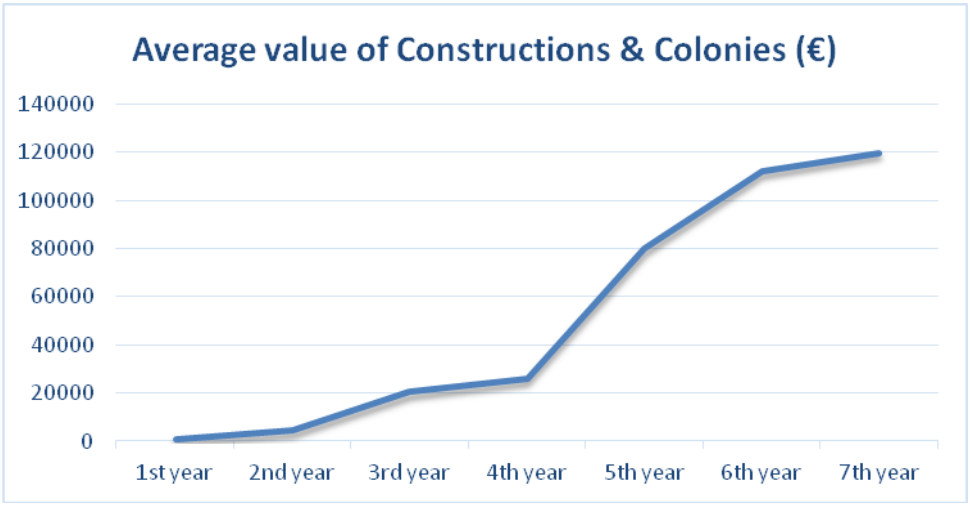

Figure 13. Average value of constructions & colonies

The increase of hives' capital is very important as it significantly contributes to the gross revenue (income), profits and farm income. Figure 13 shows the Average Value of Construction & Colonies and is the result of figure 12 that shows the Average Value of Construction & Equipment and Average Value of Colonies. From the trend of the curve, it is noticed that the candidate beekeeper invests gradually until the 4th year. From the 4th to the 6th year, the beekeeper achieves a sharp increase of his investment (because in the 5th year he builds the warehouse and in the 6th year buys the big truck), while from the 6th year the situation is stabilized. Comparing the average value of constructions & equipment to the average value of colonies, it is observed that the average value of colonies is constantly increasing, whereas the average value of constructions & equipment begins to decline from the 6th year onwards.

Table 26: Calculation of annual productive costs in beekeeping operation.

Calculation of Annual Productive Costs in Beekeeping Operation							
PRODUCTION CREDITS	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year
1) LAND							
A) Rent (of family land) non paid (land)	0,0	0,0	0,0	0,0	0,0	0,0	0,0
B) Rent paid (land)	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TOTAL	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2) LABOR							
A) Wages (of family) non paid	196,5	589,5	1179,0	2358,0	4716,0	9432,0	9432,0
B) Wages paid							
C) Financial Contribution to Agricultural Insurance Organization					950,0	950,0	950,0
D) Interest of labor cost	7,4	22,1	44,2	88,4	212,5	389,3	389,3
TOTAL	203,9	611,6	1223,2	2446,4	5878,5	10771,3	10771,3
3) CAPITAL FIXED CAPITAL							
A) Depreciation	50,3	235,9	1310,7	1520,3	2944,7	4121,7	4121,7
B) Interest of capital	79,9	332,7	1525,5	1943,3	5960,1	8377,1	8967,9
C) Maintenance	4,2	21,9	151,8	161,5	600,0	736,3	695,1
D) Insurance	2,2	11,6	80,5	86,0	318,0	390,3	368,4
E) Interest of Maintenance & insurance	0,2	1,3	8,7	6,1	34,4	42,2	39,9
TOTAL	0,0	0,0	3077,2	3717,1	9857,1	13667,6	14193,0
VARIABLE CAPITAL							
A) specific dost (inputs)	315,0	445,0	390,0	780,0	1560,0	2340,0	1560,0
B) Financial Contribution to Greek Agricultural Insurance Organization	0,0	3	8	16	32	64	127
C) third-party services	150,0	150,0	300,0				
D) overheads	50,0	100,0	100,0	150,0	200,0	600,0	600,0
E) Interest of variable capital	19,3	26,1	29,9	35,3	66,2	115,0	85,8
TOTAL	534,3	724	828	981	1859	3116	2373
TOTAL PRODUCTION COST	738,2	1335	5145	7074	17595	27555	27337

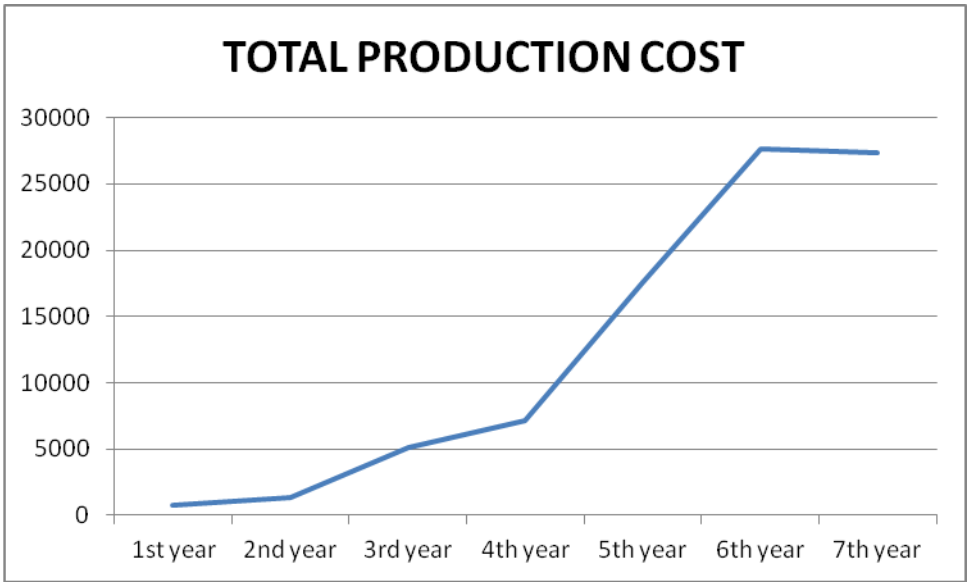

Figure 14. Total production cost.

In table 26, it is shown in detail the total cost for each production factor (land, labor, capital), separately. It is noticed that expenditure on land rent is zero[67] due to the existing legislation. In contrast, cost of employment increases proportionally with the increase in the number of hives. The capital is divided into fixed and variable. Fixed capital includes the cost of depreciation, the interest of fixed capital, maintenance, insurance premiums and interest of maintenance and insurance. While the variable capital includes expendable materials, the contribution of the Greek Agricultural Insurance Organization, the overheads (e.g. fuel, etc.) and interest of variable capital.

[6] Laws and provisions that regulate the issue of placement are applicable to all those who have beekeeping booklet.
According to Law 6238/OG/265/TA/08.14.1934 of the Ministry of Agriculture and Article 5 of Ministerial Decree
1/2008 - OG 1501/B/30.7.2008: "The placement of hives is prohibited at a distance of less than twenty five (25) meters of rural roads and streets, and less than fifty (50) meters of inhabited houses unless they enclose them with special net height at least two meters. The beekeepers are obliged to place the hives at a distance of fifty (50) meters from sheep housing and animal watering location. It is also prohibited to place hives in cultivated or uncultivated land without written consent of the owners. Beekeepers are also obliged to indicate the name, address and their phone [7] For the installation of colonies in public forest land applies the P.D. 190/81 GG 54/A/4-3-81 of Agriculture Ministry, which claims: "The authorization can be given to the beekeeping partnership, producer groups and single beekeepers. Preference line have the permanent residents of the municipality that is owned the forest and then the residents of other municipalities, with preference in the nearest to the forest area. To be granted such authorization is required: An application to the competent Responsible Officer of Forest Service, a certificate of the municipality or the Municipal District that the interested party works as a beekeeper and layout of the area to install the apiary. The authorization may be valid for up to five years with the right to be renewed every two years, while the beekeeper is obliged to exercise the occupation of beekeeper for the entire duration that license is valid, to take all measures of prevention and suppress fire and as well as tampering or destruction of forest vegetation or forest land from environmental pollution, create necessary construction (without foundation) within six months, construct makeshift fence if it is needed and not to transfer the right of establishment."

Table 27: Economic outcomes of Beekeeping Operation.

Financial Results of Beekeeping Operation							
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year
Revenue	0,0	420,0	1260,0	2520,0	5040,0	12861,6	42957,6
Net profit	-738,2	-914,8	-3866,5	-4535,4	-12528,1	-14759,5	15620,3
Gross Profit	-534,3	-303,2	433,8	1542,1	3207,4	9679,4	40584,6
Agricultural Family Income	-585,1	-559,8	-1092,4	-117,1	-1538,9	3596,2	34535,2
Return on total assets (%)	-55,2	-11,8	-11,1	-9,5	-7,9	-5,2	21,0
Return on Equity (%)	-55,2	-11,8	-11,1	-9,5	-7,9	-5,2	21,0

As it is shown by Table 27 of Financial results of beekeeping operation, revenues, profit (net and gross), income and capital efficiency are on the increase with remarkable the 6th and 7th year where beekeeping activity is stabilized.

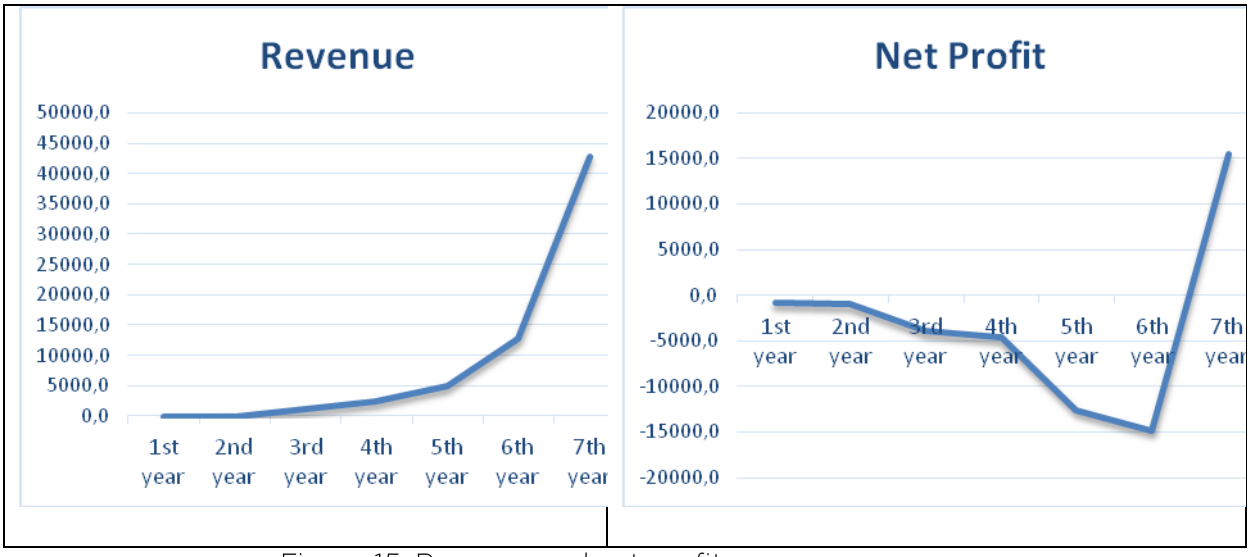

Figure 15. Revenue and net profit.

More specifically, in the figure of Revenues (figure 15), it is observed that the total produced quantity of beekeeping operation is on a constant rise until the 5th year. In the 6th and 7th year, revenues from production are ejected, as the beekeeper stabilizes the number of hives and now sells the whole produced quantity.

Combining the figure of revenue to the figure of net profit (figure 15), it is noted that the net profit of the beekeeper starts to be evident from the 6th year, where the beekeeper stops to invest in buildings and equipment.

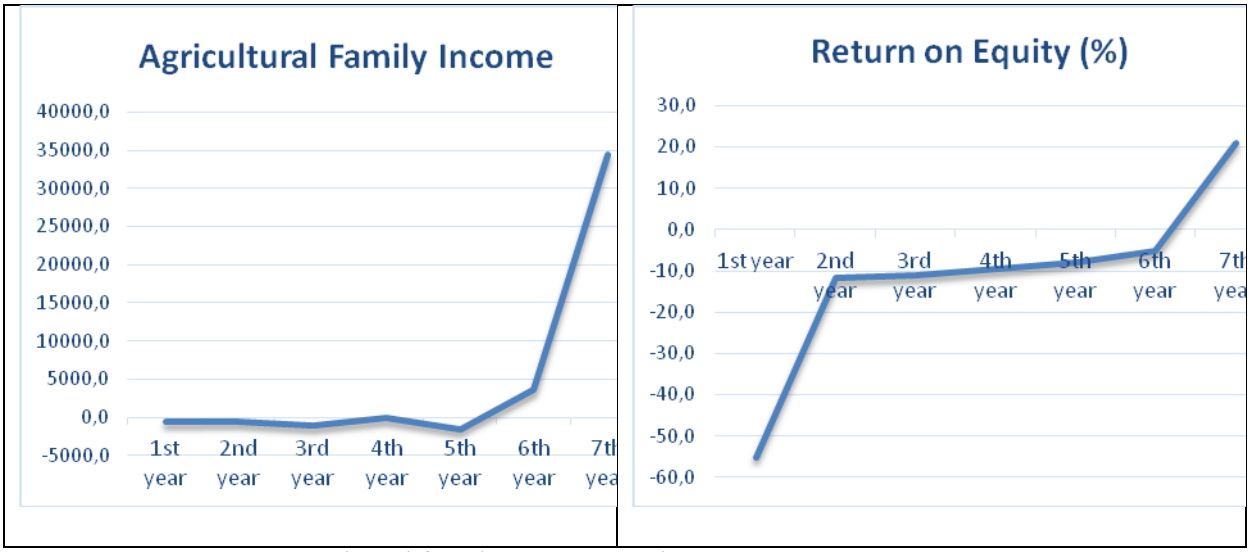

Figure 16. Agricultural family income and return on equity

In the figure of agricultural family income (figure 16), the welfare indicator of agricultural family income appears an intense increase from 6th year onwards, for the reasons that were mentioned above. Finally, in the figure of return on equity (figure 16), low prices of the indicator are accordingly greater as result of higher financial expenses. However, over the years this indicator increases, indicating that the position of beekeeping operation is improved because the beekeeper utilizes his capital most efficiently making strong sales. From the 6th year onwards, the trend of curve is an indication of the effectiveness of beekeeping operation and the profit is increasing using the available invested resources and funds (capital).

S.W.O.T. ANALYSIS

" Strengths

- The organization of beekeeping operation is conducted by a person who possesses the appropriate knowledge (through education by seminars of the program and the training and support center)
- Production quality product, tested throughout the production process
- The superior quality of products and high recognizability (eg domestically produced honey is considered excellent product quality and high nutritional value).
- They are raw material for the production of numerous other foodstuffs (eg sweets, confectionery, confectionery, etc.).
- The long life of the products concerned.
- Rich beekeeping flora and increase biodiversity.

" Weaknesses

- Risk of contamination of stored combs and stored honey, if hygiene rules are not respected in the warehouse
- High dependence of the production of environmental factors: inappropriate weather, early or late flowering, etc.

- The fragmentation and dispersion that characterizes the primary production of honey.
- Inadequate advertising and promotion of products on the international market.
- Movement of cheap imported products of dubious quality.
- Deficiencies, infrastructure & Marketing
- High production costs

" Opportunities

- Increased and steady demand in recent years in the domestic and global market for quality, healthy, organic food products
- Increase openness and sales expansion in new markets abroad.
- Penetration of products in more outlets.
- Increasing trend of making breakfast at home (or prepared at home), enhancing the use of spreads.
- The shift in consumption of traditional products (traditional nutrition) and repositioning the consumer in time honored customs.
- Provide funding and inclusion of investments in new development laws.
- Systematic production and other hive products. " Support entrepreneurship of young beekeepers.
- Improve the standardization of packaging
- Certification promoting
- Enrichment of honey flora.

" Threats

- High density colonies per square kilometer
- The market operates at foul competition
- Occupation which is considered as the "easy option" and attracts a large number of new entrants in the sector
- High risk of adulteration with foreign honeys dubious cases in impurities
- Shrinking disposable income of consumers and potential further reduction in consumer spending.
- Import and localization cheaper quality honey.
- The prolonged period of economic recession and its aftermath (reducing flowability of companies, increase in bad debts, under-funding by banks, etc.).
- Climate change and extreme weather events
- Poisoning of bees by spraying
- Introversion- inertia, stagnation

MODEL CENTER FOR EDUCATION AND SUPPORT

A. EDUCATION PROGRAMS

1. Basic training (Beginners)
2. Beekeeping management
3. Queen rearing and royal jelly production
4. Disease and Pests of honey bees
5. Special techniques to professional beekeepers

B. BEEKEEPER SUPPORT CENTER

A model center is established to educate young beekeepers to support them as well as other beekeepers on different problems and inform them on new technologies. This center will include:

1. A modern apiary with 20 to 30 colonies with all the necessary equipment for practical training.
2. A multipurpose room for theoretical and laboratory training.
3. Benches and basic equipment (microscope, stereoscope etc.) for pest diagnoses. 4. A specialized person who will run the center and will be the contact with the university (knowledge) and the country (beekeepers) (extension). It will be the reference laboratory. Using the internet and printed material will disseminate instructions and information on new issues.

5. The same center can be used for other agricultures sectors and will exploit the same rooms and equipment.

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EDUCATIONAL SEMINAR

BASIC TRAINING (BEGINNERS)

TRAINING PROGRAM FOR BEGINNERS

FIRST DAY

Theory

1. Apiculture in Greece and prospects. Instructions for beginners (Appendix, p. 94-96)
2. The biology, anatomy and physiology of the honey bee
3. Nutrition, behavior and swarming of honey bees

Practice A. The basic equipment of the beekeeper B. Acquaintance with bees (practice at the apiary) C. Preparation of the hive to install the swarm (wiring of frames, hive painting etc.)

SECOND DAY
Theory
1. Crop pollination and honey plants
2. Choosing a good site for an apiary
3.Seasonal beekeeping management, exploitation of honey flows (pine, fir, thyme)

Practice A. Acquaintance with bees (practice at the apiary) B. Honey plants C. Maintenance of old hive (repairing, plastering, painting) D. Uniting and dividing colonies E. Bee food preparation (syrup, sugar candy & pollen substitute) and colony feeding

THIRD DAY
Theory
1. Simple ways of producing queens and royal jelly
(why it is important to keep a good queen in a hive)
2. Bee's Diseases (American foulbrood, chalkbrood, nosema disease)

Practice A. Acquaintance with bees (practice at the apiary) B. Queen cell preparation and grafting for queen and royal jelly production C. Diagnosis, disease prevention and disinfection of beekeeping equipment D. Branding iron to mark hive parts

FOURTH DAY
Theory
1. Bee enemies
2. Hive products
(Honey, wax, pollen, royal jelly, propolis, bee venom)
3. Organization and beekeeping unit operation

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EDUCATIONAL SEMINAR

BEEKEEPING MANAGMENT

TRAINING PROGRAM FOR BEEKEEPING MANAGMENT

First day
- Introduction to bee management
- Preparing the hive to receive the swarm
- The care of equipment
- Special bee management practices (prevention of swarming, drifting, robbing)
- Bee feeding and its importance to colony development
- Presentation of videos and photos

Second day
- Choosing a good site for an apiary
- Seasonal beekeeping management
  - Early spring
  - The period before the honey flow
  - The honey flow period
  - Removing the extracted honey crop
  - Care of bees in the fall
- Methods of colony strengthening and the exploitation of honey flows
- Exploitation of honey flows (pine, fir, thyme)
- The disinfection of beekeeping equipment and its importance to honey yield
- Presentation of videos and photos

Third day
- How to move bees
- How to unite bees
- How to transfer bees
-.Keeping useful records
- Management for commercial honey production

- Preparing the colonies for wintering
- Protection of bees from pesticides
- Summing up and Discussion

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EDUCATIONAL SEMINAR

QUEEN REARING AND ROYAL JELLY PRODUCTION

TRAINING PROGRAM FOR QUEEN REARING

(Demo text: Appendix, pages 98-117) First day

- Introduction to queen and royal jelly production
- Preparation of grafting materials
- Preparation of colonies and queen cells
- Grafting
- Preparing the mating nuclei
- Introduction of queen cells to mating nuclei
- Methods of producing queens and royal jelly
- Colony feeding and its importance of queen rearing
- Presentation of videos and photos

Second day

- Special bee management practices (prevention swarming, drifting, robbing)
- The disinfection of beekeeping equipment and its importance to queen rearing
- Control of the success of grafting
- Preparation of sugar candy and pollen substitute
- Criteria for selecting queens and the importance of queen rearing in bee breeding
- Instrumental insemination of queens
- Methods of producing new colonies, and special techniques
- Presentation of videos and photos

Third day

- Chemical composition of royal jelly and the quality criteria
- Production and preservation of royal jelly
- Queen marking and queen introduction to colonies
- ZENDER method of queen cells production
- EZI QUEEN method of queen cells production
- Protection of bees from diseases and pests and its importance to queen rearing success
- Summing up and Discussion

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EDUCATIONAL SEMINAR

DISEASES AND PESTS OF HONEY BEES

TRAINING PROGRAM DISEASES AND PESTS OF HONEY BEES

First day
- Registrations and explanation of the seminar procedures
- Bee management for pest prevention
- Feeding bees as related to bee pests
- Uniting colonies

- Varroa control Check Mite and oxalic acid
- Nosema disease (microscopic examination and control with thymol)

Second day

- Disinfection of beekeeping store room and honey extracting room
- Disinfection of combs with chlorine
- Disinfection of hives with blowtorch and caustic soda
- Burn of combs infected by American Foulbrood & Wax moth
- Painting hives (tar, linseed oil, putty, scraping, painting oil paint)
- Branding iron beekeeping materials
- American and European Foulbrood disease
- Chalkbrood and Nosema disease

Third day

- Bee pests

Insects (Wax moth, Wasps, Ants, Death head moth, Small hive beetle)

Birds (Swallow, Bee eater, Bee Buzzard)

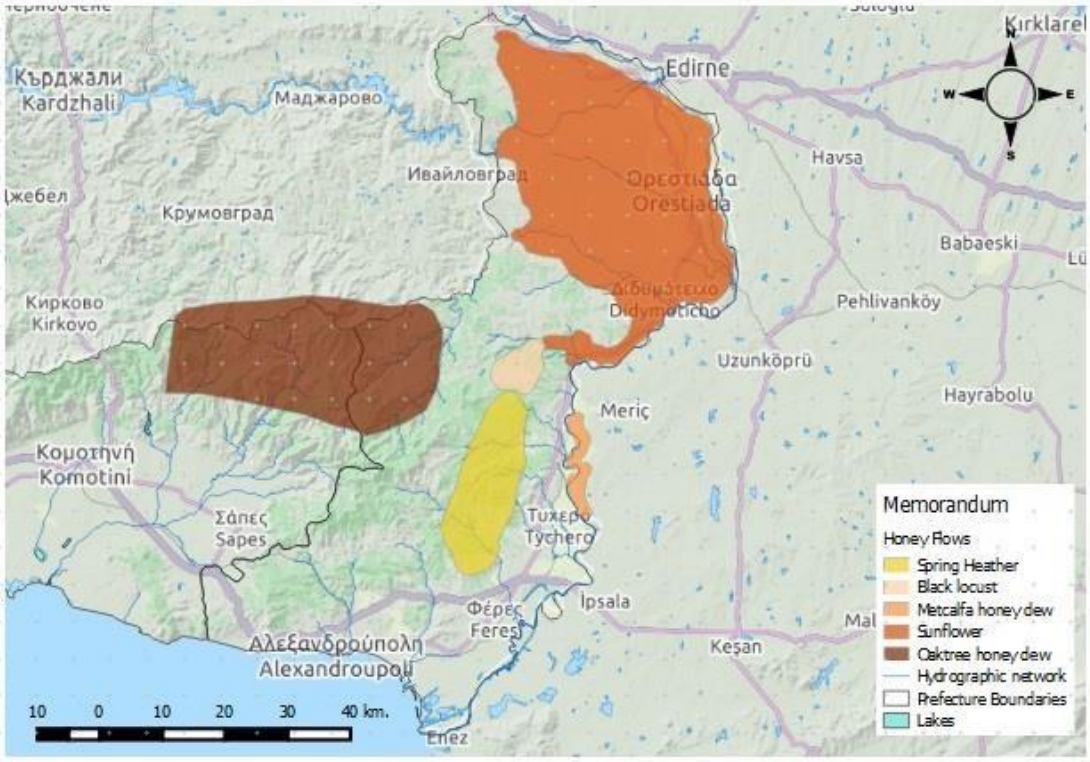
Mammals (Mouse, Bear, Badger)

- Placing wasp traps (hive and bottle type)
- Bee poisonings by pesticides
- The importance of queen rearing and breeding on bee pest control
- Conclusions

MAPS OF HONEY FLOWS

Geographical Information System is a very modern and effective tool for recording the earth surface and can be very useful for detailed mapping of the honey plants and for the examination of the seasonal changes over time. These maps can be very useful to beekeepers as they can provide information about the honey flows of various areas over Greece. To make this possible satellite and outdoor data must be used.

So far only outdoor data has been used to create some maps. As an example the main honey flows of the Evros prefecture are recorded. (for more maps see (Appendix, pages 112-116)



Map 1. The main honey flows of the prefecture of Evros, Greece

CONCLUSIONS

The object of the present sector study is the techno-economic analysis of the beekeeping sector in Greece as an opportunity for employment by young people, whether they are beginners and have no experience with beekeeping in the past or are active beekeepers with prospects.

Regarding the attractiveness of beekeeping by young people, it seems to be particularly attractive because young people are turning to the primary sector of production due to underemployment that is caused by the economic crisis of 2009. In recent years, honey production and consumption in Greece shows an increasing trend which has ranked the country in 7th place in Europe and 23rd in the world. Greece is the country with the highest hive density per square kilometer. From the statistics, it appears that in Greece large amounts of high quality honey are consumed compared to other countries. The conclusion is that in Greece and in Europe honey is an attractive product with margins in production growth in Greece as there is a large market in Europe.

Hive products are associated with other products in various sectors such as food, pharmaceutical, cosmetics, etc., which contribute significantly to the production and creation of tertiary sector of natural products.

Regarding honey exports, Greece seems to have great potential and prospects and there is a further possibility in the development of secondary and tertiary production sectors in order to reach the level of integrated production.

The economic analysis data show that investing in a beekeeping unit can be characterized as financially secure, as the initial capital is

quite small and grows gradually over the next few years as the beekeeping unit also starts to grow. Basically, over the first six years of the investment, the candidate beekeeper invests in increasing colonies, in building and mechanical equipment in order to fully exploit and maximize production in the seventh year, leading to a more profitable business. If someone has experience with beekeeping, can start with about 30 colons, will save two years and can enter full production in four years.

The project proposes a model center in order to educate young beekeepers, to support them as well as other beekeepers on different problems and inform them on new technologies. The project also proposes four training programs for not only new but also experienced beekeepers. This model center will serve as extension service and can be located in the university as it is applied in USA, exploiting the university's infrastructure.

Young unemployed people could be the new generation of modern farmers, provided a carefully designed program.

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APPENDIX

HONEY PRODUCTION IN GREECE, IMPORTS-EXPORTS

Appendix table 1. Countries of the world and honey production for the year 2012 (source FAO)

	country	Production (tons)
1	China, mainland	436000
2	Turkey	88162
3	Argentina	75500
4	Ukraine	70134
5	United States of America	66720
6	Russian Federation	64898
7	India	61000
8	Mexico	58602
9	Iran (Islamic Republic of)	48000
10	Ethiopia	45905
11	Brazil	33571
12	Spain	29735
13	Canada	29440

14	United Republic of Tanzania	28500
15	Republic of Korea	25000
16	Romania	23062
17	Angola	23000
18	Uruguay	20000
19	Hungary	17000
20	Central African Republic	16000
21	Germany	15699
22	China, Taiwan Province of	15600
23	Greece	14800
24	Viet Nam	12365
25	Poland	12176
26	France	11809
27	Kenya	11650
28	Australia	10500
29	New Zealand	10385
30	Italy	9550
31	Bulgaria	9186
32	Chile	9000
33	Thailand	8250
34	Portugal	7800
35	Czech Republic	7332
36	Serbia	6865

Appendix table 2. Honey Imports for the year 2007-2011 (source FAO)

Honey imports from other countries to Greece (Tons)										
	2007		2008		2009		2010		2011	
	quantity	values(1000$)	quantity	values(1000$)	quantity	values (1000$)	quantity	values (1000$)	quantity	values (1000$)
Bulgaria	548	1388	1020	3599	879	2738	733	2204	645	2113
Germany	847	3203	582	2860	408	2322	391	2157	642	2629
Spain	702	2023	712	2522	647	2339	574	2497	627	2314
Netherlands	49	247	72	311	126	674	64	352	133	800
Belgium	282	920	180	565	85	922	48	749	51	622
Austria	2	11	3	16	24	141	33	181	-	-

Canada	–	–	–	–	–	–	–	–	17	75
France	6	43	5	36	5	61	3	36	15	150
Hungary	219	584	63	242	19	70	4	14	10	36
United Kingdom	21	117	1	18	12	42	1	10	8	81
Italy	44	181	45	278	8	54	35	115	8	32
Sweden	–	–	–	–	–	–	–	–	3	29
Switzerland	–	–	–	–	5	32	2	19	2	25
Poland	–	–	–	–	–	–	1	8	2	9
Ireland	–	–	–	–	–	–	–	–	2	20
Romania	20	48	6	27	20	62	20	88	1	6
Denmark	34	123	–	–	20	55	–	–	1	9
Qatar	–	–	–	–	1	1	–	–	–	–
Japan	–	–	–	–	–	–	–	–	0	3
Cyprus	0	3	–	–	–	–	–	–	–	–
China, mainland	–	–	–	–	20	39	62	111	0	2
China	–	–	–	–	20	39	62	111	0	2
Σύνολο	2774	8891	2689	10474	2299	9591	2033	8652	2167	8957

Appendix table 3. Honey exports for the year 2007 - 2011 (source FAO)

Honey exports from Greece to other countries (Tons)										
	2007		2008		2009		2010		2011	
	quantity	values (1000$)	quantity	values (1000$)	quantity	values (1000$)	quantity	values (1000$)	quantity	values (1000$)
Germany	104	655	167	1250	147	1274	291	1978	308	2295
Cyprus	48	275	160	708	153	890	114	754	138	856
Canada	15	173	18	233	43	390	74	549	120	640
United Kingdom	212	1086	80	557	68	547	86	648	56	399
France	27	267	23	247	37	393	66	580	35	384

USA	51	550	45	511	39	383	49	539	33	370
Libya	–	–	0	3	–	–	16	61	–	–
Spain	16	39	0	6	–	–	0	5	15	77
Qatar	–	–	1	7	14	44	14	42	–	–
Belgium	15	152	6	83	11	139	19	223	13	175
Bulgaria	1	5	24	85	23	136	12	26	–	–
Czech Republic	1	9	1	17	3	35	4	38	11	102
Lebanon	11	113	13	157	11	129	11	139	7	92
Netherlands	4	40	8	87	7	66	16	133	6	65
Poland	2	19	3	30	3	32	8	74	6	52
Finland	–	–	1	8	–	–	4	33	5	48
Switzerland	2	31	2	29	8	93	10	100	5	55
Australia	2	23	6	85	7	106	3	37	4	62
Japan	4	47	3	49	2	34	2	22	4	62
Russian	–	–	–	–	–	–	–	–	4	41
Saudi Arabia	0	5	1	20	19	30	45	63	3	29
Slovakia	–	–	–	–	1	10	4	37	3	29
Sweden	4	31	3	36	4	27	8	52	3	18
Ireland	0	3	2	14	–	–	2	18	–	–
Slovenia	2	13			–	–	–	–	–	–
Yemen	–	–	17	62	–	–	2	10	–	–
Maldives	2	9	–	–	–	–	–	–	–	–
China	1	13	–	–	0	2	1	21	1	15
China, mainland	1	7	–	–	0	2	1	20	1	14
Italy	2	25	0	5	0	3	0	2	1	8
Norway	–	–	1	11	1	17	1	16	1	17
Zimbabwe	–	–	–	–	1	19	–	–	–	–
Singapore	1	7	1	14	1	12	1	10	1	10
Ukraine			1	12	–	–	–	–	–	–
Denmark	6	54	5	58	6	45	1	5	–	–
Liberia	1	7	–	–	–	–	–	–	–	–
United Arab Emirates	–	–	–	–	–	–	–	–	1	3
Austria	1	8	1	11	17	178	6	71	0	6
Estonia	0	5	–	–	–	–	–	–	–	–
Thailand	0	2	–	–	–	–	–	–	–	–
Albania			0	1	0	1	0	1	0	1
China, Hong Kong SAR	0	6	–	–	–	–	–	–	0	1

Armenia			0	2	-	-	-	-	-	-
Serbia	2	10	0	3	-	-	-	-	-	-
Democratic Republic of the Congo	-	-	-	-	-	-	-	-	0	2
Luxembourg	-	-	-	-	-	-	0	1	0	1
Romania	0	1	-	-	0	1	4	27	0	3
China, Taiwan Province of	-	-	-	-	-	-	0	1	-	-
Sum	538	3690	593	4401	626	5038	875	6336	785	5932

GENERAL REQUIREMENTS OF HYGIENE - SAFETY FOR BUSINESSES OF PACKAGING HONEY

1. General requirements for food premises honey packers

a) Selecting a building location

- Roads leading to the building to be in good condition and facilitate access and movement of goods. Around the building, the roads must be asphalted to prevent dust, which could contaminate the inside of the building.
- The environment of the building space not too threatened by insects, pests or rodents hardly treated.
- The area of the building should be free of fumes, odors or other contaminants.
- Areas flooded or have problems in the removal of waste must be avoided.
- At the building site must be an adequate provision of drinking water. b) Design of the building b1 - The plant size is proportional to the activities and capacity of the company (adequate rooms). b2 - Health concept of food premises area not mentioned in the panel or conventional structures (different rooms), but the efficiency and the ability to develop all work in the installation smoothly and without contamination risks.

Note that the partitions or separate rooms should be less loud because: a) set additional surfaces to be cleaned and disinfected b) does not create flexibility in adapting to new productive activities of the company c) prevent effective health control of personnel.

b3 - The building sites are designed to ensure:

- Continuous linear production flow (eg receipt honeycomb - the cap - honey extraction - filtration - place in containers - packaging - storage - handling) to avoid "cross-contamination" from products of previous production stage.
- Unimpeded and secure work (eg non-slip flooring) of workers
- Unimpeded movement of raw materials, packaging materials and equipment
- Good ventilation
- Limiting entry of insects, birds, rodents, dust, pets
- Appropriate temperatures of production areas and storage

- Efficient maintenance, cleaning and disinfection
- Adequate capacity for the conservation of food, according to the capacity of the plant.

b4 - The building shall comprise

- Storage area of raw materials and final products
- Area of production / packaging
- Storage area of packaging materials
- Storage area of cleaners, disinfectants
- Staff areas (toilets with anteroom, dressing room)

Especially for small businesses (eg small packaging units of honey) provide for national measures adapting the requirements of Reg. (EC) 852/2004 to KYA 3724 / 162303-22.12.2014 (B 3438) Article 2.

These are:

1. The input port of raw materials, B materials, packaging materials, staff and the output port of final products and staff may be common.
2. Allow failure to comply with linear flow.
3. The use of common equipment for washing both food and hands is permitted.
4. The input and output can be directly from the production site.
5. Allow the cleaning, disinfection and storage of utensils, within the production area.
6. The storage of raw materials and final products at the same cold chamber is permitted.
7. The storage of cleaning / disinfecting cabinet located within the production area is permitted.
8. The existence of locker rooms is not mandatory.

b4. Staff areas

- The toilets are equipped: foot-operated taps with hot and cold water with disposable paper devices bins with foot-operated opening, with hand disinfection devices. - The staff has individual lockable lockers for their clothes. They have 2 sections, one for civil and one for sanitary clothing. b5. The cleaners / disinfectants closet locks.

b6 - Lighting: medium in warehouses and auxiliary rooms (110 lux) and plenty in production areas (220 lux) and especially at checkpoints (540 lux) eg the checkpoint of glass containers for honey.

- Ventilation: adequate, to remove odors, water vapor concentrates on the roof, walls and equipment, heat and windows must always be protected with screens to prevent the entry of insects, birds, etc.
- Water: water used by the facility for cleaning and disinfection should have the characteristics of "drinking water". Non-potable water is used only for cooling engine fire fighting and outdoor use.

The potable and non-potable water systems have different pipes marked with a different color.
b7 - sewage system: Exist 2 separate sewer systems (a hygiene area and a production area).
The sewage system of the production area bear channels with stainless steel grates and sanitary wells with siphons. c) Building construction

- Walls, ceiling, floors, windows and doors of the building are made of waterproof and non-absorbent materials that clean and disinfect easily, smooth and free from cracks, brightly coloured with antifungal paint.
- Moreover walls made of solid materials to ensure soundproofing and not to allow entrance to the production area of undesirable substances. There are not recesses that can attract birds.
- Connections of wall, ceiling, floor are leakproof and rounded to prevent the accumulation of pollution and to facilitate cleaning.
- The floors are not slippery, have the required slope for water drainage and drainage channels have at least twice the ability of liquid removal from those provided to produce.
- The doors close with pushrods and when remain continuously open, we recommend installing protective (eg vertical plastic strips), and have windows.
- The windows are positioned on the inside of the wall profile. Otherwise they should have ledge by tilting 45°

Always covered with mobile screens, which are cleaned and kept in good condition. d) Equipment
The honey business equipment must be suitable for the intended use. Should not impart color, odor, taste or toxic substances to honey. Do not eroded, oxidized, cracked, deformed. To have a smooth and non-absorbent surface. To wash and disinfect. Be placed at a sufficient distance from the floor to facilitate cleaning. The appropriate materials used for the equipment is stainless steel and plastic materials (e.g., polyamide) suitable for food.
The wood since surface is porous and easily erodes, it cannot be cleaned adequate, so it should be excluded. It is used only for manufacturing wooden pallets for transporting, fully protected in packaged products (eg boxes with glass containers with honey) and in this case the wood must be in good condition.
The equipment systematically maintained by the maintenance program, complied with the operating manuals for the equipment. The company maintains file repair / maintenance where the damage maintenance, materials used, control effectiveness are described. Maintenance operations also signed by the person responsible for maintenance.
e) Cleaning – disinfection
Hygiene of food greatly depends on cleaning and disinfecting the equipment used for the production. By cleaning the visible pollution is removed by the surfaces. By disinfecting the living microorganisms usually are destroyed and rarely the spores as well.
After use of detergents (cleaning) or disinfectants, equipment and tools thoroughly rinsed with potable water and then dried as quickly as possible.

In case of honey, that is a highly viscous product, can be applied "controlled wet cleaning" with limited use of water and instant drying.
The process involves a) Wash b) brushing or rubbing c) suction using vacuum cleaner.
The most common method of disinfection is heat. For disinfecting utensils and small components potable water is used at temperatures over 80 ° C, in which objects are sinked in similar time or steam. There may be used chemical disinfectants. The main are the chlorine compounds, iodine compounds, amphoteric compounds are usually compounds of quaternary ammonium.
Honey packaging business, should apply cleaning and disinfection program for all equipment, production halls and warehouses. Production areas should be cleaned - sanitized once a day, after finishing work.
The company states a responsible person for cleaning / disinfection and maintains related file of approved detergents – disinfectants that have been used, which maintains in a totally lockable isolated space (cabinet). There are clear instructions for use and implementation. Only drinking water is used. After cleaning / disinfection, rinsing with potable water is followed. Toilets must be continuously kept clean and disinfected, because are places of major contamination. The sewage channels are daily cleaned after the protective grill is removed because they are the main source of microbiological contamination. The screens of the windows also checked and cleaned frequently. Storerooms should be cleaned at least once a week with vacuum cleaner. g) Against rodents and insects
Insects and rodents as carriers of a large number of pathogens are compliance indicators of hygiene rules in honey packaging firm. The extermination of rodents is with traps or poison baits, which cause internal bleeding or pulmonary edema in rodents. Fighting insects with insecticides is embedded in traps with adhesives electrical lights with visual and olfactory stimuli. Honey packaging enterprise should implement rodent control program. In that the positions that baits will exist, the materials used in these concentrations, the combat method, the control frequency and the person in charge program are identified. The traps control file, standard's files and instructions for the materials used are kept. The insect control program includes: list of insecticides used with instructions, mounting positions insects' attracting lamps with cleaning instructions and changing lamps. The control of traps and lamps of rodent control program and insects must be carried out 1-2 times a month.
to staff
All staff working in a honey packaging firm must have a health card which is updated at regular intervals. During his work, should wear protective clothing including: blouse or light-colored form without pockets and buttons, hat or cap, boots or protective shoe covers. Furthermore, he should not wear rings, watches and other jewellery, nails should not be big and painted.
By entering, each morning in the honey packaging firm, the staff goes to the locker room where he wears the working garments and places his civil clothes and jewellery in an individual wardrobe. Before beginning his work, wash and disinfect his hands in a foot wash basin which has a detergent/disinfectant, small brush for rubbing nail and towel for single use.

Especially when staff visiting the toilets at the time of work must follow the following: • before entering the toilet, remove gloves and protective clothing that leaves in the vestibule

- after using the toilet he washes his hands meticulously in the foot washbasin, wipes them with a disposable towel and disinfects with special disinfectants.
- he wears again his working garments, disinfects his hands again and wear new disposable gloves.

g) honey packaging

Packaging of honey protects against possible contamination and spoilage of its characteristics by increasing keeping quality. Distinguishing first packaging (packaging in direct contact with honey) and second packaging (packaging in which wrappings are transferred to points of sale).

g1. Packaging specifications

1. To ensure the necessary protection of honey.
2. Do not alter the organoleptic characteristics (smell, taste, color).
3. Do not carry in honey, harmful or toxic substances for humans.
4. Do not be reused. If there are returnees' containers, the packaging must have chemical cleaning and disinfection system, to wash and dry the containers.
5. Do not contaminated with foreign bodies (insects, dust, etc.)
6. Do not contaminated with pathogenic microorganisms

h) Storage specifications of packaging materials - controls

1. To be stored until their use in absolutely clean area, free from dust, insects, rodents, etc.
2. To be packaged in such a way as to ensure its health status.
3. Be inspected before use, to confirm their suitability for use. Check the cleanliness of the containers, the integrity of the containers and the cleanliness of the packaging machine if there is general conditions that exist at the packing plant and at the time of packaging, to make the necessary corrective actions immediately. After packaging the direct storage of packaged products follows.

Transfer of honey

The transfer of the honey carried out by vehicles which must meet the following requirements.

- The inner walls are smooth in order to clean and disinfect and do not contaminate the honey packages.
- Do not have odors, moisture and other parameters that can be borne by the honey packages.
- Ensuring the protection of honey packaging from dust, rain and exhaust gas. - Do not use for transferring products or objects which may spoilage or contaminate honey packages.

During transfer the following should be noticed:

- The stacking of honey packaging in order to secure their packing and therefore their safety
- Loading and unloading in order to avoid rupture of the package.

Finally, it should be checked that all honey packaging are appropriately labeled.

Appendix table 4. Greece main competitor countries for honey

	The Main Competitor Countries for honey 2014		
A/A	Competitor Countries	Percentage of Total Competition (%)	Gradually Sum (%)
1	Spain	23,8%	23,8%
2	Mexico	14,8%	38,6%
3	Argentina	8,6%	47,2%
4	Hungary	8,5%	55,7%
5	Germany	5,5%	61,3%
6	Ukraine	4,8%	66,1%
7	Belgium	4,4%	70,5%
8	Slovenia	4,1%	74,5%
9	Brazil	3,7%	78,2%
10	South Korea	3,2%	81,5%
Sum	(20 countries)		100,0%

SUBSIDIES

Appendix table 5. Subsidies for Aegean Islands from 2003 - 2010

Aegean Islands	Subsidies from 2003-2010
Kithnos	171.008
Sikinos	90.538
Ios	244.156
Andros	379.944
Naksos	449.016
Kea	1.225.264
Salamina	141.844
Tinos	149.244
Kithira	301.036
Ikaria	575.232
Samos	950.346
Limnos	564.472
Chios	542.440
Lesvos	620.260
Kos	842.432
Kalimnos	422.412
Leros	184.884
Astypalaia	183.409
Thasos	2.110.330
Kasos	251.904
Serifos	36.096
Anafi	51.048
Tilos	4.860
Rodos	548.112
Amorgos	14.148
Thira	26.016
Sifnos	45.120
Ydra	5.208
Sum	11.130.779
From 20112015	7.000.000
Total Sum	18.130.779

Appendix table 6. Apicultural centers subsidies.

Years	Apiculture centers
1998	0
1999	168.529
2000	363.235
2001	493.529
2002	624.705
2003	704.329
2004	1.150.000
2005	1.150.000
2006	1.150.000
2007	1.150.000
2008	1.353.760
2009	1.348.240
2010	1.452.720
2011	1.230.909
2012	1.270.575
2013	1.176.226
2014	1.200.000
2015	1.200.000
Sum	17.186.757 €

Appendix table 7. Subsidies for Varroa treatment and epizootic study.

Years	Varroa treatment	epizootic study
1999	0	617.647
2000	0	588.235
2001	0	1.235.294
2002	0	1.382.352
2003	1.027.146	0
2004	520.000	0
2005	1.000.000	0
2006	1.100.000	0
2007	1.100.000	0
2008	500.000	0
2009	500.000	0

2010	500.000	0
2011	0	0
2012	0	0
2013	0	0
2014	0	0
2015	0	0
Sum	6.247.146	3.823.528

Appendix table 8. Subsidies for research

Years	Research
2000	442.941
2001	588.235
2002	588.235
2003	117.388
2004	75.525
2005	80.000
2006	80.000
2007	80.000
2008	80.000
2009	80.000
2010	80.000
2011	0
2012	30.843
2013	52.669
2014	60.000
Sum	2.435.836

Research institutions subsidized
Institute of Apiculture of Chalkidiki
Apicultural Laboratory of AUTH
Apicultural Laboratory of AUA
Acarology lab of AUA
Veterinary Research Institute of Athens.
Mediterranean Agronomic Institute of Chania
Patras University
Biology AUTH
Department of Agricultural Economics AUTH

Appendix table 9. Subsidies for honey analysis

Years	honey Analysis
2003	205.429
2004	160.000
2005	210.000
2006	210.000
2007	210.000
2008	210.000
2009	230.000
2010	230.000
2011	138.223
2012	179.946
2013	189.468
2014	200.000
2015	200.000

Sum	2.573.066

Appendix table 10. Subsidies for labs support

Years	Labs Support
1998	0
1999	366.176
2000	411.764
2001	264.705
2002	58.823
2003	0
2004	0
2005	0
2006	0
2007	0
2008	0
2009	0
2010	0
2011	0
2012	10.000
2013	10.000
2014	20.000
2015	20.000
Sum.	1.161.468

Labs supported
Institute of Food Hygiene Athens
Institute of Food Hygiene Thessaloniki
Veterinary Laboratory of Larissa
Veterinary Laboratory of Kozani
Veterinary Laboratory of Kavala
Veterinary Laboratory of Lamia
Veterinary Laboratory of Heraklio
Consortium of Southern Greece
Consortium of Greece
Apicultural Cooperative of Nikiti
Apicultural Cooperative of Chania
Apiculture Institute
Inst.Technol. agricultural Products

Bee Culturing Company Attiki
Haitoglou ABEE
MAICh

Appendix table 11. Subsidies for flora enrichment

Years	flora enrichment
1998-2002	0
2003	264.123
2004	130.000
2005	130.000
2006	130.000
2007	130.000
2008	200.000

2009	204.500
2010	142.154
2011-2015	0
Sum	1.330.777

Appendix table 12. Subsidies for technical support of programs.

Years	Technical support of programs
1998	13.235
1999	29.411
2000	58.823
2001	73.529
2002	88.235
2003	88.041
2004	80.000
2005	50.000
2006	50.000
2007	50.000
2008	80.000
2009	70.000
2010	100.000
Sum	831.274

Appendix table 13. Subsidies for melinet

Years	melinet
1998	0
1999	117.647
2000	176.470
2001	29.412
2002	105.882
2003	29.347
2004	30.000
2005	22.617
2006	30.000
2007	30.000
2008	30.000

2009	20.000
2010	18.700
2011	9.999
2012	9.795
2013	10.000
2014	5.000
2015	5.000
Sum	679.869

Appendix table 14. Subsidies for certification agencies and indigenous grant.

Years	Certification agencies ♀♀	Indigenous grant ♀♀
2004	0	0
2005	60.000	0
2006	60.000	0
2007	60.000	100.000
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	0	0
2013	0	0
2014	0	0
2015	0	0
Sum	180.000	100.000

BUSINESS PLAN

COSTS PER YEAR

Appendix table 15.

1st YEAR	Quantity	Price	Total
Hives	5	47	235
Colonies	5	50	250
Wiring device	1	150	150
Hive tool	1	6	6
Smoker	1	20	20

Bee veil	1	4	4
Bee suit	1	25	25
Bee gloves	1	12	12
Feeders	5	2	10
Bee brush	1	4	4
Wax Foundation	75	1	75
Sugar	100	0,65	65
Beginners seminar	1	150	150
TOTAL (5 HIVES)			1006

Appendix table 16.

2nd YEAR	Quantity	Price	Total
Hives	10	47	470
Colonies	5	50	250
4 frame hand operated extractor	1	550	550
Fork uncaper	1	29	29
Water feeders	1	40	40
Smoker	1	20	20
Hive tool	1	6	6
Bee veil	1	12	12
Bee suit	1	25	25
Bee gloves	1	12	12
Feeders	5	2	10
Uncapping knife	1	100	100
Trailer	1	500	500
Pollen traps	2	7	14
Wax Foundation	225	1	225
Sugar	300	0,65	195
Bee Management seminar	1	150	150
TOTAL (15 HIVES)			2608

Appendix table 17.

3rd YEAR	Quantity	Price	Total
Hives	15	47	678

Hive tool	1	6	6
Feeders	20	2	40
Pollen traps	3	7	21
Branding iron device	1	70	70
Solar wax melter	1	160	160
Mixer 100 kg	1	2500	2500
Sugar grinder	1	1400	1400
Preparation Syrup tank (100 liters)	1	90	90
Transport Syrup tank (20 liters)	1	10	10
Wax Foundation	300	1	300
Small truck	1	9000	9000
Sugar	600	0,65	390
Queen rearing seminar	1	150	150
Bee pest seminar	1	150	150
TOTAL (30 HIVES)			14965

Appendix table 18.

4th YEAR	Quantity	Price	Total
Hives	30	47	1356
Feeders	30	2	60
Pollen traps	5	7	35
Queen excluder	30	1,2	36
Wheel barrel	1	85	85
Uncapping bench	1	260	260
Wax Foundation	600	1	600
Sugar	1200	0,65	780
TOTAL (60 HIVES)			3212

Appendix table 19..

5th YEAR	Quantity	Price	Total
Hives	60	47	2712
Feeders	60	2	120
Stainless Steel tank 500 kg	1	200	200
Heating Room 8 containers	1	770	770
Simple strainer	1	15	15

Honey Extractor 6 frames reversable	1	1500	1500
Queen excluder	30	1	30
Pollen traps	10	7	70
Wax Foundation	1200	1	1200
Sugar	2400	0,65	1560
Warehouse 100 sqm	1	40000	40000
TOTAL (120 HIVES)			48177

Appendix table 20.

6th YEAR	Quantity	Price	Total
Hives	120	47	5424
Feeders	120	2	240
Wax Foundation	2400	1	2400
Queen excluder	60	1	60
Pollen traps	60	7	420
Big Truck	1	9000	9000
Sugar	3600	0,65	2340
TOTAL (240 HIVES)			19884

Appendix table 21.

7th YEAR	Quantity	Price	Total
Hives	9	0	0
Sugar	2400	0,65	1560
TOTAL (240 HIVES)			1560

TABLES OF ANNUAL PRODUCTION COSTS PER YEAR

Appendix table 22.

1st YEAR					
TABLE OF ANNUAL PRODUCTION COSTS IN APICULTURE					
PRODUCTION CREDITS	Production Costs	Variable Costs	Fixed Costs	Obvious Costs	Hidden Costs
1) LAND					
A) Rent (of family land) non paid (land)	0			0	0
B) Rent paid (land)	0	0		0	0
		0			
TOTAL	0	0		0	0
2) LABOR					
A) Wages (of family) non paid	197	0	197	0	197
B) Wages paid	0	0	0	0	0
C) Financial Contribution to Agricultural Insurance Organization	0	0	0	0	0
D) Interest of labor cost	7	0	7	0	7
TOTAL	204	0	204	0	204
3) CAPITAL					
FIXED CAPITAL					
A) Depreciation	63		63	63	0
B) Interest of capital	0		0	0	0
C) Maintenance	85	0	85	0	85
D) Insurance	5	0	5	5	0
E) Interest of Maintenance & insurance	3	0	3	3	0
	0	0	0	0	0
TOTAL		0			
VARIABLE CAPITAL	0	0	155	70	85
A) specific dost (inputs)	315	315	0	315	0
B) Financial Contribution to Greek Agricultural Insurance Organization	0	0	0	0	0
C) third-party services	150	150	0	150	0
D) overheads	50	50	0	50	0
E) Interest of variable capital	19	19	0	0	19
TOTAL	534	534	0	515	19
TOTAL PRODUCTION COST	738	534	359	585	309

Appendix table 23.

2nd YEAR TABLE OF ANNUAL PRODUCTION COSTS IN APICULTURE					
PRODUCTION CREDITS	Production Costs	Variable Costs	Fixed Costs	Obvious Costs	Hidden Costs
1) LAND					
A) Rent (of family land) non paid (land)	0	0	0	0	0
B) Rent paid (land)	0	0	0	0	0
TOTAL	0	0	0	0	0
2) LABOR					
A) Wages (of family) non paid	589,50	0	589,5	0	589,5
B) Wages paid	0	0	0	0	0
C) Financial Contribution to Agricultural Insurance Organization	0	0	0	0	0
D) Interest of labor cost	22	0	22	0	22
TOTAL	612	0	612	0	612
3) CAPITAL					
FIXED CAPITAL					
A) Depreciation	248	0	248	248	0
B) Interest of capital	0	0	337	0	337
C) Maintenance	22	0	22	22	0
D) Insurance	12	0	12	12	0
E) Interest of Maintenance & insurance	1	0		0	1
TOTAL	0	0	1 621	283	338
VARIABLE CAPITAL					
A) specific dost (inputs)	445	445	0	445	0
B) Financial Contribution to Greek Agricultural Insurance Organization	3	3	0	3	0
C) third-party services	150	150	0	150	0
D) overheads	100	100	0	100	0
E) Interest of variable capital	26	26	0	0	26
TOTAL	724	724		698	26
			0		
	1.335	723	1.233	980	976

Appendix table 24.

3rd YEAR					
TABLE OF ANNUAL PRODUCTION COSTS IN APICULTURE					
PRODUCTION CREDITS	Production Costs	Variable Costs	Fixed Costs	Obvious Costs	Hidden Costs
1) LAND					
A) Rent (of family land) non paid (land)	0	0	0	0	0
B) Rent paid (land)	0	0	0	0	0
TOTAL	0	0	0	0	0
2) LABOR					
A) Wages (of family) non paid	1.179	0	1.179	0	1.179
B) Wages paid	0	0	0	0	0
C) Financial Contribution to Agricultural Insurance Organization	0	0	0	0	0
D) Interest of labor cost	44	0	44	0	44
TOTAL	1.223	0	1.223	0	1.223
3) CAPITAL					
FIXED CAPITAL					
A) Depreciation	1.323	0	1.323	1.323	0
B) Interest of capital	1.529	0	1.529	0	1.529
C) Maintenance	152	0	152	152	0
D) Insurance	81	0	81	81	0
E) Interest of Maintenance & insurance	9	0	9		9
			1.554		
TOTAL	3.094	0	3.094	6	1.537
VARIABLE CAPITAL					
A) specific dost (inputs)	390	390	0	390	0
B) Financial Contribution to Greek Agricultural Insurance Organization			0		0

C) third-party services	8	8	0	8	0
D) overheads	300	300	0	300	0
E) Interest of variable capital	100	100	0	100	30
TOTAL	30	30		0	
	828	828	0	798	30
	5.145	828	4.31 7	2.35 4	2.79 1

Appendix table 25.

4th YEAR					
TABLE OF ANNUAL PRODUCTION COSTS IN APICULTURE					
PRODUCTION CREDITS	Production Costs	Variable Costs	Fixed Costs	Obvious Costs	Hidden Costs
1) LAND					
A) Rent (of family land) non paid (land)	0	0	0	0	0
B) Rent paid (land)	0	0	0	0	0
TOTAL	0	0	0	0	0
2) LABOR					
A) Wages (of family) non paid	2.358	0	2.35 8	0	2.35 8
B) Wages paid	0	0	0	0	0
C) Financial Contribution to Agricultural Insurance Organization	0	0	0	0	0
D) Interest of labor cost	88	0	88	0	88
TOTAL	2.446	0	2.44 6	0	2.44 6
3) CAPITAL					
FIXED CAPITAL					
A) Depreciation	1.533	0	1.53 3	1.53 3	0
B) Interest of capital	1.946	0	1.94 6	0	1.94 6
C) Maintenance		0	162 0	162 0	0

D) Insurance	162	0	6	0	0
E) Interest of Maintenance & insurance	0 6	0		1.69	6
TOTAL	3.646	0	3.64 6	4	1.95 2
VARIABLE CAPITAL					
A) specific dost (inputs)	780	780	0	780	0
B) Financial Contribution to Greek Agricultural Insurance Organization	16	16	0	16	0
C) third-party services	0	0	0	0	0
D) overheads	150	150	0	150	0
E) Interest of variable capital	35	35	0	0	35
TOTAL	981	981	0	946	35
	7.074	981	6.09 3	2.64 0	4.43 3

Appendix table 26.

5th YEAR					
TABLE OF ANNUAL PRODUCTION COSTS IN APICULTURE					
PRODUCTION CREDITS	Production Costs	Variable Costs	Fixed Costs	Obvious Costs	Hidden Costs
1) LAND					
A) Rent (of family land) non paid (land)	0	0	0	0	0
B) Rent paid (land)	0	0	0	0	0
TOTAL	0	0	0	0	0
2) LABOR					
A) Wages (of family) non paid	4.716	0	4.716	0	4.716
B) Wages paid	0	0	0	0	0
C) Financial Contribution to Agricultural Insurance Organization	950	0	950	950	0
D) Interest of labor cost	212	0	212	0	212
TOTAL	5.878	0	5.878	950	4.928
3) CAPITAL					

FIXED CAPITAL						
A) Depreciation	2.945	0	2.945	2.945		0
B) Interest of capital	5.960	0	5.960	0		5.960
C) Maintenance	600	0	600	600		0
D) Insurance	318	0	318	318	34	0
E) Interest of Maintenance & insurance						34
TOTAL	9.857	0	34	0 3.863	9.857	5.994
VARIABLE CAPITAL						
A) specific dost (inputs)	1.560	1.560	0	1.560		0
B) Financial Contribution to Greek Agricultural Insurance Organization	32	32	0	32		0
C) third-party services	0	0	0	0		0
D) overheads	200	200	0	200		0
E) Interest of variable capital	66	66	0	0		66
TOTAL	1.859	1.859	0	1.792		66
	17.595	1.859	15.736		6.604	10.989

Appendix table 27.

6th YEAR					
TABLE OF ANNUAL PRODUCTION COSTS IN APICULTURE					
PRODUCTION CREDITS	Production Costs	Variable Costs	Fixed Costs	Obvious Costs	Hidden Costs
1) LAND					
A) Rent (of family land) non paid (land)	0	0	0	0	0
B) Rent paid (land)	0	0	0	0	0
TOTAL	0	0	0	0	0
2) LABOR					
A) Wages (of family) non paid	9.432	0	9.432	0	9.432
B) Wages paid	0	0		0	0
C) Financial Contribution to Agricultural Insurance Organization	950	0	950	950	0
D) Interest of labor cost	389	0	389	0	389

TOTAL	10.771	0	10.771	950		9.821
3) CAPITAL						
FIXED CAPITAL						
A) Depreciation	4.122	0	4.122	4.122		0
B) Interest of capital	8.377	0	8.377	0		8.377
C) Maintenance	736	0	736	736		0
D) Insurance	390	0	390	390		0
E) Interest of Maintenance & insurance	42	0				42
TOTAL	13.668	0	42 13.668	0 5.248		8.419
VARIABLE CAPITAL						
A) specific dost (inputs)	2.340	2.340	0	2.340		0
B) Financial Contribution to Greek Agricultural Insurance Organization	64	64	0	64		0
C) third-party services	0	0	0	0		0
D) overheads	600	600	0	600		0
E) Interest of variable capital	115	115	0	0		115
TOTAL	3.116	3.116	0	3.004		115
	27.555	3.116	24.439		9.202	18.356

Appendix table 28.

7th YEAR					
TABLE OF ANNUAL PRODUCTION COSTS IN APICULTURE					
PRODUCTION CREDITS	Production Costs	Variable Costs	Fixed Costs	Obvious Costs	Hidden Costs
1) LAND					
A) Rent (of family land) non paid (land)	0	0	0	0	0
B) Rent paid (land)	0	0	0	0	0
TOTAL	0	0	0	0	0
2) LABOR					
A) Wages (of family) non paid	9.432	0	9.432	0	9.432
B) Wages paid		0	0 950	0	0

C) Financial Contribution to Agricultural Insurance Organization	0	0	389		950	0
D) Interest of labor cost	950 389	0			0	389
TOTAL	10.771	0	10.771		950	9.821
3) CAPITAL						
FIXED CAPITAL						
A) Depreciation	4.122	0	4.122		4.122	0
B) Interest of capital	8.968	0	8.968	695	0	8.968
C) Maintenance	695	0	368		695	0
D) Insurance	368	0			368	0
E) Interest of Maintenance & insurance	40	0				40
TOTAL	14.193	0	40 14.193	0 5.185		9.008
VARIABLE CAPITAL						
A) specific dost (inputs)	1.560	1.560	0		1.560	0
B) Financial Contribution to Greek Agricultural Insurance Organization	127	127	0		127	0
C) third-party services	0	0	0		0	0
D) overheads	600	600	0		600	0
E) Interest of variable capital	86	86	0		0	86
TOTAL	2.373	2.373	0	2.287		86
	27.337	2.373	24.964		8.422	18.915

DEPRECIATIONS

Appendix table 29.

1st YEAR							
TYPE OF CONSTRUCTION / EQUIPMENT	Recon-struction Price (€)	Residual value (€)	Duration of productive life (years)	Depreciation	Previous years from the construction/ supply	Beg in-ning of Year (€)	End of Year (€)
Feeders, other equipment (1st year)	306	0	6	51	0	306	255,022
Hives (1st year)	235	0	20	11,75	0	235	3,347
TOTAL				62,75		541	8,3

Appendix table 30.

2nd YEAR							
TYPE OF CONSTRUCTION / EQUIPMENT	Recon-struction Price (€)	Residual value (€)	Duration of productive life (years)	Depreciation	Previous years from the construction/ supply	Beg in-ning of Year (€)	End of Year (€)
Feeders, other equipment (2nd year)	493	0	682,2	0		493,0	410,8
Hives (2nd year)	470	0	2023,5	0		470,0	446,5
Framehand operated extractor (2nd year)	550	0	1055,0	0		550,0	495,0
Trailor (2nd year)	500	0	2025,0	0		500,0	475,0
Feeders, other equipment (1st year)	306	0	651,0	1		255,0	204,0
Hives (1st year)	235	0	20	11,8	1	223,3	211,5
TOTAL				248,4		2491,3	2242,8

Appendix table 31.

3rd YEAR							
TYPE OF CONSTRUCTION / EQUIPMENT	Recon-struction Price (€)	Residual value (€)	Duration of productive life (years)	Depreciation	Previous years from the construction/ supply	Begi n-ning of Year (€)	End of Year (€)
Feeders, other equipment (3rd year)	697	0	6	116,2	0	697,0	580,8
Hives (3rd year)	705	0	20	35, 3	0	705,0	669,8
Mixer 100 kg (3rd year)	2500	0	10	250,0	0	2500,0	2250,0
Sugar grinder (3rd year)	1400	0	10	140,0	0	1400,0	1260,0

Small truck (3rd year)	9000	1000	15	533,3	0	9000,0	8466,7
Feeders, other equipment (2nd year)	493	0	6	82, 2	1	410, 8	328, 7
Hives (2nd year)	470	0	20	23, 5	1	446, 5	423, 0
Framehand operated extractor (2nd year)	550	0	10	55, 0	1	495, 0	440, 0
Trailor (2nd year)	500	0	20	25, 0	1	475, 0	450, 0
Feeders, other equipment (1st year)	306	0	6	51, 0	2	204, 0	153, 0
Hives (1st year)	235	0	20	11, 8	2	211, 5	199, 8
TOTAL				1323,2		16544,8	15221,7

Appendix table 32.

4th YEAR							
TYPE OF CONSTRUCTION / EQUIPMENT	Recon-struction Price (€)	Residual value (€)	Duration of productive life (years)	Depreciation	Previous years from the construction/ supply	Begi n-ning of Year (€)	End of Year (€)
Feeders, other equipment (4th year)	731	0	6	121,8	0	731, 0	609, 2

Hives (4th year)	1410	0	20	70,5	0	141 0,0	133 9,5
Wheel barrel (4th year)	85	0	20	4,3	0	85,0	80,8
Uncapping bench (4th year)	260	0	20	13,0	0	260, 0	247, 0
Feeders, other equipment (3rd year)	697	0	6	116,2	1	580, 8	464, 7
Hives (3rd year)	705	0	20	35,3	1	669, 8	634, 5
Mixer 100 kg (3rd year)	2500	0	10	250,0	1	225 0,0	200 0,0
Sugar grinder (3rd year)	1400	0	10	140,0	1	126 0,0	112 0,0
Small truck (3rd year)	9000	1000	15	533,3	1	846 6,7	793 3,3
Feeders, other equipment (2nd year)	493	0	6	82,2	2	328, 7	246, 5
Hives (2nd year)	470	0	20	23,5	2	423, 0	399, 5
Framehand operated extractor (2nd year)	550	0	10	55,0	2	440, 0	385, 0
Trailor	500	0	20	25,0	2	450, 0	425, 0
Feeders, other equipment (1st year)	306	0	6	51,0	3	153, 0	102, 0
Hives (1st year)	235	0	20	11,8	3	199, 8	188, 0
TOTAL				1532,8		177 07,7	161 74,9

Appendix table 33.

5th YEAR

TYPE OF CONSTRUCTION / EQUIPMENT	Recon-struction Price (€)	Residual value (€)	Duration of productive life (years)	Depreciation	Previous years from construction/supply	Begin-ning of Year (€)	End of Year (€)
Feeders, other equipment (5th year)	1635	0	6	272, 50	0	1635,0	1362,5
Hives (5th year)	2820	0	20	141, 00	0	2820,0	2679,0
Heating Room 8 containers (5th year)	770	38,5	15	48,80	0	770,0	721,2
Honey Extractor 6 frames reversible (5th year)	1500	75	15	95,00	0	1500,0	1405,0
Warehouse 100 sqm (5th year)	40000	5000	40	875,00		40000,0	39125,0
Feeders, other equipment (4th year)	731	0	6	121, 80	1	609,2	487,3
Hives (4th year)	1410	0	20	70,50	1	1339,5	1269,0
Wheel barrel (4th year)	85	4,25	20	4,00	1	81,00	76,90
Uncapping bench (4th year)	260	13	20	12,40	1	247,7	235,3
Feeders, other equipm. (3rd year)	697	0	6	116, 20	2	464,7	348,5
Hives (3rd year)	705	0	20	35,30	2	634,5	599,3
Mixer 100 kg (3rd year)	2500	125	10	237,50	2	2025,0	1787,5
Sugar grinder (3rd year)	1400	70	10	133,00	2	1134,0	1001,0
Small truck (3rd year)	9000	1000	15	533,33	2	7933,3	7400,0
Feeders, other equipm. (2nd year)	493	0	6	82,20	3	246,5	164,3
Hives (2nd year)	470	0	20	23,50	3	399,5	376,0
Framehand operated extractor (2nd year)	550	0	10	55,00	3	385,0	330,00
Trailor (2nd year)	500	0	20	25,00	3	425,0	400,0
Feeders, other equipment (1st year)	306	0	6	51,00	4	102,0	51,00
Hives (1st year)	235	0	20	11,80	4	188,0	176,3
TOTAL				2944,65		6293 9,8	5995,1

Appendix table 34.

6th YEAR							
TYPE OF CONSTRUCTION / EQUIPMENT	Recon-struction Price (€)	Residual value (€)	Duration of productive life (years)	Depre-ciation	Previous years from the construction/ supply	Begin-ning of Year (€)	End of Year (€)
Feeders, other equipment (6th year)	3120	0	6	520,0	0	3120,0	2600,0
Hives (6th year)	5640	0	20	282,0	0	5640,0	5358,0
Big Truck (6th year)	9000	1500	20	375,0	0	9000,0	8625,0
Feeders, other equipment (5th year)	1635	0	6	272,5	1	1362,5	1090,0
Hives (5th year)	2820	0	20	141,0	1	2679,0	2538,0
Heating Room 8 containers (5th year)	770	38,5	15	48,8	1	721,2	672,5
Honey Extractor 6 frames revers. (5th year)	1500	75	15	95,0	1	1405,0	1310,0
Warehouse 100 sqm (5th year)	40000	5000	40	875,0	1	39125,0	38250,0
Feeders, other equipment (4th year)	731	0	6	121,8	2	487,3	365,5
Hives (4th year)	1410	0	20	70,5	2	1269,0	1198, 5
Wheel barrel (4th year)	85	4,25	20	4,0	2	76,9	72,9
Uncapping bench (4th year)	260	13	20	12,4	2	235,3	223,0
Feeders, other equipment (3rd year)	697	0	6	116,2	3	348,5	232,3
Hives (3rd year)	705	0	20	35,3	3	599,3	564,0
Mixer 100 kg (3rd year)	2500	125	10	237,5	3	1787,5	1550,0
Sugar grinder (3rd year)	1400	70	10	133,0	3	1001,0	868,0
Small truck (3rd year)	9000	1000	15	533,3	3	7400,0	6866,7
Feeders, other equipment (2nd year)	493	0	6	82,2	4	164,3	82,2
Hives (2nd year)	470	0	20	23,5	4	376,0	352,5
Framehand operated extractor (2nd year)	550	0	10	55,0	4	330,0	275,0
Trailor (2nd year)	500	0	20	25,0	4	400,0	375,0
Feeders, other equipment (1st year)	306	0	6	51,0	5	51,0	0,0

Hives (1st year)	235	0	20	11,8	5	176,3	164,5
TOTAL				4121,7		77755,1	73633,5

Appendix table 35.

7th YEAR							
TYPE OF CONSTRUCTION / EQUIPMENT	Reconstruction Price (€)	Residual value (€)	Duration of productive life (years)	Depreciation	Previous years from the construction/ supply	Begin-ning of Year (€)	End of Year (€)
Feeders, other equipment (6th year)	3120	0	6	520,0	1	2600,0	2080,0
Hives (6th year)	5640	0	20	282,0	1	5358,0	5076,0
Big Truck (6th year)	9000	1500	20	375,0	1	8625,0	8250,0
Feeders, other equipment (5th year)	1635	0	6	272,5	2	1090,0	817,5
Hives (5th year)	2820	0	20	141, 0	2	2538,0	2397,0
Heating Room 8 containers (5th year)	770	38,5	15	48,8	2	672,5	623,7
Honey Extractor 6 frames reversible (5th year)	1500	75	15	95,0	2	1310, 0	1215, 0
Warehouse 100 sqm (5th year)	40000	5000	40	875,0	2	38250,0	37375,0
Feeders, other equipment (4th year)	731	0	6	121, 8	3	365,5	243,7
Hives (4th year)	1410	0	20	70,5	3	1198, 5	1128, 0
Wheel barrel (4th year)	85	4,25	20	4,0	3	72,9	68,9
Uncapping bench (4th year)	260	13	20	12,4	3	223,0	210,6
Feeders, other equipment (3rd year)	697	0	6	116, 2	4	232,3	116,2
Hives (3rd year)	705	0	20	35,3	4	564,0	528,8
Mixer 100 kg (3rd year)	2500	125	10	237,5	4	1550,0	1312,5
Sugar grinder (3rd year)	1400	70	10	133,0	4	868,0	735,0
Small truck (3rd year)	9000	1000	15	533,3	4	6866,7	6333,3
Feeders, other equipment (2nd year)	493	0	6	82,2	5	82,2	0,0
Hives (2nd year)	470	0	20	23,5	5	352,5	329,0
Framehand operated extractor (2nd year)	550	0	10	55,0	5	275,0	220,0
Trailor (2nd year)	500	0	20	25,0	5	375,0	350,0

Feeders, other equipment (1st year)	306	0	6	51,0	6	0,0	-51,0
Hives (1st year)	235	0	20	11,8	6	164,5	152,8
TOTAL				4121,7		7363,5	6951,8

INSTRUCTIONS FOR BEGINNERS

To become a beekeeper, one must meet certain conditions. He must found if he can encounter the basic problems, not to get into adventures and spend meaningless money and answer the following questions:

1. Are you allergic to bee stings?

- If you are not allergic, continue to next steps.
- If you are allergic, stop here and don't engaged in beekeeping.
- If you are allergic, do the sensitivity test at an allergiologist to determine the type of allergy you have and at what level it is. Begin the process of desensitization to be cured. Until the treatment is done, which can last 2-3 years, carry with you injections of cortisone or adrenaline. The most practical is the automatic injection device ANAPEN, a device that releases intramusculary 0,3 ml of injectable adrenaline solution. The use of adrenaline is given by the doctor's guidance.

2. Why do you want to become a beekeeper?

- Enter a program for young farmers and follow the profession of a farmer and one of the occupations to be beekeeping.
- Become an amateur beekeeper and produce your own honey.
- Become a professional beekeeper and have main occupation beekeeping.
- Other reasons

You must like bees and want to become a beekeeper and get more acquainted. You don't enjoy it, don't start it.

3. How to get experience?

- Read beekeeping books and magazines.
- Attend a proper course for beginners. You have to watch and find out who organized the seminar who teaches because there are many "experts" that attract people and charge money more than they should do. • Get in touch with an experienced beekeeper that you can trust and wants to help. Work with him, help on all tasks and familiarity and experience comes quickly.
- Get information from the internet but be very careful. There are valuable sources of useful information such as photographs, instructions, various methods etc. Unfortunately often those information are incorrect or misleading. The more experienced you are, the more easily you can filter such information. It is best to be informed by reliable sites like:

Agricultural University of Athens (Laboratory of Sericulture and Apiculture):
http://efp.aua.gr/el/beelab
Aristotle Univ. of Thessaloniki (Laboratory of Apiculture and Sericulture):
www.beelab.gr
Greek Scientific Society of Apiculture - Sericulture:
www.hssas.gr
Ministry of Rural Development and Food:

www.melinet.gr
Federation of Greek Beekeepers' Association:
www.omse.gr

4. How many colonies will buy?

You will begin with 2-3 or maximum 4 colonies to be able to handle them. It is wrong to start with many colonies. You start with few and you increase them gradually as you become more experienced.

5. Where can you buy colonies?

If you are a beginner take with you a trustworthy person who is an experienced beekeeper in order to protect you from mistakes that may be done. Do not rush to make a decision when the price is attractive.

In Greece colonies are sold with the hives or only the swarm with the frames. In this case the buyer has his own hives and do the transfer of frames and population. When the purchase is made with the hives, we must keep in mind the following:

a) Get information from the local cooperative, association, beekeeping suppliers and read classifieds in beekeeping magazines. b) Get a receipt

It has happened by some insolent, to sell colonies from apiaries which are not theirs. But when there is a legitimate sales receipt, then these crooks can easily be condemned.

c) The condition of the material

Hives and other accessories can be old or new. Have standard dimensions to avoid problems, whenever you want to exchange frames from hive to hive. The price depends on the quality of the material . d) The condition of combs

e) The amount of food (honey and pollen)

f) The number of frames of brood and population

g) The season of purchasing

h) The diseases

i) The queen quality

6. How to select your apiary site?

Choosing the correct location for installing the apiary is the fundamental concern of the beekeeper.

a) Provide good and prolonged honeyflow.

b) The land should be flat, but in cause of rain not to flood.

c) Provide clean water or place water containers.

d) Be away from residential areas, in order not to disturb the neighbors or passers (houses, hotels, shepherds, neighboring apiaries etc.). The distance from main road to be over 25 meters and 30 meters from the last house of a residential area. But if you place 200 colonies at 100 or 200 meters you will definitely annoying. e) Provide proper arrangement of the hives.

f) Provide fencing (if possible) to be protected from various animals or theft.

g) Put numbers and fireseal hives, things that are needed for proper monitoring of each colony and discouraging thieves

7. What will be produced in your apiary?

Besides honey you should produce and other products such as pollen, royal jelly, propolis. The price of these products is much higher than the price of honey and their production is less dependent on weather conditions. Later you can produce divides and queens. This applies to all beekeepers, both new and old.

9. Issue beekeeping booklet and register at the local association or club.

You are obliged to obtain beekeeping booklet when you hold 10 colonies or more. Your registration in the association or the club will give you the opportunity to be informed about everything deals with beekeeping. You can also find information on the nearest Apiculture Center and benefited from it to all services.

10. GOOD LUCK!!

QUEEN REARING

I. GENERAL

Within any colony the queen has a primary role and the performance of the colony is directly related to her quality. Every attempt at rearing queens of excellent quality is well worth the effort and the beekeeper's attempts at this are well rewarded. In order to ensure a healthy and productive colony the queen must be replaced every year or in the worst case every two years. With the correct genetic improvement and through systematic breeding many excellent queens may be produced.

II. WHERE DOES A QUEEN COME FROM?

The size and productivity of a colony depends on the genotype (genetic makeup) of the queen bee. The greater her body weight, the greater the number of her ovaries (Hoopingarner and Farrar, 1959). The difference that is often observed between various queens, in relation to their weight and quality, is due to multiple environmental factors that have an effect upon the breeding stage (Roberts, 1961), during which the characteristics of a productive queen bee are shaped.

Today it is known that the presence of the queen bee in the colony affects the behaviour of the colony, without however directing its activities.

From one fertilised egg it is possible to obtain a queen or a worker. This variation depends on the type of food that will be consumed during the larval stage. Larvae that are to become queen are fed with a lot of royal jelly throughout the larval stage. It is important for the beekeeper to know that during the first 24-36 hours of larval life a queen and a worker cannot be distinguished. The knowledge of this information is the central idea behind the rearing of queen. A good queen can occur if during the first or second day of its life the larva is moved from a worker cell to a queen cell. If this transfer (grafting) is carried out on the third day of hatching then there is no possibility of producing a queen.

In a colony a new queen is produced in the following cases:

1. When the old queen is lost.
2. When the colony is preparing to swarm.
3. When the queen is ill, elderly, not laying eggs properly, wounded or is no longer producing normal quantities of pheromones.

III. FACTORS THAT AFFECT THE QUALITY OF QUEENS A. HEREDITY

The queen's genetic characteristics are passed on to her offspring thus affecting their behaviour and performance. The purpose of every improvement programme is to produce excellent genetic material, superior to that which already exists. This improvement is achieved with the creation of an excellent growth environment for the queens and with an organised system for recording the good characteristics achieved during selection. These

improved queens will be the source of the new queens and drones for each new generation.

B. THE MATERIAL AND SIZE OF THE QUEEN CELL

Bees will not accept just any queen cell for the rearing of queens. It is highly possible that foreign material that does not have the normal shape and differs from that which is natural within the hive will not be accepted by the bees. For this reason every material and tool that is used should be tested before it is widely used.

1. The material of the cells.

Many queen producers prefer to construct cells out of wax because that is what is naturally used within the hive. However bees accept queen cells that are made of other materials, especially those made of plastic.

2. The size of the cells.

The natural queen cells have an internal rim diameter of 8-9 mm and a depth of 8-10 mm. Bees accept artificial queen cells in the size range of natural cells (Morse and Flottum 1990, Laidlaw 1979).

C. THE AGE OF THE GRAFTED LARVA

From the moment of hatching within the queen cell the small larva feeds on a large quantity of royal jelly that is supplied by the nurse bees. The duration of the larval diet is only 6 days (from the 3rd till the 9th) and the growth is very rapid. The nurse bees have a 4 day margin, from the 3rd till the 7th day, to supply the larva with royal jelly because on the 7th day the queen cell will be sealed. This 4 day supply of the queen cells is extremely crucial and the younger the age of the larvae that are grafted into the queen cells the better the larvae will be fed thus producing high quality queens (Woyke, 1971).

D. PROPER NUTRITION

The quantity and quality of food that is consumed by the queen bee is paramount. When the supply of the young larvae with royal jelly is lacking, then all following preparation techniques are useless. According to Haydak (1957) 5 day old workers that consume a lot of pollen have the largest hypopharyngeal glands. The optimal physical state of the worker bees has a direct effect on the good nutrition of the drones and the queen s. On the day of grafting there should be many 5-6 day old and well fed nurse bees within the hive. The cells that are fed under these conditions are large and uniform in size, with a very high surface relief, a sign that they have been fed well (Fig. 1).

Figure 1. Queen cells, uniform in size and with a very high surface relief.

The first days after the queen exits the cell she receives the care of the workers in the mating nuclei until she is reproductively mature. It is very important that the mating nucleus has enough food (honey and pollen) and enough population to enable the workers to regulate its temperature and to adequately feed the queen.

E. THE POPULATION OF THE CELL BUILDER COLONIES AND THE POPULATION OF THE MATING NUCLEI

The strength of the colony has without a doubt an effect on the outcome of the breeding of queens. It is not enough to merely have a good number of worker bees within the hive but it is the ratio of nurse bees and foraging bees that is also important. So with a balanced population there is a large number of nurse bees that will be decisive in the quality of the drones and queens that will be bred (Fig. 2).

For the breeding of a queen a minimum number of bees is required within the mating nucleus. The larger the number of workers the more stable the temperature is able to be maintained within the mating nucleus or the colony especially when the weather conditions are unfavourable (too cold or too hot). For Greek weather conditions the three frame nuclei is the most appropriate because it contains 4.0005.000 bees, enough to breed excellent queens even in harsh conditions.

Figure 2. The strength of a cell builder colony is crucial.

F. ENEMIES AND DISEASES OF BEES

The first prerequisite for the proper care of queen bees is to ensure healthy colonies. Sick colonies are unsuitable for the breeding of queens because their vitality is reduced and because there is the danger of diseases being transmitted to more colonies with the creation of mating nuclei. These diseases and enemies are: Nosema disease, American foul brood, Varroa mite and Tracheal mite. Each disease or enemy weakens the colony in its own way and therefore the production of quality queens cannot be ensured.

G. WEATHER CONDITIONS

The temperature (35"C) and relative humidity (40-60%) are quite stable in the brood chamber, regardless of the constant changes that occur in the atmosphere outside. A strong colony, assisted of course by the beekeeper's appropriate management of it, is in a position to regulate the temperature within the hive without thereby adversely affecting the quality of the queen bees that are produced.

IV.EQUIPMENT A. MATING NUCLEI

Mating nuclei are small colonies containing a small population, some brood and are initially without a queen. One sealed queen cell

is placed in every mating nucleus. The queen that will emerge, once she has mated and has started to lay eggs, is ready to be used to replace an elderly or a defective queen in a colony. Many beekeepers maintain some mating nuclei and thus they have at their disposal fertilised queens ready to be used in any colony that loose its own queen. The mating nuclei are also used for the multiplication of colonies.

Figure 3. Left a three frame nuclei and right a 5 frame mating nucleus.

Mating nuclei vary in shape and size. Their size is determined by their destined purpose. Where it is possible the mating nuclei and all the materials that are used should have the same dimensions with the various components of the beehives (Standard Langstroth) (Fig. 3). The possibility of being able to exchange the frames and other parts of the hive with those of the mating nucleus is essential for the efficient handling of the mating nuclei.

B. PREPARATION AND OPERATION OF THE MATING NUCLEI

One frame with sealed brood and one frame of honey is transferred from a strong colony to a nucleus. Both frames should be accompanied by the bees that cover them. Ideally bees of all ages should be present in the mating nuclei. A third frame is also added with empty drown comb or a wax foundation that the bees will draw upon in preparation for the new eggs that will be laid by the queen.

If there is no honey flow it is absolutely necessary to feed with sugar syrup.

One day after the preparation of the mating nucleus and its transportation to its new position, a sealed queen cell is placed on the brood comb, from which in one or two days a new queen will emerge.

C. FRAMES AND BARS FOR THE PRODUCTION OF QUEEN BEES

In order for the queen cells to be positioned in the center of the brood they are placed on bars that fit onto a standard frame. A standard frame can accommodate up to three bars spaced 5cm from each other. Each bar can accommodate up to 20 cells (Fig. 4).

Figure 4. Standard frame holding three cell bars.

D. QUEEN CELLS

Queen cells may be natural (made out of beeswax) or artificial, as long as their dimensions are correct (diameter 8-9mm and depth 8-10mm).

Figure 5. On the left queen cells made out of beeswax attached onto wooden bases and on the right queen cells made of plastic positioned into the bar.

The queen cells whether they are natural or artificial should not be placed directly onto the bars instead they should be first attached onto wooden bases and then in turn positioned onto the bars with the use of molten beeswax. The wooden bases allow the easy handling of the sealed cells without the fear of causing any damage to its content. There is no such fear when using plastic cells that fit directly into holes on the bar (Fig. 5).

E. THE GRAFTING NEEDLE

The classical method of producing a queen requires the transfer of the larva from a worker cell to an artificial queen cell. This transfer is carried out with a needle called a “grafting needle”. The “grafting needle” is comprised of a metal rod, a few millimeters thick, with its one end slightly wider and arched. The transfer of the larva can also be carried out with a thin paint brush or a tooth pick with a flattened end. Due to the sensitivity of the bee larvae delicate handling is necessary.

F. THE QUEEN EXCLUDER

A queen excluder is used during the production of queens in order to restrict the queen to one chamber of the hive as is the case with starter colonies and finishing colonies.

G. QUEEN CAGES

There are various sizes and shapes of cages for the transportation and introduction of a queen to a new colony. All of the cage designs are based on the same principles. Most are constructed of wood which is advisable, however some are constructed of plastic. The open part of the cage is covered with a wire mesh with openings of 3 mm. Thus a space is created to accommodate the queen accompanied by her attendant workers. Sugar candy is added to the cage to provide food during transportation. The introduction of the fertilised queen to the queenless colony is carried out with the queen cage. There is a wide variety of cages for the queen introductions.

H. THE FEEDERS

For the production of good quality queens a systematic food supply is required during all of the production phases, even when there is honey flow. There is a wide variety of feeders and each beekeeper implements his own system of food supply.

V. THE DRONES

Every virgin queen mates on the average with 8-10 or even more drones. Therefore the supply of reproductively mature drones in the flight range of the queen is of vital importance. The queens and the drones may fly many kilometres away from their colonies in order to mate. If there are no drones in the area, then the queens fly even further away and sometimes are unable to return.

The quality of a queen depends largely on the number and the quality of the drones with which she will mate. A queen that has filled her spermatheca with 5-7 million sperm will lay eggs for a large period of time.

The best method of acquiring a large number of drones is to place a comb with drone cells in the center of the brood nest of a colony that has a selected queen. In order to obtain mature drones roughly 35 days are required from the moment the comb with the drone cells is placed into the hive, that is roughly 24 days for them to emerge from the cells and roughly 10 days for them to mature. The colonies used for the drone production must be strong and in addition it must be supplied with sugar syrup and pollen, unless of course the workers of the colony collect and bring into the beehive a lot of nectar and pollen. From both sides of one frame roughly 3000 drones can emerge, enough for 200 queens (Fig. 6).

Figure 6. Comb with over 3000 drone cells reared in a strong colony.

VI. METHODS FOR PRODUCING QUEEN CELLS

There are many ways to produce both a large and a small number of queen cells. A beekeeper with only a few colonies can obtain the queens required using emergency or swarm queen cells. These methods however are not suitable to produce good quality queens. The main reason why it is not advisable to produce queens from a colony that is naturally preparing to swarm is because the queens that produced with this method will have an even greater tendency to swarm and thus perpetuate an undesirable characteristic within the colonies.

Methods must be implemented for the systematic and organised production of queens with which many good quality cells are produced, while at the same time ensuring that the laying of eggs by the queen in the colony is not interrupted for more than 3-4 days. One such method is the method of grafting.

A. QUEEN CELLS FROM COLONIES THAT ARE PREPARING TO SWARM

When a strong colony prepares to swarm it constructs 30-50 or more queen cells. To prevent the loss of all the queens reared by the colony, many beekeepers remove the queen cells, before the queens emerge, and place them into mating nuclei. Using a sharp knife the mature and sealed queen cell is carefully cut together with a small portion of the comb in order to facilitate its attachment onto the comb of the mating nucleus or queenless colony, without causing any damage to the queen inside the removed cell. It is expected that in about two weeks the queen bee from the repositioned cell will have mated and started to lay eggs.

This is a very simple and easy way for an amateur beekeeper to replace his queens or to create new colonies. However these queens have a tendency to swarm because they have originated from colonies that were preparing to swarm and therefore there is limited potential to produce queens from improved colonies.

B. EMERGENCY QUEEN CELLS

When a colony is queenless it builds emergency queen cells. These cells are usually built in the centre of the comb. The queens that are produced from such emergency queen cells can be of good quality if the colony is strong, if the previous queen is of good genetic stock and if there are good honey flow. However this is often not the case (Fig. 7).

Figure 7. Emergency queen cells for the production of queens, usually of questionable quality.

C. EMERGENCY QUEEN CELLS

When there is an elderly or problematic queen bee in a colony then the bees build queen cells. What is true of the quality of queens produced from emergency cells is also true for the quality of queens produced from emergency queen cells.

D. THE GRAFTING METHOD

Nearly all professional beekeepers use this method of producing queen cells. With this method worker larvae of a young age are transferred with a tool to queen cells that have been artificially constructed. These grafted cells are placed into suitably prepared colony to be properly reared. Sometimes they are left to be reared from beginning to end by one colony, where as other times the initial rearing is carried out in an queenless colony (starter colony) and is completed in a second colony (finisher colony). Out of the two cases the first one will be developed in more detail below because it is simpler and the queens that are produced are equally as good.

1. Grafting

Is the transfer of very young larvae from worker cells (from a colony that has a selected queen) to artificial queen cells. This transfer is carried out with a thin paint brush or with a needle especially constructed for this purpose, so as not to injure the young larvae.

Grafting should be executed in an environment with suitable temperature and humidity. The temperature of such an environment should range from 20 to 34"C and the relative humidity should be at least 60%.

Because the larvae are very small and sensitive, they should be placed into the starter colonies immediately after grafting. If the atmosphere is dry, the grafted cells should be covered with a wet towel.

There are various grafting methods that are used by queen producers. Excellent queens can be produced with all methods as long as they are executed correctly.

a) The method of "dry" grafting is currently implemented by most professional queen producers. The transfer of the small larvae into the artificial queen cells is carried out without the application of additional royal jelly. The small amount of royal jelly already inside the worker cells is enough and an experienced beekeeper can graft many more cells with this method without injuring the larvae.

b) With the method of "wet" grafting a small drop of royal jelly is placed in the bottom of the queen cell before placing the small larva inside. If the royal jelly is thick then it must first be diluted with warm water. Caution is needed during grafting with this method in order to ensure that the larva remains floating on the surface of the royal jelly and does not become submerged. If the larva becomes submerged this will result in drowning. Experiments have been carried out in order to determine whether wet grafting is better than dry grafting. So far there have been no indications that wet grafting presents more advantages in comparison to dry grafting.

2. The starter-finisher colony

During this procedure the process of rearing queen cells is completed in the same colony, namely all stages from the introduction of grafted cells until the removal of mature sealed cells ready to be transferred into the mating nuclei. The procedure is described below:

a) Sugar syrup and pollen supplement are fed to a strong two story colony for roughly 3 days before the removal of the queen. The administration of syrup and pollen supplement is of vital importance, especially when there is not a satisfactory honey flow (Fig. 8).

b) The queen is removed and placed into an empty nucleus with two frames with unsealed brood and worker bees, thus creating a small colony.

c) All the frames that have unsealed brood including eggs are removed.

d) The bees are restricted to the first floor of the colony with 9 frames in total. Nine frames are preferred to ten so that the bees have more free space for movement and also so that fewer bees are killed during the various handling stages.

Figure 8. The administration of pollen supplement is very important for successful queen rearing.

e) One frame with unsealed brood is placed in the centre of the beehive and is removed the following day, putting in its place the frame with the grafted artificial queen cells, which are immediately attended to by the nurse bees.

f) The order with which the frames should be placed within the hive is shown in table 1.

Table 1. The frame layout of the hive into which the grafted cells will be positioned.

1	FEEDER
2	SEALED BROOD
3	SEALED BROOD
4	POLLEN AND HONEY
5	GRAFTED QUEEN CELLS
6	SEALED BROOD
7	SEALED BROOD
8	SEALED BROOD
9	HONEY

g) Sugar syrup 1:1 is administered (i.e. for 2 kilos of syrup, 1 kilo of water and 1 kilo of sugar). If needed pollen supplement is also added.

h) The next day and before the grafting, all frames are inspected and all the queen cells that have been constructed are destroyed. If even one queen cell remains then none of the cells that have been grafted will be accepted.

i) Roughly 50-60 queen cells are grafted with one day old worker larvae, one day after the creation of the starter-finisher colony.

j) The feeder is refilled with syrup.

k) One day after grafting inspection is carried out to establish the success of the grafted cells. If grafting has failed then steps h to j are repeated. If grafting has been successful the feeder is refilled with syrup and the hive is closed.

l) Six days after grafting, all frames are inspected and all natural queen cells constructed by the bees are destroyed.

m) Nine days after grafting the mating nuclei are made.

n) Ten days after grafting, the sealed and mature queen cells are transferred into the mating nuclei that have been prepared from the previous day.

o) Immediately after the removal of the queen cells, the starter-finisher colony is partitioned into 3 to 4 nuclei and one queen cell is added to each one. However, one more grafting can be carried out if 2-3 frames with mature and sealed worker cells are added from another colony.

p) Three days after transferring the queen cell into the mating nucleus, very careful inspection is carried out with very little or no smoke to check if the queen has emerged from the cell. No other action is taken.

q) Twelve to fifteen days after transferring the queen cell to the mating nucleus inspection is carried out to establish if the queen is laying eggs. From this point on the queen is available to the beekeeper for any use.

r) Caution is taken to never shake frames with queen cells (whether they are sealed or with young larvae). To remove the bees a bee brush is used.

E. OTHER METHODS OF REARING QUEEN CELLS

There are other methods that have on occasion been used to produce queen cells such as methods Miller, Alley, Farrar-Harp, Hopkins and the method of the cut worker cells "Barbeau" (Harizanis, 1996).

VII. QUEEN INTRODUCTION

The introduction of a new queen into a queenless colony or into a colony that has an elderly queen is a basic procedure that every beekeeper should be in a position to carry out correctly. It is dishartening to lose a good queen during her introduction to the colony, especially after a lot of energy and time has been spent on rearing her. Colonies do not accept foreign queens. As soon as a queen finds herself in a new colony many bees, especially the elderly ones, gather around her and form a "ball". They "ball" her, as beekeepers tend to say, and they start to pull on her wings and feet and she usually dies of suffocation. This hostility displayed by the bees is sometimes more or slightly less intense. Their behaviour is dependented on many factors that are mentioned below:

A. FACTORS AFFECTING THE SUCCESS OF THE INTRODUCTION OF A NEW QUEEN INTO A COLONY

1. Queenlessness

There are two types of queenlessness:

a. A queenless colony that has lost its queen either by chance or because she was removed by the beekeeper himself.

b. A queenless colony that has been without a queen for a long time. There is even a possibility of finding egg laying workers, in which case the colony should be united with another colony.

2. The honey flow

When there is a good honey flow nearly every method of queen introduction is successful.

3. The physiological condition of the worker bees The worker bees need to be "receptive" during the introduction of the new queen just like the nurse bees. 4. The condition of the queen bee

The queen is subject to various changes in her physiology and her behaviour and her introduction is easiest when she and the workers are "synchronised".

B. THE IDEAL CONDITIONS FOR QUEEN INTRODUCTION

In order for a bee colony to accept a new queen the following conditions must coincide:

1. The colony must be queenless.
2. The colony must not have queen cells.
3. There must be even a minimum honey flow. If there is not, the colony must be provided with sugar syrup in order to replace the honey flow. When feeding a colony with syrup great care must be taken to avoid "robbing". External feeders, especially ones that leak should be avoided.
4. The colony should have a small population. The smaller the population the easier the colony accepts a new queen.
5. There must be a high percentage of young worker bees within the colony. Young workers and especially those that have just emerged, accept the queen easier than the elderly workers and some methods of introducing new queens into colonies are based on this detail.

A beekeeper should not wait for all the above favourable factors to coincide but instead must try to create the ideal conditions replacing if necessary those favourable factors that are absent.

C. SEASON AND FREQUENCY OF QUEEN BEE REPLACEMENT

A faulty queen bee should be replaced whatever the season even if she is of a young age. The same is true when a queen bee is lost. The replacement of a queen bee should be carried out as quickly as possible in order to avoid the weakening of the colony, that if left will become non-productive.

Ideally queen bees should be replaced every year. In this way a beekeeper will maintain strong colonies that are more productive. In any case, a queen bee should not be left in a beehive for more than two years.

D. METHODS OF INTRODUCTION

1. With the use of queen introduction cage

The colony is dequeened 2 to 24 hours before the introduction of the new queen. The attendant bees are removed from the small cage. The cage is positioned horizontally or vertically in between the brood frames, taking care that the side of the cage with the wire mesh is free and not covered (blocked) with the comb or the wood of the frame. The worker bees start to eat the sugar candy. It will take them one day or more to eat all the sugar candy. During this time the queen will have developed the same smell as the rest of the colony and will therefore become accepted. A week later the colony is inspected in order to check if the queen is laying eggs. If the queen

is still in the small cage she is released. 2. With the use of push-in wire mesh cage

This is the best method used so far for the introduction of a queen into a colony. The cage is constructed out of a wire mesh with openings 3 mm in diameter. The cage is square with all sides at least 8 cm in length. The wire mesh folds over all four sides at a 90" angle with a depth of about 2 cm. The wire mesh cage is open on one side and once the queen has been placed inside, alone, it is pushed into the comb. The comb onto which the cage is attached should be free of bees, should have empty cells, brood that is ready to emerge and with a few unsealed honey cells. As an improvement to the cage a short tube, about 3cm in length, that has been filled with sugar candy can be added. The bees consume the sugar candy in about two days maximum thus gaining access to the cage via the tube, and at the same time setting free the queen bee (Fig. 9).

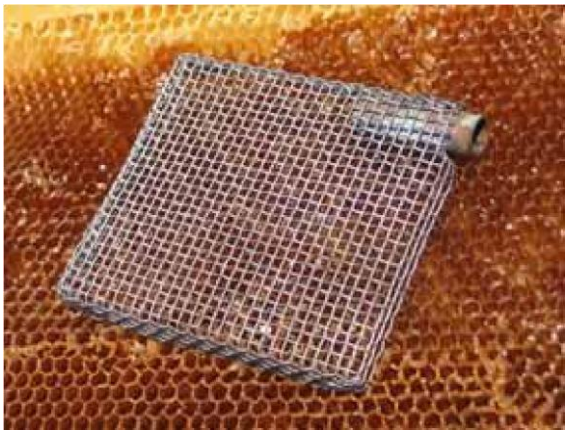

Figure9. Push-in wire mesh cage on comb.

4. Mating nucleus method

This is a very efficient and safe method with which to introduce a queen into a colony. The previous queen is removed from the colony at least one day in advance. On top of the queenless colony the beekeeper places a newspaper sheet and an empty hive body. Following this, the frames together with the new queen are taken out of the mating nucleus and placed into the hive body that has been added on top of the hive.

It is important to place the frames and the new queen from the mating nucleus on the top level because in this way the workers of the initial colony do not obliged to go through the frames where the new queen is located. Few holes with a small nail are made to the newspaper sheet that has been added in between the two hive bodies to facilitate the ventilation of the upper hive body. In about 24 hours the bees of both suppers will have chewed their way through the newspaper sheet thus unifying peacefully. The bees from the mating nucleus stay with the new queen and protect her.

E. OTHER METHODS OF INTRODUCTION

4. The swarm method
5. The frame-case method
6. The ventilation screen method
7. The honey method

8. The perfume method
9. The smoking method

VIII. QUEEN MARKING

Very often queens are marked for experimental purposes, however, many beekeepers also find marking to be very useful. There are two main advantages of marking, the first is the much easier identification of the queen bee within the hive and the second is the more confident monitoring of the queen's age.

The main method of marking queens is with the use of non-toxic quick drying paint. A very simple method is the use of type writer correction fluid. The queen bee is gently held from the thorax with one hand and the colour is carefully applied to her thorax using the other hand (Fig. 10). Usually the colour will remain on her thorax for the duration of her life. Sometimes however even the best colour may wear off.

There is an international code of colours that is used for marking that includes the following five colours:
Blue for the years ending in 0 or 5.
White for the years ending in 1 or 6.
Yellow for the years ending in 2 or 7.
Red for the years ending in 3 or 8.
Green for the years ending in 4 or 9.

Figure 10. Placing the colour on the thorax of a fertilised queen.

IX. THE QUEEN BANK

Colonies that are used to store caged fertilized queens are called queen banks. Many beekeepers that produce queens often raise more queens than they can sell. These queens that left over are temporarily stored in these colonies to be made available to sell at a later date. The queens are stored in cages without attendant workers or sugar candy and are all arranged onto special frames. One queen bank can maintain 10 or 100 or more queens. These banks are very strong colonies without a queen, usually comprised of one brood chamber and have free space for the placement of the frames that hold the cages with the queens. The queens may be successfully maintained in these colonies for many weeks or even a few months,

provided that every 5 or 6 days new worker bees are be added. This is achieved by providing the colonies with frames of brood that is ready to emerge.

The end frames of the banks have honey and pollen. There is also a feeder inside with which to provide sugar syrup, which must never be left empty.

X. SOME ADVICE FOR THE BEEKEEPER

In Greece there are many beekeepers that buy new queens to replace the old ones every year. The purchase of queens is a large investment for every beekeeper and therefore similarly high results are expected. For this reason the queens offered by the beekeeper that has reared them should be:

A. Young
B. From good genetic material
C. Healthy
D. Properly fertilised
E. Packaged and sent carefully, and finally
F. Should reach their destination on time

XI. GENERAL PRINCIPLES AND CONCLUTIONS

A. The development of the colony depends on the quality of the queen.
B. Only healthy colonies should be used for queen breeding.
C. Food (nectar and pollen) is extremely necessary during queen breeding.
D. Colonies with new queens have a smaller tendency to swarm.
E. Sealed queen cells should be 25-29 mm in length. If they are longer, then very often they are diseased or they contain larvae that are dead. Also the cells must have a high relief surface and the imprinted hexagons must be clear. This is a characteristic of the proper development of the queen cells.
F. The drifting of worker bees and of the queen between the mating nuclei can be prevented if the nuclei are positioned in an irregular layout and if they are painted with different colours. As a consequence of drifting, queens are lost, workers are distributed irregularly within the nuclei and diseases are transmitted.
G. Small mating nuclei must be protected (with adequate shading, insulation etc.), in order to avoid really high temperatures during the day and low temperatures at night, that if occur could result in the loss of the brood, leaving the mating nuclei vulnerable to diseases (mainly chalk brood disease). Problems with over heating or chilling of the brood do not occur in mating nuclei with large populations because the population is able to regulate the temperature.
H. The wire mesh of the introduction cages must have openings of 3 mm in diameter. Queen bees are never transported in plastic bags.
I. New queen bees (fertilised or virgins) are more easily accepted in partitions that have only just been created. Later on, the introduction is possible once all the queen cells that have been built in the meantime have been destroyed.

J. It is very difficult to introduce a virgin queen bee into a queenless colony.

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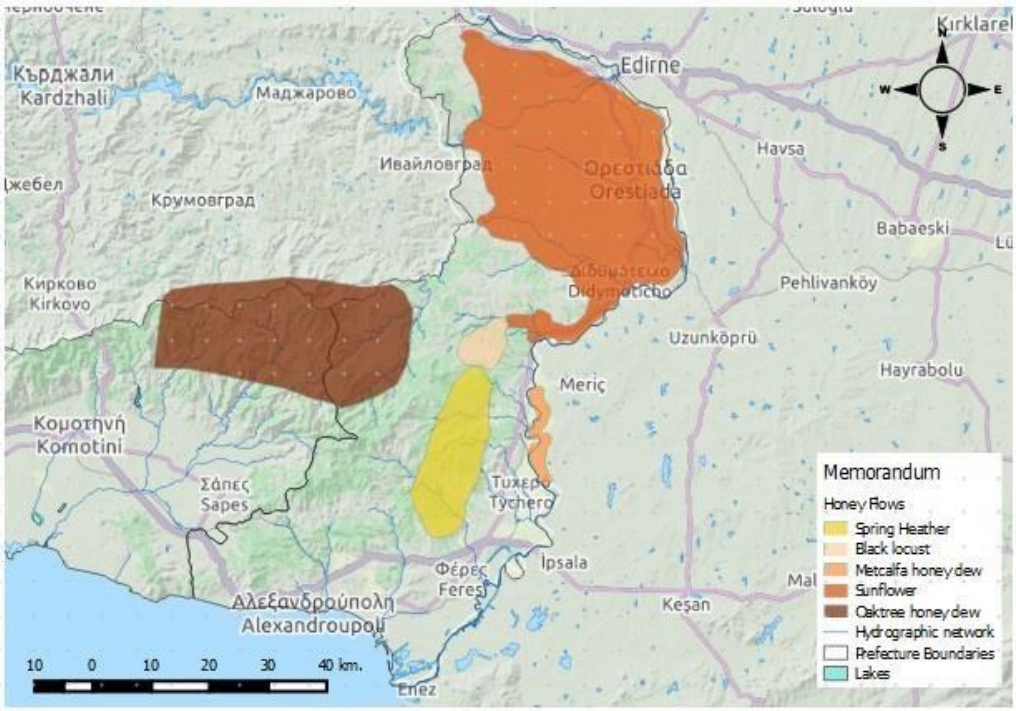
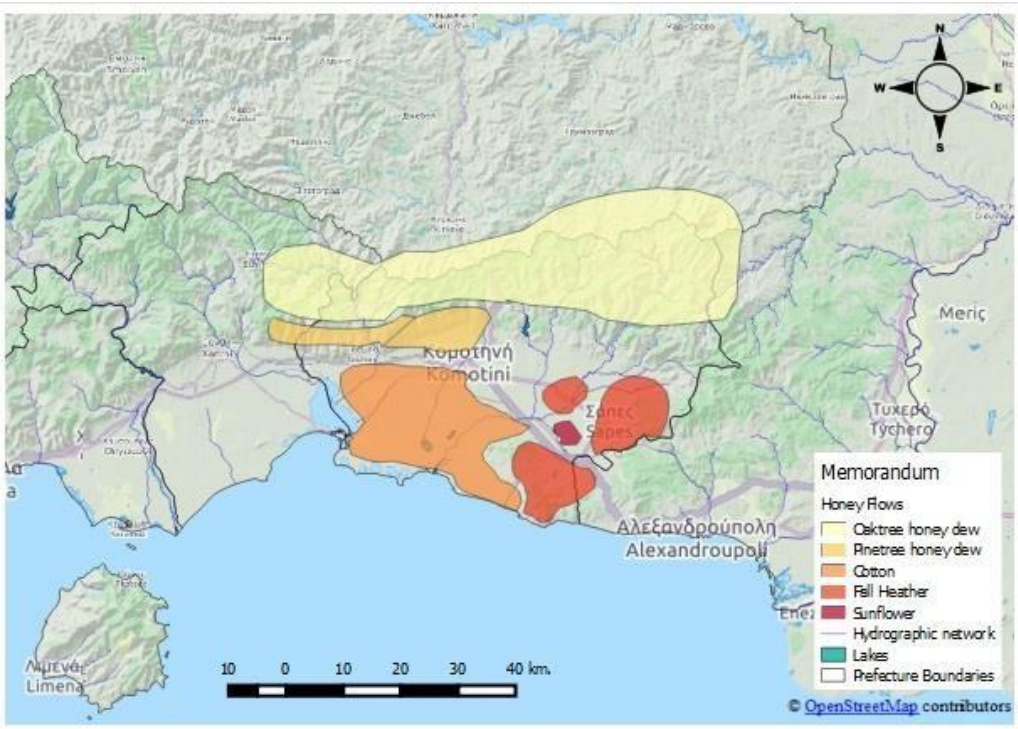
MAPS WITH MAIN HONEY FLOWS

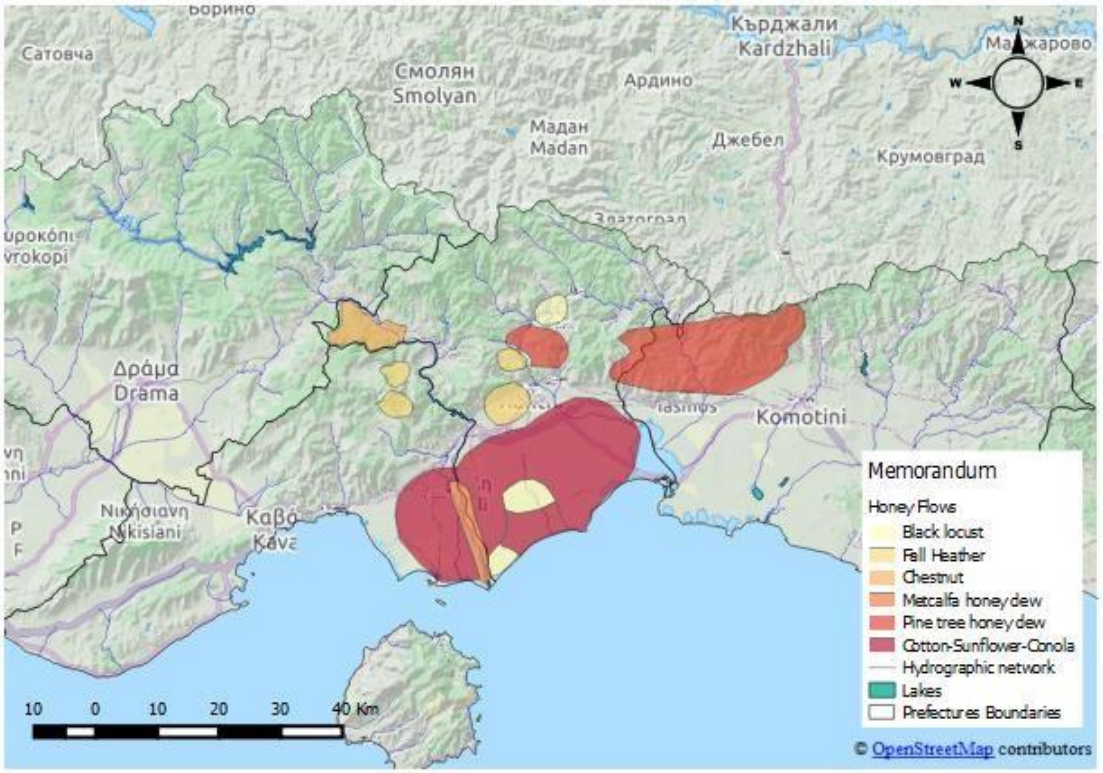
Geographical Information System is a very modern and effective tool for recording the earth surface and can be very useful for detailed mapping of the honey plants and for the examination of the seasonal changes over time. These maps can be very useful to beekeepers as they can provide information about the honey flows of various areas over Greece. To make this possible satellite and outdoor data must be used.



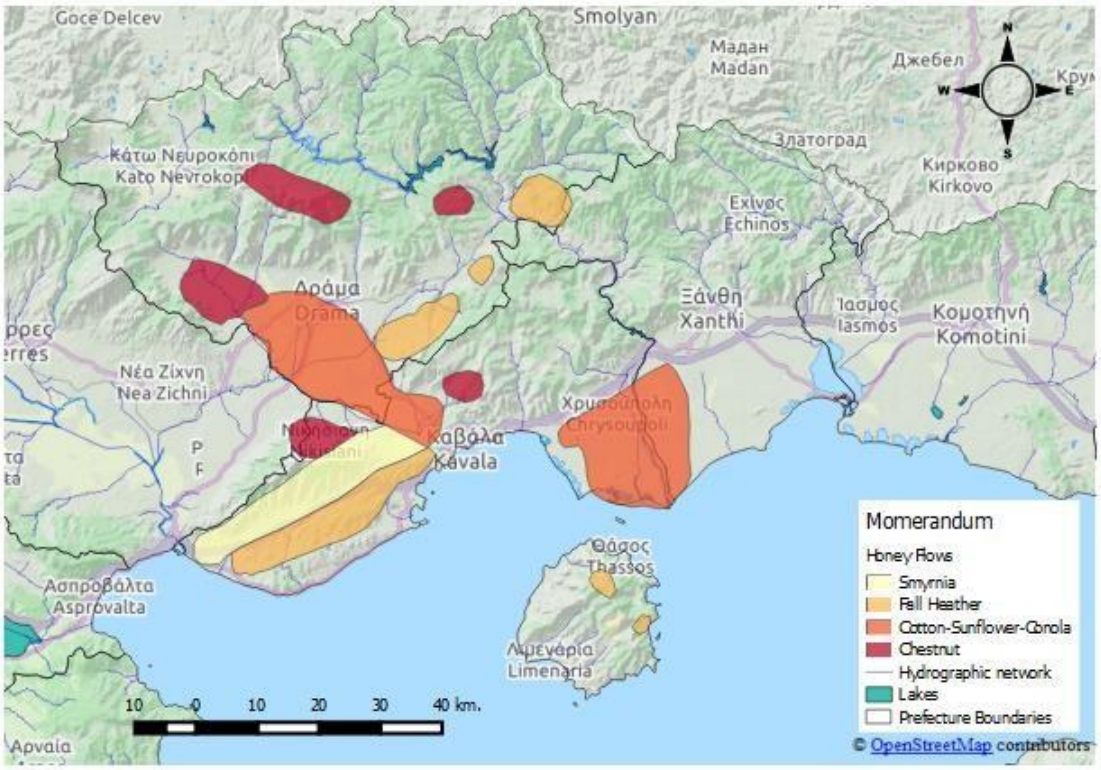
Map 1. The main honey flows of the Prefecture of Evros, Greece.



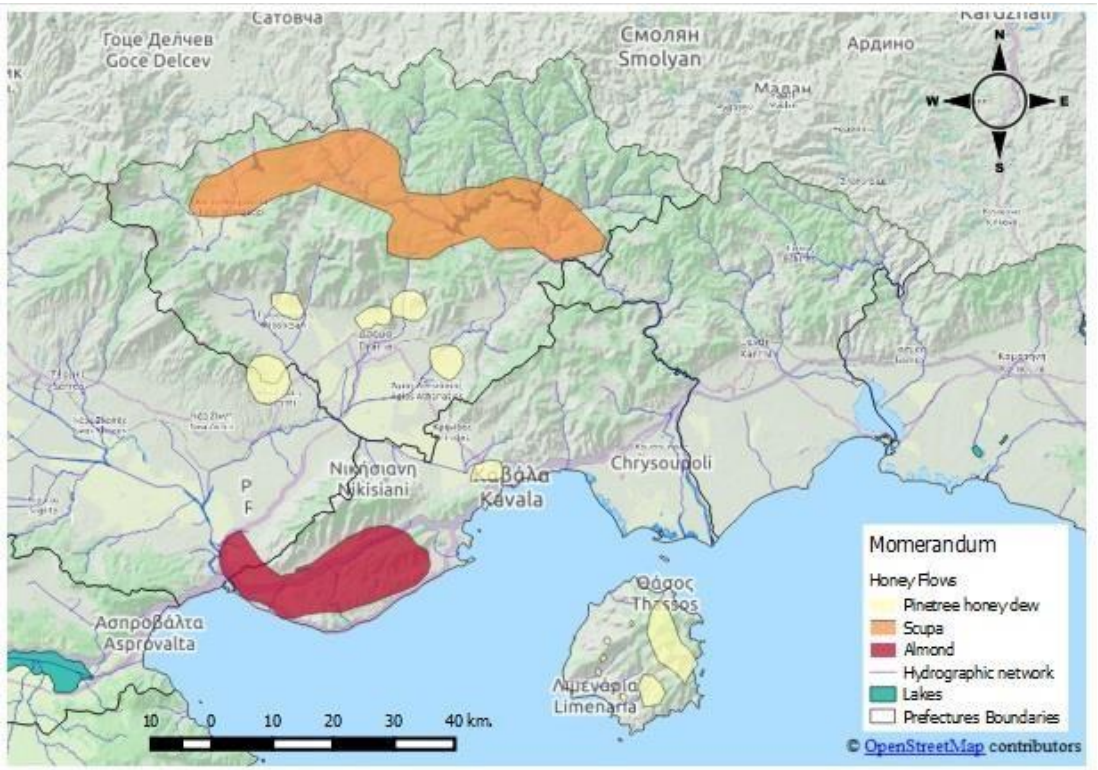
Map 2. The main honey flows of the Prefecture of Rodopi, Greece.



Map 3. The main honey flows of the Prefecture of Xanthi, Greece.



Map 4. The main honey flows of the Prefecture of Kavala and Drama, Greece.



Map 5. The main honey flows of the Prefecture of Kavala and Drama, Greece.

THE MAIN HONEY FLOWS OF THRACE

Appendix table 36

Latin name	English name	Nectar (N) Pollen (P) Honey dew (H)	Greek name
Arbutus andrachne L.	arbutus (spring)	*N,P*	γλυστροκουμαριά
Arbutus unedo L.	arbutus (fall)	*N,P*	κουμαριά
Asphodelus ramosus L.	asphodel	*N,P*	ασφόδελος
Calendula arvensis L.	daisy	*N,P*	καλέντουλα
Calicotome villosa (Poiret) Link	spiny broom	*N,P*	ασπάλαθος
Castanea sativa Miller	chestnut	*N,P*	καστανιά
Centaurea solstitialis L.	yellow star thistle	*N,P*	κενταύρια
Cercis siliquastrum L.	judas tree	*N*	κουτσουπιά
Cichorium intybus L.	chicory	*N,P*	κιχώριο
Cirsium arvense (L.) Scop.	canada thistle,	*N,P*	κίρσιο (παλαμίδα)
Cistus creticus L.	pink cistus,	*N,P*	λαδανιά

Corylus avellana L.	hazelnut	*P*	φουντουκιά
Cydonia oblonga Miller	quince	*N,P*	κυδωνιά
Dittrichia viscosa (L.) Greuter	false yellowhead	*N,P*	ακονιζιά
Erica arborea L.	spring heather	*N,P*	ρείκι ανοιξάτικο
Erica manipuliflora Salisb	fall heather	*N,P*	ρείκι φθινοπωρινό
Eriobotrya japonica(Thunb.) Lindl.	Japanese loquat	*N,P*	μουσμουλιά
Foeniculum vulgare Miller	common fennel	*N*	μάραθος
Fragaria vesca L.	strawberry	*N,P*	φραουλιά
Genista parnassica Halacsy	broom	*N,P*	αφάνα Παρνασσού
Gossypium hirsutum L.	cotton	*N,P*	βαμβάκι
Hedera helix L.	ivy,	*N,P*	κισσός
Helianthus annuus L.	sunflower	*N,P*	ηλίανθος
Heliotropium europaeum L.	heliotrope	*N*	ηλιοτρόπιο
Juglans regia L.	walnut	*N,P*	καρυδιά
Laurus nobilis L.	laurel sweet bay	*N,P*	δάφνη, βάγια
Malus domestica Borkh	apple	*N,P*	μηλιά
Malva sylvestris L.	common mallow	*N,P*	αγριομολόχα
Matricaria chamomilla L.	camomile		χαμομήλι
Medicago sativa L.	alfalfa, lucern	*N,P*	μηδική
Melilotus officinalis (L.) Pallas	yellow sweet clover	*N,P*	μελίτωτος ο φαρμακ.
Melilotus albus Medicus	white sweet clover	*N,P*	μελίτωτος ο λευκόσ
Paliurus spina-christi Miller	jerusalem thorn	*N,P*	παλιούρι
Papaver rhoeas L.	corn poppy	*P*	παπαρούνα
Pinus brutia Ten.	calabrian pine	*H*	πεύκη η τραχεία
Pinus halepensis Miller	Jurusalem pine	*H*	πεύκη η χαλέπιος
Pistacia lentiscus L.	mastich tree	*P*	σχίνος
Pistacia vera L.	Pistachio-nut tree	*P*	φιστικιά
Polygonum aviculare L.	knotgrass	*N,P*	πολυκόμπι

Prunus dulcis (Mill.) D.A.Webb	almond	*N,P*	αμυγδαλιά
Prunus armeniaca L.	apricot	*N,P*	βερυκοκιά
Prunus avium L.	sweet cherry	*N,P*	κερασιά
Prunus cerasus L.	sour cherry	*N,P*	βυσσινιά
Prunus domestica L. susp. *domestica*	plum	*N,P*	δαμασκηνιά
Prunus persica (L.) Batsch	peach	*N,P*	ροδακινιά
Quercus spp.	oak	*N,H*	βαλανιδιά, δρυς
Robinia pseudoacacia L.	black locust	*N,P*	ακακία
Salix spp.	willow	*N,P*	ιτιά
Sinapis alba L.	white mustard	*N,P*	σινάπι, βρούβα
Sinapis arvensis L.	wild mustard	*N,P*	σινάπι, βρούβα
Tilia spp.	basswood	*N,P*	φλαμουριά
Trifolium spp.	clovers	*N,P*	τριφύλλια
Vicia sativa L.	vetch	*N,P*	βίκος
Vitex agnus-castus L.	chaste-tree	*N,P*	λυγαριά
Zea mays L.	corn or maize	*H,P*	καλαμπόκι

STORES OF BEEKEEPING EQUIPMENT AND SUPPLIES

STORES OF BEEKEEPING EQUIPMENT AND SUPPLIES					
A/A	COMPANY	PRODUCT	ADDRESS	PHONE	SITE - E-MAIL
1	ANEL-E.E.PANTELAKIS & Co LP	Beekeeping supplies, equipment and machinery	45th num.6, 13341 Industrial Area Ano Liosia Attiki	2102771180 2102771101 2102483870	www.anel.gr info@anel.gr
2	S.K.EVAGELOPOULOS & Co MELISSOKINISI	Beekeeping supplies and products	2nd km Sofadon - Karditsas highway 43300, Sofades Karditsa	24430-24110 2810542120	www.evag.gr eva@kar.forthnet.gr
3	DELTA MELISSOKOMIKI (DIMITRIS GLAVAS)	Production of bee products	Vlacheika, Gomosto Achaias	2693081779 6944511577	dmelissokomiki@yahoo.gr
4	PATRAIKI MELISSOKOMIA GLAVAS	Beekeeping supplies and equipment	Akrotiriou 264, Patra	2610523776 6947027833 6944299710	www.glavasg.gr glavasg@otenet.gr

5	LEPIDAS GIANNIS	Queens and package bees	Nea Manolada Ilias, 27052	2623071900 6977249090	jlepidas@yahoo.com
6	KIRKA EVAGELIA	Beekeeping supplies and equipment	Olimpionikon 69 & Vitinis 15354 Glika Nera	2106610771 2109750198	www.kyrka.gr info@kyrka.gr
7	MELISSOKOMIA A. AMAXAS	Queens and package bees	Nea Manolada Ilias, 27052	2623072848 6977656285	antonis.a100@yahoo.gr
8	BROS GRITZALI LP	Beekeeping supplies and products	Leontari Arkadias 27910-61111	210-5551492 2102518177	arkmel@otenet.gr
9	ARISTEAS (KARAKASIS NEKTARIOS)	Supplies and tools	Methoni ,N. Pierias 60066	23530-51098	
10	MELISSOPOLIS	Beekeeping supplies and equipment	25th km Marathonos Anevue, 19009 Rafina	22940-33611 6945453168	www.melissopolis.com melissopolis@gmail.com
11	PERRIS ANASTASIOS	Hive construction	Platonos 19, 19100 Megara Attikis	22960-21523 22960-21090	aperris@yahoo.gr
				6972-776887	
12	KENTRO ELLINIKIS MELISSOKOMIAS (P. KAVOURAS & Co GP)	Beekeeping supplies and equipment	Kanari 23 & Meandrou 10 Nea Chalkidona, Athens	2102513775 2102520910	beekeep@otenet.gr
13	TENEKEDOUPOLI (SAVAS FIL. GEORGIADIS)	Tin containers	Sofokleous 37 & Sokratous, Athens	2103212193 2106011962 6944638256	www.tenekedoupoli.gr tnkdpl@otenet.gr
14	PANETAS KOSTAS	Bee products	Anthotopos Artas	26810-98088 6945992310	

15	MELISSOKOMIKI ARTAS (TSIOUNIS APOSTOLOS)	Bee products	Petra Artas, 47048	26810-67118 6944253602	melissokomianet.gr
16	PAILAS THEODOROS	Hive construction	Anilio Metsovou	26560-41879	
17	BEE SMART (TH. PATSIS - S. GASPARATOU GP)	Beekeeping supplies and equipment	Odissea Eliti 65, 26332 Patra	2610332000 6943969868	www.bee-smart.gr info@beesmart.gr
18	THEODOROU GIORGOS	Hive construction	1st km Farsalon - Lamias	24910-22624	
19	KARACHALIOS GIORGOS	Labels	Third Septemvriou 19a, Athens	210-5241363	sticker@acsmi.gr
20	FONDABEE	Bee feed	Dramas 2, 15354 Glika Nera	2106000135 2106000223	
21	MELISSOTECHNIKI (K. CH. KAPENIS)	Wax foundation and supplies	7th km Chalkidas - Kimis highway, Vasiliko Evoia	22210-51684 6978559235	melissotechnikikostas@gmail.com
22	MELISSOKOMIKI RODOPIS	Supplies and tools	Vas. Pavlou 9, 69100 Komotini	2531082070 6977958753	www.melissokomikirodopis.eu info@melissokomikirodopis.eu
23	SOUANI VASILIKI	Supplies and tools	Mpakatselou 10, 54631 Thessaloniki	2310-230025	www.melissokomika-souani.gr info@melissokomika-souani.gr
24	GEORGAKIS	Machinery	2nd km Kalivion - Anavissou	22990-48270	www.georgakisinox.com viagrebeekeeping@gmail.com
25	PAPAIOANNOU VASILIOS	Hive construction	4th km Trikalon - Larisis	24310-76055 24310-76054	www.kypseles.gr info@kypseles.gr
26	KIPSELI O PROTOS	Hive construction	Anilio Metsovou	2656041796 6979002174	www.kipselioprotos.com info@kipselioprotos.com
27	CHOUCHOUTAS GIORGOS	Wax foundation	Nikiti Chalkidikis	2375022219 6947370980	chougeo@otenet.gr

28	I MELISSOULA (KALANTZIS VAGELIS)	Bee products	Platikampos Larisas	6977407745 2410972128	www.melissula.gr info@melissula.gr
29	KOSTAMENAS V.-AGELIS M.	Hive construction	Industrial Area Ioanninon, 45500	2651003119 6947402200	www.kipselotexniki.gr kipselotexniki@hotmail.com
30	PANTELIS & PARASKEVI AGELI	Hive construction	Anilio Metsovou	26560-42025 26560-42175 6974825025	
31	CHRISIKOU (ACHIROPOULOU MARIA	Hive construction	7th km Larisas - Nikeas	2410921546 2410618120 6932005213	axyropoylos@ya hoo.gr
32	EUROPA (BALTZOIS MIXALIS)	Hive construction	Anilio Metsovou	2656041182 6976656584	mixbaltzois@mycosmos.gr
33	I AGRIA MELISSA	Supplies and queens	40th km Lamias - Karpenisiou highway	2236071257 6973538798 6974143384	www.agriamelissa.gr agriamelissa@ya hoo.gr
34	MELISSOKOMIKI BARKAS	Supplies and tools		2642024101 6946509553	www.melissokomikimparkas.gr info@melissoko miki-mparkas.gr
35	CHITAS DIMITRIOS	Hive construction	Anilio Metsovou	2656041062 6939895061 6972145596	
36	SIAFAKAS THOMAS	Hive construction	3rd km Karditsas - Tevropou highway	2441073109 6945554999	
37	MELISSOKOMIKI VORIOU ELLADAS	Beekeeping supplies and products	13th km Kavalas - Xanthis	2510317164 6937 553 306	www.melisokomiki.eu info@melisokomiki.eu
38	IPIROTIKI MELLISOKOMIA (STAMOULIS VASILIS)	Bee products	Ano Petra Artas	2681067195 6974704988	petrosdikas@gmail.com

39	TSOUKALA	Hive construction	Kefalovriso - Karpenisi	2237024747 6973734750	xilotektsoukalas@jmc.gr
40	GIONIS VASILIS	Supplies and tools	Zaxaro	6932-103746	vrd6470gsg@windowslive.com
41	MELISSOEFODIA (ATHANASIADIS NIKOLAOS)	Supplies and tools	Ag. Paraskevis 37, 60100 Katerini	2351073202 6976992188	info@melissoefo dia.gr
42	METALODOMIKI DASKALAKIS	Machinery	Industrial Area Souda, Chania	2821023566 6944543023	
43	MELISSOKOMIKI THESSALONIKIS	Beekeeping supplies and products	Lekka 3, Oreokastro, 57013 PO Box 2016 Thessaloniki	2310-689047	melissokomiki@gmail.com
44	MELISSOKOMIKI KEFALONIAS	Beekeeping supplies and products	Soullari, Lixouri	2671092246 6985752676	vasilisar2@hotmail.com
45	IKOTECHNIA MELINO	Production of bee products	Ethnikis Antistaseos 15, Eleutheroupoli, 64100 Kavala	2592024340 6944554912	melino@melino.gr
46	MAKEDONIKI MELISSOKOMIA AXIOU	Queens and package bees	Kimina, Thessaloniki	2391042850 6978560000	www.meliaxiou.gr meliaxiou@otenet.gr
47	APITEC EVAGELOPOULOS SA	Beekeeping supplies and equipment	1st km Sofiadon 43300 Karditsa	24430-22277 24430-24266	www.apitec.gr info@apitec.gr
48	APIFONDIA	Bee feed	5th km Alexandrias - Korifis	23330-26400	www.mzountsa.gr info@mzountsa.gr
49	PAPPAS FILIPPOS	Supplies and tools	Mesimeri, Thessaloniki	2392091575 6987621000	filippos_pappas@yahoo.gr
50	LYMPEROPOULOS NIKOS	Queens and package bees	Konstantinoupoleos 5, 23100 Sparti	2731082309 6944813083	
51	TECHNOSETBEE (GEROGIANNIS ARISTOS)	Hive construction	Thesi Pilicho, 19300 Aspropirgos	210-5593914	www.technosetbee.gr info@technosetbee.gr

52	LAMPROU GIORGOS	Pest control	Klisthenous 7, 10552 Athens	6932936693	glamprou61@gmail.com
53	KIMINA (PONTIKAS NIKOS)	Bee products and Honey processing	Kimina, 57600 Thessaloniki	23910-41014	www.topagrodeals.com info@topagrodeals.com
54	MELISSOKOMIA MANIKA	Production of bee products	Zip code Perivolion, Megalopolo, Arkadia	2791023903 6937145648 6932727939	melissokomia.manika@gmail.co m
55	AGROLIKI MELISSOKOMIA (AGATHOU MARIANNA)	Queens and package bees	Argoliko, Nafplio	2752400654 6995977086	
56	ALCARGO	Bee feed	Stadiou 11, Saravali, 26500 Patra	2610-61653 6981932568 6973371161	www.alcargo.gr alcargo@windowslive.com
57	CHALKIDIOTIKI MELISSOKOMIA (PETROS & PAVLOS KAMPOURIS)	Queens and package bees	Paleochora, Chalkidiki	6944968800 6947160481	www.abaton1.co m
58	APICULTURAL LAB AUTH	Honey analysis	Agroktima Panepistimiou, 57001 Thermi	2310-472983	beelab.agro.auth.gr
59	TSELIOS VAGELIS	Bee consult	Melachrinou 35, N. Moudiana, Chalkidiki	2373065622 6973791716	vangtselios@yahoo.gr
60	MELISSOKOMIKI MPERMPERIS	Bees and Honey processing	N. Malgara, 57300 Thessaloniki	2391041097 6948063423 6982348906	www.melissokomikiberberis.gr melissokomikiberberis@yahoo.gr
61	BONDEX (MIMIS PERACHIA SA)	Hive paints	Parodos Sofias Vempo PO Box 372, 57008 Ionia Thessalonikis	2310778350 2310778360	www.bondex.gr info@bondex.gr
62	BEEWIRE (CH. KATSAOUNIS	Beekeeping supplies	Thesi Megali Avli, PO Box 60019,	22990-66731	www.beewire.gr sales@beewire.gr
	&Co GP)		19001 Keratea, Attiki		
63	ATTIKI MELISSOKOMIKI ETERIA (ALEXANDROS PITTAS SA)	Beekeeping supplies and equipment and Honey processing	Protomagias 9, 14568 Krioneri, Athens	2105751896 2106220844	www.attikipittas.gr info@attikipittas.gr

64	TO METSOVO (SONS & N. GEORGALI SA)	Hive construction		26560-41580 26560-42217	www.georgelis.gr info@gerogelis.gr
65	D. KIRGOTA - N. TZAROUCHI GP	Hive construction	Anilio Metsovou	26560-41439 26560-41604	
66	HONEY LAKONIAS (IOANNIS PITTAS)	Bee products	Kastorion Lakonias	2731057646 210-2823086 6980480360	www.melilakonias.gr gpittas.gp@gmail.com
67	STEEL BEES (Vidalakis Athanasios)	Beekeeping supplies and equipment	Kastorias 4 & Serron, 10441 Athens	2105220005	www.steelbees.com info@steelbees.com
68	FOOD ALLERGENS LABORATORIES	Honey analysis	Athens: Varnali 40, 14231 N. Ionia Rethimno: Komvos Atsipopoulou, 74100 Larnaka: Kalopsidas 38, 7060 Livadia	2102712498 6978118047 6977663478 +357 99264951	www.foodallergenslab.com info@foodallergenslab.com
69	ERFAR AVEF	Bee feed	Mikras Asias 2, 15351 Pallini, Attiki	210-6665823	erfar@otenet.gr
70	MELISSOKOMIKI IPIROU (NOUSIAS CH. KONSTANTINOS)	Beekeeping supplies and equipment	6 km Ioanninon - Igoumenitsa, 45500 Ioannina	26510 61872 6946656639	www.melissokomika.gr info@melissokomika.gr

Appendix table 37.