

LdV Hop school



*Hop industry lifelong learning program
Vseživljenjsko izobraževanje v hmeljarstvu*

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***Benchmarking analysis of the EU Hop industry:
Production, Organization, Marketing***

(R4) report



Žalec, 25. October, 2012

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Martin Pavlovič et al.,
Benchmarking analysis of the EU Hop industry: Production, Organization, Marketing.
R4, project report.
Leonardo da Vinci, Transfer of Innovation.
Hop industry lifelong learning program.
Žalec, 2012.



Education and Culture DG

Leonardo da Vinci



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Training Programmes

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Foreword

Brewing industry requires traditionally its raw materials of a high quality. Beer brewing is an intricate process encompassing mixing and further elaboration of four essential raw materials, including barley malt, brewing water, hops and yeast. Particularly hops determine to great extent typical beer qualities such as bitter taste, hoppy flavor and foam stability and storage potential of beer.

Hops (*Humulus lupulus* L.) are a specialty crop produced for the female flowers (cones), which either raw or processed, are an essential ingredient in the production of beer. Lupulin glands on the hop cones contain soft resins (alpha-acids and beta-acids), essential oils that impart bitterness, flavor, aroma, foam (head) characteristics, and preservative qualities to beer. The total amount and percentage composition of these compounds vary with variety, region, growing conditions, and production technique. Since the brewing industry depends on hops to provide distinctive and proprietary characteristics to beer, a stable supply of high-quality hops is its high priority. To remain globally competitive, hop and brewing industry must respond to the ever-changing needs of consumers by providing appropriate new types of products.

Furthermore, to suit various brewing industry requirements, research programs in hop breeding, hop physiology, production and processing of hops into hop products and quality management, used to be intensified during the last few decades. However, in spite of many improvements such as development of new hop varieties, modern growing techniques, implementation of new plant protection measures, nowadays even some of the biggest and the most respectable hop research organizations are faced with the plain endurance and share the future of farmers.

This benchmarking study (“*LdV Hop school*” *project result Nr. 4*) gives an overview of the EU hop industry in the 3rd millennium – with aims:

- ↳ to give an overview of the EU hop industry production and economic characteristics,
- ↳ to demonstrate organization structures in main exporting EU hop countries and
- ↳ to present the sector’s market position for the world beer industry.

Chapter 1 begins with main technological aspects of the EU hop industry, where all core production procedures from hop planting to its processing are briefly described. Since the European Union is the main player in the world hop market production characteristics of the main countries are illustrated pointing out their supply potentials, farm structure and their level of specialization. The production structure in the hop industry sector varies greatly across EU countries. It is changing due to a market-driven structural adjustment aimed at being more competitive. Furthermore, hop farmers are slowly becoming entrepreneurs, the rate of specialization of hops farms is generally increasing and mostly they try to attain a farm size that makes production more profitable.

Chapter 2 presents organization and production structures of the three main EU export oriented hop countries. In the last decade a global hop industry has witnessed important structural and technological changes. Growers, providing hops as a raw material for breweries are obliged among others to follow carefully legislation and quality standards that are set by market demands. Only by taking all necessary quality factors within the “quality circle” into consideration, can a hop grower be able to achieve the brewing and market value of hops, a reasonable price and long-term existence of his hop farm. Presentation

is shown according to the countries hop acreage and thus also according to their exports, i.e. market supply importance: Germany, Czech Republic and Slovenia.

Chapter 3 demonstrates some of the main characteristics of the hop market. Hops are a classic international trading commodity on the markets for agricultural produce. The main role on the market plays a global hop balance, i.e. a world demand level of merchants and breweries as well as a supply from hop growers. For the market both hop quantities as well as the brewing value of hops have great importance. Following the statistics from the hop market demonstrated for the 1st decade of the 21st century it is obvious that hops make successful products in the global hop trade.

Hops are essential for the brewing industry, as they supply considerably to the aroma and quality of beer. Plentiful, quality and healthy hops give pride to the hop grower, are welcomed by the hop merchant and brewer and provide pleasure to the consumer - a beer drinker.

Chapter 1

1 Hop production – distinctive agribusiness sector

1.1 Production aspect of the EU hop industry

Hops are perennial herbaceous plants that climb around a support. Hops have either male or female flowers. Only female plants are grown in hop fields, while male ones are not desired, since they may pollinate the female plants. The life expectancy of a hop plantation ranges from 10 to 20 years and depends on growth conditions, the variety and treatment methods. Botanically, the hop species belongs to the linnet family (*Cannabaceae*), a member of which is also hemp.

A hop plant consists of underground vegetative parts and parts above ground with vegetative and reproductive organs – flowers. The parts above ground wither at the end of each growth season, leaving only underground parts to overwinter. These are the rhizome or stump and the main, fibrous and adventitious roots.

The parts of the hop plant above ground include the stalk, leaves, lateral shoots and flowers. When the bine reaches around 50 centimeters in height, it gains the ability to climb. The bines climb by winding clockwise around the support whereby using bristly hairs.

The color of the bine ranges from green to red, depending on the variety and growth conditions. A hop vine can grow to a height of 7 to 9 meters. When the plant reaches the top of its support, horizontal shoots sprout out. Cones develop from lateral shoots. The leaves on the stalk and horizontal sprouts are distributed evenly and are found opposite each other. Older leaves are three- or five-

patched, while its edges are always coarsely toothed. The surface of the leaves is hairy, while the color varies from light to dark green.



Fig. 1-1: Hop cones with lupulin glands

Its generative organs include male flowers, which are small and joined into grape-like flower clusters, and female flowers, which grow in clusters. A cone is a mature female inflorescence, 20 to 30 millimeters in size, depending on the variety. In nature, it also contains developed seeds, which, however, is undesirable in hop growing. At the bottom of cover leaves and stipules, lupuline glands are formed that contain essential oil, bitter resins and tannins.

The products of hop plants are cones. They contain lupuline, which comprises substances (hop resins, essential oil and polyphenols) that give beer its flavor, scent and persistence.

The main support for a hop plant is **a wirework**. There is a string attached to the wire around which the plant climbs. The main parts of the wirework are wooden or concrete poles, the wire netting and anchors. These are set up on flat terrain and are rectangular in shape. It is very important to carry out regular

maintenance works on wires, as this reduces the possibility of the wires collapsing and prolongs their lifespan. Anchors, attached to trellis cables, surround the yard and hold the trellis upright under the weight of the developing crop. Plant spacing depends mostly on hop variety and growing area, with 2.4 to 3.2 m between rows and about 1.1 to 1.7 m between plants within rows. The height of the wires ranges from 6 to 7 meters.



Fig. 1-2: Hop gardens with a wirework in June and in August

In the spring, before pruning, the soil added to hop plants is removed. Care is required so that the roots are not injured or even ploughed out. Soil can also be removed simultaneously with pruning, thus rationalizing production. The attachment for removal is connected to the front part of the tractor, while the cutter is in the back.

Pruning (cutting) is one of the most important agro-technical measures in hop production. During pruning, one-year-old wood is removed and, with it, the redundant eyes developed on it. By pruning, we control the dynamics of growth and development (we prolong the start of the growth) as well as the fertility of

the crops. The beginning of pruning depends on environmental conditions and the characteristics of the hop variety. As a rule, early or late pruning yields fewer crops of lower quality.

By **stringing** a necessary support for hop plants in the field is provided before the hops sprout. To support hops, various types of training strings are used. Strings must not be fixed directly into the root, so as to not injure it, but 5 to 10cm away from the main root.



Fig. 1-3: Pruning (cutting) of hops and stringing of hop fields

Training of vines onto strings is an agro-technical measure that substantially influences the quantity and quality of the crop. It is done exclusively by hand and requires entirely individual work with plants. This work stage includes the process of picking out the sprouts and winding them onto strings clockwise. By doing this, we can considerably correct any mistakes made when pruning.

In the growth period, hops are **cultivated** and **shed**. By doing this, the growth conditions for the plants are enhanced: the soil is softened and aired, excessive

evaporation of water is prevented, weed is destroyed and mineral fertilizers are introduced into the soil. By shedding, soil is added to the plant. This way, bines are fastened in order to prevent breakage due to wind, weed is covered and suffocated and favorable growth conditions for adventitious roots are enabled. Shedding takes place twice or three times during season. For soil processing and shedding, different variations of cultivators, circular harrows and tormentors are used.

In order for the hop plants to obtain adequate nutrients, hops have to be **fertilized** appropriately during their growth and development. By fertilizing, adequate amounts of nitrogen, phosphorus, potassium, calcium, sulphur and magnesium are added. Micronutrients are ordinarily applied to the plants foliarly. This means that hops are fertilized with a solution of fertilizer sprayed over the leaves. Fertilization with organic manure improves the structure of the soil. This also enhances the capacity of the soil to retain moisture, the aeration of the soil is better and the temperature regime of the soil is balanced. Hop growing areas use horse manure, liquid manure, compost and hay, while associate crops are ploughed.

Irrigation was fast established as an agro-technical measure in hop growing. Proper irrigation requires regular monitoring of the condition of moisture in the hop field soil. There are two basic techniques of irrigation: irrigation with movable sprinklers (drum irrigators) and different varieties of drip irrigation. Both irrigation techniques have their strengths and weaknesses, although drip irrigation has more strengths than weaknesses, e.g. smaller consumption of water and rationalization of work.

Diseases and pests are controlled by applying **plant protection** products. The primary goal behind this is a careful, economical and environmentally

acceptable application of appropriately prepared chemical preparations onto targeted areas in order to reduce any negative consequences to the largest possible extent. Therefore, spraying has been carried out in the hop industry according to prognosis for over twenty years. Plant protection products are applied using sprinklers. To spray hops, classical pulling axial sprinklers are most often used that can have two types of nozzles built in: the classical whirling and the latest nozzles for reducing the application of plant protection products.

The most common hop diseases caused by fungi include the Hop Downy Mildew, Hop Powdery Mildew, Verticillium wilt of the hop, gray mould, *Cercospora cantuariensis* on hop, gray leaf spot on hop, drying of hop cones and armirallia root rot. The most common pests are aphids, the common spider mite, corn borer, hop pyrethrum and hop weevil. Furthermore, viruses and viroid diseases can also appear on hops. So far, 3 viroids and 17 different viruses have been discovered on hops, the most harmful ones being the apple mosaic virus, hop latent virus, hop mosaic virus and arabis mosaic virus.

Hop harvest (apart from training of hop vines) represents the second working peak in hop production and starts when hops are technologically ripe. This is when the cones have the highest content of alpha-acids, reach their maximum height and mass as well as their typical structure of essential oils, thus ensuring quality machine picking. Technological ripeness in hops depends on the variety, technological measures and weather conditions during the growth period and on soil attributes. This happens at the end of August and in September. Hop picking is divided into three procedures: harvesting the crop in the field, transporting the plants to the picking machine and harvesting the crop at a picking machine. In the hop field, plants are cut and torn together with guides from the supporting strings of the wire, allowing them to fall onto the loading attachment pulled by

the tractor in the direction of plant picking. Plants are cut mechanically, in some cases also by hand. Cutters cut the plants at the height of 120 to 150cm above ground.

At the picking machine, bines are inserted in the grips of the inserting track. Plants are put in with the cut-off part first. The cleaning part of picking machines consists of a ventilation and conveyor belt component. The role of the ventilator is to remove the major part of the leaf mass from the cones. Sorting conveyor belts then separate the remaining leaves, parts of stalks, stems and other parts from the cones. Sorting conveyor belts require that the plant mass enter evenly, with such layer thickness that still allows the cones to roll. According to this principle, the separation of cones from other plant components takes place on sorting conveyor belts.

Picking machines must operate as flawlessly as possible. Machines have to be cleaned regularly during picking and adapted to the variety of the hop and weather conditions. This way, the share of damaged cones and other components is decreased. When operating a picking machine, safety at work is to be observed at all times. While drying, moisturizing, loading and storing hops, care is to be taken primarily to preserve the quality of hops and reduce energy consumption. Hop dryers are either multi-storey or conveyor-belt dryers. Multi-storey dryers achieve a better utilization rate of thermal energy and have a larger capacity of drying per surface unit of the drier.

Drying and moisturizing hops are the final technological stages in hop production. Through incorrect or inaccurate drying and moisturizing, we can actually destroy the quality of hops in merely half an hour. Technologically ripe hops contain between 77 and 80% of moisture.



Fig. 1-4: Hop harvest: transport of hop bines from a field to a picking machine

In order to achieve the optimal storage durability, cones have to be dried to the moisture content ranging between 9 and 11%. Hop varieties differ from one another in physical, chemical and morphological properties of cones. The flow of the drying air can be regulated with the thickness of the poured layer of hop. During the drying process, hops must not be heated to temperatures exceeding 60°C. Higher temperatures may cause accelerated evaporation of easily evaporative essential oil components or a disintegration of bitter ingredients, in extreme cases also a change in the color of lupuline. After about six hours of drying, when hops are technically dry, the moisture content is between 8 and 9%.

Since it is difficult to remove the moisture from the vertebra, hops have to be over-dried during the drying process. Over-dried hops crumble easily and are, as such, not suitable for packaging. The purpose of moisturizing is to restore elasticity to the cone and hop moisture to the desired 9 to 11%. Hops can be moisturized on a pile, with a conveyor belt moisturizer or in a chamber. The latest variations of moisturizing chambers are automated.

Packing dry hops according to the market demands is the final task. Properly moisturized hops can be “stuffed” into RB-60 “cube” bags or “bale” production bags. Only properly moisturized hops can be “stuffed”. Hops that are too dry will crumble, while hops that are too damp will go moldy. Such hops are technically useless and have no market value.

If hops are stuffed into “cubes”, attention must be paid to the moisture content of the hops, which is to be 9%, because hops are more compressed in these bags and, therefore, more prone to harmful influences. A properly filled RB-60 bag should weigh 60kg. Hops that are filled in the production bag (“bale”) are moisturized to between 10.5 and 11.0%. A properly filled (“stuffed”) production bag weighs between 50 and 70kg. Irregularities in the storage of hops can also influence the quality of the produced hops.

A storage room that is not selected properly affects the increase of moisture in the hop, resulting in a lower microbiological stability of hops. The storage room must be dark, cold and dry. The relative humidity of the air in the storage room cannot exceed 65% if hops are to retain 11% of moisture.



Fig. 1-5: Hops packed in RB-60 “cube” bags or processed into pellets

1.2 Production structure of the EU hop industry

The European Union is the most important supplier of hops globally. Hops are produced by fourteen EU member states although together Germany and the Czech Republic account for more than 80% of the total EU production by volume. Poland is the only other member state to account for more than 5% of total EU production. Traditional hops production areas can be found within each hop-producing member state, including Bavaria, Saxony, and Bitburg in Germany; Bohemia in the Czech Republic; the Lublin region in eastern Poland; Savinja Valley, Ptuj, and the Koroška region in Slovenia; South East (Kent, Sussex) and West Midlands (Herefordshire, Worcestershire) in England; the León area in Spain; Alsace in France; the Horna Streda region in Slovakia; the Poperinge area in Belgium, the Velingrad area in Bulgaria, etc. Table 2-1 shows hop supply elements during the period between 2010 and 2011 on a global level, where acreage and production are clearly illustrated.

With the exception of Germany, hop acreage in Europe is diminishing in the last decade, following the global trend. This is mainly due to the launch of new bitter hop varieties by the USA and Germany that provide a higher yield per hectare so that less acreage is needed for the same amount of alpha acids, required by the global brewing industry. However, the acreage reduction was insufficient to prevent an oversupply of hops in years 2009, 2010 and 2011. Again, farmers' on-time business decisions linked to making forward contracts for their crop production play a crucial role in the farmers' hop supply competitiveness as apparent throughout the period under scrutiny here.

In the period 2001-2008, the hop-growing surface area in EU countries varied from 32,569 ha (21,554 ha of aroma hops and 11,015 ha of bitter hops) in 2001 to 29,705 ha (19,756 ha of aroma hops and 9,949 ha of bitter hops) in 2008. In

2008, the total EU hop production was about 57,000 tons; more than 50% of the world hops production. The largest producer within the EU is Germany (39,676 t), followed by the Czech Republic (6,753 t), Poland (3,446 t), Slovenia (2,359 t), France (1,469 t), the UK (1,410 t), etc. Hops acreage is decreasing steadily in the EU, with a 16% reduction since 2001. Bitter varieties are grown in about one-third of the area. This percentage has been constant throughout the eight years analyzed.

Hop growers must respond to the ever-changing needs of the brewing community by providing appropriate varieties at a certain quality demanded by the market as well remain competitive in the global hop industry.

Hop industry is one of the highest capital- and work-intensive types of agricultural production. It is estimated that on EU competitive hop farms (more than 10 ha of hops) the initial capital investment required for hop fields with wirework is more than 15,000 EUR/ha. Additional investments for specialized mechanization such as spraying and picking machines as well as a hop kiln with all necessary equipment would require at least an additional 25,000 EUR/ha. The amount of machine and labor hours varies related to the level of mechanization. The amount ranges between 60 and 80 machine hours and 200 and 350 labor hours per hectare. Based on the production costs model, 39% of the variable costs in hop production involve hop picking and drying, 26% stringing and training of hop bines, 13% plant protection, 12% winter and spring activities in hop fields, etc. with 10 ha of hops and an average yield of 1,800 kg/ha.

Hop plants are grown on a wire and cable trellis usually suspended about 6 to 7 meters above the ground on a regular arrangement of wooden or concrete poles. Once established, the hop rootstock will produce indefinitely although industry

practice is to rotate plantings every 15-20 years. The timing of the rootstock replacement is influenced by declining yield caused by insects, disease and pests and by merchants', i.e., brewers', demand for specific varieties. The major production practices used annually to produce hops include pruning, stringing, training, irrigating, protecting plant against pests and diseases, harvesting, drying as well as processing and packing according to market demands.

1.2.1 Number of hop farms (holdings) in EU

During 2000-2008, the number of holdings growing hops declined significantly in the main hop-producing countries (Table 2-2). The reduction ranges from 10.9% in Poland to 37.7% in Spain. In Germany, the decrease was 22.9%, with a loss of 446 farms. While the number of holdings has decreased, the average acreage per holding has increased in all the listed countries from +2.5% in the Czech Republic to +31.6% in Germany. These data series show a large variability in average acreage across member states. The largest holdings are in the Czech Republic (40.7 ha per holding in 2008), and the smallest are in Spain and Poland (around 2 ha per holding).

In the period 2004-2007, according to the data available for all member states, more than 480 farms abandoned hop production. Comparable data for the period 2001-2007 were not at hand. However, if we keep the number of farms abandoning hops growing in the new member states (which make a conservative estimate) constant, we estimate that more than 1,350 farms in Europe stopped producing hops in the period 2001-2007.

Growers mostly exit the hop sector as their farms and hop gardens are not able to guarantee a sufficient income. This phenomenon is affecting old farmers,

whose farms are not continued by younger generations, and farmers who have small farms. Land abandonment is thought to occur rarely, but no relevant figure exists for hops. Farmers who stop growing hops normally sell their hop gardens to other hop growers, who continue to grow hops.

1.2.2 Average size of hop farms

The average hop acreage per farm increased in almost all the member states because several farmers stopped growing hops. The farmers mostly stopped because of ageing rather than for economic reasons, according to the interviewees. However, the economic component might be stronger than what the interviewees suggested. Related to measures of the EU Common Agricultural Policy (CAP) in the hop sector 2004-2008, some growers of the countries adopting full decoupling may wait to leave the hops sector until they face the next heavy investment (for instance, when renewing hop gardens) and exit at this point, keeping the decoupled support. No figures are available at the national level on the causes of the cessation of hops production, so the estimates are based on personal assumptions made by the interviewees. The hops gardens were mainly sold to other farmers who stayed in business.

Hop farmers are stepwise becoming entrepreneurs; thus, most try to attain a farm size that makes production more profitable. The main concern of farmers is to be able to spread the high fixed costs generated by hop growing over a sufficient number of hectares, so that the farmers can make profits per hectare. When this is not possible, hop growers are slowly stopping hop production, according to the interviewees. Spain, for instance, is an emblematic case in this sense.

Most Spanish and Polish hop holdings are extremely small (< 2 ha) so farmers do not find it convenient to invest in machinery and in new technology. In the long term, farmers will either abandon hop growing or will expand their business to become specialized. The size threshold that makes a farm profitable varies across countries. In Germany, a holding having 10 ha of hops starts being economically viable (once one takes subsidies into account). A similar size enabling the hop farm competitiveness is envisaged for Slovenia.

European hop farms (holdings) are becoming larger. The farm structure varies greatly across the EU countries. The main reason lies in the competitiveness at the international level. No effect of the CAP reform after 2004 on a farming structure was discovered. The difference in the average size of European farms depends on historical and agronomic reasons. In the Czech Republic, the current farms are the heritage of the enormous socialist collective farms; thus, Czech farms are much bigger than the European average. On the other hand, hop farms in Poland and Slovenia used to be much smaller and predominantly in the hands of independent private farmers during the socialist period. In Slovenia, the hop farms on average were significantly enlarged from 3.5 ha to 10 ha per farm after significant structural changes in year 1999 as the company *Hmezad kmetijstvo* had collapsed. Consequently, about 1000 ha of hop fields were purchased by 70 local hop farmers.

The average hop farm size is increasing in all EU member states. The growth in the average size is mainly due to the reduction in the number of growers, while the reduction in hop area is less pronounced. Small hop-producing countries with weak or no sector-linked national research and development support have seen a sharper decrease in growing area and in the number of farmers. In some countries, such as Spain, Belgium, Bulgaria, Portugal, and the UK, the reduction in the number of growers has endangered the very existence of the hops sector.

The few farms left are becoming more specialized in hops in terms of equipment and other investments. However, the farms are still much smaller than in the U.S., and this could affect the competitiveness of European hops in the medium term.

Table 1-1: Number of hop farms and average acreage per farm in major hop-producing countries (2002-2008)

Country	Indicators	2002	2003	2004	2005	2006	2007	2008	2000/08 Change (%)
Germany	Nr. of farms	1943	1710	1698	1611	1554	1510	1497	-22.9
	ha/farm	9.5	9.7	10.3	10.7	11.1	11.7	12.5	+31.6
Czech Rep.	Nr. of farms	185	165	162	145	145	139	131	-29.2
	ha/farm	40.0	36.0	36.0	39.0	37.0	39.0	41.0	+2.5
Poland	Nr. of farms	1191	1129	1121	1144	1113	1066	1061	-10.9
	ha/farm	1.9	1.9	2.0	2.0	2.0	2.0	2.1	+10.5
Slovenia	Nr. of farms	189	186	176	176	150	140	140	-25.9
	ha/farm	9.6	8.9	8.8	8.8	10.1	11.0	11.0	+14.6
UK-England	Nr. of farms	85	76	60	60	60	60	58	-31.8
	ha/farm	21.4	19.0	22.6	17.9	17.4	17.7	18.5	-13.6
France	Nr. of farms	111	100	96	96	96	90	89	-19.8
	ha/farm	7.4	8.2	8.2	8.4	8.3	8.8	9.3	+25.7
Spain	Nr. of farms	398	400	395	353	325	248	248	-37.7
	ha/farm	1.7	1.7	1.7	1.9	1.9	2.0	2.0	+17.7
Belgium	Nr. of farms	52	49	47	45	44	42	29	-44.2
	ha/farm	4.8	4.7	4.4	4.6	4.5	4.4	5.8	+20.7
Portugal	Nr. of farms	14	12	12	12	7	4	4	-71.4
	ha/farm	2.6	3.1	3.1	3.3	2.6	5.3	5.0	+89.2
Austria	Nr. of farms	72	73	70	70	67	65	63	-12.5
	ha/farm	3.1	3.0	3.0	3.0	3.0	3.1	3.3	+9.6
USA	Nr. of farms	60	60	52	52	56	62	74	
	ha/farm	196.3	188.6	216.0	227.3	212.7	201.7	267.0	

The IHGC statistics demonstrate that the average hop acreage per farm in Europe is increasing but is still much lower than in the USA. This may affect the competitiveness of European hops in the medium term. Therefore, the production structure of U.S. farms is more competitive than European farms. For an idea of the comparative advantage enjoyed by the United States in terms of production structure, the 12,510 ha devoted to hops in 2007 in the U.S. (WA, OR, ID) were spread over 62 farms. This works out to 202 ha per farm, 18 times the average German farm and more than five times the average Czech farm.

Table 1-2: Hop farm structure by class size in 2003

	< 2 ha	2<ha<5	5<ha<10	10<ha<20	20<ha<30	30<ha<50	50<ha<100	>100 ha	TOTAL
Belgium	0.0%	0.0%	0.0%	25.0%	25.0%	50.0%	0.0%	0.0%	100%
Czech R.	0.0%	0.0%	0.0%	6.3%	12.5%	6.3%	12.5%	62.5%	100%
Germany	0.0%	3.3%	11.5%	31.7%	20.8%	23.0%	7.1%	2.7%	100%
Spain	31.6%	57.9%	10.5%	0.0%	0.0%	0.0%	0.0%	0.0%	100%
France	0.0%	0.0%	16.7%	16.7%	8.3%	25.0%	25.0%	8.3%	100%
Austria	0.0%	0.0%	11.1%	33.3%	33.3%	22.2%	0.0%	0.0%	100%
Poland	8.7%	26.1%	41.7%	17.4%	2.6%	1.7%	0.9%	0.9%	100%
Slovenia	6.3%	6.3%	25.0%	25.0%	25.0%	12.5%	0.0%	0.0%	100%
UK	0.0%	0.0%	0.0%	6.3%	6.3%	12.5%	25.0%	50.0%	100%

Table 1-3: Hop farm structure by class size in 2007

	< 2 ha	2<ha<5	5<ha<10	10<ha<20	20<ha<30	30<ha<50	50<ha<100	>100 ha	TOTAL
Belgium	0.0%	0.0%	0.0%	25.0%	25.0%	50.0%	0.0%	0.0%	100%
Czech R.	0.0%	0.0%	0.0%	7.7%	0.0%	7.7%	15.4%	69.2%	100%
Germany	0.0%	3.2%	10.9%	28.2%	19.9%	23.1%	12.2%	2.6%	100%
Spain	30.8%	53.8%	15.4%	0.0%	0.0%	0.0%	0.0%	0.0%	100%
France	0.0%	0.0%	0.0%	16.7%	8.3%	50.0%	25.0%	0.0%	100%
Austria	0.0%	0.0%	50.0%	25.0%	0.0%	25.0%	0.0%	0.0%	100%
Slovenia	0.0%	10.0%	20.0%	20.0%	30.0%	20.0%	0.0%	0.0%	100%

1.2.3 Rate of specialization of hops farms

The rate of specialization of EU hop farms is generally increasing. The interview results showed that hop farms tend to become more specialized in Germany and Czech Republic. In Germany, the specialization rate (defined as the amount of revenues determined from hops of the overall farm revenues) for hop-producing farms increased from 42% in 2003 to 59% in 2006. A similar trend can be observed in the Czech Republic, with the specialization rate increasing from 16% in 2004 (the first year for which data were available) to 25% in 2006. As these data come from the FADN (Farm Accountancy Data Network) database, they are limited to these two countries.

Other EU countries had no hop sector FADN data available. However, a number of interviewees in other member states have confirmed this trend. Interviewees also linked the increased level of specialization to the high revenues that hops provide if cultivated on an adequate scale.

1.2.4 Economic aspect of the EU hop industry

What hop growers are trying to achieve is good market value of their yield. The brewing value of hops for breweries is the market value of hops for growers. Since hop plantations are permanent (10-15 years), fast adaptation to the market requirements and the right selection of varieties present a big problem in technological as well as economic sense. Changes in the production structure on a global level have been recorded i.e. reduced number of hop growers in nearly all growing countries and the concentration of production and the capital in the brewery sector. The whole trade has also decreased, and that indicates even worse conditions for the survival of individual hop growers.

There are many issues that influence hop business decisions. The main factor that does influence significantly is the market situation (hop demand and hop supply balance). It relates strongly to climate circumstances, hop varieties portfolio, research and development results (breeding program, plant protection), exchanging rates (EUR towards Sterling or USD), availability of seasonal workers, etc. Economic situation and long-term trends of development in hop growing are mainly conditioned by technological and market happening in the brewing industry. All this has a great effect on production development and offer due to the market saturation, or our own technological development and more updated hop handling and storage, as well as on the desired hop varieties (hop cultivars).

The income of the hop production is estimated from 5,000 to 15,000 EUR per ha - depending on hop price and yield levels obtained in certain years. How about the costs on the other side? While the main factor determining prices on the spot market is the continual imbalance between supply and demand, prices are many times unpredictable and by the depression of the market the growers could even not cover the cost of their own labor and depreciation costs.

If the price for hops is lower than the grower's costs for several years in succession, some of the growers would go out of business. That is why hop growers are always forced to analyze their own production by making their decision for the future. Since they cannot influence the price level directly, the only way they can make their production reasonable is (a) to cultivate the varieties that are interesting for the market for the sake of high yields and alpha value and (b) to use all possibilities to reduce their production costs.

Farmers are usually eager to obtain information on production costs. With such data they can compare themselves with other farmers and make, according to the market prices, further plans about their future agricultural production. To offer the possibility of such analysis which should lead to easier decisions, a *SIMAHOP* model has been formulated (**S**imulation **M**odel for **A**nalysis in a **HOP** industry), which found its use in various EU countries.

The model is supposed to be an example of economic models for farm management in a hop industry and has been formulated in order to be used as a support for planning and decision making via simulation. Supported by the MS Excel spreadsheet program with its own macro menu it enables, by using the simulation technique on a PC, fast calculations and renders possible investigation of the influence of various model inputs on its outputs at different levels. It demands a collection of the following:

- production system data,
- technological data (for pesticides, fertilizers, etc. use/ha),
- price lists (for investment prices, manure, pesticides, etc.),
- legislation framework (% of amortization, insurance, etc.),
- estimates (% of farm own capital used in hop production, etc.).

The *SIMAHOP* has 2 sub models. The sub model *LABOR* illustrates and renders possible the working procedure time analysis with the help of 259 input parameters. These enable case studies including simulation of the production system, production techniques, various distances, material quantities, use of different machines and farm equipment, etc. There are 15 working procedures which are gathered into 7 main groups. With the help of descriptive figures and 35 mathematical formulas, the calculation of machine, tractor and labor hours as output can be simulated.

The Sub model *COSTS* includes costs calculations of the 3 cost groups:

Area dependent fixed costs (*Currency units / farm*) depend on the acreage of a farm. The bigger its acreage, the more equipped is a farm with various machines and needed implements. During the year these costs normally do not change except in the case of selling the capital or of new investments. From the number of equipment or implement items, their replacement prices, % of their use in hop production, it is possible to estimate farm annual fixed costs, which depend on local prescription for repair, insurance and investment costs.

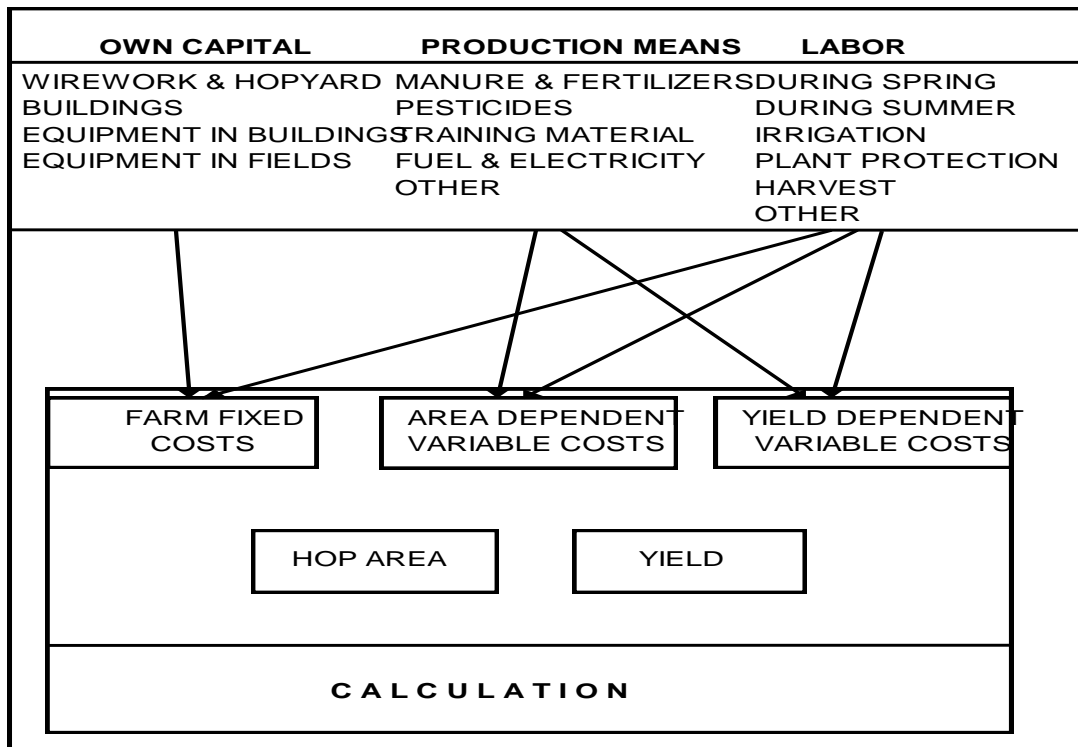


Fig. 1-6 *SIMAHOP* data flow

Area dependent variable costs (*Currency units / ha*) contain material costs of production means, labor costs and sundry overhead costs (taxes, duties, fees and other charges) and change in accordance with the level of hop production intensiveness. To calculate material costs, classified into items average costs, the model demands the data for units, the quantity of use per ha and their prices per unit. Concerning labor costs analysis for particular activities the model differs between machine and hand labor as well as between the costs of own and hired (occasional) labor force. Such a division has got the intention to point out more directly to the sources of costs differences.

Yield dependent variable costs (*Currency units / kg*) alternate from year to year. It was determined that the crop yield has an effect on the production costs concerning material (packaging), labor (picking) and energy (drying). For these reasons the model embodies a part of material and labor costs within this group

expressed per kg of dried hops. For getting the final calculation the input data on acreage (ha) and yield (kg/ha) are required as well.

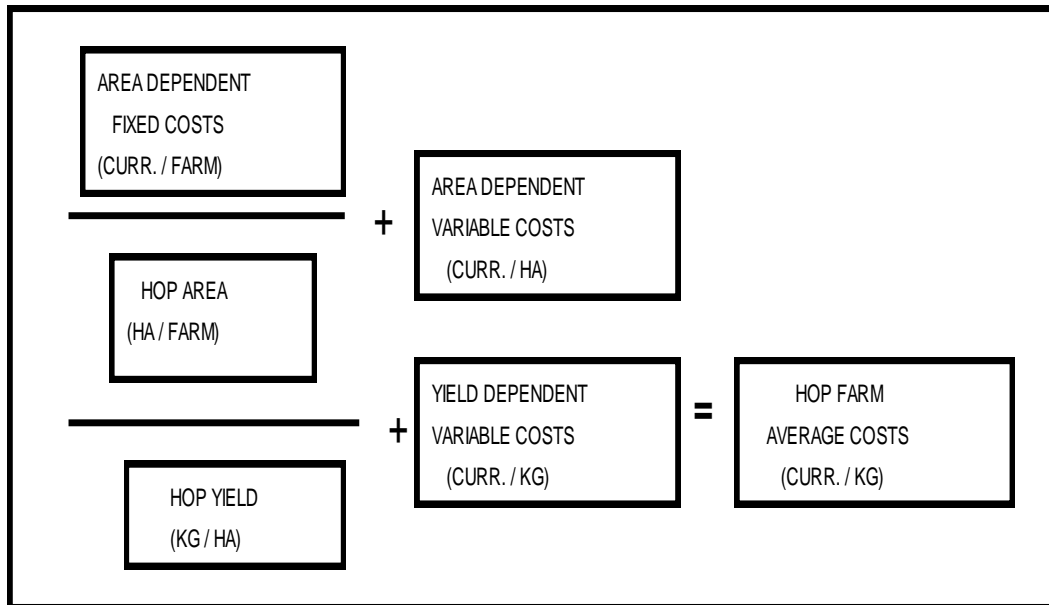


Fig. 1-7 *SIMAHOP* costs calculation

The *SIMAHOP* enables also a simulation of different scenarios with the intention to simulate a reduction of production costs. Such possible scenarios might be in the field of:

- reduction of the labor or material needed for the production,
- better use of the machines having in mind the formation of machinery cooperatives i.e. the decision of more producers to invest in and use jointly some machinery and buildings,
- changes of hop area and yield as an effect on model production costs etc.

The reason for the formation and further use of the model is apart from time planning and production costs analysis also the model cost comparison between hop farms with different areas under hop cultivation and various yields as well.

This model found its application already in some of the EU countries - members of the International Hop Growers' Convention (www.ihgc.org).

Chapter 2

2 Organization, advisory and production structures

In this chapter organization, production structures and CAP practice in the 1st decade of the 21st century are presented. The three main export oriented hop producing countries from EU (Germany, Czech Republic and Slovenia) are briefly discussed. Presentation is shown according to the countries hop acreage and thus also according to their market supply importance.

2.1 Germany

In Germany agriculture brings certain stability of economy and population. Their hop growers have centuries' long tradition of production and they are very well structured and organized. Furthermore, they catch the first position in a hop supply on a global level.

Hop areas in Germany (Hallertau, Tettwang, Elbe-Saale, Spalt) are seen as stable to slightly increasing for the sake of a good competitive position towards other producers' region. This has been achieved through an optimal organization, research and development as well as successful marketing activities of all national hop industry stakeholders.

The Association of German Hop Growers (*Verband Deutscher Hopfenpflanzer e.V.*) is the central umbrella organization of the hop - producers in Germany and their regional organizations. There are all the regional, national and international strings of the German producer side converge at the Association's office in the House of Hops in the town of Wolnzach (Bavaria). Its main task areas cover:

foreign seasonal workers, hop supply contract, hop market regulation, representation and cooperation within the International Hop Growers' Convention, sales promotion, market reports/crop assessment, organizing events/public relations work, plant protection, advice for members, tax advice, legal advice, expertise, cases for compensation, etc. The Association's own publishing house the Hopfen-Rundschau issues the Association's monthly magazine of the same name "Hopfen-Rundschau" as well as once a year the special edition "Hopfen-Rundschau International".

The HVG (*Hopfenverwertungsgenossenschaft e.G.*) is a producers' organization of German hop-growers. Besides processing German hops into HVG hop pellets, HVG hop extract and other hop products as well as marketing the German hop production the HVG also fulfils important tasks as a producer group. Among these are: promoting measures to improve the production, promoting the Independent Quality Appraisal, supporting hop research, supporting research and registration procedures in plant protection, also marketing those hop varieties for the growers which are difficult to sell, worldwide promotion / worldwide marketing of hops from German production, surveying hop acreage and editing data to obtain informative statistics on hop production in Germany, paying out subsidies in accordance with the European Hop Market Regulation. In the period analyzed there are two producers' groups in Germany – the main in Hallertau and a smaller in the Spalt region. Both are very successful in ensuring market stability and supply concentration.

For 2010 it was estimated that on 1,497 **hop farms** – apart from family labor force also about 20.000 seasonal workers were required for spring works and for harvesting. Workers came mostly from Poland. They were paid in minimum 7.52 EUR/h. Most of the farms were mixed with other crops. Average farms' hop areas in Germany increased from 9.8 ha of hops per farm in 2003 with

1,789 hop farms up to 12.5 ha of hops per farm in 2008 with 1,497 hop farms. This is a global sector trend and is mostly not linked to the CAP reforms. In average growers are aging.

The **research and advisory work** for hop growers is carried out by the institutions in Freising and Hüll – mostly dealing with breeding new hop varieties, plant protection issues and production technique development.

The German acreage of bitter **hop varieties** (Hallertauer Magnum, Herkules, Hallertauer Taurus, etc) which have higher yielding crop in terms of quantity and alpha-acid supply) rose on country level from 41% in 2004 to 45% in 2008. On the contrary the relative area of aroma hop varieties (Perle, Hallertauer Tradition, Hallertauer, Hersbrucker, etc) has slightly decreased.

Within the EU – Germany developed stepwise its own competitive and unique structure of EU aids. In Germany the portfolio of measures for agriculture (hops, other crops, environment,) have various very important indirect and long term effects on international competitiveness. The CAP aids were especially welcome in years of bad crops or bad market prices, mostly for small growers being before a decision to continue or not with a hop production. For the case of HVG - it was agreed that the 25% of decoupled aid related to hop growers as its members (around 2 mio EUR) is managed by HVG Hallertau producers group through projects focused to marketing activities, research and development projects done by the institute in Hüll (Bavaria), TU München (Weihenstephan) and other companies, quality management (certification of origin and quality, neutral control of a hop quality) and technology development (plant protection, irrigation, hop drying, storage,...).

2.2 Czech Republic

Agriculture in Czech Republic is supposed to be a stable factor for population in rural areas. The hop industry has also a long tradition and a proven quality character. Related to hop acreage (4,632 ha) - it takes a position 4 on a global level after Germany, USA and China. The three Czech traditional geographical hop areas of production (Saaz, Auscha, Tirschitz) are stepwise shrinking and thus in period 2004-08 reduced in size. Compared to Moravia, the hop fields in the Saaz (*Žatec*) region are older. The Czech main hop region around Saaz is a rather hilly region that is not appropriate for other classic agriculture. Furthermore, in that area industry is not widely developed.

The Czech hop growers are organized on a national level in two ways: (1) the representative, promotional and non-commercial role plays the Union of Hop Growers (*Svaz pěstitelů chmele České republiky*) while (2) a commercial role is reserved for a traditional cooperative (*Chmelarstvi družstvo Žatec*), which finances growers' production, buys, does processing and storage of their hops. Both organizations are legally separated organizations related to the hop production sector. The five hop merchants' organizations that sell hops from CZ to brewers are linked to the *Chmelarstvi* for the sake of their joint business interests. One of these for example is Bohemia hop, ltd. (40% of national market share) that is its daughter company.

In 2010, about 95% of the hop area in Czech Republic was included within the control of the Union of Hop Growers (UHG), which provides various professional services for growers. The UHG owns a Hop Research Institute Co. Ltd. in *Žatec* that is responsible for research and development studies as well as for the advisory service. The Union of Hop Growers is not appointed as producers' organization, which can thus neither put veto on a hop selling of

national production nor receive EU subsidies. Hop growers pay regular annual acreage dependant fee to the union.

Average **farms' hop areas** in a sector did increase up to 40 ha per farm and they became more specialized as well. In a rule (with 2-3 exceptions) hop farms benefit of an income also from their additional farming activities such as production of weed, corn, livestock... In the Czech hop industry there are about 600 permanent employed persons. In addition, over 10,000 seasonal workers are required for spring works and about 4,000 for harvesting.

The **number of growers** diminished from 160 in 2004 up to 130 in 2008. However, this could be seen as a general sector trend also in other countries (also in third countries and overseas regions) and should not be linked with the CAP reforms.

Hop varieties politics in Czech Republic relates to national research success and market adjustment strategy. From 1994 on, stepwise domestic new varieties were introduced. Apart from their traditional hop variety Saaz (originally *Žatecký poloraný červeňák*) they brought into a production Sladek (1994), Premiant (1996), Agnus (2001), Harmonie (2004) and Rubin (2007). Premium and Sladek with about 600 tons of hops each are offered to big brewery concerns as dual purpose varieties.

The CZ hop production structure was affected with its membership in the EU in 2004. In previous years it was much easier to apply for hop sector **national subsidies**. Furthermore, those aids were also in a higher amount than after a membership and were also not focused on a rural development as within the CAP. After 2004, the following types of EU subsidies in CZ were available: (i) SAPS as for all farmers, (ii) EU top up payment per ha of hops, (iii) national

subsidies in a form of 50% back of the crop insurance premium, (iv) pay back of 50% for replanting costs, (v) EAFRD rural development support for investments in harvesting facilities as well as in hop trellis and wireworks.

2.3 Slovenia

Hop growing is the most typical agricultural branch in Slovenia in the sense of export. Globally, Slovenian acreage has for decades constituted approx. 3% of all global hop cultivating areas. The hop harvest is primarily intended for export to different European and overseas markets (90%). It is predominantly cultivated in the area of the Savinja Valley – near the town of Žalec, while the rest of the hop growing fields are located near Celje, Slovenj Gradec, Radlje ob Dravi, Ptuj, and Ormož. In 2010, we recorded that hops were being produced on, along with the resting fields, approx 1,400 ha, while 140 hop farms were involved especially with aromatic varieties, which are the result of a traditionally successful national hop breeding program.

The most common **hop varieties** – including their names as well as marketing synonyms, and abbreviations – are: Aurora (Super Styrian Aurora, SS), Bobek (Styrian Golding B, SGB), Celeia (Styrian Golding, SG) and Savinjski golding (Styrian Savinjski Golding, SSG). Concerning the sector infrastructure the following important **sector institutions** are involved in a hop industry on a national level:

- The Slovenian institute of hop research and brewing (www.ihps.si) in Žalec (1952) is a research, experimental, advisory and educational public organization. Its activities embrace various R&D projects and services in hop industry, but also wider in agribusiness and environment.

- The chamber of agriculture that takes care for necessary promotion and advisory activities (regional units with 300 agricultural experts) as well as political represents also for the hop sector. It has strong relations to the national ministry of agriculture and environment.
- Hop merchants (*Hmezad 'exim', Inbarco, Vitahop, Joh.Barth&Sohn,...*) that buy the hops on a first chain level for processing into hop products (pellets 90) as well as their further export.
- A producers' group (*Hmeljarska zadruga z.o.o. Žalec*), which involves about 35% of hop producers. The rest of growers are organized on a business level otherwise – mostly through various local agricultural cooperatives.

The CAP measures related to hops from 2004 were offered as the 25% coupled aid for hops, which is transferred directly to hop growers for their further use. It comprises: Regional payment for hop fields (production areas or idled areas with trellis): 332 EUR/ha (if farmers have also cattle, this aid could be even higher) and Production area aid for hops: 120 EUR/ha. So, all hop growers received in those years: 332 + 120 EUR/ha. In addition hop growers were entitled also to other aids from the second pillar of rural development aid such as: either *SKOP* (Slovenian Farming and Environmental Program) with its integrated hop production program (older program till 2008): 151.80 EUR/ha + special national measure only for rare varieties (on a national level the hop variety Styrian Savinjski golding was chosen with a support for growers: 75.60 EUR/ha; or: *KOP* (Farming and Environmental Program) with an integrated hop production program – a new program from 2007: 197.21 EUR/ha + special national measure only for growers that produce Styrian Savinjski golding: 102.91 EUR/ha.

2.4 France

Growers in France produce mainly aroma hop varieties such as *Strisselspalt*. In 2009 they had to reduce the aroma acreage because of the “**Anheuser-Busch Inbaw (ABI)**” brewing concern cancelled their contracts and thus reduced demand for their hops. However, they want to remain in a hop business also in the future, because they have invested a lot in the structure of plantations and in specialised machines, which can only be used in the hop production.

The **Cophoudal** – the cooperative of hop growers is obliged to ensure the marketing of hops – according to previous agreements with producers. In this way it makes market stability by forming so called hop pool i.e. stocks of unsold hops. In such a pool growers deliver their hops and the cooperative makes activities to sell it – mostly as contracted hops. Hop growers receive average price which is managed by the Cophoudal. The EU subsidies in France are not supposed to be a key driving factor for a hop growing, but they are important additional income for growers and a main factor in a decision to stay in a sector during worse hop market periods. The 25% of coupled aid related to hops is delivered to growers – through the Cophoudal cooperative. An important advisory service for hop growers is provided by the **EPLFPA** (*Etablissement Public Local d’Enseignement et de Formation Professionnel Agricole*) from Obernai - a Public Agribusiness High School of the Bas-Rhin Region with 150 employed staff. It consists of 5 educational and training centres. These centres provide and carry on various VET programs as well as practical experiences for agribusiness.

In last 5 years the number of hop growers diminished from 100 in 2004 up to 83 in 2008. Namely, hop growers are predominantly aged persons. Average farms’ hop area in 2008 was around 10 ha per farm. Farms also become more and more

specialized. Most hop farms receive income also from other crops such as weed, corn, vegetable... In 2008/2009 there were very important hop varieties changes in France. This has been reached since the ABI cancelled part of contracts for the fine aroma variety *Strisselspalt*. Growers did decide not to finish with growing but to replant their fields with new varieties – however in a period of 3 years. Instead of their traditional aroma variety – they are stepwise replanting their hop fields with *Golding*, *Fuggle* and *Celeia* varieties. However, some hop areas remained idled and will be replanted only if they make contracts for these hops.

Both French traditional geographical hop areas of production (Alsace and Nord) are stepwise reducing. There are two reasons such as reduced market demand for their hops as well as many phyto-sanitarian measures i.e. restrictive politics of plant protection use in a hop industry. This means that less and less products can be used to spray hop fields against pests and diseases. A focused aid to a production gives stability to hop growers.

In France all growers are associated within the 2 producers' groups and those groups have a large influence on stabilizing of market. In 2009 100% of hops from France were contracted, in 2010 in addition 90%. Forward contracts of 3 to 5 years give constancy to producers. Growers have to make up to 3 reports per year to the **AGRIMER** on their hop supply situation. Relevant French authorities are very well informed about the hop market position. French hop growers are active also on international level in organisations such as COPA/COGECA and IHGC.

Producer groups in France make basic service for growers related to the employment of seasonal labour. The rest of the work related to organizing seasonal workers from Eastern Europe to come to their farms make growers

themselves. The cost of a labour force has a minimum price of 13,40 EUR per hour (total) while the workers obtain about 7 EUR/h. A rather big difference means various high taxes, which put French farmers into a less competitive position. The production costs in a hop sector are estimated in 2008 on a level of 6500 EUR/ha. In France there is no signal from new farmers to start hop growing.

The Common Agricultural Policy 2004-2008 for hops favourably influenced the environment, which means that farmers use natural resources more sensible and rational. There is no observation that soil was abandoned. Hop growers – if possible will not turn out of the hop business. However, if growers finish growing hops and having none to continue their work - the land is sold (with a help of **SAFER** agency) to other farmers or users. One of the main environmental issues is related to amounts and products of pesticides which are used. The French growers consider that further restrictions of plant protection products, as now discussed, may harmfully affect the world wide trade of hops and thus consequently the supply of the brewing industry.

Chapter 3

3 Hop market supply for the global brewing industry

3.1 Characteristics of a hop trade

Hops are grown in relatively few countries throughout the world. Due to hops' latitudinal sensitivity, production is restricted to those countries situated between the 35th and 55th parallel north and south of the equator. Hops are currently grown in about 30 countries world-wide, the majority of which are in the Northern Hemisphere. The international hop market is characterized by a few large players, and a large number of small players. Namely, the world production of hops is dominated by two countries, Germany and the United States of America. They represented jointly in the period analyzed i.e. in the 1st decade of the 21st century about two thirds of the world hop production. Moreover, as stated by the IHGC, Germany (34,234 tons of hops / 3,600 tons of alpha-acids) and USA (29,707 tons of hops / 4,026 tons of alpha-acids) produced in 2010 already over 75% of the total alpha-acid quantity worldwide. Given their huge size in the world market they are supposed to be price makers, and any shortage or surplus in their production directly influences international hop prices.

A list of other significant and export oriented EU hop producing countries includes Czech Republic, Slovenia, Poland, UK, Slovakia and France. While some other small sized EU hop producing countries have predominantly their hop industry focused on domestic breweries (Spain, Austria, Belgium and Romania).

On the other hand, only a small proportion of market hops (about 3% of world production) are produced in the Southern Hemisphere (Republic South Africa, Australia, New Zealand).

In the hop industry – similarly to the brewing sector and hop trade – we have been noticing the concentration of capital and of the decision-making process for decades. The economic situation within the hop sector is controlled by the production, market and research activities of the global brewing industry. The demand of breweries for more profitable hop varieties, modern processing methods, and storage of hops, as well as the business decisions of the internationally organized hop merchants affect the economy of the hop industry.

Hops are a classic international trading commodity on the markets for agricultural produce. Trade between the individual importing and exporting countries is at present relatively free of tariffs and other barriers to trade, as only a few hop-producing countries protect their growers through customs duties.

The main role on the market plays a global hop balance, i.e. a world demand level of merchants and breweries as well as a supply from hop growers. The supply of hops (S_x) is determined mainly by the area under cultivation (S_1), growing conditions (S_2) and the cultivated varieties (S_3). On the other hand their demand (D_y) depends on the quantity of beer production (D_1), the usage rate for hops (D_2), trends in consumer preferences (D_3) and varying levels of technology employed by the breweries (D_4).

Hops can be sold on a contract base or on a spot market. Long term contracts for selling hops are treated as an important instrument to stabilize the market. **Forward contracts** are a useful means of hedging against price volatility. Unlike **spot hops** whose price is often unreliable, it is customary nowadays for fixed supply contracts - valid for several years - to be agreed between the hop growers and the hop trade. These contracts bind the two parties to supply or purchase an agreed quantity of hops on a particular variety at a fixed price. In this way price fluctuation on the hop market as well as the production risk are

reduced. However, many growers still avoid producing hops on a contract basis. Some of them – predominantly from the East European countries - still prefer to play with speculative market situations – producing hops for a spot market.

So, to reduce the risk faced by both growers and breweries against fluctuating world prices, the bulk of hops produced world-wide are sold under forward contracts on a fixed price basis for 3-5 years, rarely more, ahead. This means that up to 80% of a farmer's crop could be sold at a price determined, before it is harvested. Thus, between 80 and 90% of all hops globally are sold by way of forward contracts. Any residual quantities, the volume of which depends on the size of the harvest, are sold on the spot market where prices fluctuate considerably according to supply and demand.

In the past, hop supply had predominantly a seasonal nature. However, from the 1980s onwards the hop industry itself increasingly suggested that hop products could also be marketed outside of the usual 6-months period. So in the 1990s extensive refrigerated storage capacities were constructed to deliver quality hops at all times and to market the refrigerated storage of hops as a service. From then on hop products were on hand more or less in fitting quantities, at all times and to the required quality specifications, even without showing considerable signs of ageing.

Hops are a successful product in the global hop trade. However, during the last 60 years the number of hop merchants worldwide has been significantly reduced. In the 21st century, the international hop market is dominated by a small number of large international merchants. They are nearly all German based, with agents in the United States and other parts of the world. Most of the merchants are vertically integrated and own hop gardens to aid their control of the market. The two biggest hop trading houses that are active globally in

producing, processing and trading hops (*Joh. Barth & Sohn* and *Hopsteiner*) control over two thirds of the global trade with hops as well as hop products and thus also most of the EU supply. As an example, with a volume of over 156 million EUR, the German hop industry supplied in 2007 breweries in 130 countries.

3.2 Brewing value of hops

Since a brewing industry depends on hops to provide distinctive and proprietary characteristics to beer, a stable supply of high-quality hops is a high priority. Hops take a very small part in the structure of costs in brewing industry (less than 1%). However, to avoid unexpected supply risks main breweries and hop merchants do also have globally their own hop farms worldwide.

In the last decade brewers' demands change, especially following mergers where the policy on which hops are used might be altered. When this happens negotiations are necessary to stop producers from producing unwanted hops, which the brewers would be obliged to buy. Agreements are usually reached to pay a proportion of the price to the growers as compensation.

It is obvious that the topic of beer is of great attention not only to the brewing community but also to the beer consumer, as shown by the various references on this subject. If hop growers want to be competitive in the quality circle, they have to take into consideration standard quality requirements which are set by European Legislation. Hop growers also have to comply with the new requirements, which were induced by global economic, technological, social and socio-economic changes in the last decade, and which are strongly present in hop growing and brewing.

The brewing value of hops is assessed according to the content of bitter substances (alpha-acids), aromatic substances (essential oils), tannin (polyphenols, anthocyanogenes, tannoids), the oxidation state of hops, i.e. the degree of oxidative deterioration of hops during handling and storage, utilization of bitter substances, the quality of bitterness and aroma. Still newer and newer quality requirements are being set in hop production, such as consumers' health protection, pesticide residues, nitrates and the presence of heavy metals.

Hops affect flavor stability of beer in various ways, most of them positive; in particular by suppressing typical ageing flavors. Certain mechanisms of action can be supported by the tailored addition of hops. For one thing, it appears to be beneficial to increase the quantity of humulones and polyphenols by means of several doses in the brew house – as this generates a larger quantity of free radical scavengers and radical inhibitors. This results in an intensified hop aroma which aids in the sensory perception of the beer as it ages. The fact that brewery use of hops would increase in the process is, of course, a positive side effect – particularly for the hop industry.

Science and technology development has gradually caused big changes in a hop and brewing industry. Most changes have taken place in: (i) beer production (automatic dosage, additives and hop portion, the time of malt brewing, frequent use of hop products), (ii) hop processing (pellets 90 and 45, hop extracts, isomeric hop products), (iii) hop breeding (changes in the variety structure), (iv) analytical methods, (v) ecological aspects and (vi) health-protective effects on consumers.

For beer brand marks certain hop variety or their mixture are used. The conservative character of beer brewing does not allow many changes in their process. However, with a concentration process in a brewing sector, where

merging of breweries appear more and more often, the brew masters’ decisions are being replaced by financial experts, who decide also for buying the raw materials (hops). Their prior strategy is not always quality of hops (aroma varieties), but the price of hops or kg of alpha-acids (higher yielding super-alpha varieties). If buying of hops base on a kg of alpha-acid price, than aroma varieties with lower yields are less competitive. The expansion in beer products has created the need for more distinctive hop varieties. The global hop variety list with all - on a market available hop varieties – is yearly updated by the International Hop Growers’ Convention (www.ihgc.org). In this way misunderstandings or a bad business practice could be avoided.

Introducing the **HACCP** system (Hazard Analysis of Critical Control Points) into a hop industry enables very efficient quality control as far as the consumers’ health protection is concerned. Beer is foodstuff and it has to comply with the valid regulations. Breweries have introduced the HACCP system into beer production and they require the same of raw material producers, that is the producers of barley and hop growers.

Table 3-1: Hop varieties divided into commercial groups

GROUP I: Fine aroma hops	such as Hallertau Mittelfrueh, Hersbruck Spaet, Klon 18, Lubliner, Saazer, SA-1, Spalt, Savinjski Golding, Styrian Golding (Celeia), Strisselspalt, Tettnang.
GROUP II: Aroma hops	such as Aurora, Bobek, Cascade, Cluster, First Gold, Fuggles, Golding, Hallertau Tradition, Mount Hood, NZ Hallertau, Opal, Perle, Saphir, Smaragd, Spalt Select, Sterling, Willamette.
GROUP III: Bitter hops/ High Alpha hops	such as Admiral, Chelan, Chinook, Columbus/Tomahawk/Zeus (CTZ), Galena, Hallertau Magnum, Hallertau Merkur, Hallertau Taurus, Herkules, Kirin Flower, Marco Polo, Marynka, Millennium, Northern Brewer, Nugget, NZ Pacific Gem, Phoenix, Pride of Ringwood, Super Pride, Target, Tsingtao Flower, Victoria, Warrior.

Source: Joh.Barth&Sohn, The Barth report, Hops 2010/2011

The HACCP is a preventive system of quality control which does not only ensure the quality of the final product but also the quality of raw material. It makes sure that the yield complies with the specification. So, only by taking all these factors in the “quality circle” into consideration, will a hop grower be able to achieve the brewing value of hops, their market value, a reasonable price and a long-term existence of his hop farm.

The **certification of hops** is another traditional procedure and has intention to declare the hop geographical origin and its quality. This is a fundament of the stable quality supply of beer raw materials. In EU the process is carried out by neutral state institution on a country level.

Hops and hop products, as far as they are produced within the European Union, are marketed according to the criteria of variety, growing region and crop year. The certification regulations of the EU assure that hop products can be traced back to the raw hops used and that they are classified correctly according to the aforementioned criteria.

The development of hop products minimized the use of raw hops in breweries mainly due to the considerably improved storability of e.g. pellets and extract. Although this stability is proved in many publications, the crop year is still of great importance when purchasing hop products.

3.3 Market statistics for hops

As the production of hops is confined to relatively few countries, a considerable amount of hops are traded internationally. Many varieties of hops are traded, with different regions having specific preferences for particular varieties,

depending on consumer tastes and existing production. For example, the US growers are traditionally specialized in producing super-alpha hop varieties and therefore the USA imports large quantities of aroma hops. On the contrary, German growers were conventionally focused in aroma hops and thus merchants and breweries in Germany import necessary quantities of bitter or super-alpha hops.

However, for the sake of the existing global competition, growers in both countries act in farm management as entrepreneurs. They are forced to adjust dynamically their farming variety spectrum to changing demands of the global brewing industry.

On the following tables and figures, statistics from the hop market supply are demonstrated for the 1st decade of the 21st century. From these figures it is evident the importance of the EU hop supply for the brewing industry. In addition, also the dynamics of hop acreage changes is obvious as well.

Table 3-2: Evolution of worldwide hop production area from 2001–08 (ha)

	2001	2002	2003	2004	2005	2006	2007	2008
Europe (EU-27)	36259	34942	33019	33370	31020	29881	30167	31300
Europe (others)	3004	3346	2404	2308	1886	1884	1373	1452
America	14536	11776	11314	11232	11817	11912	12509	15889
Asia	4918	6109	5642	4400	3486	3544	5796	9369
Africa	512	510	503	503	506	438	438	444
Oceania	1176	1288	865	957	852	717	791	831
World	60405	57971	53747	52770	49581	48376	51074	59285



Source: Joh.Barth&Sohn, The Barth report, Hops 2010/2011

Fig. 3-1: Global hop areas 1999 – 2010 in ha



Source: Joh.Barth&Sohn, The Barth report, Hops 2010/2011

Fig. 3-2: Global hop production 1999 – 2010 in metric tonnes

Furthermore, if we had analyzed a longer time period, this negative trend would have appeared still more obvious. In 1992 for example, there were over 92,000 ha of hop fields in production worldwide. Such a trend in acreage cutback could be explained by large spreading of higher yielding super-alpha hop varieties from the USA (Columbus/Tomahawk, Summit, Zeus) and Germany (Hallertauer Taurus, Herkules) with over 15% of alpha-acids, as well as by a changing trend of brewing technology using new (isomerized) hop products and reduced hopping ratio in the brewing process. The hopping ratio changed in 10 years from 5.5 in 2001 to 4.1 g of alpha-acids/hl beer in 2010. On the other hand, a quantity of hops produced globally is influenced by hop acreage, hop variety spectrum, production technique and last but not least by weather circumstances.

Table 3-3: Development of acreage and yields of hops worldwide

		2001	2002	2003	2004	2005	2006	2007	2008
Acreage (aroma varieties)	Ha	28,069	27,000	25,595	25,903	25,879	25,862	25,583	27,105
Acreage (bitter varieties)	Ha	27,460	25,725	25,064	24,197	22,565	20,212	23,940	26,759
Total acreage	Ha	57,967	55,348	52,203	51,408	48,995	46,095	49,523	53,865
% bitter varieties	%	47.4	46.5	48.0	47.1	46.1	43.8	48.3	49.7
Acreage (new)	Ha	2,438	2,623	1,544	1,362	586	844	1,551	5,420
Yield (aroma varieties)	Kg/ha	1,361	1,448	1,233	1,486	1,636	1,338	1,559	1,706
Yield (bitter varieties)	Kg/ha	2,203	2,911	2,116	2,238	2,265	1,846	2,171	2,426
Yield (all varieties)	Kg/ha	1,703	2,059	1,812	1,802	1,907	1,766	1,815	2,063
Yield of alpha-acids	Kg/ha	149	155	135	164	167	151	165	194
% alpha-acids	%	8.8	7.5	7.4	9.1	8.7	8.5	9.1	9.4
Production (aroma varieties)	Tons	38,212	39,090	31,566	38,504	42,336	34,594	39,893	46,228
Production (bitter varieties)	Tons	60,494	74,892	53,024	54,160	51,106	37,306	51,974	64,912
Total production	Tons	98,705	113,983	94,590	92,655	93,445	81,401	89,866	111,140
Production of alpha-acids	Tons	8,639	8,596	7,023	8,452	8,158	6,956	8,161	10,468

The requirement of hops for brewing beer internationally is very specific in both quantity and quality, while the supply of hops is unpredictable. Therefore there is an extremely inelastic demand for hops with variable supply, which results in shortages and surpluses of specific hops in any given year. World hop production is cyclic. In the period analyzed an extreme shortage of hops globally appeared in 2007. However, already after the harvest in 2008 - several years of world hop surpluses and depressed spot market prices followed.

The demand for hops world-wide is dependent on beer consumption. In Europe, America and Africa beer consumption is rather stable. In East Asian countries - it is increasing. Furthermore, in 2003 China took the 1st place in a global beer production that in 2001 globally totaled 1.42 mill hl while in 2010 it reached already a quantity of 1.85 mill hl. Supply of hops is assured by the diversity of production centers, which specialize in certain markets. Bitter hops and high alpha hops continue to be the most widely produced varieties worldwide. The production of aroma hops is stepwise decreasing. In 2001 aroma hops represented 39% of the global harvest, and decreased to 37% in 2010. However, an increasing growth of craft breweries in the USA and worldwide - that use predominantly aroma hops - might change this tendency in the future.

3.4 Conclusion

Wherever beer is produced around the world, regardless of the type or brand, it is hops which preserve beer, make it bitter and provide its unique hop aroma. Unlike malted barley, which can be supplemented by rice, wheat or maize, hops have no substitute as a raw material for brewing. Plentiful, quality and healthy hops give pride to the hop grower, are welcomed by the hop merchant and brewer and provide pleasure to the consumer - a beer drinker.

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