This document concerns:

SHELL FARMING SECTOR IN CROATIA

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Abstract:

The mission of this Study is to give the highlights into the shell farming sector in Croatia, including national perspective, present situation in the sector and relevancy of the purification centres. The aim of the study is to identify possibilities and challenges in order to improve efficiency, productivity and competitiveness of the sector.
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1. INTRODUCTION

The main objective for CroNoMar is to find interesting business opportunities, and to implement them in business-relations together with interested cooperating partners.

CroNoMar’s goal is to identify potentials for business improvements, and markets for new products and services in marine and maritime sector, and to participate in processes to commercialize these new business propositions. The end-result shall be prosperous new jobs and activities in Croatia.

CroNoMar is spending considerable resources on stimulation activities in order to generate deal-flow of new commercial ideas and business opportunities.

The types of stimulation activity will be:

- PR and publicity activities to market our services and contribute to an improved business oriented culture and attitudes in the region. Establish good relations to relevant public and private development agencies where potential idea-holders seek assistance and contribution
- Proactively towards national R&D-institutes, educational institution and students from the region to be trained in entrepreneurship and look for maritime relate business opportunities during their studies
- Establish proactive cooperation with existing business communities, national and regional public authorities, with financial and knowledge development organizations, branches, clusters, unions, associations, etc, in order to highlight non-released potentials and opportunities for new businesses and new business models, and jointly take new ideas into:
  - Feasibility studies
  - Pre projects
  - Development project
  for further development and evaluation as new business opportunities

The prime objective from CroNoMar with feasibility studies is two-sided:

- Identify new marine and maritime business concepts that are relevant as new competitive products and services to be produced and marketed from Croatia.
- Identify cooperative partners that have interest and capabilities to be our partners in such commercialization.

A secondary result is that these studies very likely will identify considerable improvement potentials by upgrading the structure and operational focus of integrated business branches and sectors. Such commercial potentials can only be achieved by close cooperation with all parties from individual private companies and local and national agencies and policy makers.

This feasibility study highlights the shell farming sector in Croatia and includes view of following areas: including

- Regulations and motivations for a sustainable aquaculture sector and further steps in that area
- Purification centre
- Market conditions
- Highlights improvements and expansion possibilities, etc.
2. DATA ABOUT SECTOR

The whole aquaculture sector in Croatia includes farming of Sea bream, Sea bass, Tuna, Mussel, and Oyster with 138 shell farmers, 32 white fish farmers and 8 tuna farmers.

The yearly aquaculture production in 2008 was:
- Shells some 4.000t
- White fish some 4.000t
- Tuna fish some 6.000t

Present number of shell farms with capacity is:

**Dubrovačko-neretvanska county**
- Shell farms, 102 with production of some 3.000t* Note – over estimation which need to be adapted to official data when they will be published

**Splitsko-dalmatinska county**
- Shell farms, 2 with production of some 50t

**Šibensko-kninska county**
- Shell farms, 18 with production of some 500t

**Zadarska county**
- Shell farms, 5 with production of some 100t

**Istarska county**
- Shell farms, 11 with production of some 500t

Present production is not enough even for the domestic market.

(Source: Current time in aquaculture, fishing port, discharging places for fish, Antun Pavlović 2008)
In order to maintain sustainability of this value chain there is a need to achieve coordinated cooperation between all parties involved in it. It is relevant to have estimation about the production of shellfish and estimation of intended quantity that will be operated through the purification centre in order to have an economically worthwhile process.

The majority of shells are sold during the season, so the size of the purification centre should be determined by the estimation of shell quantity that will be operated by that centre. For example, in case of “brake out” of some kind of contamination or diseases zone A is transfer into zone B. If that is the case 2 times in one year that mentioned zone A becomes zone B for the entire year. In that case, the purification can be conducted in module system – like 2t + 2t. It is important to mention that the centre can have multifunctional role – like hatchery and purification or just hatchery when needed.
2.2. SHELL FARMS

Aquaculture is the food production sector with the fastest growth in the past 30Y. Some factors are giving determination for these facts:

- Increase of demand
- Limited Offer
- Constant development of technology

Majority of shell farms in Croatia are located in Dubrovnik region (102), Šibenik region (18) and Istra region(12). Concessions are issued on period from 5 to 20 years. So far concessions were typically for 50t/y and less. Now concessions for 400t/y are way where ambition is to professionalize the sector. Mentioned quantity is max production limit in coastline protected area without obligation to made IPA (Impact assessment). Over that quantity there is obligation for an environmental protection study. As distance from shore for production site are increasing production limit is also increasing.

The shell farms are usually operational as family crafts and their way of work is not industrialized (there is not a professional system for quality testing, processing and marketing). Producers are selling their products from “hand to hand” (directly to restaurants, or on markets, etc.). There is a lack of official data about exact quantity sell on domestic market and export is still not allowed due to adjustment to European rules and common practise.

In 2008 quantity of produced mussel and oyster together in Croatia can be estimated on some 4000t/y. Some indication shows that this number can be increased by some significantly increased due to shells sold on the "grey market ".

In 1991, Croatia was forbidden to make an export to EU countries due to demand of adjusting regulation to EU standards (91/492/EEC). Main difficulty was a requirement to establish sufficient numbers of authorised monitoring laboratories and declare a production area. Monitoring is established and conducted, and the other requirements are satisfied. The next step is arrival of EU commission to get the needed approval related to export to EU market. Major obstacles are expected to be changed during the 2010.

Related to all above shells are not competitive on the abroad market jet.

Main advantages of Croatia for developing the aquaculture sector are:

- Length of coast with many islands
- Clean environment
- Tradition in shell farming and fishery, etc.
- Zone for mariculture in major shellfish area included in spatial plans

Main disadvantages are:

- Non existence of necessary value chain for infrastructure (cleaning, packing, etc.)
- Long procedure to establish new area and site for shellfish culture where aquaculture is not planned
- Many small and independent farms do not create basics for a professional value chain development making quantity oriented processing and distribution
2.3. NATIONAL PERSPECTIVE

National Strategy of Croatia for aquaculture and fishery sector is from year 2002. The plan in 2002 was to increase annual production of white fish in Croatia from 3.000t to 10.000t and shellfish from 2.500 to 20.000t up to year 2010. Long term strategic goal of Croatia is to bring Croatia among leading Mediterranean countries in fish and shellfish production and in competitiveness of products. The plan was to significantly increase production and an assortment of cultivated fish and shellfish with internationally recognized quality, and with compliance of all environmental standards in production, with special care about environmental protection and compliance with other users.

Cultivation of shellfish in Croatia:

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</thead>
<tbody>
<tr>
<td>Shells</td>
<td>790t</td>
<td>900t</td>
<td>1.100t</td>
<td>1.111t</td>
<td>3.000t</td>
<td>2.500t</td>
<td>Estimated 3000-4000 t</td>
<td>20.000</td>
</tr>
</tbody>
</table>

(Source: Ministry of agriculture and forestry, State Institute of Statistics)

These estimations in 2010 were not achieved. Major reason for it was the EU barrier to export. In 2008 production of mussel and oysters was some 4000t.

(Source: Current time in aquaculture, fishing port, discharging places for fish, Antun Pavlović 2008)

According to the Ministry of Agriculture, Fishery and Rural development; Fishery Department and State Bureau for Statistic, the estimated production in 2008 was 2.800t of mussels and 1mill pieces of oysters only for domestic market.

In relation with national strategy basic determinants that should lead to the realization of future development of aquaculture and included shellfish culture in some points are:

- Cultivation of indigenous (autothone) species of fish and shellfish
- Reducing of production costs
- Take necessary measures to improve standards of environmental protection and improvement of product quality

The way how to come to the defined strategic objectives, should take place in three strategic directions:

1) Improvement and upgrading of production in the aquaculture sector through:
   
   - Alliance of aquaculture with the environment
   - Modernization of production and introduction of new technologies, education, training
   - Introducing new species into the industrial production
   - New investments
   - Development of new facilities directed to the aquaculture production
   - Coastal zone management, etc
2) Strengthening of basic infrastructure through:

- Establishment of a national reproductive centers
- Introduction of new ecological standards
- Organizing and directing infrastructure and logistical support to aquaculture sector,
- Adjusting a spatial plans in regions etc.

3) Support to research and development projects oriented towards the diversification of production (domestic new types and new species) and aquaculture products (range) in the direction of:

- Definition of marketing and promotional strategies
- Construction Centers for auction and trading of fresh fish and other aquaculture products, in accordance with modern standards for the sale of fish and aquaculture products
- Increase the production of shellfish and the construction of centers for cleaning, opening and packing of mussels
- Promotional and marketing strategy
- Creation of positive attitude related to aquaculture

(Source: Strategy for agriculture and fishery, 2002, Croatian Parliament)

**Priorities are given to this sector in order to create:**

- Official long term strategy
- Consistent regulations and administrative procedures
- Coordination science—administration—production; flow of information's
- Valorization of recently undeveloped area/ total area development
2.4. PURIFICATION CENTRE, CLEANING, PACKING, ETC.

Shellfish feed by filtering sea water and thus give them the ability to concentrate substances from their environment. Various microorganisms can be present in the sea water, as well as the chemical and physical substances harmful to human health that during the life cycle and breeding process, can accumulate in the body of shellfish. Therefore, live shellfish must be put on the market only through the dispatch center/distribution center.

Activity of this center consists of:

1) acceptance
2) wash
3) sorting (categorization)
4) packaging and labeling of shellfish
5) and their storage or loading for transport to market

After catching / gathering, the shellfish is initially cleaned from fouling (obraštaj), in the breeding area immediately by loading. On that way, a large part of fouling is removed, and after a rough selection by size a part of shellfish that are not ready for the market returns to the breeding park at the same locality. Shellfish that are mature enough to market size are transported to the shipping center.

In accordance with the regulations, after the hunting / gathering in the sea with the best quality of water (breeding zone A) mussels have to go through dispatch/distribution centers (otpremni centar) only for cleaning, sorting, packaging, and labeling.

In the cultivated area of zone B, the sea is suitable for cultivation with it quality of quality, but the shellfish prior to packaging and labeling in the dispatch centers and sending to market, must be submitted to a process of purification in the system for purification, which is usually located in the dispatching center. Using this process that is obligatory by the law, the elimination of the most common causes of illness in humans caused by consumption is ensured. The process of depurification lasts until the proper microbial products is obtained, which is usually 48 hours.

Rooms for storing and packing of shellfish are part of the dispatching center. Packaging is done properly in a hygienic way. Material for packing must be strong enough. Should not endanger the organoleptic characteristics of live shellfish, and should not be harmful to human health. Each package of live shellfish has to be labeled with a declaration which must contain the following information: country of origin, type of living shellfish (traditional Croatian and Latin name), the name and veterinary approval number of the dispatching center, date of packaging, label series or lot (as a deviation from the regulations, which regulates food labeling, duration, may be replaced by the text: “These mussels have to be alive for sale”). The declaration and sign on the declaration must be durable, waterproof, and the data on it must be legible and indelible.
General design and construction of distribution - purification centre follows the technological process of preparing shellfish for market

(Source: Regional Development Agency Šibenik)

2.5. MARKET CONDITIONS

It is not necessary to emphasize that quality product from water suitable for human food can be achieved only if the product is sanitary-veterinary correct.

Basic characteristics of shellfish market in the EU are:

1) increase of demand for cultivated mussels
2) growing concern for the safety of products
3) increased competition from all around the world
4) the increasing diversity of products based on bivalves (školjkaši)

When comes to domestic market, there are some present difficulties that in the future have to be resolved especially in shellfish culture:

1) Existing collecting and distributing centers for aquaculture products are mostly based on the floating pontoons and rarely on the shore and their capacity is not enough for present production from farming and from wild catch
2) No existing market channels
   • Strong “grey” market
3) No capital investment and high production costs
   • No technology development
4) Not sufficient zones for aquaculture
   • Conflicts aquaculture-fishery-tourism; “Bad image”
5) No promotional and marketing activities
   • Bad cooperation science-production-administration(very slow)
a) PRICES

Price of the mussel is mainly determined by the mode and state of shellfish during the sale, so the mussels which are processed into meat during the main season have the lowest price, as in the case with Spanish mussels. Mussels, which are coming on the market in fresh condition have significantly higher price. Consequently, the price paid to the producers significantly wavers as well in the world and in the EU. The average producer price of European mussels is around 650 € / per ton, but significantly wavers from different countries and regions. So in Spain the average cost is around 350 € / ton, up to € 1,750 / ton in the UK. Prices of European mussels were significantly higher than in the rest of the world; from 200 € / ton in China until the average price of about € 500 per ton for other producers.

The structure of the retail price of mussels on the EU market, €/ ton

It is obvious that the producer price presents a ¼ of retail price, and most profit in the whole chain is in retail. The rest of the price presents preparing mussels for sale, meaning cleaning and packing and transportation costs from farms to retail chains.

By simple comparison of today’s profit of producers where the price on ex-farm or in the direct sales on the farms ranges from 5 to 6 kuna, the conclusion is that entering to the EU market or competition from EU producers in the country, will not lead to significant reductions in price of the mussels. So, today’s price Croatian mussel in spite of higher costs of traditional production rates is competitive to European production costs.

Present market price:

1) 3 - 6 KN/pc oyster
2) 7-12 KN/kg mussel depends is it clean, or in a stock
The structure of the import market of the EU – according to the values in € and toward total amount in tonnes.

European countries importers of mussel-total imports of 191 million, 168 000 tons. (Source: Eurostat)

The largest importer of mussels is France with imports of about 47,000 tons annually, followed by Italy, with approximately 33,000 tons per year. However, from the picture is also evident that the highest price for mussels is paid by Belgium, more than 36% of total imports, which clearly indicates a large difference between the price of mussels imported to the Belgian market, in relation to the markets of France and Italy.

b) Export-import

The most important question is where to place future Croatian mussel production of planned 15-20 000 tonnes annually. That is, how to increase spending in the Croatian framework, and what measures to take in order to increase the total consumption of seafood.

For the export prospects, the fresh mussels are relevant only to the Italian market during the summer season, which is close to delivery within 24 hours, and whose capacities of spending are enormous. However, the Italian production of mussels is big, prices are relatively similar to the existing Croatian prices so the large placement of the production is in question, unless the Italians run out of local mussels. We should not ignore the possibility of the opposite scenario, import of the Italian mussels in Croatia on the same principles. Next option is to develop value added products, and canned mussels in various sauces.

In 2008 total import of shells and shell product was 315t. (Source: CCE 2009).

Import is related to fresh shell and to processed one. Shells are usually imported from France, Italy, Spain, Chile, etc.

Export in 2008 was 1.635t - mainly re-export. Export was only to Bosnia and Herzegovina and Montenegro. Export included mussels fresh and dried and scallops.
3. COMPARISON OF SHELL PRODUCTION BETWEEN EU AND CROATIA

In Europe there are three ways of breeding mussels:

1) French "bouchot", the way of growing mussels on raised poles into the mud, which dominates at the French Atlantic coast.
2) Farming on the bottom ("bottom" culture), which represents extensive management of bottom that is under concession, which is best developed in the Netherlands and Denmark.
3) Farming on a floating park, which dominates in the Mediterranean.

In order to find out our potential with respect to the size of the coast, and to reveal market demand for this product, we present a brief comparison of production from the EU.

Table 1. Comparison of shellfish production level from some EU members and Croatia

<table>
<thead>
<tr>
<th>Country</th>
<th>Length of the coast</th>
<th>1993</th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Francuska</td>
<td>5 500 km (Corsica, Mediterranean, Atlantic coast and the islands, Channel and North Sea)</td>
<td>205 500 t</td>
<td>218 500 t</td>
</tr>
<tr>
<td>Grčka</td>
<td>15 000 km (4 600 km of mainland coast)</td>
<td>19 000</td>
<td>26 598</td>
</tr>
<tr>
<td>Italiya</td>
<td>8 600 km</td>
<td>165 000</td>
<td>178 000</td>
</tr>
<tr>
<td>Španjolska</td>
<td>6 000 km</td>
<td>1998</td>
<td>263 000</td>
</tr>
<tr>
<td>Hrvatska</td>
<td>5 835 km (1 777 km of mainland coast)</td>
<td>1000</td>
<td>2 100</td>
</tr>
</tbody>
</table>

The length of the island's Mediterranean coast is approximately 45 000 km of which 17 700 km makes the length of the island coast. The length of the island's Adriatic coast is 4058 km, which makes up 23% of the length of the island's Mediterranean coast.

Table 2: The main producers of mussels in the world 2004th (FAO, 2006)

<table>
<thead>
<tr>
<th>Country</th>
<th>Farming (tona)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>534 503</td>
</tr>
<tr>
<td>Spain</td>
<td>247 730</td>
</tr>
<tr>
<td>Italy</td>
<td>94 000</td>
</tr>
</tbody>
</table>


From these numbers it is obvious conclusion that there is a possibility and the need to increase the cultivation of shellfish on the coast without going into greater competition with other activities.
4. STRUCTURING THE SHELL FARMING SECTOR

Important is to mention that issuing a concession is a matter of a public tender, and everything starts by letter of intent. All required will be in the conditions of the tender. The initiative to start the process of getting the concession at maritime domain (pomorsko dobro) for cultivation can be started by any physical or legal person registered for performing activities of breeding fish and other marine organisms. The initiative is submitted to the competent administrative authority in the county.

Starting point for calculating the amount of investment is information about technology and technical elements of the project as well as other elements of the project. The first phase includes the investment in fixed assets for setting up parks/farms and their floating anchor. Volume of investment is affected by the capacity. The second phase is investment in the materials (nabavu repromaterijala) and building the handling dispatch/distribution centre.

For example present model includes:

- Establishment costs for the farm, depending on the capacity, is in range from 15,000 EUR to 130,000 EUR.
- The costs of distribution center, whose needs are regulated by law, is in range from 40,000 (small floating)-140,000eur (larger on the mainland)
- Cost of other equipment (boats, etc.) - 10000-100000eur
- Necessary water surface 7.000m2 - 50.000m2
- 2-7 employees

Example of present model of calculation profit and loss in relations to farming mussels in 50t and in 500t at floating farms

<table>
<thead>
<tr>
<th>Mussel production/kg</th>
<th>50.000</th>
<th>500.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>300.000</td>
<td>3.000.000</td>
</tr>
<tr>
<td>Production costs</td>
<td>190.000</td>
<td>930.000</td>
</tr>
<tr>
<td>Material and others</td>
<td>40.000</td>
<td>430.000</td>
</tr>
<tr>
<td>Own work and employees</td>
<td>150.000</td>
<td>500.000</td>
</tr>
<tr>
<td>Concession on the maritime domain</td>
<td>6.000</td>
<td>50.000</td>
</tr>
<tr>
<td>Amortization</td>
<td>48.000</td>
<td>270.000</td>
</tr>
<tr>
<td>Investment održavanje</td>
<td>5.000</td>
<td>60.000</td>
</tr>
<tr>
<td>Other costs</td>
<td>8.000</td>
<td>40.000</td>
</tr>
<tr>
<td>Total expenditures (Ukupno rashodi )</td>
<td>257.000</td>
<td>1.350.000</td>
</tr>
<tr>
<td>Gross income (Bruto dobit)</td>
<td>43.000</td>
<td>1.650.000</td>
</tr>
<tr>
<td>Taxes</td>
<td>8.600</td>
<td>330.000</td>
</tr>
<tr>
<td>Net income (Neto dobit)</td>
<td>34.400</td>
<td>1.320.000</td>
</tr>
</tbody>
</table>
a) Example of existing model of shell farms
b) Example of other possibilities for shell farming
(Instead to use buoys, other possibilities are polyethylene pipes)

This way of farming requires few technical components:

- 2x200m barge (carrying capacity 86 t of mussels, 10 000 m 6.5m deep collectors, 50 t mussels with 5kg/m)
- 2 end tubes
- 600 m main line
- 200 buoys of 100l
- 1600 rope ends for collector
- 3800 knots

Attachment                                          Collector attachment
Attachment
- Upper "comb"
- Zigg zagg-50%improvment, utilizing length
- Zero torosion
- Attachment above surface-no fouling
- Locked by gravity-collector “strangulated”
- Loosens by upward pull

Advantages of this model are:
  a) Restocking
  - Small boat (less investment costs)
  - One person (launches 400kg (one box in 7min)
  - Double speed with half manning
  b) Easy access
  - Excellent working conditions
  - Dry work (connection above water level, no heavy lifting operations)

Conclusion
- One unit, all integrated (high second hand value)
- Simple installation
- Simple attachment
- Handled by small boat, no crane
- Movable
- Nice looking

This model is very industrialized way of doing things but also requires more investment costs. If the size is in order of certain limit and the workmen costs are ineffective, than this model is economical.
5. SHELL FARMING IN ŠIBENIK AREA

Area in the Krka river estuary from the line of Martinska / Crnica up to the Prokljansko lake is a zone that is in size, morphology and ecological characteristics ideal for growing shellfish and fish. As this is an extremely biologically productive and physicochemical quality protected area, that is a unique place in the Adriatic for the production of healthy food.

Growth and survival of cultivated shellfish depends on several factors:

- the quality of the younger
- the amount of available food (phytoplankton)
- physical-chemical characteristics of farming areas
- the temperature regime, oxygen, salinity, water currents,
- organisms that grow to it (obraštajnim organizmima)
- diseases and attention at work

Process of mussel farming

Spawning is almost during the whole year and primarily in spring and secondary in the summer. Consumer size of 60 mm is achieved in 12-15 months.

When the mussels reach commercial size, begins their collection and preparation for the market. For production from 65 to 70 tons of mussels per year (basic breeding unit), the need is only for one floating line for acceptance of younger and 5 floating line for growing up to the size for consuming. All above mentioned includes an area of 3.000m².

Oyster farming

The technology process of controlled farming of oysters requires the following equipment:

- Floating line for the cultivation of shellfish (10 floats at a distance of 10m - a total length of 100m, a protective belt of 3m from the side and from the ends - total area 742m²) with equipment for anchoring
- Collector to accept the younger oysters
- Boxes for the cultivation of oysters

Consumer size from 80 to 100mm can be achieved for only 20-24 months.

For the production of about 100,000 pieces or 8 tons of oysters per year (basic breeding unit), the need is only for one floating line for acceptance the young's and 4 floating lines for farming oysters up to the consumer size (because it is grown in the two-year cycle). That all together includes an area of 2.400m². Mostly exists/lives in regions with a constant flow of fresh water.
Farming of scallop shell (jakovska kapica)

In the Šibenik region, this shell lives on sandy-muddy, rocky seabed, from 5 to 25m depth. This shell is spawning mainly in spring and early summer. This shell requires environment with higher salinity (above 30 ‰), lower limit for the survival of larvae and adult specimens is 20 ‰ and the largest number of them are in the northern Adriatic. The specie prefers cooler areas of the sea with strong currents. It can grow up to 17 cm, although it is rare to find examples of more than 15 cm.

Consumer size of 85mm and 85g is achieved a little faster, that is only in 20-24 months.

Most likely is that expansion area is to be based on mussel farming in this region.

6. ENVIROMENTAL IMPACT

Presently, aquaculture has a very bad image in the media. However, realistically looking, the main influences are:

- Occupation of space
- Giving a new visual perspective to the environment (Unošenje nove vizure u okoliš)
- The impact on the surrounding population (infection, etc.)

6.1. RELEVANCY OF THE PURIFICATION CENTRE

The prevalence and the possibility of illness caused by consumption of shellfish could be reduced if consumers, farmers and fishermen inform themselves better, to understand the risks and most importantly learn how to recognize and prevent the possibility of shellfish poisoning. If the shellfish is consumed from the non contaminated areas, areas under monitoring are on proper way catch, grown, if necessary purified, stored and controlled the risk is significantly reduced.

Shellfish, whether they come from farming or catch, are very vulnerable to physical, chemical and biological pollution, which raises the question of safety of consuming contaminated food. Shellfish filter daily in relation to their mass, very large amounts of water so the contamination of shellfish meat is by microorganisms, parasites and bioreziduama that are conditioned by their environment. Bacterial contamination of shellfish among others are coming from Clostridium botulinum type E and F, Vibrio parahaemolyticus, Salmonella spp, Escherichia coli, Streptococcus faecalis, Proteus spp, Clostridium perfringens, and as the scale for the pollution of area and possible contamination of shellfish, we look at the number of faecal coli forms as well as the presence of Escherichia coli and Salmonella. A large number of bacteria are reproduced in the meat and shellfish during their storage at the temperatures between 0 and -5 ° C (Pseudomonas and Achromobacter, Dobrota, 1970).

Viral contamination of shellfish is possible also with bacteriological "clean shell" so there is possibility of developing some diseases such as gastroenteritis and hepatitis by eating shellfish that come mainly from the port areas.
Chemical-toxicological correction of shell refers to their possible pollution by heavy metals (Pb, Cd, Hg, methyl Hg, As and Fe, Zn, Cu), PCBs, and biotoxins (Paralytic Shellfish PSB-poison; IPC NeuroparalyticShellfish poison; DSP-Diarretic shellfish poison), radioactive isotopes, as well as herbicides, insecticides, etc.

Improving the safety of shellfish for consumption is achieved partly through a controlled breeding in local waters with the prescribed monitoring, catch from the area under monitoring, purification, heat treatment, hygiene standards in processing and trade as well as with the introduction of new procedures in the processing of shellfish. Exchange of information from fishermen and farmers to consumers via the dealer or a possible insight into the origin of products is another very important step when buying products. For this purpose, the legal issue is the specifically prescribed content of the declaration.

Controls in the cultivation and harvesting of shellfish must be permanent, and related the harvesting areas. The shell must have known origin, well known process after the catch, supervised storage and its transport, and fresh shell must be alive at the time of the sale, unless subjected to processing.

(Source: Mr.sc.Mario Lovrinov, hzpss)

6.2. Example of the modern purification centre
## 7. SWOT Analysis

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
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</thead>
<tbody>
<tr>
<td>3) Natural Resources</td>
<td>6) Ineffective management (high production costs)</td>
</tr>
<tr>
<td>4) Appearance of the coast</td>
<td>7) Lack of quality financial monitoring and production support</td>
</tr>
<tr>
<td>5) Existing experience</td>
<td>8) Incomplete and misfits landscape plans</td>
</tr>
<tr>
<td></td>
<td>9) Protective tariff barriers to EU</td>
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<td></td>
<td>10) RH incompatibility sanitary-hygienic and environmental standards for shellfish farming with the EU standards, no possibility of sale on the EU market</td>
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<td></td>
<td>11) Non reliable data</td>
</tr>
<tr>
<td>12) Greater demand than supply; the trend of healthy eating on the EU market</td>
<td>16) Increase of supply from competing countries with more efficient production (increase in production in Italy resulted in a price drop)</td>
</tr>
<tr>
<td>13) Reduced catch of marine organisms</td>
<td>17) Bad image in public</td>
</tr>
<tr>
<td>14) Aquaculture as an important part of the island development</td>
<td>18) Lower competitiveness of the products</td>
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<tr>
<td>15) Need good marketing</td>
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8. CONCLUSION

The implementation of new legislation will lead to major changes in the work of local farmers. Given that, almost all farms in Croatia are in small capacity of farming (up to 50 tons) and are using traditional technology. There is no commercial breeding ground, which means that farming depends entirely on the plantation of young from the nature- in the sea, it will be necessary to change the approach to this activity.

Next difficulty is related to present legalization for this sector:

1) Divided between 3 Ministries (Ministry of Agriculture, Fishery and Rural development, Ministry of the Sea, Transport and Infrastructure, Ministry of environmental protection, Physical planning and Construction)
2) No active cooperation-coordination
3) Inspection problem

For further efficient development of this sector in relation to strengthening of the production base, and adaption of legislation frame there is a need to define some things:

- Production areas, both catch areas and breeding areas
- Areas for Re-laying of shellfish
- The introduction of systematic monitoring
- Define the institutions for conducting the monitoring
- Simplify the implementation of regulations in the practice
- Define the zone of collection of youth
- Redefine the criteria of regulations according to EU criteria
- Predict in the county zoning plans construction of the depuration Centers
- Consider and provide compensation for farmers in case of fytotoxina and the consequent prohibition of sale
- Solve the problem of financing of environmental impact studies

The current lack of infrastructure, particularly the organized port and handling space on land is a major problem for the farmers. Due to the lack of any working surface on the land, the primary manipulation of shellfish, especially cleaning takes place in or on boats or floating platforms.

In addition, waste management is not organized, and most of the fouling organisms and shells of shellfish ends up directly into the sea, which is generally prohibited. Trash must be separated, stored in special containers and disposed at dumpsters, or continue to process it in the compost.

The modern marketing is completely undeveloped. A placement of products is connected to the local consumption, and the market for the modern way of trading at the moment does not exist. Mainly, shellfish are sold locally on farms or packaged in large 30-kg bags at a fish market and big market chains, without stamps or marks of origin.

With respect to this way of selling important is also the existence of an unregistered traffic of shellfish, which is clearly visible between total productions of issued and paid benefits of subsidies for the production of oysters and mussels. The existence of informal “grey” markets should be reduced to the minimum, although it exists even in the EU, especially when selling at farms. The problem will occur by the first confirmed health problems, when the consequences will affect the entire sector.
The majority purchase of shellfish is carried out on the "gray market". There is no control of the collection or product quality. Establishment of traceability would make it possible that ultimately the buyer knows exactly what he bought, and that such a product can be marketed with a higher price. Further development of these activities will depend on the economically organized farmers.

Some modifications can take place in the future in order to improve competitiveness of this sector, like:

- Joining farmers into groups or associations
- Zoning the areas
- Ensuring the continuing health care quality and standards
- Adaption of production to the market needs (domestic needs, tourism needs, export)
- Market development and promotion
- Control of collecting on "grey"
- Organized purchase of shellfish - a transparent purchase
- Branding of products - control of the origin
- Adding higher value to the existing aquaculture products
- Farming domestic species
- Diversification of production by including new species
- Improving managing and reducing production costs
- Alliance with standard of environmental protection,
- There is no education; people do not realize the opportunities
- etc.

At present there are no sustainable marketing efforts from Croatian shell producers. This sector has no developed channels for processing and selling the products and that’s the challenge for all participants involved in this business.

Investment in the purification and distribution centre in size of about 140m² with capacity of 2t per day (24-48h) including pools and distribution centre is around 800,000,00 Kn without costs of construction, so only equipment costs.

Prior to that there should be some analysis like:

- analysis of the need to build such center
- a consensus of all participants-farmers, restaurateurs, retailers, consumers
- SWOT analysis for the justification of the construction
- identification of locations
- Creating/making documents for construction

The needs of one such centre should be economically satisfied if the annual traffic of shells would be around 2000t.

All mentioned above emphasises the importance of the future purification centres. It arises not only from this study but also from numerous available scientific works and from the need to harmonize present standards with EU rules. But primary, it is a necessary to conduct a detailed risk analysis and analysis of financial viability of the whole project in the current and projected conditions.
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