Preliminary study for DOTT symposium on bluefin tuna (BFT) impacts on local development: A socio-economic approach

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Preliminary study for DOTT symposium on bluefin tuna (BFT) impacts on local development: A socio-economic approach

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SUMMARY – The study presents BFT fattening socio-economic impacts on Mediterranean major BFT fishing fleet and the major fattening region. Impacts on fishermen are mainly: BFT price increase, modernisation, concentration of the fleet and integration of BFT fatteners. Positive impacts on Murcia region are observed on small scale fisheries, exportation and regional economy, while impacts on tourism, coastal management and environment are detailed. Is BFT aquaculture complete cycle production a future sustainable activity? In the context of world competition the question is even more acute as BFT fattening seems to pass from a pioneer profitable phase to a less profitable phase with increasing risks. Common priorities of socio-professionals and regional officers are presented.

Key words: Preliminary study, integrated coastal zone management, research priorities.

RESUME – *"Etude préliminaire pour le Symposium sur la Domestication du Thon Rouge, concernant les impacts du thon rouge sur le développement local : Approche socio-économique". L'étude d'aide à la décision présente quelques éléments de précision sur les impacts socio-economiques du développement rapide de l'embouche de thon rouge sur la principale flotte thonière et sur la première région d'embouche de Méditerranée. La modernisation et la concentration de la flotte ainsi que l'intégration des capitaux espagnols dans les flottilles sont les principales conséquences de ce développement. Les impacts économiques sur la région de Murcia sont nombreux et ceux sur l'environnement ou le tourisme, sont présentés. Est-ce qu'une production aquacole de thon rouge est économiquement durable à l'avenir ? Dans un contexte de compétition internationale exacerbée, la question est très prégnante d'autant plus que la filière engraissement de thon rouge semble passer d'une phase pionnière lucrative à une phase plus incertaine où les risques augmentent. Les priorités de recherche communes aux socio-professionnels sont présentées.*

Mots-clés : *Etude préliminaire, développement intégré des zones côtières, recherches prioritaires.*

Introduction and objectives

This preliminary study is part of a DOTT seminar as a support tool for decision making. Its objective is to give some concrete socio-economics indicators and involve, from the beginning, representatives and organisations that will not be able to express themselves in the seminar. The aim is also to present some impacts of Bluefin Tuna (BFT) fattening in Mediterranean context and synthesis of opinion of various stakeholders of the coastal area concerned by the results of a potential ambitious BFT European Research Programme: i.e. fishermen and producers organisations, environmentalists and consumers, regional policy makers (environment, tourism, fisheries offices).

The study also presents some recommendations concerning sustainable fishery and aquaculture in a context of integrated and harmonious development of coastal areas.

Methodology

The study is built around the comparison of two exemplary sites in France and Spain:

(i) Murcia region (Spain) is a pioneer territory in Mediterranean Sea where BFT fattening exist for 5 years. The main interests consist of measuring the impacts on local economy, employment and environment, new interactions (tourism, small fisheries), new activities and future perspectives.

(ii) Languedoc-Roussillon Region (France): this region has the largest tuna fleet in the Mediterranean Sea but does not produce BFT in cages. The main interest is to present perspectives of interactions between fattening and BFT fisheries in a context of tuna fisheries restrictive stocks.

In each of the two sites, CEASM collected and summarised existing data concerning the impacts of BFT fattening on the local economy (PIB) and employment, the coastal environment, the interactions with other users. In each of the two sites, CEASM collected and summarised the points of view of various structures and regional officers through the following questions: What are the indirect impacts of BFT and the perspectives of development for the fattening production channel? What are the perspectives of development for a sustainable BFT aquaculture in the Mediterranean Sea? What are the breaks, the needs and the priorities for a future BFT research programme?

Languedoc-Roussillon BFT production

With 32 boats permanently specialised on tuna fishing, BFT fisheries production represent 21% of total value for the fishery production field. BFT French fishing fleet major production is centred on the Balearic Islands (70-75% of regional BFT production) during the months of May-July, targeting 117-126 kg/fish on average. The French fleet is seeking as well smaller BFT, in the Golf of Lion, during the early season (March-May: 28 kg/fish) and the late season (August- October: 14 kg/fish).

BFT catches from Balearic Islands (estimation of 4800 kg in 2001) are transferred alive from fishing nets to cages and pulled to the Murcia region, where they are fattened in a short-term cycle (3-6 month). It is assumed from the data and interviews that between 1997 and 2001, the quantity of catches transferred alive to cages increased from 20% to almost 95% of Balearic captures. Nowadays, BFT Spanish fatteners are also seeking BFT resources in southern Mediterranean countries (Malta, Italy, Tunisia, Libya) (15-50 days trip) (CEPRALMAR, 1999).

Impacts of BFT fattening on French fishing fleet

No data could be collected on BFT fattening effects on regional PIB and fishing companies accounts since most of the data are kept private and secret.

Prices increase for BFT primary product: the prices for "BFT livestock" are 50 to 100% higher than the "dead tuna" since fishermen have to spend longer time between fishing runs. In addition prices increased (+30% average) during the last 5 years and 65% for live tuna increasing from 4 to 6 euro/kg.

Modernisation of French fleet and strategic changes: the rapid rise of BFT fattening demand, and the increase in prices supported technical, and comfort improvements onboard. Since BFT is valorised as "live BFT", the target for producers is a better access to BFT resources and is less focussed on storing techniques (freezing units, etc.). The consequences of BFT fattening on French fleet are:

(i) Specialisation on BFT: before 1995, some of the fleet was partly fishing small pelagic fish. During the period 1995-2000, specialised BFT fleet increased from 21 to 32 boats in the region.

(ii) Increase detection efficiency (sonar, planes): the fleet bought 2 new sonars/year in the years 1990-1993 and 6 to 7 new ones/year in the last 5 years. For BFT school detection in the Balearic islands, fatteners rented 2 planes in 1993 and this increased to 22 planes in 2000 to support the fishermen, introducing aerial traffic problems. In 2001, planes were forbidden in July.

(iii) Increase speed (size): the priority is not any longer to store the fishes (since they are transferred to cages alive) but to reach BFT resources as fast as possible, thus, increasing speed and length of the boats. In 1992 all the boats were below 27 m length, in 2001 the newest boats (less than 10 years old) have an average size of 35 m.

(iv) Diminution of investment on quality facilities: new freezing equipment on fishing boats are less and less important since alive tuna are purchased. In the first years of fattening, Spanish fish processing industry rented "cargo: swimming pool boats" from Atlantic side (Russia, Galicia, Scotland) to improve storage capacity for dead fish. In 1997, they bought almost 20 carriers.

(v) Changing capture techniques: increase in number of skiffs, platforms to lift the skiffs onboard, increase net sizes in order to catch bigger schools and store the fish better (waiting for the tugboat and the transfer to the cage). Some producers start to imagine inflated cages (stored onboard) that would allow to stock fishes allowing pursuing new schools instead of waiting for the tugboats.

(vi) Improving security, communication, comfort: desalinisation systems, security systems, etc.).

Concentration of the fleet: the French fleet is becoming more and more concentrated to compete with other countries and fishermen. In France, 3 major fishermen and fish processing companies are leading the sector (3 to 5 BFT fishing boats each). Recently individual boat owners developed a shared company in order to face competition and allowing fatteners to participate in fishermen's boat capital.

Diminution of pressure on BFT resources: catching *"live fish"* could induce reduction on fishing effort (reduction of fishing time) since the fishing boats have to wait for arrival of tugboats (often hours) in order to proceed to after transfer to transport cages. Thus they are not seeking new schools. Better studies have to be conducted to determine the precise impact on captures.

Impacts of BFT fattening on French fish processing companies

5 companies out of 23 processing fish companies are specialised in BFT (70% of their incomes is due to BFT). They have contracts with the major French supermarket chains (Carrefour and Auchan) to secure commercialisation of small fresh tuna[1]. All BFT products now reaching Sète harbour are directed to French supermarket chains. The quick Spanish move to fattening "live tunas" induced some negative impacts on local companies and public investments:

(i) Lack of use of transformation plants: the Stock of BFT frozen in Sète facilities is almost at zero.

(ii) 1/5 Reduction of local manpower capacity: qualified manpower used by the processing companies had to be disbanded. For some of the companies that developed partnership with Spanish fatteners, some French qualified workers are sent to Spain in order to form Spanish professionals and work at the Spanish partner site during the high season.

Impacts of fattening on Murcia region

In 2000, the BFT annual turnover of 270 million euro contributes to more than 2.2% of the regional GDP. Murcia is the first BFT fattening region in the world and the pioneer region in Mediterranean Sea with 6 farms owned by 4 major fish processing companies (Fuentes, Albaladejo, Mendes, Caladeros del Mediterraneo). While fisheries production is stabilising at 10 million euro in value, the BFT aquaculture passed from 77 tonnes in 1996 up to 3660 tonnes in 2000 (Fig. 1) representing 8 times the value of all regional fisheries (80 millions). This evolution is due to their very rapid adaptation to Japanese market, and development of strong partnerships with Japanese companies.

Between 1994 and 1999, public investments represented 53% of the global aquaculture projects (4 million euro). With 158 million euro of exportations, regional benefits are clear (further detailed study is needed on indirect economical impacts) (CES, 1999; CES, 2000).

Impact on Murcia commercial exchange

BFT exports are ranked 6th among all other exports from the region and represent now more than 94% of the global marine exports (Fig. 2).

Tuna is the first ranking product exported to Japan with 158 million euro in 2000 (94% of all tuna export, 76% of all export to Japan) after plastics (12.8%) and wood furniture's (2.3%). Due to BFT fattening (no BFT fishing fleet in the region), Murcia is now the 4th region of Spain for exportation to

[1]The biggest fresh tuna market for consumption in Europe is the French market.

Japan and the second for tuna exportation. After Asia (Japan) representing 94% of total BFT export, Europe (4%) and USA (2%) are the main exporting regions. France is the country with the highest commercial exchange after Japan (INFO, 2000; INFO 2002).

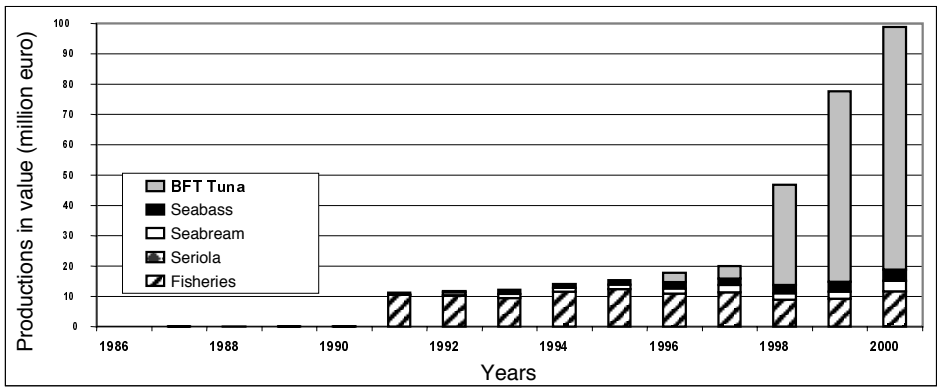

Fig. 1. Evolution of aquaculture/fisheries production in Murcia region (Services of Fisheries of Murcia, 1999-2000).

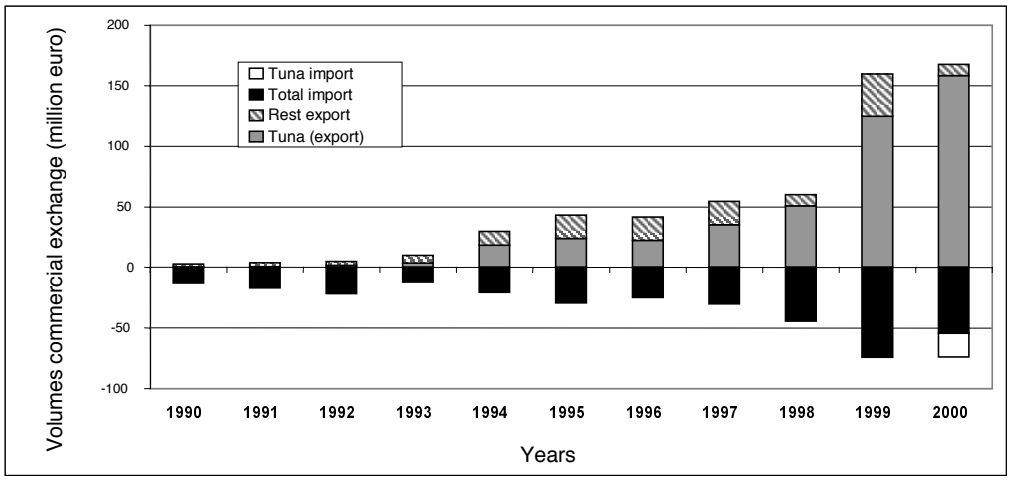

Fig. 2. Murcia regional marine products commercial exchange (source: INFO, 2000).

Murcia fish-processing industry developed various transformation plants, explaining the importation of tuna from various countries in Europe and Central America. New markets in USA and Europe are also developing in the last years. In 2001, tuna exportations to Europe increased by 50%, to America by 76% and to Asia by 3%.

BFT experience valorise strongly Murcia region capacity for exportation and commercial reactivity. Nowadays, Murcia uses Japan experience as a marketing argument (excellence, seriousness) for other countries, especially in Asia. Murcia region is thinking of a marketing campaign in Japan for Murcia agro-products supported by the BFT experience.

In addition, the rapid adaptation of BFT fatteners to Japanese market, its leading ranking place in the world is a strong example for the younger population in the Murcia region.

Impacts on MURCIA infrastructures (harbours, airports)

Impact on local harbours is important since fatteners are using large amount of supply boats

(maintenance, taxes, diesel, etc.), however the present study did not allow this to be studied fully. As an example for 2 farms producing more than 2500 tonnes in total, they need 40 boats comprising: 5 boats over 30 m length, 14 boats of 15-25 m for feeding supply, 10 small boats for support divers and transfer, 4 tugboats and 8 local fishing boats to tow cages and support the feeding campaign.

After using local Murcia airport, BFT fatteners prefer Alicante airport (no precise data available).

Impact on MURCIA local employment

According to ASETUN, the BFT industry provides 500 places for direct employment. No precise data was available at social or fishery services on indirect employment. However data collection from 2 companies conclude that 70% of the employees are divers working at sea. As an example 2 companies increased from 15 persons to 113 persons in 4 years and employees are young (between 25 and 35 years old). In addition, professional diving with BFT is concerned with security and social regulations especially for BFT transfers after fishing and at BFT killings in the cages.

Interactions of BFT fattening activity with local fisheries

In the beginning, strong conflicts developed because of fisherman's opposition to BFT farms. Although some animosity remains, after 5 years, the relations are better and most of the interactions found between BFT activities and local fisheries are positive.

BFT fattening impacts on local fisheries employment: BFT fattening supports local employment of marine workers. BFT fattening is attractive for young fishermen since the working conditions are better than on the fishing boats (regular hours between 7 a.m. and 4 p.m., regular salary, everyday at home, week-end on land). This has been reported to slightly affect the local fisheries since fisheries have more and more difficulties to find qualified marine workers. However, the decrease in fisheries attractiveness is a general difficulty of fisheries to adapt to the evolution of society in Europe. The increase of foreigners (North Africa and Africa) in fishing crews does not seem to be linked specially to BFT fattening. A specific study should conduct to give more precise conclusions.

Reduction of local fishing effort: one of the side effects of BFT fattening is the contracting with small-scale fisheries boats in order to support BFT activities and specially:

(i) Feeding BFT cages: for each fattening company, 2-6 fishing boats (with 4-8 crew members) are contracted each year for a period of 5 month between July and December. From fisheries statistics, an average estimation of 3-7% of total catches are not purchased per year.

(ii) Towing cages from fishing grounds to Murcia feeding cages: during Balearic season, high demand on tugboats (BFT, transports, harbours, etc.), increased the price of tugboats renting. Therefore, during this season, fatteners contracted with fishing trawlers (2-6 in total). It can represent an average of 1-3 or 4% of annual regional trawler catches that could be saved (to be studied in details).

New incomes for local fishermen (new pelagic fish): "Alacha" gilt sardine (*sardinela* spp.), local small pelagic fish were, for years, thrown away at sea by pelagic seine fishers as a by-catch product and is nowadays the 1st major product of landings in the region. While the total fish landing volumes are decreasing since 1995 from 8000 to 5000 tonnes, gilt sardine passed from less than 5% in 1993 to almost 35% of the landings in 1999 (Fig. 3) mainly because of BFT activity. In addition, gilt sardine prices doubled in 5 years. Mackerel, and Kingfishes are also part of BFT meal when local prices are down. Feeding is one of the highest expense factors and producers are seeking prices below 1 euro/kg (gilt sardine is bought at about 0.5 euro/kg).

The supply of BFT production with regional small pelagic fish is not the priority of fatteners because of the small volumes involved. The regional BFT fattening industry approximately requires between 35,000 to 50,000 tonnes of small pelagic fish/year (estimations) and small pelagic fisheries represent a small part of this needs (2000 tonnes). An increase of gilt sardine (sardinela) volumes is however due also to specific fishing campaigns and small pelagic stock management becomes a priority in addition

to BFT stock management. Demand and prices on high quality small pelagic could increase (competition of fish meal for aquaculture, risks of metals concentrations in pelagic fish from the North and Baltic Sea).

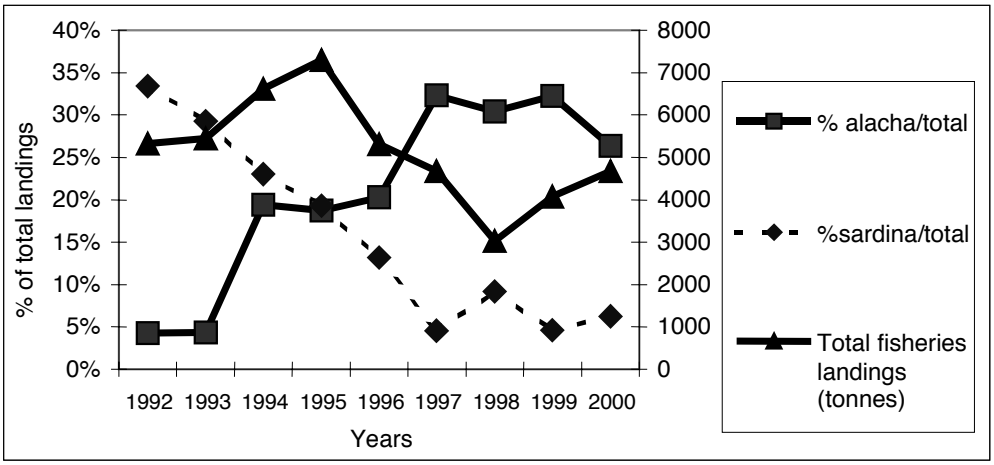

Fig. 3. Valorisation of local gilt sardine (Allacha) small pelagic fish from BFT industry (Services of Fisheries of Murcia, 1999-2000; CES, 2000).

Some fishermen and environmentalists criticised BFT farming assuming that diminution of pilchard (sardina) captures in the Murcia region is linked with the development of BFT farms (BFT in cages would scare small pelagic, etc.). According to landing statistics, it seems not to be true: the increase of other small pelagic fish (Gilt Sardine and Kingfish) was observed during the last 10 years, and the decrease of pilchard captures occurred since 1990 [much before the first BFT farms (1994-1995)].

Interaction with longliners: tugboats, with cages of 25-35 m depth, cross from time to time longlines and destroyed them. Some conflicts are presently under discussion (Spanish and Maltese longliners). Some of longliners seem to plant their longlines on purpose in front of the tugboats in order to receive compensation. To solve the problems of expenses, BFT companies prefer to rent special boats in order to guide the tugboats during their long trip from fishing grounds to Murcia (15-50 days).

Interaction with fishing auction hall and local fisheries: BFT fattening is a fishing-linked activity and not completely an aquaculture one. For these reasons, fishermen are asking that BFT fatteners to use the fishing auction halls and pay taxes, while fatteners refuse because auction halls are not providing to them any service compared to fishermen (weight, collective selling, ice, etc.). For local social peace BFT companies are sometimes making small donations to fishermen organisations.

Some small-scale fisheries confirm that some of them are now often putting their nets close to the cages since the concentration of fauna is higher close to the cages.

Impacts on BFT Spanish fisheries: BFT fatteners interactions with French fleet had impacts of developing new partnerships with Spanish tuna boats for fishing campaigns.

Impacts of BFT fattening on the environment

Here are presented some of the conclusions of discussions with regional officers, farmers and university specialists.

BFT fattening advantages: BFT needs very high quality water (O_2, currents, far from freshwater sources). Thus densities higher than 4 kg/m^3 are not possible zoo-technically, the average practice is 2 kg/m^3. As a comparison, the average density for Seabream-Seabass is 20-25 kg/m^3 in cages. The pattern measurements over 4 years does not show an impact on the water column and small differences between control and under cages data for granulometry of sediments and organic matter

content. If anoxia happens, it is partial and recovery of sediments is observed often after the feeding period.

Benthic fauna and algal communities: there is an increase in fish populations under the cages (*Mugilidaes, Salpa salpa, Anguila* spp., etc.) attracted by the feeding and the lack of fisheries around this area. Diversity of fauna of the sediments (polychaetes and annelids) seems to change. Some data shows even an increase of polychaete and annelid diversity compared to controls. Thus, more independent studies have to be done.

The effects of cages on *Posidonia* (Sea grass meadows) and other sensitive populations (Maerl) are clear if the cages are too close (lack of photosynthesis, degradation). Murcia region now imposes a law to place the cages at a minimum of 300 m from *Posidonia* beds.

Thus the main environmental priorities for BFT aquaculture or fattening installations are: (i) study the currents and place the cage regarding to current patterns; (ii) place the cages at secure distance from sensitive species like *Posidonia* and Maerl (300 m); (iii) keep the farms as far as possible from tourism activities and the coast to avoid complaints (visual pollution, fear, interaction with activities); (iv) receive a political regional support for specific zones and Integrated Coastal Zone Management (ICZM) approach.

Interactions of BFT fattening and tourism

With more than 700,000 tourists/year (1% of Spain tourism) Murcia tourism is undergoing strong development.

Sport diving on BFT cages: one trial was conducted in Murcia. The experience stopped when, during a feeding watch, a BFT hit a diver with its fin by accident. Even if interesting economically for the diving company, it became too dangerous for the BFT company to risk its image for such little activity. Lessons could be taken into account in order to plan a better system with risks controls.

Sportfishing: BFT cages attract fish and sport fishermen, who profit from the ease of catch. They are often fishing close to the cages. It is a problem for professional divers that can hurt themselves with hooks or lines caught in the cage nets. No extension of these interactions are possible, control is difficult.

Competition for space: future place of aquaculture in coastal zone development? Critics of tourism on BFT cages are more a psychological fear of intensive farm systems (pollution) and visual pollution than knowledge on the real impacts. The regional council has conducted a study in 2000 in order to establish the suitable zones for aquaculture concessions (Services of Fisheries of Murcia, 2000). A SIG cross-mapping has been done according to the possible sites and restricted area presented by each of the offices concerned by coastal zone occupation: Tourism office, Environmental office, Fisheries offices, Marine Military office. In conclusion, little space is available for aquaculture and further political coastal management decisions affect private visibility. A regional coastal zone management plan is therefore needed urgently.

Tourism (actual priority of economical development for the region) interactions and conflicts between BFT fattening will be stronger and stronger in the future even if tourism is also moving from "mass production" to higher quality, cultural and environmentally sustainable tourism.

Increasing risks for the BFT production channels

The main questions arising as expressed by the producers, regional officers and analysed during the study are detailed below. The context of low visibility at middle or long terms reduces the margins of this actual profitable sector and will affect the sustainability of some companies.

Production and investments costs are increasing (boats, tunas, trashfish, insurance, etc.)

For fishermen, as consequence of modernisation and concentration of the fleets, the increase in

boat prices impose plan strategies (like major industries) of up to 10-15 years (loans, new investments, etc.). For fatteners, the increase in the prices also affects their profitability [primary BFT products limited by quotas (+30% in 4 years), pelagic fish for feeding (+25% in 2001), insurance] since the Japanese market is slowing down.

Insecurity on access to Mediterranean resources

The countries from the south Mediterranean sea (Tunisia, Algeria, Libya) will soon have access to BFT quotas for political reasons between North and South. This competition is strongly feared by French fishermen even more nowadays when Spanish fatteners develop southern-partnerships in order to secure their production and market. In addition, EU regulations and the difficult ICCAT negotiations on Atlantic stocks will also affect private sector visibility.

Insecurity on BFT markets capacity related to international competition

In France, prices for BFT are around 1.5 to 3 euro/kg. BFT industry is completely dependent on the most interesting market of Japan where TORO flesh quality (all fattened BFT in cages are concerned) reaches often 40-57 euro/kg (Canadian Embassy, 2001). But the Japanese market is changing.

Crisis of Japanese economy/unique market for BFT: focusing on a unique market (Japan) is becoming risky for fishermen and fatteners. A drop in the Yen in 2000 affected benefits and investments of farmers (-20% of the precedent year, according to farmers). Statistics show a continuous drop of consumer prices for more than 10 years. Japanese consumers start changing their consuming habits (choosing less expensive products).

Competition on BFT providing resources to main markets: increase of fattening supply by other Mediterranean countries (Malta, Libya, Tunisia, Italy, Croatia) is observed. In addition, competition increase from other fattening areas in the world (Australia, Mexico, etc.) or from new potential ones (South Africa, Philippines, Pacific Islands, Central America) will probably affect market prices. Their competitiveness is based on better manpower costs than European countries but also on their geographical location allowing savings on feeding costs (trashfish access at better costs) or transportation costs (access to USA and Japanese market).

Competition on "sushi-sashimi" primary sources/change mentalities: the competition is already starting with other tuna species (big eye, yellowfin) (3-6 euro/kg at Japan import), less expensive than BFT (20-40 euro/kg) or from salmon that becomes a cheap basic product for sushi-sashimi consumers. Japanese youth are more and more influenced by "supermarket culture", and might be less exacting on sushi-sashimi products as far as quality and freshness are guaranteed.

Perspectives of new markets for tuna: is "outside of Japan markets" economically sustainable? The BFT fattening industry is looking to develop its market outside of the sushi-sashimi niche, on other consumers markets. In the context of a meat crisis, developing a new mass product from the sea, with a high quality product assimilated as "the steak of the sea", presents interesting potentials.

The question remains if future aquaculture production will be economically sustainable while supplying a European market with half price fresh tuna. Nowadays, BFT primary sources in Europe for fresh tuna steak is around 1.5-3 euro/kg, which seems incompatible with estimations of 17-18 euro/kg production costs for BFT fatteners. Further technical-economic simulations and potential markets studies are needed to implement decision for research and industry.

Insecurity on environmental regulation and social pressure

Access to new sites and renewing concessions: fishermen interested in diversification of their activity will face European regulations presenting marine aquaculture as a polluting activity. There will be a need for rigorous "impacts studies" and "public studies" before installation or exploitation permits are granted. In addition lack of political concern for coastal zone management of BFT installations, new potential sites or renewing old sites is not supporting the dynamics of the local private sector.

Immediate adaptive strategy

Faced by this conjectural insecurity, private stakeholders of the sector are developing adaptive strategies

Fatteners are exploring three directions in order to maintain their competitiveness:

(I) Concentration of BFT industry, integration of fisheries: the aim is to stabilise their activity and integrate the production part in order to secure BFT primary product supply and their markets.

(ii) International development: the fattening industry tendency is to develop European scale companies and exchanges in order to share costs, risks, export capacities and investments and look for less regulated countries. Recent partnerships have been developed with other fatteners or fishermen in Malta, Croatia, Tunisia, Algeria, Libya.

(iii) Market niche: in order to be less dependant on Japanese market, to reduce risks, some of BFT fatteners are looking for new commercial opportunities in Asia and USA. Some are also developing direct valorisation at the production site and new commercialisation's channels.

Fishermen are scared by southern Mediterranean fisheries developments, feeling they are late in the aquaculture development. They fear they will loose their independence at the same time some of them are interested in sharing the risk and added value of the fishing products with successful and strong companies. They have a choice on exchanging shares between their companies and BFT fatteners companies or developing diversification and leadership in a fattening project since they have access to the primary resources.

It is assumed that 3 possible prospective directions exist for BFT future activities:

(i) *Integrative regional politic strategies?* The alternatives for aquaculture depends strongly on regional and European politics and on strengthening annual productive traditional activities (fisheries and aquaculture) in ICZM programmes. These permanent activities would play an important role not only in terms of employment and economical impact but also in terms of culture and identity of a region.

(ii) *Offshore technical developments?* The reality of pressure of the public opinion and competition with tourism might impose rapid changes of production areas and move to 5-16 km offshore. However, apart from technical aspects, the main problems of offshore techniques are economical ones. A platform installation leads to very expensive costs. In addition, offshore cages do not allow monitoring, feeding, harvesting during heavy seas (winter), thus being too dependent on weather and which affects their economic performance, and the capacity to provide the market all the year round posing a question for their sustainability.

(iii) *Southern countries production?* If no possible development of aquaculture is realistic in Europe, moving production to southern regions where environmental, tourism or public pressure is less important present most advantages for private companies even if presenting a loss for the regional economy. These strategies are already being developed by some of BFT fatteners.

Breaks for research programme

Fishermen are frightened of aquaculture development of BFT in terms of impacts on their fishing activity (diminution of prices, competition in the same markets, etc.) as has happened with seabream-seabass fisheries (the situation is different because of low prices of BFT). They do not want to support a development that they will neither be able to control nor receive the benefits since they will be used by larger companies which may even not be linked with fisheries. For developing aquaculture research, they expect strong partnerships in order to be the first informed and able to adapt their private strategies accordingly.

Fatteners are the most interested in research programmes. They expect European protection on European scientific data and priority access to the knowledge.

Regions expect market studies and local impacts of BFT studies before huge investments would be launched in research developments. If they are assured scientific interest, they are suspicious and interested in knowing the feedback of public investments in BFT existing activities in their region.

Consumer organisation opinion

The main concern is quality and traceability of the products: (i) there is a lack of communication on aquaculture products (origin, etc.), traceability, and quality and there is strong need for information on aquaculture nutrition process (components) in order to educate populations; (ii) there are fears of mercury and heavy metals concentrated in large pelagic fishes and specially in BFT; (iii) aquaculture, by controlling the feeding sources would be able probably to valorise itself; and (iv) there are also concerns on animal welfare.

The second priority, without direct impacts on prices, are the environmental and ethical aspects. The public is more and more aware and sensitive to sustainable production. An aquaculture that would consume millions of tonnes of other fishes will probably not be well accepted in the future.

Immediate needs and priorities: Secure development of European private sector capacity

All the priorities below have been define through a participation process. We present a synthesis of the common priorities of research for fishermen and fatteners supported by regional fisheries officers. Fishermen are specifically asking support for diversification and studies on simulations for installations for new fattening activities.

Stock management research at Mediterranean level

BFT stock management research: all stakeholders are asking for the strengthening of research studies on BFT Mediterranean stocks and discussion at the Mediterranean level (CGPM) and specially on: (i) the use of genetics to distinguish if possible between two existing Atlantic stocks; (ii) to measure the impact of reproductive behaviour and spawning in the cages on BFT stocks; (iii) to improve data collection from fisheries; (iv) to provide correcting factors for stock estimations of biomass going from fishing to fattening cages; and (v) to identify the origin and future of small BFT huge schools that have been observed this year.

Small pelagic stock management research is required in order to determine pelagic fish stock health and its impacts on BFT and/or large pelagics in the Mediterranean or produce data to explain the decrease of small pelagics captures (environmentalist and fisheries concerns).

Secure information on market and production perspectives

This has a high priority since private sector needs to get a precise idea either on sashimi-sushi market (short term projections) or on fresh tuna steak new markets (perspective on products issued from complete BFT aquaculture). They identify the following needs for information and research on:

(i) The elasticity of Japanese market on sushi-sashimi, the state of the art of world markets for BFT, the trends of consumer profiles in Europe, USA and Asia in the context of world competition.

(ii) The future perspectives of BFT new products (filets, cooked meals, steaks, sub-products, etc.).

(iii) The economical feasibility and cost effectiveness of complete BFT biological cycle production, the market perspectives for small BFT. Is it economically viable to invest in the complete mastership of the biological lifecycle of BFT for aquaculture or not?

(iv) Installation costs simulations (immediate need): BFT fishermen ask for costs simulation for

fattening installations (minimum size, volumes and investments). This would allow them to identify their participation in a partnership as well as the types of partnerships needed.

Define potential sites for aquaculture of tuna in the coastal zone area

BFT requires specific conditions (current, O_2) thus special studies have to be done specifically on: (i) mapping (SIG) presenting the potential sites, constraints and interactions; (ii) summary of coastal zone management and aquaculture installation procedures in each country; summary and information on environmental and coastal zone laws; and (iii) they expect both political and inter-sectoral concentration in order to better valorise their activity in coastal zone management (ICZM process).

Technical and economic feasibility of off-shore aquaculture

Technical and even more economical simulations programmes are expected to give some answers to cost effectiveness, costs of production and constraints of exploitation in off-shore cage installations.

Research on improvement of grow-out techniques

(i) Transportation of live fish procedures.

(ii) The harvesting and killing procedures in relation to fish welfare and the killing systems.

(iii) Nutrition: flesh quality, trashfish and artificial feed quality and traceability.

(iv) Pathology: anticipation of problems of pathology (stress, food-handling).

Environmental research

Private sector expects research in order to determine the proportional impact of BFT fattening compared with other polluting sources such as tourism, agriculture, industry and other aquaculture species. Local fisheries and regional officers ask for independent research on the local impact of BFT fattening. This would support objective information for all parties and producers could use these arguments for communication campaigns.

Image and communication valorisation tools (crisis anticipation)

Fatteners that already suffered from environmentalists and public attacks know that there is collective interest for developing communication tools to face crises like the future possible effects of: (i) environmental impact of BFT on small pelagic fishes, on coastal areas; (ii) worm, parasites and flesh quality; and (iii) mercury, heavy metals concentrations in large pelagic fishes (toxicity, etc.).

Regional and administrative officers' priorities regarding research programmes

(i) *Precise the socio-economical impact of BFT industry:* the objective is to get a better European and regional picture of socio-economics impacts of BFT on the regions (side effects, inductive employment, impacts on local fisheries and tourism, impacts on public finance, impacts on environment, regional image, etc.).

(ii) *Socio-economic studies on diversification of tourism:* simulations (risks, economic benefits, constraints, legislation, etc.).

(iii) *Divers work security conditions harmonisation:* there is specific need for studies on new problems, in terms of security, minimum salary, insurance, retirement, legislation, etc.

Conclusions: Specificity of BFT DOTT research programmes in the Mediterranean

The world global economic situation is defined by rapid changes and the difficulty in planning long term provisional models. Companies will have to adapt rapidly and react to market changes while world trade development will impose the concentration of companies into large scale development, to the detriment of small companies.

In addition, environmental and ethical concerns impose regulations and constraints. The increasing importance of these concerns will lead producers to adapt their production programmes and facilities in terms of traceability, quality, environmental measures and animal welfare. BFT specific activity (fishermen and fatteners), will need support since we are probably passing from a very profitable pioneer activity to a period where risks and lack of visibility are increasing.

If all stakeholders agree at the moment on international competition and the rapid development of BFT fattening for Japanese sushi-sashimi market, no clear market perspectives are present for "the steak of the sea" for BFT aquaculture. Studies have to be done on socio-economical sustainability "from larvae production" (see Japanese BFT producers economical constraints while starting from 500 g fishes); in order to answer more precisely the following question: *"is BFT research on closing the life cycle a long term or a short term story?".*

In this context, and according to the above remarks, BFT research programmes in the Mediterranean and Europe have to integrate some specific characteristics of the private sector: (i) a private sector in centralising all the biological material for research; (ii) a private sector with fisheries and aquaculture strongly integrated; and (iii) a fishery sector with financial potential for diversification strategies.

In this respect, EU concerted research will have to integrate these specificities and especially: (i) enhance the EU companies competitiveness while sustaining their diversification of production; (ii) recognise the rising interaction of fishery/fatteners and their leadership as private partners; (iii) develop strong interaction between research, fisheries and fatteners; and (iv) develop short-term as well as long-term research to secure investments in a rapidly changing and international competitive environment.

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