Seaweeds Fisheries Management in France, Japan, Chile and Norway

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Abstract

Coastal communities have long gathered seaweeds for their own consumption, for animal feed and for fertilizer. The development of industrial use and trade of seaweeds generated income to local communities. The intensification of the exploitation led local communities to implement rules to regulate harvesting. This paper analyses the evolution of seaweed management regimes in four countries: France, Japan, Chile and Norway. Social justice within the communities and equity among gatherers appear to be the basic principles to these rules. Conflict avoidance is their concern much more than resource conservation. This review highlights the role played by fishers' organisations and the processing industries in the management of seaweeds.

Résumé

Les communautés côtières ont de tout temps ramassé des algues soit pour leur alimentation soit pour d'autres usages domestiques, fourrage ou engrais. L'usage des algues pour des fins industrielles et le développement de leur commerce a généré des revenus au sein des communautés côtières. L'intensification de la collecte des algues les a poussées à mettre en place des règles pour gérer l'exploitation. Ce papier analyse l'évolution des régimes de gestion des algues dans quatre pays : France, Japon, Chili et Norvège. Il en ressort que les règlements établis avaient pour objet la régulation de l'activité et non la conservation des ressources. Ils répondaient aux principes des communautés qui n'étaient autres que la justice sociale et l'équité entre les membres. L'objectif était l'évitement des conflits au sein de la communauté et entre communautés voisines. Les exemples traités mettent en évidence le rôle des organisations des pêcheurs et des industries de transformation en matière de gestion des algues.

Keywords: seaweeds, management, France, Japan, Chile, Norway

Introduction

Kelps and, more generally, brown algae are important for the coastal ecosystem because they constitute food supplies for different invertebrates and also create areas condusive to recruitment (Vasquez 2007). Kelp provides nursery grounds for many pelagic and benthic organisms and also habitats for mobile organisms which lie and feed directly on the kelp or its associated assemblages. Kelp forests function "as physical environment by modifying wave strength, and therefore, influencing water flow and associated processes of segmentation, recruitment and production". (Santelices, 2007).

Brown algae are not only important for the coastal ecosystem but also for coastal populations. Coastal communities gathered algae for the own consumption, for animal feed and for fertilizer. The use of seaweeds for industrial purposes began early, as is demonstrated in this paper, by the French and Norwegian examples. In the the 17th century, seaweeds were used for the production of glass and during the 19th they were used to produce iodine. After the crisis in the iodine market, seaweeds were used for the extraction of alginate acid. This new use of algae, started in the middle of the 20th century, opened new opportunities for this activity.

The commercial use of seaweeds either for food or for industrial purposes pushed local communities to implement rules to regulate its harvesting. For example, in Finistère (France), each local community defined the start and the end of the seasons and also the hour one was permitted to leave harbour and return. By establishing local rules they avoided conflicts between members of the community and also between gathers from different communities. These rules, which at the early period were promulgated by local communities, later became royal or republic laws. Later fishers' organisations were given the competencies to edict regulations in collaboration with scientists and also with the seaweed processing industry. In

Japan seaweeds are important resources and they have been harvested for commercial purposes since the Edo period (1603) until today. The management of seaweeds and all coastal resources is also old and it was undertaken by the community and later by the fishers' cooperatives. Japanese cooperatives have the competencies to edict rules for the regulation of fisheries activities with the objective of avoiding conflicts between local fishers. They also have the competency to monitor fisheries activities within its territory.

In France and Japan, fishers' organisations have different origins and function but they have one common feature, both manage all fisheries activities within the territory under their responsibility.

Another case to be presented here is Chile where the production of seaweeds is very high and recent when compared to France and Japan. The historical use of seaweed in this country was for human consumption. Since 1960, seaweeds are used also for industrial purposes, extraction of alginate, etc. A large number of people are attracted by this activity. Some practise this activity as gathers and others as divers. Until 1991, coastal resources were under an open access regime, except in some places where there was customary management, especially for seaweeds. The situation was modified in 1991 when the Fisheries law allocated Territorial Uses Rights in Fisheries (TURF), for benthic resources, to fishers' organisations within coastal communities. Local fishers' organisations, which manage a fisheries territory, were given the competency to manage and monitor fisheries activities targeting benthic resources. Seaweeds are part of benthic resources but for the moment the main objective of the local organisations is to manage the shellfish activity. In Norway, seaweed harvesting was developed at the beginning of the 1960's. Seaweed harvesting and management is the responsibility of the seaweeds processing industry. Two main companies are Algae and FMC Biopolymer. Algae SA harvests and processes Ascophyllum nodosum and FMC SA harvests and processes *Laminaria hyperborea.*

The object of this paper is to describe the main features of the management regimes in the four countries by highlighting the role played by fishers' organisations and processing industries in the management of seaweeds. Examples of others countries are presented briefly in the discussion to give a broader view of the existing situation.

Method

Data was collated from semi-structured interviews realised during field trips in Japan, Chile and Norway and from interviews and a survey conducted in Iroise Sea (France). These interviews were conducted with the main stakeholders: fishers' organisations, fishers, scientists and public institutions at national and local levels. Additional data, through bibliographical sources, were also used to illustrate the issues developed by this paper.

Results

The results will be presented here case by case with a general discussion at the end. The object is to present the main characteristics of kelp management in the four selected countries.

Case of France

Nowadays, the main area of kelp harvesting is Iroise Sea located in the North Finistère. The main exploited species are *Laminaria digitata* and *Laminaria hyperborean.*

Traditionally, kelp was harvested by the local coastal population for domestic purposes. Kelp was used as fuel, manure for agriculture, and a food for animals. The use of kelp for industrial purposes forced local and national authorities to produce rules to regulate the harvesting and gathering activities. The harvesting techniques changed during that time at the beginning

seaweeds, which were cast ashore, were gathered by the local population. Then, seaweeds were gathered and cut by hand using specific tools. During Charlemagne, the seashore became royal domain. The exception was the seashore of Leon (North Finistère) where "population of littoral parishes have the right to use rejected kelp and river algae" (ordinance d'usance de la principauté de Léon) (Arzel, 1987). The main national legal frame regulating kelp harvesting activity was the ordinance of 1681. This ordinance fixed the main rules of the harvesting season (15/1 to 15/4) of kelp and the number of harvesting days (30). Harvesting of kelp at night, outside the stipulated season, and outside the community territory were all illegal. The gathering of stray kelp was practised freely by the local population.

After the French revolution, kelp was declared a public good and accessible to all citizens. Later fishing rights were restored to the coastal population. The bylaws of 1852, regulating maritime fisheries included kelp harvesting within fisheries. Since 1853, the cutting of kelp (goémon de fond) could be practiced only by professional fishers.

With the law of 1945, establishing the first organisations of fishers, kelp harvesters got the opportunity to establish themselves as a specific group, concerned only with the issues affecting them. The first issues discussed by the committee were economic and social. For them it was necessary to support the construction of new boats and to attract young people to the work. Later they supported seaweed fishers and their families cope with the economic difficulties provoked by the iodine crisis. In 1952, the three processing industries created an association to develop research on the new uses of seaweeds. The production of alginate acid was their solution.

Collaboration between harvesters, through the seaweeds committee, and processing industries was established and led to the establishment, in 1961, of a common committee call CIAM (Inter-professional committee of marine seaweeds). The board of CIAM was elected for 3

years and it was chaired alternately by a fisher or by a representative of the processing industry. (Arzel, 1998)

The first tasks of this committee were the mechanisation of seaweeds harvesting, the motorisation of boats, new uses of seaweeds and also new methods to dry seaweeds. Until the end of the 1970's the seaweeds were dried on the dunes. Motorisation of the boats and the mechanisation of the harvesting occurred between 1962 and 1971. These two changes impacted on the size of the boat used and increased the production of seaweeds. Now new processes to dry seaweeds were even more necessary.

In 1979, CIAM began to discuss the introduction of rules to regulate the activity, for example to define the starting day of the season, to avoid areas where kelps were overexploited, and later the implementation of Total Allowed Catches, the implementation of a license system, etc. CIAM was also the place where the processing industries and the fishers negotiated the price of kelp.

A brief overview of the different management rules discussed within the CIAM will show the importance played by this committee. In 1985, it established a license system for boats harvesting *Laminaria Digitata* and in 1986, maintaining a logbook was made mandatory. Boats without logbooks could lose their license. In 1987, it was decided to permit only one landing per day with the objective of limiting productivity. The first discussions about the establishment of Individual quotas by boat began also in 1987 and it took 5 years to reach an agreement. It must be noticed that all the decisions of CIAM got scientific support and the approval of the fisheries authorities.

These close collaborations between fishers and the processing industry ended in 1991 with a new law governing fishers' organisations. The law gave fishers' organisations the competency to manage marine resources. The regional fisheries committee of Brittany acquired the

competency to manage kelp harvesting. For that reason and based on the previous experience, the committee constituted “the commission of seaweeds” in which all matters concerning seaweed harvesting could be discussed and new rules introduced.

The implementation of TACs, a discussion started by CIAM, was decided by the “commission of seaweeds”. The processing industry participates at this commission but without right to vote it can express its ideas and advice. Scientists, from the French Institute of the Exploitation of the Sea (IFREMER), also participate at this commission again by giving advice. All regional committee decisions, concerning fisheries management, are submitted to and approved by the State.

Some events, external to the fisheries sector, modified the existing situation and resulted in the implementation of new rules. One of these measures was the attribution of individual quotas to each boat. This decision doesn’t respond to any conservation objective but to some difficulties faced by the processing industry. The two plants, due to an EU regulation, cannot treat more than 600 tons of raw materials weekly and that is because their sewage purification plants do not have the capacity to process greater quantities. Kelp fishers had to find a solution to this constraint and decided on the allocation of Individual Quotas which were calculated from their historical catches and the technical characteristic of their boats. All fishers were not satisfied with the new distribution of quotas but they accepted them as no other solution could be found. As a result the biggest boats of the seaweed fleet, as compensation, are now permitted to harvest *Laminaria hyperborea* commercially. Up until this time, this species was only harvested on an experimental basis. *Laminaria hyperborea* harvesting is based on rotation system and it is monitored by IFREMER

In 2007, a new institution, able to play an important role in kelp management, was established in the area; the Marine Natural Park of Iroise Sea. This institution can participate and also initiate new policies concerning fisheries management within its territory. The Marine Park can intervene in matters of resources and biodiversity conservation by imposing the use of more friendly fishing gears, or by banning the use of some fishing gears or by allocating geographical areas to fisheries or to others uses. In a case that the Marine Park decides to take greater responsibility in kelp management some institutional changes and priorities should be made. Until now resources management is under the responsibility of fishers' organisations. For the future, it will be interesting to know how the legal frame might be modified by giving more power to the park in matters of territorial marine resources management.

Case of Japan

In Japan, the management of coastal fisheries, including kelp, is under the responsibility of Fisheries Cooperative Association (FCA). The cooperative system in Japan is old and it is characterised as a successful co-management experience in resources management. The current system of fisheries cooperatives found its origins within the fisheries law of 1949. "Under this law, marine fisheries were classified into three categories: (1) fishing rights for coastal fisheries, (2) fishing licences for offshore and distant waters and (3) free fisheries. Coastal fishing rights were classified, in turn, as 1(a) common fishing rights (only for FCA's), 1(b) large-scale set-net fishing rights and 1(c) aquaculture (demarcated) fishing rights". (Makino, 2005). The fisheries law was revised in 2002 but the main ideas of the law are still the same even if some new points were added.

In Japan, it can be found, 1264 FCA in 2006, all fishers are members or associate members of the cooperative. "*Each cooperative has fishing rights on the adjacent territory of the*

community and are extended to the sea". (Ushida, 2004) The extension to the sea is variable and it is dependent on the number practising the activities within the territory such as shellfish and seaweeds harvesting, demersal fisheries, fisheries with fixed gear and other type of fisheries such as beach seine. The FCA territory is accessible to professional fishers of the community. The local cooperative has the competency not only to regulate all fisheries activities but also the people working within its territory. FCA has the power to regulate fishing effort, to allocate fishing rights to its members (determines who can have access to which species), and to determine the type of gear to be used for harvesting some species within its territory. FCA is in charge of the restoration of some emblematic species, for example sea urchins, salmon and others, to increase the natural productivity of the species. It is responsible for monitoring all the activities.

FCA has some extra roles: marketing fish (auction), giving credits to members, supplying business and education and training for fishers. Despite the local regulations there are also national or prefectural regulations, for example a licensing system (national and prefectural levels), a TAC system (national) and some others prefectural measures.

Seaweeds harvesting and cooperative

In practice, each cooperative is responsible for rules concerning kelp harvesting which today is primarily kombu (*Laminaria angustata*). Nowadays, kombu harvesting takes place mainly in Hokaïdo which has a long history with this species. Kombu harvesting activity started in the 18th century with the export of this species to China. The harvesting season is the summer and each cooperative fixes the start and end day of the season. Every day a person, authorized by the cooperatives, decides if the boats can operate or not. His decision is based on weather and wave conditions and even on the state of the resources. His decision is communicated to

the whole the community before 5 am. In Minami Kayabe the community harvesting season lasts one month and half. The starting date of the season is fixed by the general assembly of FCA and the hours of fishing too. The fishers start harvesting at 5am and stopped at 9am. Only 4 hours daily are allocated to kombu harvesting by boats. Fishing gear is also regulated by the cooperative as the day that they can be used. Usually kombu is cut with the knife but some days during the season fishers are authorised to use more productive gear. Fishers after finishing the kombu season move to other fishing activities like sea urchin or demersal species.

The same system observed in Minami Kayabe can be found in others fisheries communities in Hokkaido. In Shoya and Meguro communities the use of fishing techniques to harvest kelp is also limited "(..) the period allowed for using a *nejiri*, a special tools for harvesting smaller kombu, is subject to "the decision of the meeting of the KCU". Because *nejiri* harvest immature kombu as well as large ones, this tool is regarded as a threat to sustainable resources management and its use is strictly limited". (Iida, 1998) The cooperative doesn't permit the use of a second boat to transport kombu to land. This is to limit the productivity of each fisher.

Other local arrangements can be found. For example in August and for some days fishers are authorised to harvest kombu in extremely shallow places but without the use of the boat. This type of harvesting is call *Isonuki*. Again the authorised person informs the community about the day and the time that this practice will take place. "*Isonuki* can be practiced only when the sea is rough and harvesting by boat is dangerous. But as *kombu* do not grow in shallow places this type of harvesting is practising only 2 or 3 days during the season". (Iida, 1998)

Cooperatives are also in charge of selling *kombu.* Kombu is dried by each household and gathered into the cooperative building. The cooperative then fixes the price. Each piece of

seaweed is priced according to its future use. It is of note that wild *kombu* and aquaculture *kombu* do not get the same price.

There are other institutions involved in coastal fisheries management in Japan. For example the Fisheries Management Organisation (FMO) can be constituted for specific reasons. It is an autonomous body and it regroups fishers from the same cooperative or from different cooperatives. The regulations made by FMO are more detailed and stricter than the FCA regulations.

The Area Fishery Coordinating Committees (AFCCs) is another interesting organisation. AFCC is a prefectural organisation and it is composed of elected fishers (9), academics (4) and administrators (2). Its main competency is to advise prefectural authorities on rights based on fisheries grounds and on licences. "AFCC decides the allocation of fishing rights and licenses in areas within their jurisdictions but it can be also restricts these rights and licenses" (Makino, 2005),

In Japan kelp harvesting is a seasonal activity practised by fishers who the rest of the year practise other fishing activities. The kelp harvesting is well managed by the fishers' cooperative and has as an objective the conservation of the wild stocks by editing regulations and rules at local level.

Case of Chile

In Chile the gathering of brown seaweeds was started in 1960. Seaweeds were used as raw material for the extraction of alginate acid. At the first period, coastal populations gathered seaweeds which were a result of natural mortality. These were collected by hand. Gathers

dried the seaweeds on the beach and sold to middlemen. The final destination of the dry seaweeds was the grinding industry.

Since 1998, the demand of seaweeds has increased and seaweed harvesting has become a more intensive activity. For example, in North Chile the harvesting of *Lessonia spp* shifted from extensive to intensive. This modification of harvesting is linked to the fact that for the "last 25 years, brown algae landings have fluctuated between 40 000 and 280 000 t year" (J. Vasquez, 2007). *L. nigrescens* and *L.trabecultata* constituted more than 90% of the total production of brown algae and *Macrosystis sp* and *Duvillaea antartica* which are consumed locally are far behind. In Chile harvesting of seaweeds is carried out by divers and not by boat as is the case in France and Japan. Seaweed gathering is still practicing by the local population.

Divers and gathers

In theory, all people practicing a fishing activity should be declared as fishers at the national register. Each fisher declares the targeted species and the region where they operate. Fishers today cannot move from one region to the other as they did in the past. In 2006, 2000 persons declared that they practice seaweed harvesting either as divers or as gathers and the national register is now closed. No more people can be registered. According to the sub-secretary of fisheries in 2007, only 50% of those registered actually practiced this activity.

But the real situation is different because every year a large number of people living in others areas of the country migrate to the coast and gather seaweeds to support their livelihoods. Scientists and managers, met during the field work, believe this illegal harvesting should stop so as to avoid the overexploitation of the stocks. But limiting the harvesting to professional artisanal fishers will be difficult because for artisanal fishers the notion of illegal doesn't exist

within artisanal fisheries. Children and adults living in coastal areas have always gathered algae. Everybody is working to get some extra income for winter". (Chair of Conapach). Professional fishers tolerate "illegal" fishers *"*because they cannot exclude poor people to practice this activity without to be perceived as selfish*"* (Secretary of Canapach). It seems that Chileans politicians share the opinion of artisanal fishers about illegal harvesting of seaweeds because despite the pressures of scientists and managers they have yet to vote (2008) any law about this issue. They probably consider that seaweeds constitute a source of income for the poor as was the case in Brittany in last century when seaweeds were called "the bread of the poor"

Extensive to More intensive harvesting requires greater management rules

The harvesting of *L. nigrescens* and *L.trabecultata* became more intensive and this is shown by the increase in production. Scientific specialists of stock population reacted by claiming the implementation of some management rules to conserve the stocks of *L. nigrescens* and *L.trabecultata.*

Here it will be examined how kelp management could be integrated into the existing legal frame should Chilean authorities decide to establish management rules. The fisheries law, of 1991, attributed a designate geographical area to artisanal fishers' organizations or to fisheries communities who were responsible for the management benthic resources. These fisheries rights allocated to fishers organizations or communities are called Territorial Use Rights in Fisheries (TUFR). TURF got the name of Management and Exploitation Areas of Benthic Resources (MEABR)

In Chile TURF was a response to the overexploitation of benthic resources and particularly of loco (*concholepas concholepas*). TURF appeared a good mechanism to avoid the

overexploitation of abalones, compared with individual quotas. This system benefited from the support of scientists working on the restoration of benthic resources in collaboration with fishers in fisheries communities. (Castilla, 2006)The implementation of TURF required some preconditions, first the availability of fishers' organizations and second those organizations having the capacity to manage fisheries activity within the allocated territory and avoid conflicts. According to the fisheries law all organizations should regroup with only professional fishers enrolled in the national register.

Duties and competencies of MEABR

Each MEABR should realize a baseline study of the evaluation of the stocks and estimates "the abundance of all target species" (San Martin et al, 2009). Based on the results of this study each MEABR should establish its management plan, which must get the approval of fisheries authorities. The two documents should be revised every year and should be financed by the MEARB. Until now it seems that MAERB didn't have the financial capacity to pay for these documents. Each MEARB can decide the harvesting period for each species, closed areas to fishing activity; apply the rotation principle, etc. All local rules respect the national legal frame.

MEABR has the power to sanction members who don't respect the rules established within the territory and in particular poaching. In areas where MEABR are present, fishers of others communities are excluded, even if in the past, they operated within this territory. The exclusion of the outsiders was a case of conflict within fishers of the same community and between communities. The loss of fishing rights is always a cause of conflict. It seems that the case of the community of Arund is famous in Chile. The implementation of TURF didn't recognize the historical rights of professional fishers outsiders of the community and as a

consequence they were illegal. The conflict was resolved after many years of negotiation and with the assistance of the bishop (Chevalier, 2007).

In others communities the MEARB system didn't take into account the customary management of some benthic resources, such as seaweeds. The case of the "parcela (small harvesting area) system used to manage bull-kelp (cochayuyo) and intertidal resources" (Gelcich et al., 2006) Communities practicing this system allocated the harvesting area to fishers by using a lottery system. This traditional system of seaweeds management is modified by the implementation of MEARB system.

The establishment of MEARB didn't face the same difficulties in all parts of the country. For example in Central Chile where communities had managed the "*adjacent fishing territory*" fishers accepted the implementation of TURF more easily. (San Martin et al, 2009)

As the TURF system is very new in Chile, compared to Japan, it is still difficult to evaluate its real impact on resource conservation and also on fishers' organizations. But it must be noted that the number of MEARB having their management plans approved has increased considerably in five years. From 188 in 2003, it approved 516 in 2008.

This system seems to fulfill its first objective, the conservation of abalone. But it also impacted on the organization of fishers who now are members of MEARB and also on their professionalization. This system put end to fishers' migration practiced traditionally by artisanal fishers. These moved from place to place following the abalone season. It has contributed to the marginalization of some of the population who can no longer practice this activity, such as the *orilleros* (hunter gatherers of the pre-Hispanic period) (Escobar, 2007).

To strengthen the TURF system it is important to conduct some research on the social structure of MEARB and to try to identify the reasons why in one place the system is working well and in others it is not. This is probably the best way to improve these new institutions

and to strengthen their role in fisheries management and to extend their competencies to seaweeds management. The major species are harvested in open access areas so it is difficult for MEARB to manage them. However, a new regulation could see the MEARB system extended to cover open access areas.

Case of Norway

In Norway, seaweeds have been used for industrial purposes, the production of potash, since the 18th century. This activity was undertaken by farmers and provided them a considerable income. The use of seaweeds changed during time and a significant increase in demand began at the beginning of the 1960's. Until 1963, the harvesting was done by hand.

The use of boats (trawl) and the mechanization of the cutting arrived during the 1960's. This evolution of harvesting techniques contributed to a considerable increase in the production of *Laminaria hyperborea* and of *Ascophyllum nodosum. Laminaria digitata* was exploited until 1975. Last year there were attempts to harvest this species again but we do not know if they were successful.

Nowadays, Norway is one of the most important producer of *Laminaria hyperborea,* 160 000 tons of raw material in 2008 and 20 000 tons of *Ascophyllum nodosum. Laminaria hyperborea* is used for the production of alginate acid and the Norwegian production supply about 1/4th of the world's alginate. *Ascophyllum nodosum* is used for the production of seaweed meal. The meal contains valuable nutrients and prevents iodine deficiency, and is mixed in meals for cattle, poultry, pig, sheep, pets, horse and fish. Seaweed meal is also used in food powder for supplement or as a food ingredient, preparation of food pills and capsules and as a salt replacement.

Two processing industries have the exclusive harvesting rights of the two species. *Ascophyllum nodosum* is exploiting by Algea S.A. and *Laminaria hyperborean* by FMC BIO Polymer. At first, both of the companies were maintained by Norwegian capital but now both are owned by international capital. The name of the companies may have changed during the years but the management rules applicable to each species have not changed much since 1973.

Ascophyllum nodosum

Algea SA has the exclusive fishing rights of *Ascophyllum nodosum* and as this species grows in the lower littoral zone to around 2 m depth along the coast of Norway the company has agreement with the people owning this part of the sea. "In Norway land owners also own the sea until the line of the low tide". (Interview with the director of Algea SA) The maritime area where Algea is operating needs the agreement of a large number of private owners and it takes considerable time to manage them. But as the company has exploited seaweeds since 1937, the land owners (children or grand children) are well known to the company and they just renew the agreement. The company pays financial compensation to land owners on the basis of the agreement. This means that Algea doesn't have to negotiate the use of the maritime space with public authorities but it must follow the national regulations concerning seaweeds. Environmental protection laws and other area regulations can restrict areas for harvesting.

The company owns 22 boats, which are harvesting *Ascophyllum nodosum.* People working on the boats are either employees of the company or self employed. People interested in becoming harvesters of *Ascophyllum nodosum* need to ask Algea for a boat and training. "*Nobody can start this activity now because the investments are high*". (Interview with the director of Algea).

For the self employed, the company provides the boat, the oil and the maintenance of it. Algea buys the raw material from harvesters. For safety reasons but also for better working conditions, each boat employs two persons on board. Seaweeds are cut at high tide with a mechanical knife, leaving at least 10 cm of the plant for re-growth (interview with the director of Algea) then, they are stocked in nets, which are picked up by a boat and transported to the plants. To avoid conflicts between the boats of self employed and employees of the company, the company allocates the harvesting area to each category. "Every year, they know in which concessions they will operate and they move from one concession to the other". (Interview with the director of Algea)

Laminaria hyperborea

Laminaria hyperborea is exploited by FMC Biopolymer SA and the exploited areas are located in the South part of Norway between Haugesund and South of Trondheim. The company has 4 collection stations where the kelp receives the first processing treatment. Then they are transported by boat to Haugesund for further processing.

11 boats harvest around 160 000 tons (2008) of *Laminaria Hyperborea*. They operate all year round and the most productive season is summer. This tonnage is fixed by the company because "*they don't want to create a problem for the sustainability of the resources*" (Interview with FMC Biopolymer AS manager) even if the company has the capacity to process a higher tonnage. The people working on board the boats are declared as fishers and the boats are considered as fishing boats. Some of the boats are own by FMC Biopolymer and some others by fishers who sell their production to the company.

Each boat owner has to report to the regional office of Fisheries Directory (FD) one month before the planned harvest, which area is to be harvested, and the start and end date of

harvesting. FD informs the local County Governor. The boat skipper has to report one week ahead before the harvesting in an open field starts, and the day the harvesting is finished. All stops shall be reported. Harvest journals shall give the date, place and quantity of harvested kelp, and can be inspected by the FD. A yearly report of harvesting quantity for each field is required by the FD.

Management of Laminaria hyperborea

Until 1973, the harvesting of *Laminaria hyperborea* was not regulated. The first regulation was introduced to put an end to conflict between fishers and seaweeds harvesters. Fishers accused kelp trawlers of destroying lobsters. The first regulations were suggested by a fisheries biologist, a kelp specialist, working at the University of Bergen. This biologist suggested the implementation of a rotation system and the division of the harvesting areas into smaller fields around one nautical mile each. The fields have a number and are coded with a letter A-E. Until 1993, each field was harvested every 4 years. Then the rotation period stretched to 5 years, except the zone of Rogaland where the rotation period is still 4 years.

The modification of the harvesting period was decided in common between the industry and the scientists of the Institute Marine Research (IMR). The industry considered that "*the rotation system is very important for the durability of kelps fields. Fishers harvest 10 to 15% of the available biomass in each field.*" (Interview with FMC Biopolymer AS manager). And usually each field is harvested at different times during the year. The evaluation of kelp stocks is assessed by IMR as is the monitoring of trawling activity for *Laminaria hyperborea* and its impact on the ecosystem. Since 2003, the investigations are financed by the Fisheries directory but prior top that they were financed by FMC Biopolymer

In 2003, an environmental NGO called for the closure of some kelp harvesting areas in order to protect seabirds. For them, kelp harvesting has an impact on some species of fish eaten by seabirds. FMC Biopolymer reacted to these accusations and asked IMR to conduct a study on the impact of kelp harvesting to fishes. “IMR evaluated fish population before starting harvesting and after harvesting. They found exactly the same species as before”. (Interview FMC Biopolymer) In spite of this finding, several fields were declared marine protected areas and the exploitation of kelp was restricted.

Discussion

The different examples of seaweed management, illustrated in this paper, show that the management regime of seaweeds fisheries is the allocation of fisheries used rights on a specific territory to fishers’ organisations or to the seaweeds processing industry involved in the harvesting activity. The example of Japan and France show the capacity of fishers’ organisations or fisheries communities to successfully manage this type of sedentary resource. Often the main regulations enacted by fishers organisations are based on fishers traditional knowledge rather than on scientific evidence but the results on resources conservation are positive. Fishers’ decisions are approved by scientists and validated by fisheries authorities. It is only in Chile, that annual management plans established by fishers’ organisation must be based on scientific knowledge, which means annual stocks evaluation. But again in this case rules and regulations are accepted, voted and monitoring by fishers. In New Zealand an association, call SANZ, regrouping seaweeds harvesters, scientists and others stakeholders was created; a co-management system for seaweeds harvesting instead of the allocation of individual quotas as was planned by the State. Within the four studied countries, Norway has a different management regime based on territorial uses rights which are allocated to seaweeds processing industries. The Norwegian example isn’t unique. The same type of fishing rights allocation is found in Canada for the exploitation of *Ascophyllum nodosum.* In

this case, seaweeds harvesting is undertaken by boats own by the processing industry which employs people to work on board.

This situation can be modified by new societal and economics demands observed around Europe. Environmental conservation and biotechnology are probably the new drivers' forces determining the future of seaweed harvesting in Europe. Both objectives are currently on the political agenda but their objectives are contradictory. The decline of marine resources calls for the adoption of new policies targeting conservation, on the one hand and the possible production of bio-fuel from macro-algae, on the other. In countries where there is no longer any commercial exploitation of seaweed (UK for example), there are calls for the public authorities to support the development of an alternative energy without taking in account conservation concerns. The claims for conservation of the resource and the ecosystem demand the implementation of tools targeted to these objectives. Marine Protected Areas, Natura 2000, Special protecting areas, Marines reserves, MEABR, etc. is one such tool. The use of these tools in targeting the conservation of this rich ecosystem is often perceived by European fishers and/or the processing industry as an obstacle to harvesting. Because harvesting territories have decreased, fishers have the feeling, that in recent years they have lost their territory, to the profit of other activities and/or to conservation objectives.

The production of bio-fuel from macro-algae puts considerable pressure on the wild stocks and to this rich ecosystem. Scientists promoting this idea are suggesting the development of intensive seaweeds farming to satisfy the increasing demand. The development of algae farming can be a source of different types of conflict. Here is a general overview of the kind of conflicts: European marine space is limited, who will have the right to develop this new activity (fishers, shellfish farmers, old industry or new comers), how will they manage the issue of invasive species in relation to aquaculture development and how will existing

institutions react and adapt to the changes. All these questions cannot be answer now but call social scientists to follow the future evolutions.

Concerning wild seaweed harvesting, the choice, of the best management regime to be applied in each country, should be decided by the local people taking into account the local knowledge and local social structure as well as skills and competencies. The development of macro-algae farming for bio fuel production risks modifying all the existing management regimes for wild seaweeds harvesting by creating a discordance between old (fishers, gathers, industry) and new users.

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