



Journal Homepage: -[www.journalijar.com](http://www.journalijar.com)

## INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/11412  
DOI URL: <http://dx.doi.org/10.21474/IJAR01/11412>



### RESEARCH ARTICLE

#### OVERVIEW OF THE FISHERY PRODUCTS PRODUCTION AND PROCESSING SECTOR: WAYS OF RECOVERING FISH RESIDUES.

Abdelaziz Mounir<sup>1,2</sup>, Nawal Hichami<sup>1,2</sup> and Safaa Bendami<sup>1,2</sup>

1. Laboratory of Water, Biodiversity and Climate Change, Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco.
2. The Natural History Museum of Marrakech, Cadi Ayyad University, Marrakech, Morocco.

#### Manuscript Info

##### Manuscript History

Received: 28 May 2020  
Final Accepted: 30 June 2020  
Published: July 2020

##### Key words:-

Fishmeal Deodorized, Defatting, Solvent Extraction, Fermentation Of Fish Waste, Trimethylamine

#### Abstract

The fish waste from the industrial processing of fishery products is an important source of raw materials for the production of fishmeal mainly intended for animal feed. However, the strong smell of fish limits the incorporation rate of fishmeals in the diet of animals especially poultry. Issues related to the presence of the smell of fish in the flesh, carcasses and poultry eggs have led to the evaluation of potential deodorizing fishmeal by any advantageous and workable process. The literature review led this study to deodorize by solvent extraction and biological fermentation of fish waste for the production of fishmeal deodorized.

Copy Right, IJAR, 2020,. All rights reserved.

#### Introduction:-

Fish and fishery products are essential sources of protein and trace elements, very valuable for nutritional balance and health. According to the FAO (2012), world production of fisheries and aquaculture reached 158 million in 2011, including 131 million intended for human consumption. The industrial development of fishery products involves abundant quantities of fish residues. It is estimated that 50% of the weight of world fish production is discarded as by-products during processing operations. This percentage represents around 32 million tons of fish waste and co-products. Essentially organic, these fish residues consist of heads (40%), viscera (25%), skins (7%), bones and tail (27%) and fins (1%). Today, there is a growing awareness of the risk of environmental pollution posed by the rejection of this waste in nature and of the potential source of nutrients that it contains. Following this observation, new techniques for recovering these residues have emerged. The products derived from this recovery have different added values according to their applications in animal nutrition, agriculture and agri-food, cosmetics, dietetics, energy, medicine, etc.

The production of fishmeal is the most important way of valorization. With high quality nutritional properties, fish meal finds its main use in animal feed. In addition to other staple foods, fishmeal is introduced into the diet of animals, especially poultry.

However, due to its strong smell typical of fish, its rate of incorporation into animal feed is limited. Indeed, this odor can sometimes prove to be perceptible in the flesh and the eggs laid of animals (in particular poultry) which received a diet containing fishmeal.

#### So, our work will focus on:

1. the development of technologically feasible and commercially competitive deodorization methods.

**Corresponding Author:- Abdelaziz Mounir**

Address:- Laboratory of Water, Biodiversity and Climate Change, Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco.

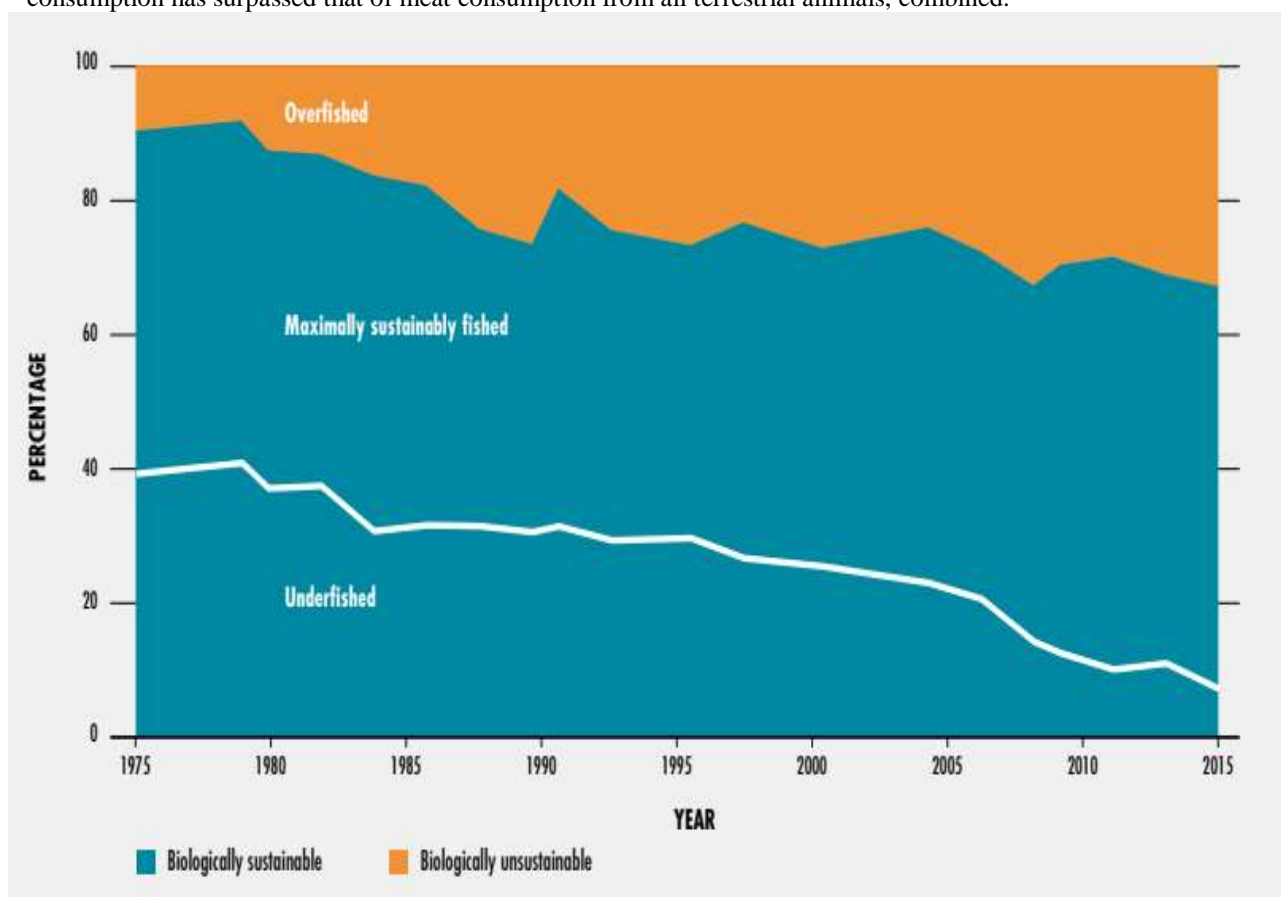
2. the sensory and nutritional characterization of deodorized flour.

**To achieve these objectives, we have divided this work into two major parts:**

A bibliographic study divided into 4 chapters and which made it possible to draw up a state of the art on the technique of making fishmeal as well as the potential methods of its deodorization.

**World fish production:**

The first part "State of the World" in the 2018 State of the World's Fisheries and Aquaculture report presents FAO's official world fisheries and aquaculture statistics. World fish production in 2016 reached a record value of around 171 million tons (FAO, 2018), with the aquaculture sector accounting for 47 percent of this figure, or 53 percent if production for uses is excluded. non-food (including the production of fishmeal and fish oil). Since capture fishery production has been relatively stable since the late 1980s, aquaculture has been responsible for the continued and impressive growth in the supply of fish for human consumption (Figure 1), In 2016, 88 percent of the total fish production (151 million out of 171 million tons) was for direct human consumption. This share has increased significantly in recent decades, as it was 67 percent in the 1960s. In fact, the annual growth rate of food fish consumption has surpassed that of meat consumption from all terrestrial animals, combined.

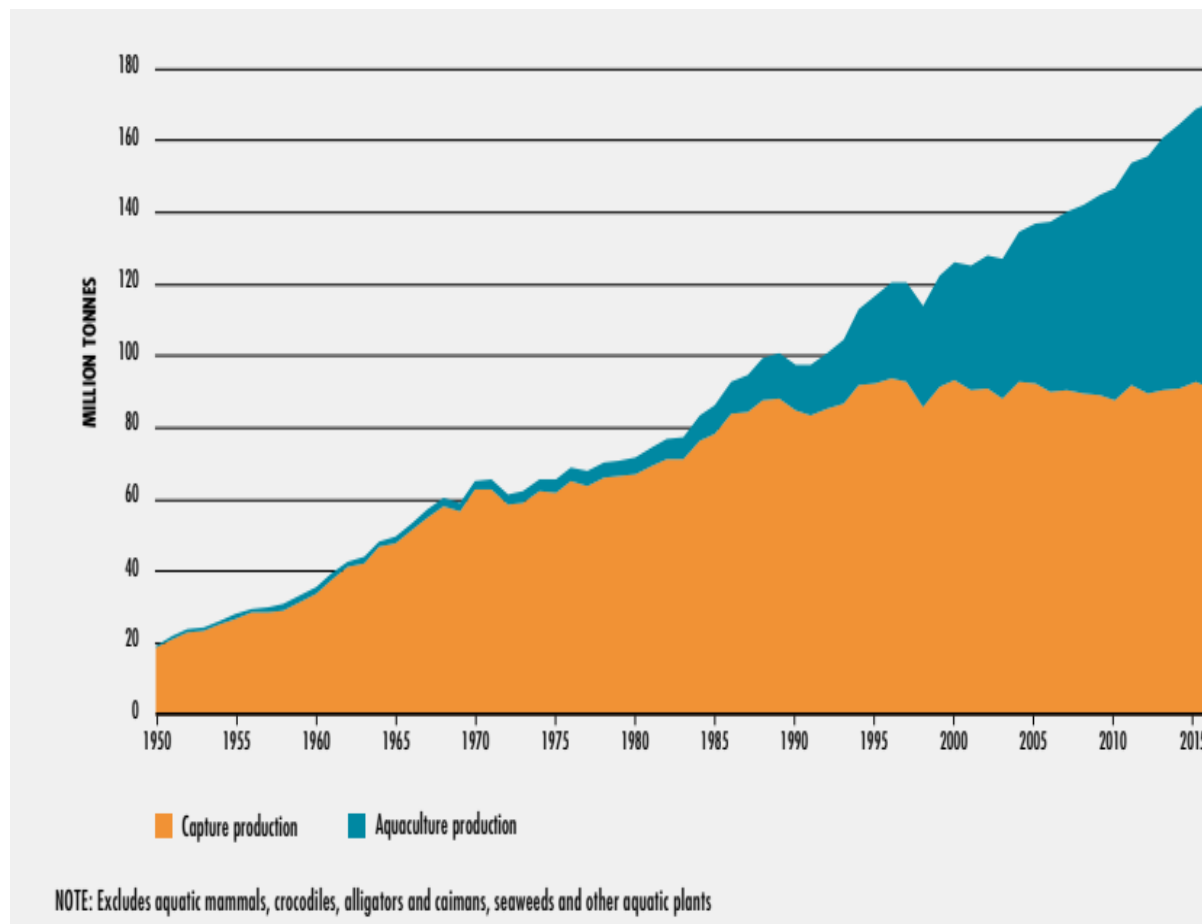


**Figure 1:-** World fish production (FAO.2018). (NOTE: Aquatic mammals, crocodiles, alligators and caimans, seaweed and other aquatic plants are not taken into account).

**The status of fishery resources:**

The fraction of fish stocks that are within biologically sustainable levels has exhibited a decreasing trend, from 90.0 percent in 1974 to 66.9 percent in 2015. In contrast, the percentage of stocks fished at biologically unsustainable levels increased from 10 percent in 1974 to 33.1 percent in 2015, with the largest increases in the late 1970s and 1980s (Figure 2).

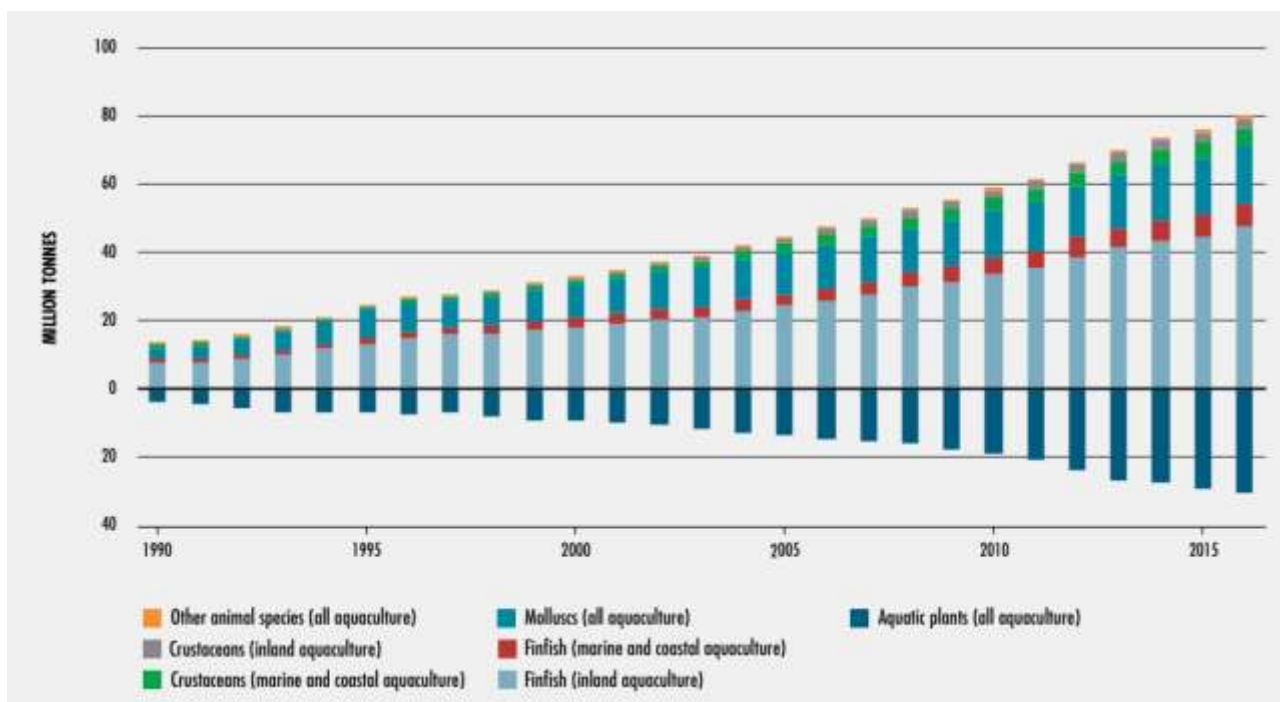
In 2015, maximally sustainably fished stocks (formerly termed fully fished stocks) accounted for 59.9 percent and underfished stocks for 7.0 percent of the total assessed stocks. While the proportion of underfished stocks decreased continuously from 1974 to 2015, the maximally sustainably fished stocks decreased from 1974 to 1989, and then increased to 59.9 percent in 2015, among the 16 major statistical areas, the Mediterranean and Black Sea (Area 37) had the highest percentage (62.2 percent) of unsustainable stocks, closely followed by the Southeast Pacific 61.5 percent (Area 87) and Southwest Atlantic 58.8 percent (Area 41). In contrast, the Eastern Central Pacific (Area 77), Northeast Pacific (Area 67), Northwest Pacific (Area 61), Western Central Pacific (Area 71) and Southwest Pacific (Area 81) had the lowest proportion (13 to 17 percent) of fish stocks at biologically unsustainable levels.



**Figure 2:-** Global trends in the state of the world's marine fish stocks, 1974–2015.

#### **Aquaculture production:**

Global aquaculture production (including aquatic plants) in 2016 was 110.2 million tons, with the first-sale value estimated at USD 243.5 billion. The first-sale value, re-estimated with newly available information for some major producing countries, is considerably higher than previous estimates. The total production included 80.0 million tons of food fish (USD 231.6 billion) and 30.1 million tons of aquatic plants (USD 11.7 billion) as well as 37 900 tons of non-food products (USD 214.6 million) (Figure3). With 5.8 percent annual growth rate during the period 2001–2016, aquaculture continues to grow faster than other major food production sectors. For the first time aquaculture provides 53 percent of fish for human consumption.



**Figure 3:-** World aquaculture of food fish and aquatic plants, 1990-2016.

#### **world wide use and consumption of fish:**

Due to global population growth, the Earth is subject to increasing pressures to meet food needs. Therefore, the question of food security becomes central: how to feed the nine billion people our planet is expected to count shortly? How to change fishing and farming practices to feed

humanity, without damaging the environment? Will we be able to resolve distribution problems peacefully and fairly on the horizon for 2050? Global food needs estimating to double over the next 35 years. Certainly, from a technological point of view, it seems possible to produce enough food for 10 billion people (Evans, 1998). In terms of calories, farmers around the world harvest about a third more food than necessary to feed the population planetary (BMEL, 2015). Yet one billion people still suffer from hunger on a daily basis because of poverty which is linked to a problem of distribution of food and not shortage. Especially since the resources, which are sorely lacking in certain regions, are unnecessarily wasted in others: globally, between 30 and 40% of the food produced ends up in the trash (WWF, 2015). He is very unlikely that the area of land cultivated for the production of food base is increasing: in many regions, there is already no more land available. If today our farming systems are producing huge crops of maize, rice, grain or even meat, it comes at the cost of soil and water degradation. To guarantee the food security of the globe, fish has a preponderant role to play. Beyond providing 20% of "animal proteins 2 "Essential for balance of the diet of over 3.1 billion people, it is a source notable of fatty acids and micronutrients (FAO, 2016; Thilstedt et al., 2016; Béné et al., 2015). If fish already represents 17% of all proteins consumed around the world, this percentage is expected to increase as where the growth in consumer income is accompanied by increasing demand for high-quality fish (World Bank, 2013). Beyond its nourishing function, fish generates significant economic activity: in total, approximately 500 million people earn their living livelihoods of the fishery industry in one form or another (FAO, 2014). The state of world fish stocks is a cause for concern. On the whole of stocks subject to scientific assessment, 31% are considered victims of overfishing and 58% as fully exploited (Costello et al., 2016; FAO, 2016). In this context, we understand that any intensification of effort may seriously endanger the health of stocks already fully exploited (FAO, 2016). WWF believes the need for good quality protein intake for all obscures the interdependence of the two food production systems (fishing and farming). However, one cannot dissociate their natural limits. For example, soybeans, rich in protein, are used in fish farming, while that fishmeal and fish oil are part of the pig diet and poultry. The rate of marine catches cannot, moreover, increase anymore and stagnates even for almost 30 years. As a result, the current demand for fish is far superior to the productive capacities of the oceans. His satisfaction already depends on half of the livestock and aquaculture combined. Now, this branch of industry food, booming in the last 40 years, maintains just as many relations with the sea than with the land (see in this regard the box "Aquaculture"). Designed to protect fishery resources and allow exploitation sustainable (viable in

the long term both ecologically and economically), fisheries management is the responsibility of policymakers. A certain number of researchers are however convinced of the need to improve it, whether to establish global food security or to prevent collapse imminent fish stocks (Pauly et al., 2005; Worm et al., 2006, 2009; Branch, 2008; Branch et al., 2010; Allison et al., 2012; Quaas et al., 2016). Although the planned reforms may prove very costly in the short term, they are necessary to restore stocks to a reasonable level (Quaas et al., 2012; Sumaila et al., 2012). Thus, fisheries management combining coherence and efficiency by taking into account several essential criteria (adoption of an ecosystem approach, the guarantee of the correct application of the rules, firmness in the fight against illegal fishing, integration of the concept of sustainable management in all fisheries) would further increase the global supply of fish.

This imperative is vital, not only to support the continued growth of demand for fish but also to safeguard the functions of biodiversity and marine ecosystems (Worm et al., 2009; Froese and Propels, 2010), since definitive, the good state of fish stocks depends on the preservation of healthy oceans.

#### **Situation of Morocco:**

Creating more than 2.5% of GDP, sea fishing is one of the foundations of the Moroccan economy. With its coastline stretching over 3,500 km of coastline and a sea surface estimated at 1.2 million km<sup>2</sup>, Morocco has a fishing arsenal estimated at 1.5 million tons. Morocco is also said to be the world's leading exporter of sardines, in this case, "Sardina pilchardus".

#### **Structure of the fisheries and aquaculture sector:**

The fisheries sector concerns maritime and inland fisheries.

Sea fishing brings together all the extraction activities carried out at sea, from the coasts and lagoons. While inland fishing concerns all activities practiced in rivers, wadis, dams, on land etc. Aquaculture means "any activity of breeding or cultivating aquatic organisms such as fish, crustaceans, mollusks and marine plants. It can be marine (open sea or lagoon) or continental (closed river, dams or ponds)".

1. The sea fishing sector: It is divided into different sub-sectors
2. Deep-sea fishing: It's a fishing activity that is practiced on the high seas, offshore
3. Coastal fishing: This activity is carried out using a fleet of coastal vessels
4. Artisanal fishing:
5. Coastal activities: They target fishing for algae, shellfish and echinoderms.
6. Madragues: This sector concerns tuna fishing activities (mainly bluefin tuna).
7. The fishing industry:

It concerns the canning, semi-canned, frozen-on-shore, packaging of fresh fish, fishmeal and fish oil and seaweed processing industries.

#### **Contribution of the fishing sector to the Moroccan economy:**

The national coastline, which is teeming with considerable potential in fishery resources, favors a noticeable inflow of foreign currency into the country, which has repercussions on the country's trade balance. Exports of seafood products represent a turnover of 13.2 billion dirhams, thus ensuring 10% of total exports and 50% of agri-food exports from Morocco.

Furthermore, the decisive place of the marine fisheries sector in the national economy is reflected above all by its significant contribution to the employment sector. In fact, the sector provides 170,000 direct jobs and 490,000 indirect jobs. Studies have also revealed that 13 million people live in the fisheries sector.

#### **Resources and Fisheries Production in Morocco:**

The total biomass of small pelagic (sardines, anchovies, horse mackerels, mackerels and sardinella) at the Moroccan EEZ, estimated during sea cruises aboard of the research vessel Al-Amir Moulay Abdallah, in autumn 2015, amounts 7,45 million tons (INRH, 2016).

The volume of catches made on this biomass in 2016 is around 1,457,000 tons, rising by 11% in 2016 compared to the previous year. The reported catch volumes for these species in different fishing zones show an increase of 36%

in the northern zone, 24% in the central zone and 4% in the southern zone, while the Mediterranean zone has experienced a regression of -3% in comparison to 2015.

The biomass of small pelagic stocks in the two central and southern zones is estimated in autumn 2016 at 4.45 million tons, showing a decrease of 30% compared to autumn 2015 (6.25 million tons).

The sardine biomass alone accounts for 67% of the total small pelagic stock. The remaining stock is mainly made from mackerel (24%) and horse mackerel 6%. The diagnosis of stocks exploitation levels in 2016, carried out using global, dynamic and analytical models, reveals:

1. A state of overexploitation of sardine stocks in the Mediterranean zone and mackerel in the central zone. However, it should be noted that the most recent assessments carried out in 2017 at the regional level (FAO / GFCM) for the sardine stock in the western Mediterranean, jointly between INRH and IEO (Spain), showed a state of full operation in 2016;
2. A full exploitation state for sardine stocks in the northern zone and anchovy in the central zone;
3. A state of non-full exploitation of sardine and mackerel stocks in the southern zone. It should be noted that the stocks considered in full exploitation, mean that the quantities fished from these stocks are sustainable (INRH, 2016).

The evaluation of the exploitation status of the sardine stock in the southern zone by other methods, in particular the ASPIC models, however, revealed a state of full exploitation with an over-exploitation of this stock whose contribution to catch volumes is growing. These less optimistic results call for vigilance regarding the level of fishing pressure exerted on this stock, particularly because of its great instability with respect to hydroclimatic changes. Regarding the resources of large pelagic, the updated information on the state of the stocks concerned only the swordfish in 2016 in the Mediterranean Sea, the only stock which assessment was updated by the ICCAT in this year. These assessments have shown that this stock is still overexploited despite the management measures established since 2011. However, thanks to the recent management measures implemented by ICCAT, biomass stocks of bluefin tuna and the North Atlantic swordfish that recovered in 2013, after the historic peak of 2013, the relative decline in yields of bluefin tuna caught by traps between 2014 and 2016, while remaining at higher levels than in 2008-2012 (INRH, 2016).

Small tuna's exploitation Indicators, including the abundance and catches index, show positive trends in recent years especially for skipjack and palmetto, suggesting that stocks of these species are not yet fully exploited. 14 For cephalopod resources, the year 2016 was marked by a fall in octopus yields of the different fleets operating south of Cap Boujdor as well as a decrease in catches in this species. In addition, squid yields improved from 2015 to 2016 according to the South Atlantic survey (INRH, 2016).

The same observation was confirmed by the exploitation. For the cuttlefish, abundance indices decreased in this area compared to 2015.

The estimated octopus's biomass in the South Atlantic for the 2015 autumn season (November 2015) was 24,000 tons, an increase of 56% compared to the biomass recorded during the fall 2014 campaign. The estimate for the summer season in 2016 (April 2016) is 7008 tons, a decrease of 35% compared to the same period in 2015 (9456 tons).

In terms of assessment for the South Atlantic area at the end of 2016, the state of the octopus has improved although this stock still has a delicate balance, which requires the continuation of management measures already undertaken in an adaptive framework, which takes into account the dynamics of this resource. The cuttlefish was assessed as overexploited, while squid assessment was inconclusive. For these last two species, it is time to develop appropriate management measures, within the framework of specific management plans for these two resources. The stock of deep-water rose shrimp, which is also a very important species for both the local market and for export, was marked in 2016 by an increase in catches in the Moroccan EEZ by 14% compared to 2015. This situation is mainly due to the increase observed in the catch of this species in the Atlantic. 60% of the deep-water rose shrimp catches are made by the coastal fishery. The global and analytical model assessment indicated that for the Mediterranean area, deep-water rose shrimp appears to be a relatively sustainable harvest level. On the other hand, for the Atlantic area, the deep-water rose shrimp stock is in a state of overexploitation confirmed by the results of all the models and

evaluation methods applied. To this end, it is recommended to continue the effort already put in place for the management of shrimp stocks and to reinforce the current management measures, particularly in terms of reduction and control of fishing mortality. In this context, the protection of spawning and recruitment areas, TAC management and adequate networking are all necessary measures to ensure the sustainability of this fishery. The hake fishery is regulated by the Order of the Minister of Agriculture and Maritime Fisheries No. 4195-14 of 2 Safar 1436 (November 25, 2014), defining two management units respectively in the Mediterranean and the Atlantic and setting a set of management measures that relate to fishing periods and zones, mesh size and market size that applies to both units. The last CECAF Working Party (Tenerife June 2017) concluded that the stock of white hake is overexploited with excessive fishing pressure on young age groups. Indeed, this stock is weakened by a high exploitation rate combined with stock biomass located at low levels.

In addition, the analysis of the exploited size frequencies reveals a high rate of individuals below the regulatory size (20 cm). The size of the commercial white hake is significantly lower than the size of the first maturity. This requires, in addition to the application of the measures already in place for the management of hake species, to continue the experiments on trawl selectivity to propose an appropriate mesh, coupled with simulations of different market sizes.

The assessment of the shellfish resources for the year 2016 concerned the natural deposits of the razor shell and the common edible cockle of the Dakhla Bay, which have undergone interesting fluctuations in the biomass and their geographical distribution area, compared to the year 2014. The total biomass of the razor shell improved during this year 2016. It increased from  $1294.90 \pm 270.30$  tons in 2014 to  $3325, 23 \pm 72.9$  tons in 2016. This increase in total biomass is probably linked to the new introduction of the biological break period that has been linked to the old period, thus giving a stop of the exploitation that lasted more than one year. Regarding the common edible cockle, its total range has increased from 2.82Km<sup>2</sup> in 2014 to 3.121Km<sup>2</sup> in 2016. The total biomass of this species has increased significantly from 320 tons in 2014 to 566 tons in 2016.

**This increase can be explained by the low demand of the species in Dakhla Bay. In fact, the annual production does not generally exceed 1/3 of the quota proposed in recent years. Regarding the assessment of algal resources, the year 2016 was marked by:**

1. An increase in the average biomass of Gelidium from 11,862 wet tons in 2015 to 14,600 tons in 2016, an increase of 18%;
2. An increase in the average biomass of H.incurvus from 10 913 wet tons in 2015 to 14 987 tons in 2016, an increase of 37%;
3. A halving of the average biomass of P.cartilagineum between 2015 and 2016. These biomasses increased from 10 064 to 5141 tons in wet weight.

## References:-

1. Allison, E.H. et al. 2012. Rights-based fisheries governance: from fishing rights to human rights. Fish and Fisheries, 13: 14-29. DOI: 10.1111/j.1467-2979.2011.00405.x.
2. Béné, C. et al. 2015. Feeding 9 billion by 2050 – Putting fish back on the menu. Food Security - The Science, Sociology and Economics of Food Production and Access to Food, 7: 261-274.
3. BMEL (Bundesministerium für Ernährung und Landwirtschaft) 2015. Welternährung verstehen. Fakten und Hintergründe.
4. Branch, T.A. 2008. Not all fisheries will be collapsed in 2048. Marine Policy 32:38-39.
5. Branch, T.A., Jensen, O.P., Ricard, D., Ye, Y., Hilborn, R. 2010. Contrasting Global Trends in Marine Fishery Status
6. Costello, C.; Ovando, D.; Clavelle, T.; Strauss, C.K.; Hilborn, R.; Melnychuk, M.C.; Branch, T.A.; et al. 2016. Global fishery prospects under contrasting management regimes. Proc. Nat. Acad. Sci., 5125.5129 69 p. +suppl. www.pnas.org/cgi/doi/10.1073/pnas.1520420113-/DCSupplemental.
7. Evans, L.T. 1998. Feeding the ten billion – Plant and population growth. Cambridge University Press, 264 p.
8. FAO 2014. The State of World Fisheries and Aquaculture: Opportunities and Challenges. Food and Agriculture Organization of the United Nations. Rome.
9. FAO Committee on Fisheries 2014. Report of the fourteenth session of the Sub-Committee on Fish Trade. Bergen, Norway, 24-28 February 2014.
10. FAO. 2016. The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all. Rome: 204 p.

11. Froese, R. and Proelss, A. 2010. Rebuilding fish stocks no later than 2015: will Europe meet the deadline? *Fish and Fisheries*, 11: 194-202. DOI: 10.1111/j.1467-2979.2009.00349.x.
12. Pauly, D., Watson, R., Alder, J. 2005. Global trends in world fisheries: impacts on marine ecosystems and food security. *Philosophical Transactions of the Royal Society B*, 360: 5-12. DOI: 10.1098/rstb.2004.1574.
13. Quaas, M.F. et al. 2012. Fishing industry borrows from natural capital at high shadow interest rates. *Ecological Economics* 82, 45-52.
14. Quaas, M.F. et al. 2016. It's the economy, stupid. Projecting the fate of fish populations using ecological-economic modeling. *Global Change Biology*, 22(1): 1365-2486. DOI: 10.1111/gcb.13060.
15. Sumaila, U.R. et al. 2012. Benefits of Rebuilding Global Marine Fisheries Outweigh Costs. *PLOS one*, 7(7). DOI: 10.1371/journal.pone.0040542.
16. Thilstedt, S.H. et al. 2016. Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015 era. *Food Policy*, Vol 61, 126–131.
17. World Bank. 2013a. World Bank Group Agriculture Action Plan 2013–15. Washington, DC: World Bank.
18. Worm, B. et al. 2006. Impacts of biodiversity loss on ocean ecosystem services. *Science* 314, 787-790. Worm, B. et al. 2009. Rebuilding Global Fisheries. *Science* 325 (5940), 578-585.
19. Worm, B. et al. 2009. Rebuilding Global Fisheries. *Science* 325 (5940), 578-585.
20. WWF 2015. Das große Wegschmeißen. Vom Acker bis zum Verbraucher: Ausmaß und Umwelteffekte der Lebensmittelverschwendung in Deutschland.