SEAS AT RISK

Ensuring sustainable aquaculture feed ingredients

Discussion paper for SAR workshop 7-8th October

21st September 2015

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Executive summary

This discussion paper is a follow-up from the joint NGO position paper Priorities for Environmentally Responsible Aquaculture in EU[1]. One of the key priorities NGOs have identified in the latter is "ensuring the sustainable sourcing of feed", and this paper explores and defines in more detail the issues, solutions and actions required to develop an ecologically sustainable feed resource on which European aquaculture can rely.

The feed related priorities listed in the paper are as follows:

- **Immediate guarantees that all fish meal and oil used in EU aquaculture is at least certified to IFFO RS – the responsible standard for production and sourcing;**
- **Within 5 years of its availability, the incorporation of an increasing percentage of independently certified fishmeal and fish oil within feeds, with certification done by a credible and independent environmental and social certification scheme– such as MSC – that uses low trophic index assessment criteria and FAO code of conduct principles.**
- **In the longer term, ensuring that all fin fish aquaculture facilities are net producers of fish protein;**
- **An increased use of non-fish based feed ingredients (such as algae, vegetable proteins and oils and land animal proteins) that are sourced sustainably. All plant proteins used should come from certified responsible sources;**
- **A commitment to the commercial trial of ecologically responsible alternatives to fishmeal and fish oil based diets, i.e. plant-based feed, other existing sources of marine proteins and oils and innovative feed ingredients;**
- **Discouragement of the use of discards or bycatch (the latter should be eliminated rather than utilised, unwanted catches should be avoided and the amount to be landed reduced as much as possible);**
- **Maximise the use in the production of fishmeal and fish oil of by-products and trimmings from the processing of seafood for human consumption;**
- **Assessments of the environmental footprint of alternative feeds.**

The purpose of this paper on feed is to ensure that NGOs are able to deliver a consistent message on the issue of feed sustainability, regardless of audience or geographical location. The issues of concern are global, and therefore not confined to any member state.

In the EU, the Common Fisheries Policy and the Blue Growth strategy aim to promote sustainable aquaculture growth and this is being implemented through the development of national multi-annual strategic aquaculture plans (2014-2020) that are a prerequisite for obtaining financial support through the European Maritime and Fisheries Fund.

However, European aquaculture cannot be termed "sustainable" unless the use of poorly managed and/or overexploited marine ingredients in the diets of European farmed fish are eradicated and the use of ecologically responsible marine and alternative non-marine ingredients is encouraged. It is imperative that increased production does not indirectly result in any further overfishing to provide these marine feed

[1] Priorities for Environmentally Responsible Aquaculture in EU. 2014. Seas at Risk. http://www.seas-at-risk.org/19-aquaculture/540-ngos-set-priorities-for-environmentally-responsible-aquaculture.html

ingredients. Proper safeguards need to be established to ensure that growth in aquaculture does not jeopardise the MSY objectives of the Common Fisheries Policy, nor lead to the overexploitation of other, non-EU fisheries that provide marine proteins and oils for feed. Ensuring the traceability of feed components is key to this.

Environmentally sustainable aquaculture can in principle be achieved without compromising the other two dimensions of sustainable development, namely social and economic objectives. Aquaculture's can help to meet the increasing demand for fish protein for future generations, but its ability to do so does not diminish the need for wild capture fisheries to be managed in an ecosystem based framework that enables them to achieve their full potential. In fact, the growth of aquaculture is reliant upon it. The global and EU industry must develop within a robust, enforced and meaningful regulatory framework that has ecosystem health as a core principle, rather than treating the environment as just another sector. A healthy and diverse environment is a pre requisite to support aquaculture operations and ensuring this is the case must be the foundation for any and all future growth plans.

If European aquaculture is to grow and fulfil the ambitions of matching global aquaculture growth a key target should be to ensure that all species farmed provide a net gain in fish protein. Aquaculture can only fill the fish gap if it does not remove more wild fish for the oceans for feed requirements than in produces. This is already the case for many species such as carp and tilapia, whose reliance on fishmeal and fish oil in the diets is low. Progress is also being made to achieve this for other, more popular carnivorous species such as Atlantic salmon, where inclusion rates for both fishmeal and fish oil have been steadily declining. However, if we are to maximise the benefits of using wild capture marine proteins and oils in feed, it is essential that their inclusion be seen as a strategic ingredient to deliver health benefits rather than the predominant source of protein.

It is equally imperative that an ecologically sustainable source of aquaculture feed is developed and utilised if European aquaculture is to fulfil its aim of producing "sustainable" farmed products. To rely upon unsustainable, poorly managed or discarded fish, vegetable proteins and oils, and by relying on feed ingredients using GM technology that is associated with a high environmental cost or whose impacts are unknown, is not acceptable and will not receive the support or endorsement of the environmental NGO community. However, the use of ecologically sustainable marine proteins and oils; by-products and trimmings; land animal proteins and innovative solutions such as insect meal and microalgae provide a good platform from which European aquaculture can develop whilst ensuring environmental stewardship and NGO support.

Seas at Risk would like to see, as a starting point, all European aquaculture feed sourced from International Fishmeal and Fish Oil Organisation Responsible Supply (IFFO RS) certified suppliers. Whilst we appreciate that for imported products, particularly from Asia this is a long-term goal, we would however encourage progress towards this certification via the IFFO Improvers Programme and other initiatives, such as being undertaken by FAO and partner organisations[2].

From this platform of responsible supply we would like to achieve the long term goal of European aquaculture compromised of feed fisheries certified as sustainable by the Marine Stewardship Council (MSC) using their low trophic index assessment methodology where appropriate; full use of by-products and trimmings and partial replacement of marine proteins and oils with non-marine alternatives.

[2] FAO. http://www.fao.org/fishery/topic/16920/en

The European aquaculture industry and European policy makers, including the Aquaculture Advisory Council, should set clear targets and commitments relating to the sourcing of responsible and ultimately ecologically sustainable fishmeal and fish oil. Without the achievement of these targets Seas at Risk believe it is unacceptable to claim that EU aquaculture products are environmentally sustainable.

A summary of the policy targets, actions and timelines are provided in Table 1.

Table 1: Seas At Risk's proposed policy targets and actions

Audience	…within 5 years	…longer term
International	All aquaculture products for sale in Europe are fed using feed than is independently certified as using responsibly sourced marine proteins and oils, such as the "International Fishmeal and Fish Oil Responsible Supply Standard" IFFO RS	All feed fisheries are certified to a sustainability standard using low trophic index assessment criteria such as that of the Marine Stewardship Council.
European Commission	Immediate guarantees that all fish meal and oil used in EU aquaculture is at least certified to IFFO RS – the responsible standard for production and sourcing.	
European Parliament (MEPs)	Within 5 years of its availability, the incorporation of an increasing percentage of independently certified fishmeal and fish oil within feeds, with certification done by a credible and independent environmental and social certification scheme– such as Marine Stewardship Council (MSC) – that uses low trophic index assessment criteria and FAO code of conduct principles.	The development and promotion of environmentally sustainable aquaculture that provides a net fish protein gain and therefore becomes a significant contributor to future food security is encouraged and supported.
Member states	Sustainable development principles are enshrined in all legislation that applies to or affects aquaculture. EU financial instruments support and incentivise practices and technologies that reduce the environmental impacts and improve the sustainability of the sector. Discouragement of the use of discards or bycatch (the latter should be eliminated rather than utilised, unwanted catches should be avoided and the amount to be landed reduced as much as possible).	Assessments of the environmental footprint of alternative feeds.
Producers and Producers Organisations	A commitment to the commercial trial of ecologically responsible alternatives to fishmeal and fish oil based diets, i.e. plant based feed, other existing sources of marine proteins and oils and innovative feed ingredients.	
Feed manufacturers and representative bodies	Maximise the use in the production of fishmeal and fish oil of by-products and trimmings from the processing of seafood for human consumption.	

Source: Seas At Risk et al, Environmentally responsible aquaculture in the EU, joint position paper, August, 2014

1 Aquaculture: facts and figures

Wild capture fisheries are at their maximum capacity, yet the demand for seafood continues to rise, driven by increased fish consumption and population growth, which has been predicted by the United Nations to reach around 9 billion people by 2050[3], 2 billion more people than today (2015). This widening "fish gap" is increasingly being filled by aquaculture, which will continue to expand to meet this requirement unless a radical new approach to managing and restoring our fish stocks can be implemented.

Between 2000 -2012 aquaculture expanded at a global average of 6.2 % per year leading to world food fish production more than doubling from 32.4 million tonnes in 2000 to 66.6 million tonnes in 2012[4]. This growth is however often occurring without first ensuring the ecologically sustainable management of the resources on which it relies, for example fresh water, suitable sites and in particular feed-fish. The sourcing and use of feed ingredients to supply and support European aquaculture is one of key environmental importance.

At present a quarter of seafood products consumed in the EU comes from aquaculture. European aquaculture is diverse; it incorporates a number of species in a range of production systems both in marine and freshwaters. 43% of aquaculture products consumed in the EU are also produced there, whilst 57% comes from non-EU countries, with Norway being the EU's principle supplier[5].

In Europe, 2.88 million tonnes were produced in 2012, i.e. 4.3% of the world supply of aquaculture production, down from 12.2% in 1990[6]. The European Union's share in world production decreased from 7.9% in 1990 to 1.9% in 2012[11], with a production total of 1.274 million tonnes in 2012 (see Figure 1). The difference between Europe and EU figures is explained by the increase in Norwegian salmonid production figures. In 2012 the main European aquaculture producers was Norway, whilst the five main EU producers are Spain, UK, France, Greece and Italy (see Figure 2).

The top European aquaculture species are mussel, trout, salmon, oyster, carp, sea bream and sea bass (Figure 3).

In the EU, aquaculture production has been stagnating the last decade, yet the EU now has ambitions to encourage European aquaculture production to equal the 6.2% global average growth rate[7]. Growth objectives are set out in the Common Fisheries Policy and the EU's Blue Growth strategy for economic growth and employment.

Given aquaculture's dependency on finite and limited supplies of fishmeal and particularly fish oil, there is an urgent need to achieve true ecological sustainability of marine feed ingredients.

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[3] Department of Economics and Social Affairs. United Nations. New York http://www.un.org/esa/population/publications/longrange2/WorldPop2300final.pdf

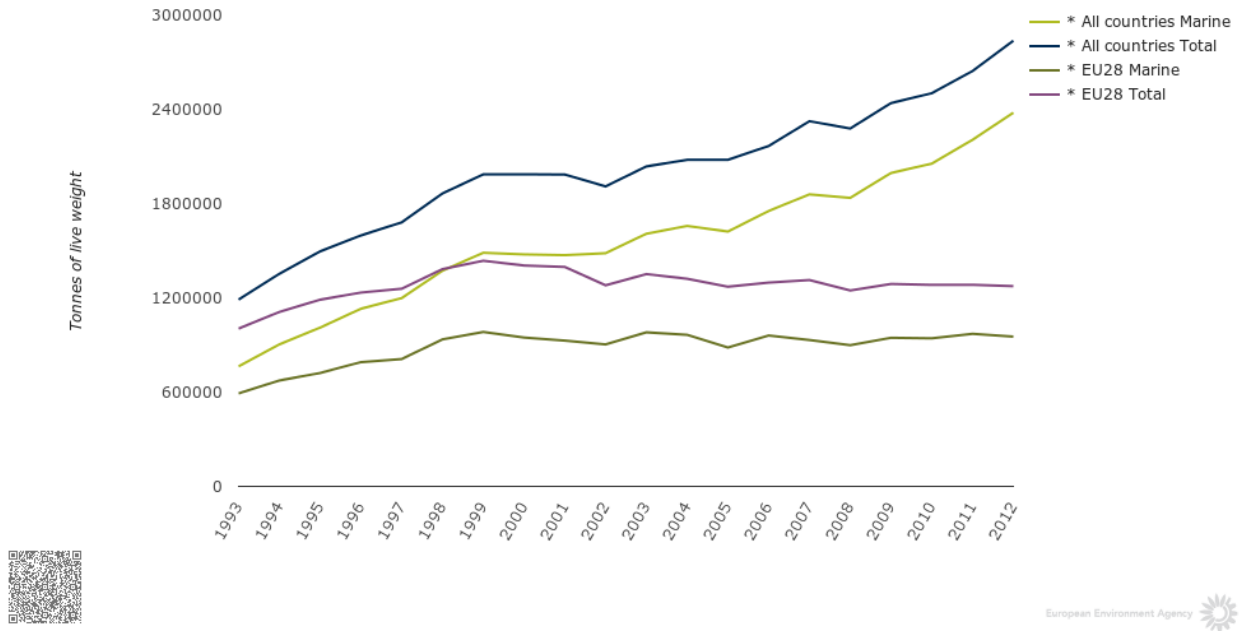
[4] FAO. 2014. State of World Fisheries and Aquaculture.

[5] http://ec.europa.eu/fisheries/documentation/publications/2015-aquaculture-facts_en.pdf

[6] FAO SOFIA, 2014. The State of World Fisheries and Aquaculture, Opportunities and Challenges. Food and Agriculture Organization of the United Nations. ISSN 1020-5489 http://www.fao.org/3/d1eaa9a1-5a71-4e42-86c0-f2111f07de16/i3720e.pdf

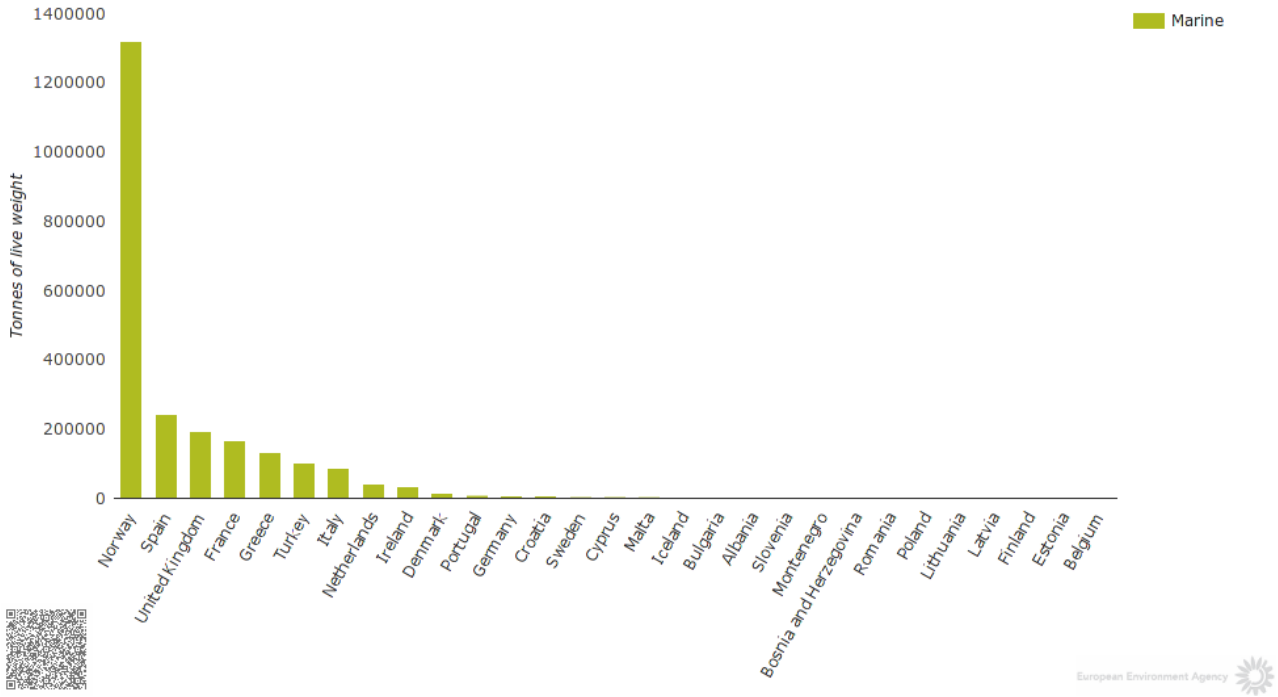
[7] FAO. 2014 SOFIA Report

Figure 1 **European aquaculture production (marine + fresh and brackish water, tonnes live weight)**



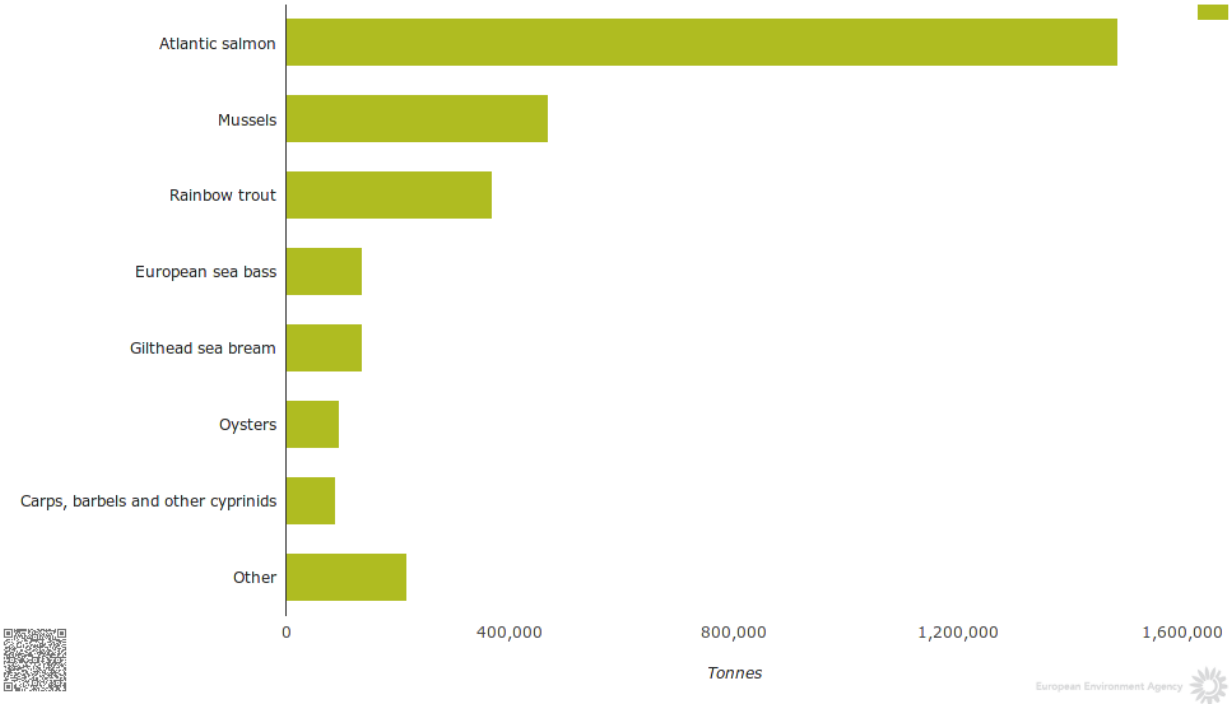
Source: Annual aquaculture production by major environment across Europe provided by Food and Agriculture Organization of the United Nations (FAO)

Figure 2 **Marine aquaculture production per country in 2012**



Source: Annual aquaculture production by major environment across Europe provided by Food and Agriculture Organization of the United Nations (FAO)

Figure 3: European aquaculture production: major species (2012)



Note: This figure shows production in tonnes of the main cultured species (or groups of species) in 2012. Data includes all EEA countries (i.e. EU-28 + non-EU countries that are part of the EEA Eionet network) where production exists and production environments (i.e. marine, brackish and freshwater).

Source: Major Aquaculture species in Europe in 2012 provided by Food and Agriculture Organization of the United Nations (FAO)

2 Trends in aquaculture feed: use and composition

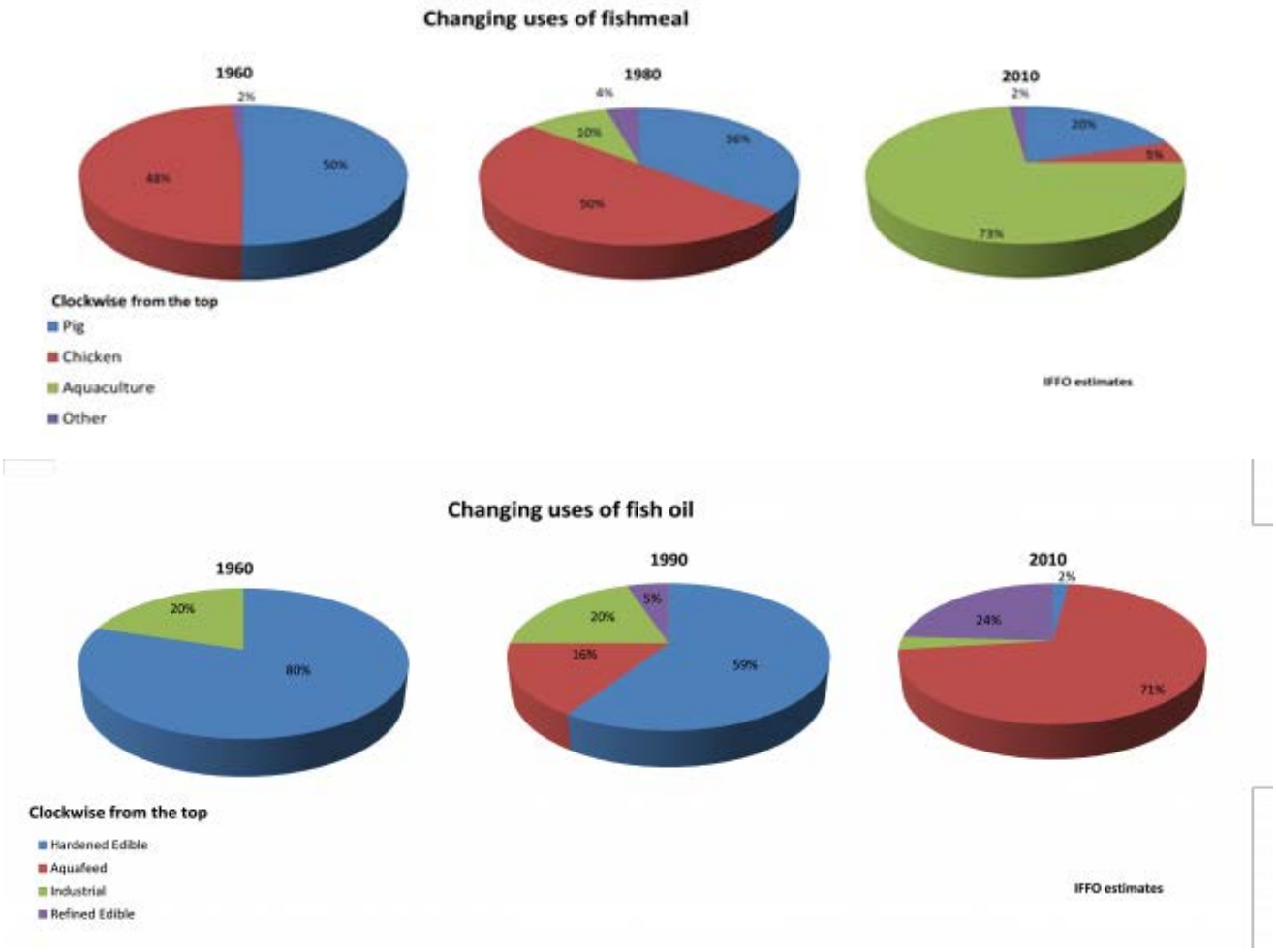
Many of the fin fish species farmed in Europe are heavily reliant on fishmeal and fish oil based diets, including species such as Atlantic salmon, trout, sea bass, gilthead bream and turbot. As these key species are likely to be the focus of increased EU aquaculture production, it is an opportune time for environmental NGO's to develop a cross organisational position paper on this issue.

Figure 4 shows the changing uses of fishmeal and fish oil over a 50 year period. It shows a huge reduction in the amount going to pigs and particularly poultry diets as aquaculture grows to become the largest user.

Outside of those feeds which are certified as responsible sourced by the International Marine Ingredients Organisation's Responsible Standard (IFFO RS), there remains approximately 15-20% of non-certified fishmeal and fish oil used in the EEA (EU plus Iceland and Norway)[8]. This percentage of feed ingredients will rely upon some species that are unassessed and from data deficient or poorly managed fisheries. Our concern is that without assurances of responsible or environmentally sustainable certification in place, any increase in European aquaculture production will directly lead to the increased pressure on these already vulnerable stocks, as well as seeking new untargeted species of which little information is known.

[8] Dr Andrew Jackson, IFFO. Pers Comm 02/04/2015

Figure 4: Changing uses of fishmeal and fish oil 1960-2010



Source: http://www.iffo.net/node/464

On the positive side, we see fishmeal and fish oil are being used more efficiently (Figure 5), partially as a result of an increase in the amount of non-marine ingredients used in feed production, which is further detailed in section 5. The inclusion of by-products and trimmings also contributes to this trend, the use of which in 2014 makes up about 35% of marine raw materials in feeds compared to 25% in 2010[9]. Seas at Risk would like to encourage greater utilisation of these by-products to ensure that marine protein and oils waste is reduced to as near as zero as practically possible, particularly given the finite nature of wild fish stocks. To enable this, full utilisation of infrastructural investment, such as processing and transport solutions, may be required.

The increase of the amount of non-marine ingredients in feeds is the result of years of investment and research in feed formulation, primarily salmonid feeds and to a lesser extend bass and bream diets, to provide the nutrients the fish need to growth and remain healthy, whilst reducing the reliance on marine ingredients. In Norwegian fish feeds for example, there has been an increase from 10% plant proteins and oils in feeds in 1990 to a 70% in 2013[10]. This steady increase of both the replacement of fishmeal and fish

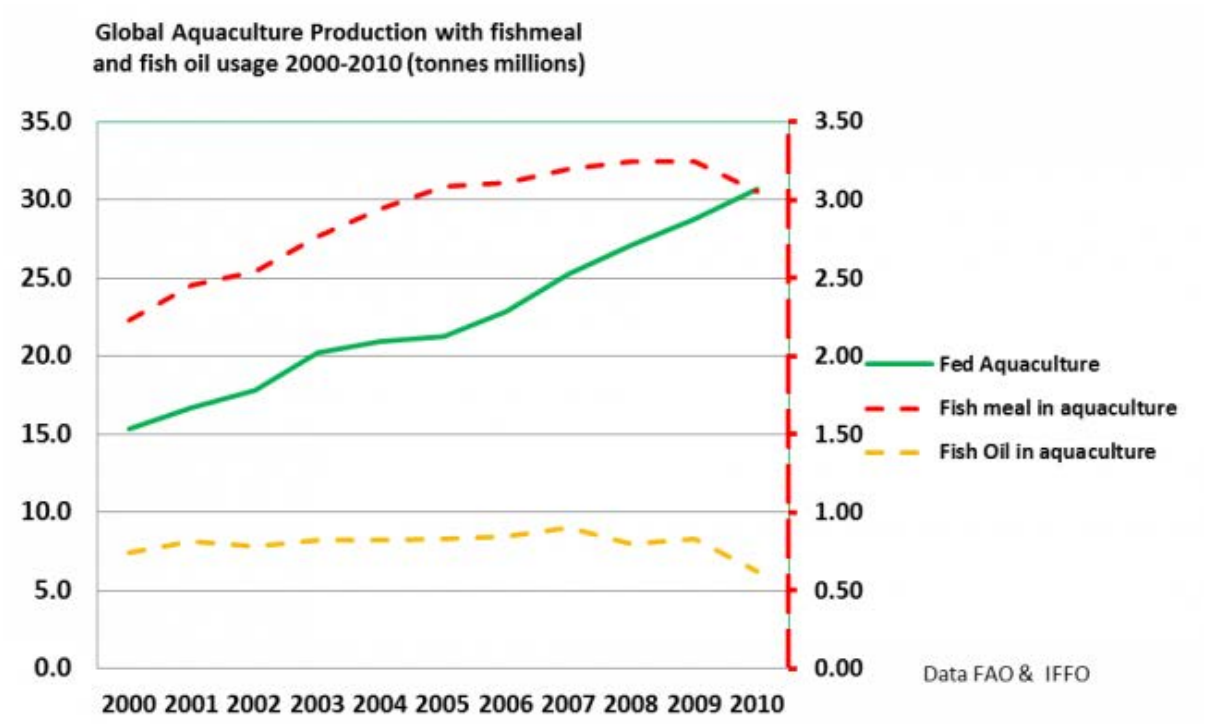
[9] FAO. 2014 SOFIA Report
[10] FEAP Aquaculture in Motion Conference. 2014. Niels Alstead Presentation. "Feeding Fish is not an embarrassment"

oil with alternatives and the increasing use of by-products and trimmings to supply marine raw ingredients focuses this paper on justifying the need to ensure the responsible and sustainable sourcing of feed fish rather than their inclusion rate (referred to Fish In, Fish Out ratio) in diets.

We are concerned however about the limited uptake of non-marine feed ingredients in some countries such as the UK, with barriers in place such as retailer sourcing policies preventing the use of processed animal proteins, and production standards such as Label Rouge requiring a high marine feed ingredient inclusion rate. This limited uptake is driven by concerns over Omega 3 content of fish flesh being reduced as a result of being fed a partially substituted diet. A number of retailers prefer to market their fish as having a high Omega 3 oil content, a claim they cannot maintain if non-marine ingredient inclusion rates are increased.

There is also reluctance to include haemoglobin meal from land animals in diets for concern over consumer acceptance, particularly within the UK retail sector. This by-product from terrestrial farming is being used in some countries as a protein source for aquafeed but use in Europe is limited.

Figure 5 **World fishmeal and fish oil consumption compared with a growth in "fed" aquaculture 2000- 2010.**



3 Future growth of European aquaculture: feed implications

EU aquaculture growth is being promoted by the reformed Common Fisheries Policy (CFP) and the EU Blue Growth strategy[11], which is the long term strategy for economic growth and employment in five priority maritime sectors. Aquaculture is one of those five Blue Growth sectors.

This growth is to be solidified through Multi-Annual National Aquaculture Plans (2014-2020) at member state level, which are also a prerequisite to apply for funding under the European Maritime and Fisheries Fund (EMFF). These national plans set out clear targets for growth, e.g.:

- Scotland: the National Marine Plan sets a target of 210,000 tonnes of fin fish aquaculture by 2020[12], a 30% increase from the 162,374 tonnes produced in 2014.[13]
- Spain: was in 2012 the leading country in Europe for aquaculture production accounting for 21% of the EU total production. However Spanish aquaculture production has since stagnated. The 2014-2020 Multi Annual Aquaculture Plan hopes to address this by reviewing the current legal framework; increasing competiveness of the sector; reviewing marketing and using integrated coastal zone management to expand and identify new areas for production.
- The Netherlands: main production is bottom cultured blue mussels; oyster and land-based production of fish, mostly eel and catfish, produced a total of 43 500 tonnes in 2011. Total value from production amounted to €64.4 million the same year. The Dutch objective is to increase the value of aquaculture production via niche and high-value products[14].
- Latvia: by 2023, aquaculture activities are expected to treble from the 2013 figure of 643 tonnes, 80% of which was carp farmed in pond systems.[16]

A recent joint study carried out for the European Parliament's Committee on Fisheries by The European Aquaculture Society, the Federation of European Aquaculture Producers (FEAP) and the University of Stirling summarised this growth by each production sector and provided an estimate of volumes, value and additional feed requirements. It states: [15]

- "For coldwater marine species, growth is foreseen to be 100% by 2030, meaning 4% per year over the period, based on solid markets and achievement of potential, representing an additional 192,000 tonnes and a value increase of 587 M€; an increased feed demand of 173,000 tonnes is seen.
- Similar growth trends are predicted for warm water marine species, where a production forecast of 240,000 tonnes is made for these species, providing increases in value of 1.200 M€ and feed demand of 160,000 tonnes.

[11] http://ec.europa.eu/maritimeaffairs/policy/blue_growth/
[12] Scotland's National Marine Plan. 2015. Scottish Government
[13] Scottish Fish Farm Production Survey 2013. Marine Scotland. http://www.gov.scot/Resource/0045/00459981.pdf
[14] http://ec.europa.eu/fisheries/cfp/emff/doc/op-netherlands-fact-sheet_en.pdf
[15] European Parliament, 2014, The long-term economic and ecological impact of larger sustainable aquaculture, study. IP/B/PECH/IC/2013_162

- Production growth in the freshwater sub-sector is lower at 40%, which is 1.5% per year. Volume growth is 144,000 tonnes providing a value increase of 487 M€ and with an additional feed requirement of 62,000 tonnes.
- The total increase in volume from 2010 to 2030 is therefore 772,000 tonnes in volume (+56%), with a corresponding value increase of 2.7 billion euros and **requiring an additional 395,000 tonnes of feeds.**

If we were to then take this figure of 395,000 tonnes of feed (which consists of fishmeal and fish oil from wild capture fisheries and by-products, combined with vegetable proteins and oils) and calculate the amount of additional wild capture fish needed to provide it we get the following:

Table 2 Additional feed and fish requirements to support predicted European aquaculture growth by 2030

Additional feed required to support growth = 395,000 tonnes		
Range of fishmeal % content in feed*[16]	10 - 30%	395,000 x **10%** =**39,500 tonnes of whole wet fish** 395,000 & **30%** = **118,000 tonnes of whole wet fish**
Range of fish oil % content in feed[16]	5 -20%	395,000 x **5%** = **19,750 tonnes of whole wet fish** 395,000 x **20% = 79,000 tonnes of whole wet fish**
Average % yield of fishmeal from whole wet fish[16]	22%	**39,500 (10%) of fishmeal = 140,010 tonnes of whole wet fish** 118,000 **(30%) of fishmeal = 418,314 tonnes of whole wet fish**
Average % yield of fish oil from whole wet fish[16]	5-20%	19,750 (**5%**) yield = **375,250 tonnes of whole wet fish** 79,000 (**20%**) yield = **316,000 tonnes of whole wet fish**
If we assume that the 316,000 – 375,250 tonnes of whole wet fish used to produce fish oil also provide us with the fishmeal we need, that results in **316,000 – 375,250** tonnes of whole wet fish required		

Average percentage of by-products and trimmings used in feeds	35%[16]	316,000 – 35% = 205,400 375,250- 35% = 243,913
Total additional amount whole wet fish required to provide food requirements	**Between 205,400 – 243,913 tonnes**	

*Range of fishmeal and fish oil in feeds covers major European farmed fin fish – bass, bream, salmon and trout.

Table 3: Fishmeal and fish oil inclusion in European farmed fin fish diets.[17]

Species	Fishmeal inclusion range	Fish Oil Inclusion Range
Bass & Bream	15-22%	5% (average)
Atlantic salmon	10-30%	10-20%
Rainbow Trout	10-25%	5-12%

This leaves an extra demand of between **205,400 and 243,913 additional tonnes of wild capture fisheries**, assuming that all of the remainder marine proteins and oils are supplied in this way. As shown in Table 4, the amount of feed used in European aquaculture in 2012 was 2.6 million tonnes [18], this additional 395,000 tonne requirement therefore represents a 15% increase.

However, we know that our wild capture fisheries are at their maximum capacity at best; many are overfished, particularly in Europe, where 41% of known stocks are overexploited[19] . Globally wild capture fisheries are at their maximum capacity with 61.3% being fully exploited and 28.8% overexploited[20]. This then begs the question of where these addition fish will be sourced to provide feed to support this growth.

Table 4: A breakdown of feed usage in Europe by species.

Aquaculture feed in Europe 2012	
Species	**Feed in tonnes**
Crustacea	456
Marine Fish	396,000
Salmonids	2,080,000
Eel	10,500

[16] FAO. SOFIA Report 2014
[17] Nick Bradbury, Biomar. Pers Comm. 21/07/2015
[18] Andrew Jackson, IFFO. 2015. Pers Comm.
[19] European Commission. 2014. Concerning a consultation on Fishing Opportunities for 2015 under the CommonFisheries Policy.
[20] FAO. The State of World Fisheries and Aquaculture 2014.

Cyprinds	121,500
Tilapia species	225
Other Freshwater species	23,800
Total	**2,632,481**

Source: Andrew Jackson, IFFO. Personal communications. June 2015

4 Certification programmes: responsible versus sustainable

It is imperative that European aquaculture development should not lead to further overfishing, therefore proper safeguards need to be established to ensure that growth in aquaculture does not jeopardise the Maximum Sustainable Yield (MSY) objectives of the Common Fisheries Policy. Ensuring the full traceability of species within feeds is a key component of this.

The aquaculture industry should set clear targets and commitments relating to the sourcing of responsible and ultimately sustainable fishmeal and fish oil. Without this, it is unacceptable to claim that EU aquaculture products are environmentally sustainable.

With regard to marine proteins and oils used in aquaculture, there are two main certification standards for sustainable and responsible supply: the Marine Stewardship Council (MSC) and the IFFO Global Standard for Responsible Supply (IFFO RS).

Appendix 1 provides a summary of the key elements of both of the standards, their scope and the claims can that be made by certification holders.

4.1 Marine Stewardship Council (MSC)

The MSC runs a consumer facing eco-label fisheries program, based on standards for sustainable fishing practices and seafood traceability. The MSC programme was the first one of its kind and is the most widely recognised standard covering fisheries, although at present there are only very small volumes of whole-fish from MSC certified fisheries being made available for fishmeal and fish oil production. The fisheries standard when combined with the Chain of Custody standard is designed to permit the final vendor to label individual fish products as sustainable.

Each fish species undergoes a review to determine its trophic index and therefore assessment pathway, it is this process that provides the ecosystem based fisheries management approach that results in ecologically sustainable fisheries. The MSC assessment process is not perfect, as fisheries can achieve an overall score of 60% against the MSC principles and receive a conditional pass, with conditions to be met within 5 years. Also the cumulative effects of the wider certified and non-certified fisheries are not taken into consideration, however to date it offers the best option for the management and identification of sustainable feed fisheries to support aquaculture.

4.2 IFFO RS

IFFO RS certification enables marine ingredient producers to demonstrate their commitment to responsible practices in the areas of raw material procurement and feed safety. In order to achieve this, IFFO, via a multi-stakeholder Technical Advisory Committee developed a Global Standard and Certification Programme for the Responsible Supply of fishmeal and fish oil (IFFO RS). It is a business-to-business standard covering responsible raw material sourcing and good manufacturing practice. The IFFO RS achieved ISO65 accreditation through its Certification Body in September 2012.

As a business-to-business tool IFFO RS does not offer any assurances to the end consumer, as it not a point of sale eco-label. The standard is also limited to the fishmeal/fish oil factory as the unit of certification and as such does not carry out audits at fishery level nor allow fisheries to make any claim of responsibility. IFFO RS certification does not necessarily meet the objectives of Maximum Sustainable Yield as set out by the reformed CFP. The IFFO Standard refers to the 'long term conservation' of the resource, use of the precautionary principle and requires biologically based reference points (or some type of similar proxy) to ensure long term conservation. The Standard also uses terminology such as ensuring stocks are not outside of safe biological limits with respect to excess fishing capacity.

4.3 From IFFO to MSC: a phased approach

Seas at Risk would like to see, as a starting point, all European aquaculture feed sourced from International Fishmeal and Fish Oil Organisation Responsible Supply (IFFO RS) certified suppliers. Whilst we appreciate that for imported products, particularly from Asia this is a long-term goal, we would however encourage progress towards this certification via the IFFO Improvers Programme and other initiatives, such as being undertaken by FAO and partner organisations[21]. From this platform of responsible supply, we would like to achieve the long term goal of European aquaculture consisting of feed fisheries certified as sustainable by the MSC using their low trophic index assessment methodology where appropriate; full use of by-products and trimmings and partial replacement of marine proteins and oils with non-marine alternatives.

In many Asian countries that supply Europe with popular farmed species such as warm water prawn and pangasius, there is a serious concern regarding feed sourcing. Fish used to make feed are caught in multi-species pelagic trawls, with no technical or fisheries management measures in place to ensure their long-term sustainability. This mixed catch includes unidentified species and juveniles; there is currently no way to ascertain the environmental impact of their removal[22]

Closer to home the story is more encouraging, with the majority (approximately 80%) of fisheries supplying feed requirements for European aquaculture being responsibly managed as defined by IFFO RS certification criteria. However, this responsible management does not necessarily achieve the Maximum Sustainable Yield objectives of the reformed CFP, nor is it ecosystem-based management and, therefore, does not take into consideration the wider environmental impacts of the removal of large numbers of small pelagic fish that occupy the base of the food chain (see Appendix 1 MSC/IFFO comparison).

[21] FAO. http://www.fao.org/fishery/topic/16920/en

[22] Asian Pacific Fisheries Commission. 2005. Asian Fisheries Today: the production and use of low value/trash fish from marine fisheries in the Asia Pacific region. FAO.

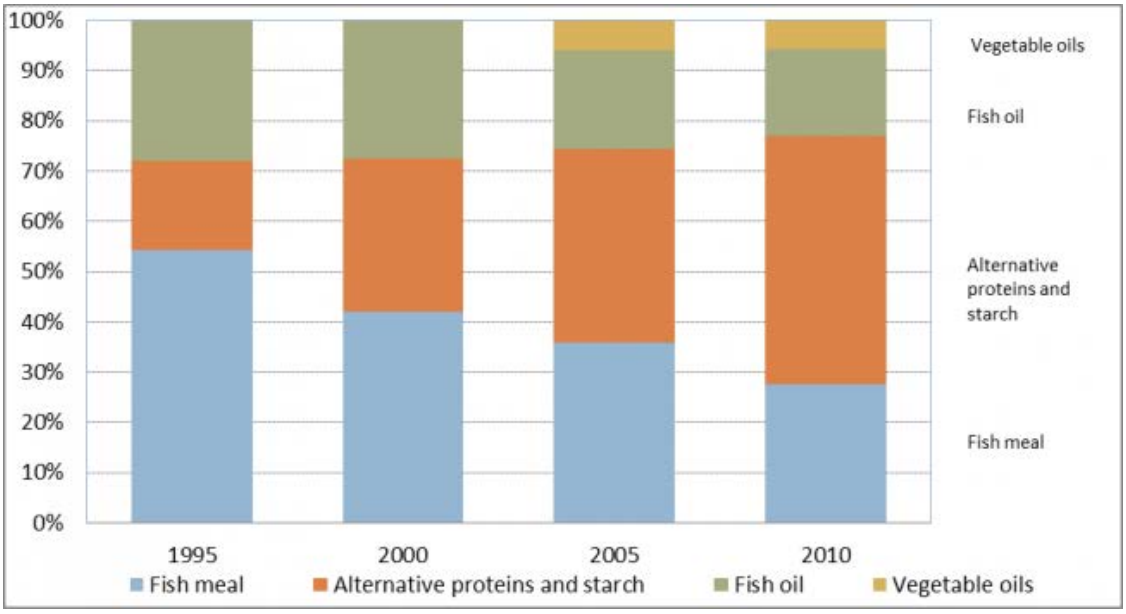
There is currently some discussion about the use of discarded fish arising from the reformed Common Fisheries Policy discard ban being used for fishmeal and fish oil. This complex issue is discussed more fully later on this document.

5 Alternative, non-fish based feed ingredients

With wild capture fisheries at their limit of exploitation under the current management regime, there is an increasing need to augment their use with alternative, non-marine ingredients. Seas at Risk believe the ideal feed composition would comprise of a combination of fully utilized by-products (from fish processing); certified ecologically sustainably managed marine proteins and oils, supplemented by a range of non-marine raw materials such as vegetable proteins and oils, algae oil, processed animal proteins and other emerging ingredients such as insect meal.

The high levels of omega-3 fatty acids in the flesh of farmed oily fish such as salmon is achieved by the inclusion of fish oils in their diets. Fish oil is becoming a limiting factor to aquaculture growth as its availability is in turn limited by the fisheries that provide the raw material for its production. The price of fishmeal and fish oil is rising, driven by an increasing demand for aquaculture products and fish oil supplements in the nutraceutical sector. The aquafeed industry has thus been looking for alternatives to partially replace these Omega-3 rich fish oils, resulting in an increasing proportion of non-marine oils now being used. In addition, an increasing percentage of fishmeal in also now being replaced with non-marine alternatives (see below graph)[23].

Figure 6: Graph showing the increasing percentage of fishmeal and fish oil replacement



Source: http://www.iffo.net/node/464

[23] http://www.iffo.net/iffo-rs-standard

In European feeds, these other ingredients are primarily plant based and comprise of a range of vegetable proteins and oils that include but are not limited to: wheat gluten; field beans; soya; soya protein concentrate and linseed and rapeseed oils. However the use of vegetable oils does not deliver the same level of these long-chain polyunsaturated fatty acids (LC-PUFA) to the end consumer. As a result, alternative methods of delivering these healthy fatty acids are being developed with the use of GM technology. GM technology is also being used to extensively to farm soy – the most popular vegetable protein replacement used in the diet of farmed fish.

5.1 Soy and GM ingredients

Over recent decades, soy has been undergoing the greatest expansion of any global crop. Around 270 million tonnes were produced in 2012, of which 93%came from just six countries: Brazil, United States, Argentina, China, India and Paraguay. The area of land devoted to cultivating soy has grown from less than 30 million hectares (ha) in 1970 to over 100 million ha today (WWF 2014). Even with higher yields per hectare, the FAO calculates that by 2050 the soy growing area will need to increase by almost half as much again up to 141 million ha.

Genetically modified (GM) soy was first introduced onto the market in 1996, principally to make soy crops resistant to herbicides. Although resisted in some regions, notably Europe, GM soy is now grown in many parts of the world. By 2009, 77 % soy production was from GM seed, covering 69 million ha, an increase of 4.9 % on 2008 [24]

Both conventional and GM soy production results in a number of environmental and socioeconomic impacts of concern:

- Deforestation and the subsequent impact of climate change
- Loss of ecological services such as clean water; healthy soils; pollination and pest control
- Loss of biodiversity
- Erosion of soils
- Loss of soil fertility and nutrients
- Dependence on synthetic fertilizers
- Resistance build up to fertilizer use
- Excessive use of agrochemicals
- Potential desertification
- Possibility of transgene escape
- Social impacts of displacement of indigenous communities

Soy and soya protein concentrate are widely used in aquaculture[25], particularly as recent feed formulations have reduced the percentage of fishmeal included in the diets of farmed fish.

There are a number of environmental concerns with the production of GM soy as outlined above, however both the positive and negative issues regarding the use and implications of GM technology are complex and

[24] WWF, 2014. *The growth of soy: Impacts and Solutions.* WWF International, Gland, Switzerland.
[25] Nick Bradbury, Biomar. Pers Comm. July 2015

require extensive research which is outside the scope of this paper. Whilst awaiting further research, Seas at Risk is unable to present a position on the use of GM soya. However, Seas at Risk supports the use of ProTerra certification for non-GM soy to address environmental concerns. Seas at Risk also supports the work of the Round Table for Responsible Soy (RTRS) and encourages all end users of soy to source exclusively from RTRS members (and preferably from ProTerra certified sources if possible). Seas at Risk believes that the use of GMO ingredients in aquaculture feeds should be clearly labelled and communicated to the end consumer.

5.2 Camelina and GM Yeast

Oil derived from GM *Camelina* (the false flax plant) and feeds made using GM Yeast are both proposed feed solutions either in development or commercial use that are contributing to the provision of Omega 3 oils (LC-PUFA's) from non-marine sources. The *Camelina* trials are in their infancy and as yet both the short and long term implications of its production and use are unknown.

GM yeast is in commercial production in aquafeeds and it being used to grow *Verlasso*[26] salmon in Chile. The closed system production process used for the yeast growth and the destruction of the GM yeast ensures containment within the production plant, but the pathway of the product via digestion and excretion into the wider environment is unknown at this time.

These other uses of GM technology in aquaculture diets are in their infancy, and as such do not demonstrate the same level of environmental concern as soy does. In these early stages of their development and application, the long term implications of their use cannot be fully determined.

The use of these GM ingredients needs further research; until this is completed Seas at Risk will advocate the application of a precautionary approach due to the high level of unknown long-term impacts.

5.3 Land animal proteins

A Commission Regulation (EU 56/2013) to re-authorise the use of processed animal proteins (PAPs) derived from non-ruminant farmed animals (i.e. mainly from pigs and poultry) in fish feed came into force in June 2013. Such use was prohibited twelve years ago when the total feed ban was introduced in 2001 to tackle the Bovine Spongiform Encephalopathy (BSE) epidemic. PAP's such as porcine meal; porcine blood meal; poultry meal and feather meal are used in non-European aquaculture production in countries such as Chile and Canada but are not used to the same extent in Europe and not at all in the UK where the barrier of "consumer acceptance" is cited at the retailer level.

Such PAP's represent a good source of nutrients and can and have been used successfully as an ingredient in the diets of farmed fish. As these "waste" by-products are both nutritionally suitable and able to partially replace the limited supply of marine proteins Seas At Risk has no issue with the inclusion of land animal proteins in the diets of farmed fish, provided responsible production and traceability standards are in place.

5.4 Insect meal

Insect meal is produced by separation of proteins and fats followed by drying of insect larvae. Insects can utilise a variety of organic material for growth such as food waste. On a global scale, insect meal based on

[26] http://www.verlasso.com/

organic waste could provide three times as much protein as all the soya produced today[27]. Insects as a feed in aquaculture is not new, and some scientific trials have already been carried out on tilapia and rainbow trout, among other species, although insect meal has never been brought into use on a large scale. However, the current EU TSE and Animal By-products Regulations[28] do not permit the use of insect meal in animal feeds.

The Research Council of Norway has allocated NOK 13 million to the AquaFly project[29] which will spend the next four years investigating the potential of using insects as safe and healthy ingredients of future fish feeds. Seas at Risk is supportive of the insect meal research and innovative solutions being trialled.

5.5 Algae oil

A number of types of microalgael produce large quantities of lipids, with several species producing exceptionally high concentrations of long chain Omega-3 oils, therefore potentially being a good source of this essential fatty acid. The advancement of this production has however been impeded by the high costs associated with processing harvested algae and the extraction and refinement of valuable components. The algal fuels industry is very much in its infancy with no large scale production of algae-based biofuels occurring in Europe today. The costs to develop the necessary production infrastructure are considerable and the investment-driven development rate is most likely to be a function of the rate of price increase in crude oil. [30] Seas At Risk is supportive of the use of microalgae oil use in aquafeeds.

5.6 Commercial use and environmental footprint of alternative feeds

There is both a growing need and urgency combined with a huge potential for alternative non-marine feed ingredients to contribute to aquaculture feed formulations. There has been and is ongoing extensive research on the capabilities of these ingredients and their success in commercial trials. Seas At Risk would like to see this research translated into commercial scale use to both fully explore the potential contribution these ingredients can make and to drive the market for their commercial scale production which will in turn, reduce the cost of ingredient production.

As part of this development process, Seas At Risk believe there should also be a requirement for the inclusion of an evaluation of the environmental footprint of the ingredient production. This would include full traceability to source; impacts on biodiversity and the wider environment; freshwater use and life-cycle analysis. This information is essential if we are to evaluate the performance on non-marine ingredients and benchmark them against the production of their marine counterparts.

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[27] http://aquaculturedirectory.co.uk/counting-insects-future-fish-feeds/#sthash.jSRF18GG.ssTfqf8a.dpuf

[28] REGULATION (EC) No 1069/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) & Regulation (EC) No 999/2001 of the European Parliament and of the Councilof 22 May 2001 laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies.

[29] http://nifes.no/en/counting-insects-future-fish-feeds

[30] Scottish Aquaculture Research Forum. 2014. Use of algal and other non-fish oils in Refined Edible Products. SARF 091

6 The use of discards

Prior to the reform of the Common Fisheries Policy (CFP) in 2013, discards were assumed to amount to almost 1 Million tonnes in the North Sea alone[31]. This was recognized by the European Parliament and highlighted as a major issue, resulting after serious discussions in a discard ban in the latest reform of the Common Fisheries Policy[32]. The landing obligation itself though has its flaws and allows for a series of exemptions. The effectiveness of the ban has also recently been degraded following the amendment of the CFP in spring 2015 through the so-called Omnibus regulation[33]. That will allow fish damaged by predators to be excluded from the discard ban, in addition to the existing exemptions.

While, for the reasons given above a sufficiently large amount of the catch will not be subject to the landing obligation, for the remaining fish caught that will have to be landed the provisions are not sufficient to prevent it to be channelled to aquaculture. Though Art 15.11 of the CFP states that such fish below the minimum conservation reference size (MCRS) is not allowed to be used for human consumption, it does allow its utilization to e.g. fishmeal and fish oil. Art 2.5b, stating to make best use of unwanted catches without creating a market for those catches below the MCRS, might be insufficient to prevent such a market.

The problem arises if the incentive to sell the fish to fish meal producers for a satisfactory price becomes stronger than the incentive to avoid the unwanted catch in the first place.

In the course of the Omnibus negotiations, the responsibility for the now to be landed catches has been given to the Member States that “shall have in place measures to facilitate their storage or finding outlets for them”[34]. Whether the establishment of these measures will facilitate or discourage the landing and therefor the catch in the first place remains to be seen.

NGOs emphasize the need to adhere to the objectives of the CFP and avoid unwanted catches in the first place. If fishers do not apply all possible efforts and measures to eliminate these at sea, the status of fish stocks will not improve as initially envisaged through the landing obligation. Utilizing unwanted catches misses the point when these fish, if they had not been caught, could have contributed to the reproduction capacity of wild stocks.

7 Conclusions and further work

As with all food production systems, aquaculture is not without its impacts, but the negative impacts on the wider ecosystem, biodiversity, habitats, species and water quality can be minimised by responsible operators farming to robust standards and the use and development of innovative practices. By operating responsibly a balance can be achieved between the development and diversification of the aquaculture industry and the maintenance of marine ecosystem integrity and sustainable resource use.

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[31] Catchpole T.L., Frid C. L. J., Gray T.S. 2005.Marine Policy - Discards in North Sea fisheries: Causes, consequences and solutions. doi:10.1016/j.marpol.2004.07.001

[32] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:354:0022:0061:EN:PDF

[33] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R0812&from=EN

[34] Directorate-General for Internal Policies of the Union, Secretariat of the Committee on Fisheries 11 December 2014: Landing obligation, State of play after the first trialogue.

SAR's position is that ecologically sustainable aquaculture can be achieved without compromising the other two principles of sustainable development, namely social and economic. We believe that aquaculture will continue to expand to fulfil the increasing demand for fish protein for future generations, but its ability to do so does not diminish the need for wild capture fisheries to be managed in an ecosystem based framework to achieve their full potential, in fact the growth of aquaculture is reliant upon it.

Aquaculture has the ability to produce healthy fish protein for an increasing population of seafood consumers, but in doing so the EU and global industry must develop within a robust, enforced and meaningful regulatory framework that has ecosystem health as a core principle, rather than treating the environment as just another sector.

If European aquaculture is to grow and fulfil the ambitions of matching global aquaculture growth a key target should be to ensure that all species farmed provide a net gain in fish protein. Aquaculture can only fill the fish gap if it does not remove more wild fish for the oceans for feed requirements than in produces.

It is imperative that an ecologically sustainable source of aquaculture feed is developed and utilised if European aquaculture is to fulfil its aim of producing "sustainable" farmed products. To rely upon unsustainable, poorly managed or discarded fish or proteins and oils using technology that is associated with a high environmental cost or whose impacts are unknown is not acceptable and will not receive the support or endorsement of the environmental NGO community. However, the use of ecologically sustainable marine proteins and oils; by-products and trimmings; land animal proteins and innovative solutions such as insect meal and microalgae provide a good platform from which European aquaculture can develop whilst ensuring environmental stewardship and NGO support.

To achieve the objectives of European aquaculture growth the following research and work areas are critical:

- The establishment of proper safeguards to ensure that growth in aquaculture does not jeopardise the MSY objectives of the Common Fisheries Policy nor lead to the overexploitation of other, non-EU fisheries that provide marine proteins and oils for feed;
- Developing a requirement for the traceability of feed components, including to species level, for all species that available and farmed in Europe;
- A phased and targeted plan to ensure that all European farmed fish deliver a net gain in fish protein;
- The review and investment in infrastructure, such as processing and transport, to ensure maximum utilisation of marine by-products and trimmings in aquafeeds, with the aim of ensuring that marine protein and oil waste is reduced to as near a zero as practically possible;
- The settings of phased targets for the use of IFFO RS certified fishmeal and fish oil in all EU aquaculture feeds;
- A targeted phased approach to the progression from IFFO RS to MSC certified marine feed ingredients in European farmed fish diets;
- Commission/support research to evaluate the environment costs and benefits of the use of GM technology to provide feed solutions for aquaculture;
- Encourage the use of insect meal in aquaculture feeds and allow for their use by implementing legislative amendments;
- Encourage and support, including financially the commercialisation of algae oil production.

8 Appendix: MSC/IFFO standards: comparison

	IFFO RS	MSC Principles and Criteria	
		MSC Non KEY species	MSC LTL (Low Trophic Level) KEY Species
UNIT OF CERTIFICATION	Fishmeal and Fish Oil factory	Fishery	LTL species fishery
PERMITTED CLAIM	Responsible supply	Sustainable	Sustainable
INDEPENDENT STANDARDS SETTING BODY	Yes	Yes	Yes
INDEPENDENT CERTIFICATION BODY	Yes	Yes	Yes
GOVERNANCE	IFFO RS Governing Board Representatives of fishmeal and fish oil producers, traders, fish feed producers, fish farmers, fish processors, retailers, environmental NGOs, related standards and the IFFO Technical Director.	Board of Trustees Technical Advisory Board Stakeholder Council Representatives for industry, environmental and science.	Board of Trustees Technical Advisory Board Stakeholder Council Representatives for industry, environmental and science.
CHAIN OF CUSTODY	Chain of Custody Standard	Chain of Custody Requirements	N/A
TIMELINE FOR REVIEW AND CONSULTATION PROCESS	Continual review and improvement	Two years (every 5 years)	Two years
IMPACT ON PET (Protected Endangered and Threatened) SPECIES	Recorded	Avoided	Fully assessed and mitigated for with documented evidence

			of actions
WILD CAPTURE FISHERIES	Whole fish and by-products	Yes	Yes
FARMED SPECIES	From by-products	Enhanced wild fisheries/cultivation only	Enhanced wild fisheries/cultivation only
FISHERIES AND THE ENVIRONMENT	Sourcing for responsibly managed fisheries: Whole fish must come from fisheries scientifically assessed and meeting the key principles of the FAO Code of Conduct for Responsible Fisheries. MSC certification is accepted as evidence of compliance. Fish by-products must come from well managed stocks and not included IUU or IUCN red listed fish stocks. No consideration for wider ecosystem impacts of harvesting forage species.	Three key principles: Sustainable fish stocks: fishing activity must be at a level which is sustainable for the fish population. Minimising environmental impact: fishing operations must be managed to maintain the structure, function and diversity of the ecosystem. Effective management: fishery must meet all local, national and international laws and have a management system in place to respond to changing circumstances to maintain sustainability.	MSC LTL requirements focus on limiting the ecosystem impacts of fisheries management.

FOOD SAFETY	Good manufacturing practice for safety, purity and traceability Factory must have attained Certification to the International Feed Ingredients Standard (IFISI) of the International Feed Safety Alliance (IFSA) or equivalent, as proof of responsible manufacturing. The applicant must be in possession of all relevant permits and licenses for the production and sale of fishmeal and fish oil products.	N/A	N/A
TRACEABILITY INCLUDED	Yes. It covers full traceability from the fishery to the fishmeal factory gate. The IFFO RS Programme also has the Chain of Custody Standard which requires the applicant to demonstrate that the products used are IFFO RS certified. An applicant must be	Yes. The MSC Chain of Custody Standards ensures that all MSC-labelled seafood comes from a certified sustainable fishery. Chain of Custody requires effective traceability, storage	Yes. The MSC Chain of Custody Standards ensures that all MSC-labelled seafood comes from a certified sustainable fishery. Chain of Custody requires effective traceability, storage

	able to demonstrate that IFFO RS products are segregated from non-IFFO RS products and that traceability can be maintained at all times throughout the distribution.	and record-keeping systems. The MSC also tests the traceability with random trace backs and DNA testing.	and record-keeping systems. The MSC also tests the traceability with random trace backs and DNA testing.
COMPLY WITH THE FAO CODE OF CONDUCT FOR RESPONSIBLE FISHERIES	Yes – key elements	Yes	Yes
Conformity ASSESSMENT BODY (CAB)	Yes. This standard is fully accredited by INAB to ISO 65 (EN 45 011)	Yes. MSC certifications are structured in sequence based on the ISO Guide 65. Also ISEAL compliant	Yes. MSC certifications are structured in sequence based on the ISO Guide 65. Also ISEAL compliant

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