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The implications of aquaculture policy and regulation for the development of integrated multi-trophic aquaculture in Europe

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ABSTRACT

Demands for fish and shellfish as food products are increasing; however, the potential for large scale production faces numerous challenges. Policy and legislation are likely to have an impact on the development of more sustainable aquaculture practices such as integrated multi-trophic aquaculture (IMTA). This study investigated the flexibility within the current governance frameworks across six European countries to allow for the adoption and management of IMTA. A snowball approach was used to identify relevant EU legislation, which was used as the basis by which to identify national/regional legislation which implemented EU requirements. This data was combined with a desk study to create a legislation overview for each of six countries, which was then subject to a Comparative Legal Analysis of the regulatory frameworks. Key findings were that *inter alia*: an existing policy focus on environmental sustainability and technological innovation may be an incentive for IMTA; and that the regulatory framework is complex and extensive and this may be a barrier to IMTA. Overall, this study found that national frameworks were generally amenable to experimental IMTA pilot schemes, but that for commercial expansion substantial regulatory reform would be required. Particularly, there may be a need for change to some aspects of legal regimes relating to the transfer of disease, fish health and food safety.

1. Introduction

Aquaculture accounts for nearly 40.1% of fin- and shellfish consumed worldwide, reaching 62.7 million tonnes in 2011 and estimated to have reached approximately 66.5 million tonnes in 2012 (FAO, 2013). To meet future demands for fish and shellfish as a food product, aquaculture production will need to more than double to 140 million tonnes by the year 2050 (Waite et al., 2014); however, although global production has been growing at nearly 7% per year, the European Union (EU) overall output has been largely constant in volume since 2000 (European Commission, 2013a). It has been suggested that large-scale growth of aquaculture in the EU has been constrained by a shortage of suitable sites and the ecological carrying capacity of existing sites (e.g. Simard et al., 2008) as well as public criticism based on perceived environmental impact (Kaiser and Stead, 2002). Therefore to address the aforementioned constraints, plus challenges such as environmental impact and consumer acceptance of farmed products, innovative solutions offering long-term environmental, economic and social sustainability are required to increase aquaculture production.

At the scale of the European Commission the challenges facing aquaculture are increasingly recognised and addressed through the EU Blue Growth Strategy and the reformed Common Fisheries Policy. Of particular note is the emergence of the 2013 Strategic Guidelines on Aquaculture (European commission, 2013b). The strategy promotes an 'open coordination' approach to policy, promoting a unified European approach to common issues such as administrative burdens and access to space and water. The strategy calls for the development of an Aquaculture Advisory Council in 2014 to provide evidence based advice to EU nations and for nations to prepare multi-annual strategic aquaculture plans.

A number of methods for expansion have attracted attention. These include offshore aquaculture installations (NOAA, 2008) and developments in recirculating aquaculture systems (Martins et al., 2010). One innovative technology that is also viewed as potentially environmentally and commercially sustainable is 'Integrated Multi-Trophic Aquaculture' (IMTA) (Chopin et al., 2004). IMTA involves the integrated cultivation

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of fed species (e.g. finfish) together with extractive species (marine invertebrates and/or algae) that feed on detritus from the fed species. This conversion of particulate waste (including fish faeces and unutilised feed) and dissolved waste (mainly ammonia) into secondary raw materials addresses key environmental impact concerns related to open-water aquaculture systems. Both these organic and inorganic discharges have been shown to have negative environmental impacts such as sedimentation in the vicinity of farms, nutrient loading in the water column that may lead to the increased occurrence of harmful algal blooms and the creation of an anoxic bottom water layer that can cause defaunation on the seabed (Hargrave et al., 2008; Holmer, 2010). Furthermore, if proven to be less harmful to the environment, finfish produced within these systems could potentially be marketed as 'environmentally friendly' products (Whitmarsh and Wattage, 2006). With the inclusion of value adding and emergence of suitable markets, additional components of the system such as seaweeds would be likely to also have a commercial value with relatively little or no additional cost.

China has been practicing IMTA for centuries (Troell et al., 2009) and a number of IMTA systems are currently also operating in North and South America (Canada and Chile), Africa (South Africa) and Europe (Spain, Portugal, France, Norway, UK) although the majority of these operations are at the research or pilot scale (Barrington et al., 2009). A new European research project, IDREEM, (www.idreem.eu) which aims to protect the long-term sustainability of European aquaculture by developing and demonstrating IMTA has led to seven experimental-scale IMTA systems being set up in Scotland, Ireland, Norway, Italy, Cyprus and Israel. The IMTA operations involved in this project did not require the development of new farm sites or changes to existing regulation; however, this may not be the case for larger scale operations and for this reason it is important to explore regulatory barriers to further development of IMTA in Europe.

Aquaculture regulation seeks to achieve a balance between a variety of demands including environmental pressures, animal welfare and food safety. In doing so, regulation can have a significant impact on innovation. The debate is ongoing as to whether regulatory constraints (including standards and operating permits) can be a barrier to environmentally sustainable innovation (Post and Altma, 1994) or whether in fact regulation can provide a framework for facilitating innovation (Porter, 1991). A review of case study literature showed that the specifics of policy and the situation in which they are applied are important for the outcomes of innovation (Kemp and Pontoglio, 2011). A workshop investigating policy and regulatory implications for IMTA in Canada found that changes were needed to federal and provincial regulations and policies, otherwise IMTA developments would be impeded. The most obvious example was that the Canadian Shellfish Sanitation Program prevented shellfish and finfish from being raised within 125 m of each other. Other issues included the need to develop protocols to ensure the safety of IMTA products and the multitude of authorities that fish farmers had to deal with in terms of licensing (Chopin and Robinson, 2004). It is likely that similar issues will arise in Europe and elsewhere as described in Bermudez (2013).

The aim of this study was to identify regulatory incentives and barriers to the development of IMTA within Europe and for this reason the suitability of current legal systems within Europe to cater to adoption and management of production under IMTA principles was explored. This paper describes the methods used to comprehend and analyse the regulatory systems for aquaculture in each of the six European countries. A brief policy and regulatory overview is provided for each country. A cross-country synthesis compares the policy and regulatory systems and identifies the opportunities and constraints for IMTA progress in the European countries involved in this study. A typology is presented that allows readers to identify factors that promote or constrain aquaculture in general and IMTA more specifically. Finally policy recommendations are provided to allow for advancement of the technology.

2. Materials and methods

2.1. Policy/legislation data collection

Rapid policy network mapping (RPNM) (Bainbridge et al., 2011) was used to identify relevant EU level legislation relating to aquaculture. RPNM investigates policy and legislation relationships within a defined policy or jurisdictional boundary. It uses a 'snowball sampling' approach by which each policy instrument is used as a referral source to identify new instruments to a defined degree or until saturation is achieved. Using these data as a starting point, national/regional legislation, created in order to implement EU level requirements, was identified. Lastly, other relevant national/regional legislation as well as 'soft' regulation such as certification and voluntary programs was identified.

These data were combined with a desktop study of peer-reviewed and 'grey' literature to define the existing procedures for planning and operating in aquaculture. This led to the creation of a 'regulatory overview' for each country. To enable the regulatory frameworks for the different countries to be comparable, it was necessary to identify specific functions of marine aquaculture legislation and to ensure that regulation was identified for each of the following three functions (and associated sub-functions):

- Governance structure (institutions responsible for aquaculture)
- Planning
  - Authorisation/Licensing
  - Access to land and water
  - Environmental impact assessment

- Operation
  - Water and wastewater
  - Fish movement and disease control
  - Drugs and pesticides
  - Feed
  - Food safety

Overall, the combined regulatory overviews for each country allowed for a comparison of policy and regulation using the method of 'comparative legal analysis'.

2.2. Comparative legal analysis

Comparative law is the 'systematic study of legal traditions and legal rules on a comparative basis' which has been used in research to aid legislation and law reform as well as the construction of law (De Cruz, 1999) There is no generally accepted framework for comparison and the definition and methodology used were heavily influenced by the specific scenario addressed (White and Glenn, 2006). De Cruz (1999) built upon previous studies on comparative law in order to develop a methodological blueprint for conducting comparative legal analysis. This blueprint formed the basis for a study into the use of bio-filter deployment in fish farms across Europe (White and Glenn, 2006) and the methodology adopted by us is based upon a framework adapted from that study.

The methodology consists of a number of steps, including: identifying the problem, identifying/collecting/organising data (based on the functional categories specified in the above section), highlighting differences and similarities between legal systems and the critical analysis of the legal systems relative to the research question.

The critical analysis consisted of a number of questions:

1. What are the implications of existing policy and institutions for deployment of IMTA?
2. Are any conditions within the planning regime affected by the deployment of IMTA?