



# Estimating the Irish public's willingness to pay for more sustainable salmon produced by integrated multi-trophic aquaculture



Suzanne van Osch<sup>a,\*</sup>, Stephen Hynes<sup>a</sup>, Tim O'Higgins<sup>b</sup>, Nick Hanley<sup>c</sup>, Danny Campbell<sup>d</sup>, Shirra Freeman<sup>e</sup>

<sup>a</sup> Socio-Economic Marine Research Unit (SEMURU), Whitaker Institute, National University of Ireland, Galway, Ireland, Republic of Ireland

<sup>b</sup> Marine and Renewable Energy Ireland (MaREI), Environmental Research Institute, University College Cork, Ireland, Republic of Ireland

<sup>c</sup> Geography & Sustainable Development, School of Geology & Geosciences, University of St. Andrews, Scotland, UK

<sup>d</sup> Economics Department, School of Management, University of Stirling, Scotland, UK

<sup>e</sup> Recanati Institute of Maritime Studies, University of Haifa, Israel

## ARTICLE INFO

### Keywords:

Sustainable aquaculture  
Choice experiments  
Ecolabels  
IMTA  
Willingness to pay

## ABSTRACT

Integrated Multi-Trophic Aquaculture (IMTA) has been put forward as a potential sustainable alternative to single fin fish species aquaculture. In IMTA, several species are combined in the production process. Integrating species has a conceivable dual advantage; the environmental impact can be lowered through nutrient cycling and from an economic perspective there is potential for increased efficiency, product diversification and a higher willingness to pay for more environmentally friendly produced salmon. This paper presents the results from a choice experiment which examines whether the Irish public is willing to pay a premium for “sustainably produced” farmed salmon from an IMTA process. Uniquely, an ecolabel was used in the design, based on familiar energy rating labels, to communicate the environmental pressure of fish farming to respondents. The experiment demonstrates that the Irish public has a willingness to pay a price premium for sustainability in salmon farming and for locally produced salmon.

## 1. Introduction

Despite the contribution that an expansion in aquaculture can make through significant employment and economic opportunities in rural areas and in feeding a growing global population, concerns exist over the environmental implications of such an expansion. These concerns are especially evident for the production of carnivorous fin fish species such as Atlantic salmon (*Salmo salar*) which utilizes feeds derived from wild caught fish [1]. Other environmental impacts consist of the intensive use of drugs and chemicals [2], the spreading of diseases and parasites [3], emissions of organic waste [4], escapees [5] and the intrusion of nets and sound into the natural environment [6]. However, substantial geographical differences should be recognised, as environmental impacts fluctuate according to appropriate production technologies and governance. Over the last decades, improved feed and feeding technologies have led to a steep decline in the FiFo ratio (Fish In – Fish Out ratio); i.e. the rate between the mass of harvested fish used for aquafeed and the mass of harvested fish from the fish farm [7]; improved site location and sea cage technology have significantly reduced waste sediments; better management and improved equipment

has seen a drop in the number of escapees and the development of oil-based vaccines has led to a decrease in the use of antibiotics and chemicals in salmon farming [8]. Environmental safeguards include regulatory, control and monitoring procedures such as in place at the European and national level [9]. In the case of salmon production in Ireland, environmental standards and monitoring requirements have developed that focus on sea lice, impacts on the benthos and nutrient concentrations in the water column and on the sea bed. Additional monitoring programmes required under various EU Directives are in place, including the monitoring of chemical residues in salmon and disease status [10,11]. Nevertheless, the development plans for large scale salmon farms in Ireland have been met with serious public opposition due to concerns about the impact on the marine environment [12] and especially in relation to the spread of sea lice.

Integrated Multi-Trophic Aquaculture (IMTA) could help resolve the apparent conflict between the growing demand for seafood and environmental concerns. IMTA has been proposed by NGO's, industry actors and scholars as one approach to decrease the environmental impact of aquaculture [13,14]. In an IMTA system several species are combined in the production process, selected by their function in the

\* Corresponding author at: Socio-Economic Marine Research Unit, St. Anthony's, Room 101, J.E Cairnes School of Business and Economics, National University of Ireland, Galway, Ireland, Republic of Ireland.

E-mail address: [s.vanoschl@nuigalway.ie](mailto:s.vanoschl@nuigalway.ie) (S. van Osch).

<http://dx.doi.org/10.1016/j.marpol.2017.07.005>

Received 27 March 2017; Received in revised form 10 July 2017; Accepted 10 July 2017

Available online 03 August 2017

0308-597X/ © 2017 Published by Elsevier Ltd.

ecosystem and their economic value. Species are combined to facilitate the absorption of undesirable outputs from the production process, allowing for nutrient cycling and decreased nutrient outflow [15]. IMTA has several advantages over monoculture, as it diversifies the economic risks of fish farmers by generating income from additional marine products such as lobsters, sea cucumbers, mussels, crabs and seaweed, rather than just the primary finfish species [16]. Additionally, higher profits may be made if production costs are lower through nutrient cycling [14] or if consumers are willing to pay a price premium for aquaculture products with lower environmental impacts. Higher profit margins on products may act as a stimulus for fish farmers to shift from monoculture to IMTA production techniques.

Research has indicated that consumers value an IMTA approach to salmon farming. A small scale study in New York found a positive attitude towards IMTA in comparison to monoculture salmon. IMTA salmon was perceived as being better for the environment and animal welfare and, to a lesser degree, as being safer and healthier [17]. In addition, a positive consumers' Willingness to Pay (WTP) was identified in several studies for salmon produced in an environmentally friendly manner, similar to what would result in an IMTA scenario (in Scotland by Whitmarsh & Wattage [18], in the US West coast by Yip et al. [19] and in Canada by Barrington et al. [20]). It is also recognised that in order for IMTA to be accepted, consumers must be able to distinguish between conventionally farmed salmon and IMTA salmon [21]. Eco-labelling is an increasingly used tool to differentiate aquaculture produce and stimulate informed purchasing decisions, thus creating economic incentives for producers to adopt environmentally friendlier technologies. Wild seafood products with ecolabels have been found to be preferred by consumers [22–25], but research on preferences for aquaculture ecolabels is limited to Roheim et al. [26] and Yip et al. [19]. Aquaculture products are viewed distinctly different from wild-caught products, where wild-caught is generally preferred over farmed produce [26]. Yet within the aquaculture market, consumers prefer Closed Containment (CC) and IMTA systems over monoculture production, with strongest preferences expressed for IMTA.

A key aspect of investment in IMTA will be the extent to which consumers are willing to pay higher prices for fish and shellfish which are produced using this technique. This paper estimates the Irish public's WTP for IMTA salmon products labelled with quantitative information on sustainability using a choice experiment (CE). The current plans to expand Irish aquaculture and invest in the sector, paired with national and EU policy goals to facilitate blue growth and protect marine ecosystems, means that uncovering evidence on the value of sustainable production is necessary. In what follows, the details of the design of the choice experiment are set out in Section 2 and the survey containing the CE is then outlined in Section 3. The Irish public's attitudes and WTP are reported in Section 4 while Section 5 draws conclusions and sets out policy recommendations.

## 2. Methodology

Choice experiments (CE) are widely used to estimate public preferences and willingness to pay (WTP) for changes in environmental quality and new products with new attributes or attribute levels [27–29]. This approach is consistent with other applied literature in seafood valuation, such as Yip et al. [19], Jaffry et al. [24], Uchida et al., [25], Roheim et al. [26], Brécard et al. [23] and Johnston et al. [30]. The CE approach is rooted in consumer theory and the concept of utility maximization as described by Lancaster's consumer theory [31]. According to Lancaster, a product derives its utility from the characteristics of that good, not from the consumption of the good itself. Thus, the value of a good is represented by the sum of the value of its attributes. Based on this theory, in a choice experiment, respondents are presented with choice cards that present a set of alternatives out of which the respondents chooses his/her preferred alternative. Each alternative consists of several attributes that vary in terms of the level

which they take. Respondents are asked to select their preferred alternative in each choice card, so they have to take into consideration their preference for a relative change in attribute A versus a relative change in attribute B. Choice experiments are based on the assumption that a rational decision making process underlies every choice, so the respondents' utility is maximized in every choice. The various choice sets that make up the choice cards allow the random utility model (RUM) to derive the underlying utility function for each product attribute [32,33].

The statistical analysis of the CE data, which aims to derive respondents' utility is based on random utility theory. Random utility theory recognises that there is both an observable and unobservable component to a products' utility. While the former is "observed" through survey response data, the researcher has to make assumptions about the distribution of the unobserved components of utility when modelling the probability function to predict which alternative are most preferred over the sample. More formally, the indirect utility function ( $u$ ) of individual respondent ( $i$ ) given the  $j$  options, consists of two independent parts; (1) the deterministic part ( $V$ ), comprised of the CE attributes ( $X$ ) under the  $j$  alternatives in the choice set; and (2) a stochastic part ( $e$ ), which reflects the unobserved factors that influence respondents' selection of the choice card alternatives, and/or randomness in the choice process itself. The utility function is represented by

$$U_{ij} = V_{ij}(X_{ij}) + e_{ij} = \beta_{ij} \quad (1)$$

where  $V_{ij}$  is typically specified as being a linear index of  $X_{ij}$  and  $\beta_{ij}$  reflects the utility associated with that attribute [34]. In creating a model, the researcher aims to maximise the variation in the data captured by  $V_{ij}$ , while minimising the stochastic part, so that the modelled utility  $\beta_{ij}$  represents as accurately as possible the utility of the population. It is assumed that respondents always select the option that maximises their utility; or the probability that a respondent chooses alternative  $k$  over alternative  $j$  in any given choice card is considered equal to the probability that the respondents' utility from alternative  $k$  exceeds the utility from option  $j$ . This can also be expressed as

$$P[(U_{ik} > U_{ij}) \forall k \neq j] = P[(V_{ik} - V_{ij}) > (e_{ij} - e_{ik})] \quad (2)$$

The parameters of  $V$  are commonly estimated by the multinomial logit (MNL) and the random parameter logit (RPL) models. Under the MNL, the random term is assumed to be independent and identically distributed (IDD) [35]. The RPL model often supplements MNL as it allows for correlation between the error terms in each individual's multiple choices, allowing the parameters of the CE attributes to differ across individuals.

The aim of the choice experiment and the resulting model estimation procedure is to derive marginal values of the attribute levels from the preferences of each respondent. The CE design usually includes a monetary indicator as an attribute, allowing implicit prices to be elicited for each of the parameters ( $\beta$ ). This implicit price reflects the respondents' WTP for a relative change in the attribute, given the changes in the other attributes [36]. Implicit values for a product attribute  $x$  are derived by:

$$WTP_x = - \left( \frac{\beta_x}{\beta_m} \right) \quad (3)$$

The WTP estimates reflect changes in consumer utility for variations in individual attribute levels. However, an aquaculture product will consist of a set of attributes that vary across products; i.e. production location, sustainability and price. Changes in attribute levels may therefore be considered in combination with other product attributes so that the WTP for the product can be assessed as a complete set of attributes [37,38]. The marginal WTP for the different attributes in our model (the implicit prices) and the welfare impact from a move from  $\times^0$  to  $\times^1$  (where  $\times^0$  to  $\times^1$  represent the attribute levels before and after the change respectively) are conditional on the individual taste

Download English Version:

<https://daneshyari.com/en/article/5117987>

Download Persian Version:

<https://daneshyari.com/article/5117987>

[Daneshyari.com](https://daneshyari.com)