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Review

Use of geotechnologies for aquaculture site selection: suitability factors and constraints for production in ground-excavated ponds

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ABSTRACT. Remote sensing (RS) and geographic information systems (GIS) have been used to guide the selection of suitable areas for aquaculture. This systematic review synthesizes the key suitability factors and constraints reported in the literature for establishing inland pond aquaculture. We searched for primary studies on Scopus and Web of Science according to preferred reporting items for systemic reviews and meta-analysis (PRISMA) guidelines. Between 1991 and 2020, 354 articles were published in 104 academic journals. The maximum annual number of publications occurred in 2020, with 22 publications, and there is an increasing trend in studies published over the past 30 years. From 12 selected studies, we identified 48 suitability factors, 11 related to soil suitability, 19 to socioeconomic and infrastructure suitability, and 18 to water quality and availability. The most frequently used suitability factors were road proximity, local market center distance, soil texture, soil slope, and water temperature. We listed 15 constraints that restrict or limit the selection of specific geographic locations for inland aquaculture. Urbanized areas, roads, and forests were the most frequently restricted areas. Geotechnologies provide powerful tools for spatial planning and management of aquaculture. Availability, quality, and access to spatial data are critical for the use of geotechnologies in the process of aquaculture site selection.

Keywords: geotechnology tools; remote sensing (RS); geographic information systems (GIS); aquaculture; suitable sites; site selection

INTRODUCTION

Geotechnologies consist of tools that enable geographic data acquisition, processing, analysis, and access. Some tools, such as geographic information systems (GIS), remote sensing (SR), global satellite navigation system (GNSS), or digital cartography, among others, have been exploited for improving site selection and spatial planning in aquaculture (Aguilar-Manjarrez 2010, Ross et al. 2013, Falconer et al. 2018, Yen & Chen. 2021). These technologies allow versatile, fast, and precise analysis of large spatial datasets, enabling the creation and spatial analysis of multiple scenarios, which can be used to support better decision-making (Salam 2000, Francisco et al. 2019, Yen & Chen 2021).

Site selection depends on spatial elements and is a prerequisite for any aquaculture system, laying the foundations for a profitable and sustainable business (Falconer et al. 2018). A range of factors may be considered when defining the criteria used to guide the selection of appropriate areas for aquaculture and determine their degree of suitability (Assefa & Abebe 2018, Nayak et al. 2018, Francisco et al. 2019).

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Aquaculture involves many spatial issues that must be understood to support sustainable development and mitigate potential issues (Falconer et al. 2019). Inappropriate practices could lead to many negative consequences, including habitat destruction, biodiversity loss, and other environmental problems, damage to facilities, low productivity, loss of stocks, the unwanted introduction of non-native species, and the emergence and spread of disease (Naylor et al. 2000, Walker & Mohan 2009, Aguilar-Manjarrez et al. 2017).

Several cases with a negative impact due to poor spatial planning, inadequate site selection, and management have been reported (Kumar & Cripps 2012).

Naylor et al. (2021) reported that freshwater aquaculture needed to be more represented in the proliferating literature on global environment and food system interactions despite its dominant contribution to aquatic food supplies and nutrition security. Most geotechnologies and aquaculture literature focus on marine and coastal environments (Naylor et al. 2021). Yen & Chen (2021) found that RS applications in fisheries mainly occurred in the northeastern marine area of the USA, the high seas area of the North Atlantic Ocean, the surrounding sea areas of France, Spain, and Portugal, the peripheral areas of the Indian Ocean, the East China Sea, Yellow Sea, and Bohai Sea areas to the north of Taiwan. All these areas correspond to marine and coastal areas, revealing a gap in the literature production we carried out in this study.

Therefore, the aims of this study were (i) to perform a systematic review of the scientific literature, specifically of peer-reviewed journal studies, to identify and quantify all relevant studies addressing the use of geotechnologies for aquaculture site selection; and (ii) to identify studies focusing on the selection of suitable areas for inland aquaculture using ground-excavated ponds, to analyze and discuss the most important suitability factors and restricted areas.

Selection of bibliographic material

The literature search was based on the guidelines defined in preferred reporting items for systemic reviews and meta-analysis - PRISMA (Page et al. 2021) with the inclusion of backward snowballing from the list of articles selected in the full-text assessment. An overview of each step is provided in Figure 1, which shows the number of studies included and excluded, based on the selection criteria defined, at each stage of the identification, screening, and eligibility assessment step.

We searched for relevant studies using two online academic literature databases, Scopus and Web of Science, which gather much of the world's most impactful research. Our search was restricted to studies published in peer-reviewed journals from the earliest record until the end of 2020. The search employed Boolean logic and English terms subdivided into three levels: a) level 1, terms related to geotechnology use - "GIS", "geographic information", "geotechnologies", "mapping", "remote sensing (RS)", "spatial"; b) level 2, terms related to area classification/selection approach - "site selection", "sustainable", "suitable", "classification", "modeling", "planning", "zoning"; c) level 3, terms related to aquaculture approaches - "aquaculture", "fish", "fishery", "fisheries", "tilapia", "shrimp", "carp", "catfish".

The number of items retained was counted at each step of the selection process, i.e. after the database search, after duplicates were removed, after screening the title and abstract, and after the final eligibility assessment of the full text of the studies.

To better analyze the identified studies addressing geotechnologies for aquaculture site selection, they were organized by publication year, country of authors' affiliation, and publication in main indexed journals. In the title and abstract reviews, we considered all studies relevant to the topic of interest, meaning the application of geotechnology for inland aquaculture in ground-excavated ponds. Studies dedicated to marine or coastal aquatic areas or unrelated to the topic under study, i.e. that did not employ geotechnology tools, were excluded. At full-text article assessments, we restricted the selection to studies of greater methodological relevance, i.e. that applied a multicriteria analysis for evaluating and classifying site suitability.

To broaden the extent of our search, we used backward snowballing, which consists in using the reference list of the studies selected at the full-text assessments to identify new relevant studies. This approach, combining database searches and reference list screening, allowed us to reach a final list of included studies for the synthesis.

Finally, we examined the selected literature to pinpoint the constraints and suitability factors used for informing the selection of adequate areas for aquaculture. Predominant factors considered in studies were analyzed and discussed in more detail. Suitability factors were classified based on three criteria: soil suitability, socioeconomic and infrastructure appropriateness, water quality, and availability.

Characterization of literature

Scopus and Web of Science search returned 354 articles (listed in the Supplementary Tables 1-2) published in

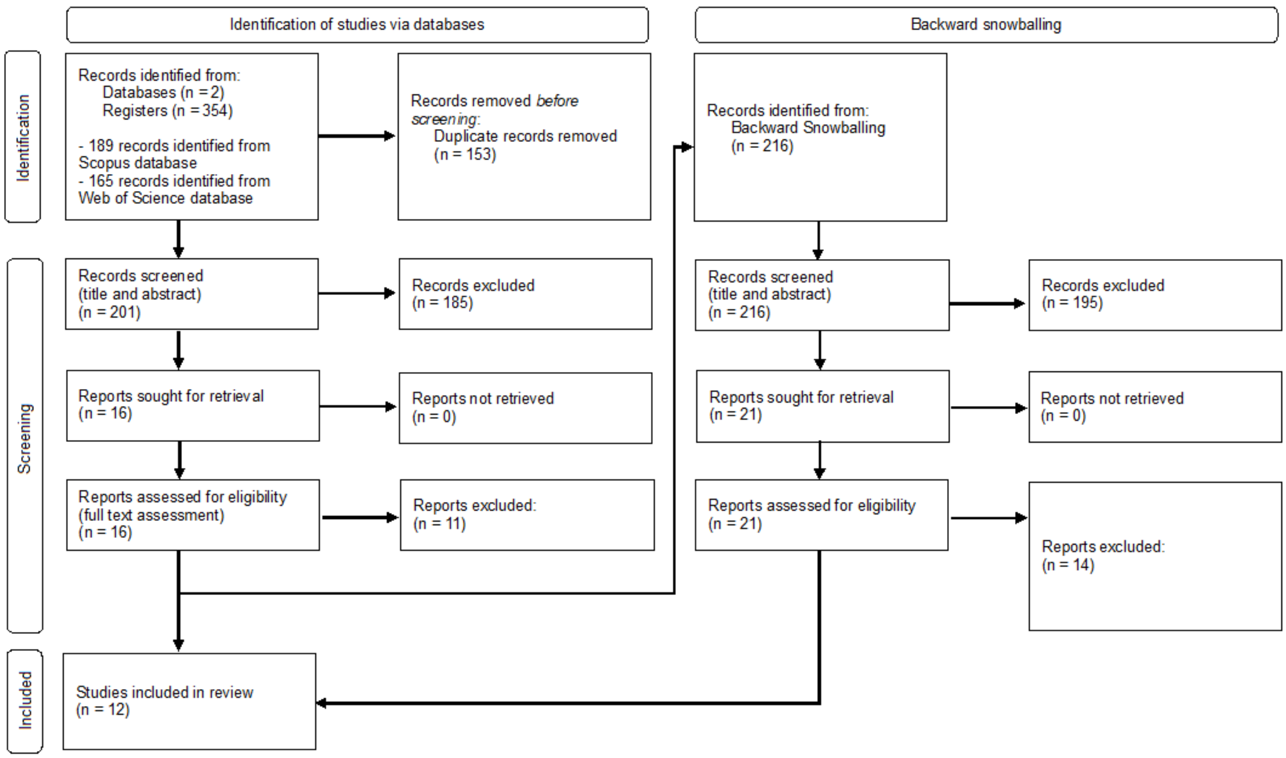

Figure 1. Overview of the literature search and identification of studies on the application of geotechnology for aquaculture (adapted of Page et al. 2020).

peer-reviewed journals, of which 189 were indexed in Scopus and 165 in Web of Science. Records obtained from each database were organized chronologically by year of publication and are shown (Fig. 2).

The earliest publication found was from 1991, and since then, it was possible to note a growing trend in the number of publications in both databases over the past three decades (Fig. 2). The maximum annual number of publications occurred in 2020, with 22 publications in the Web of Science base. Similar observations were reported by Vianna et al. (2016) and Falconer et al. (2019), which identified the late 1980s and the early 1990s as the starting point for such a trend, driven by the growth of the aquaculture industry and the technological advances that made GIS software more accessible and easier to use. Yen & Chen (2021) also reported a sharp increase in the number of publications from 2009 to 2018 when using "remote sensing" and "fishery" keywords on the Web of Science base.

The geographic distribution of authors by country of affiliation is shown (Fig. 3). In the case of international authorships, all involved countries were counted. There were researchers from 58 countries involved in the results, with a larger number of publications coming from authors in the USA, UK, France, Germany, and Australia. Regarding the number of researchers in the field, Yen & Chen (2021) found the USA, sequentially followed by China, India, the UK, France, Italy, Japan, and Australia.

Studies using geotechnology to assess or study aquaculture were published in 104 academic journals. The journals with the largest number of articles were Marine Policy, ICES Journal of Marine Science, and Canadian Journal of Fisheries and Aquaculture, with 14, 14, 11, and 8 studies, respectively (Fig. 4).

After comparing records between databases and removing duplicates, i.e. records that were indexed in both databases, a total of 201 studies were selected for screening (Fig. 1). At the title and abstract review stage, we retained 16 studies that focused on the use of geotechnologies for inland aquaculture production specifically on ground-excavated ponds. After a full-text assessment of the articles, five studies were selected based on greater methodological relevance, in which multiple suitability factors were judged for guiding aquaculture site selection: Hossain et al. (2007), Nayak et al. (2014, 2018), Assefa & Abebe (2018), and Francisco et al. (2019). Finally, the back-

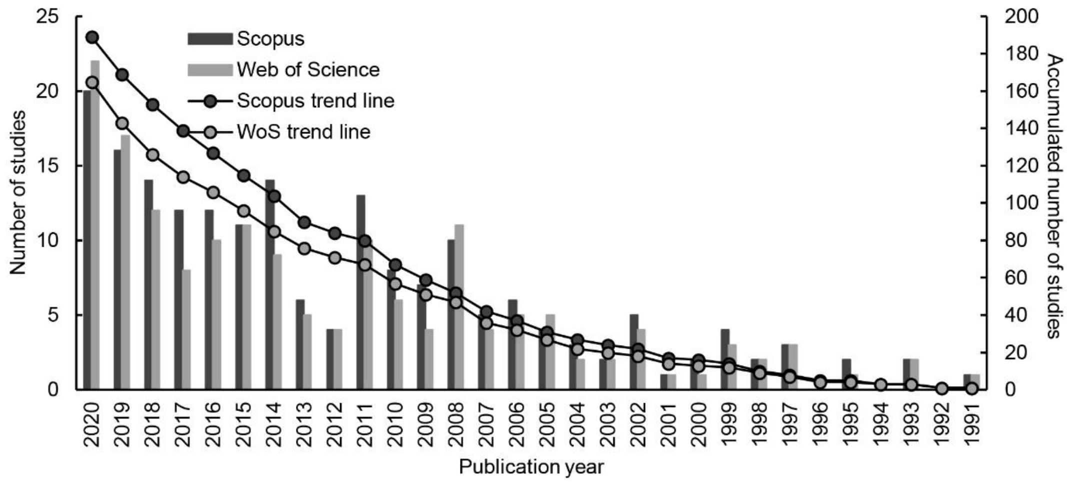

Figure 2. Number of studies per published year in Scopus and Web of Science.

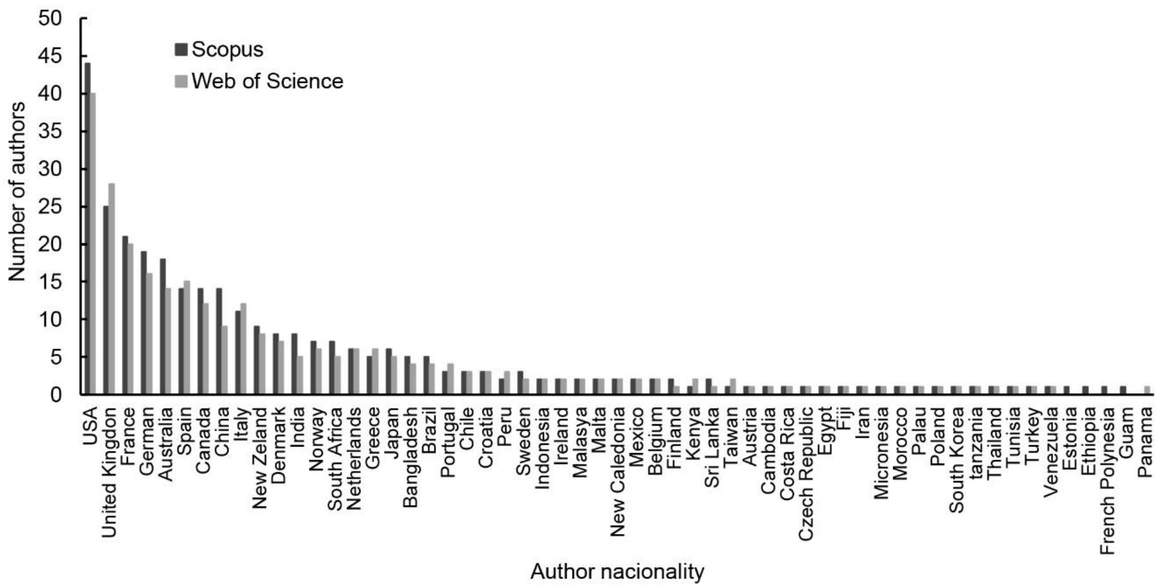

Figure 3. Number of authors per country of affiliation.

ward snowballing of references cited by the final set of studies yielded seven additional references: Giap et al. (2005), Salam et al. (2005), Völcker & Scott (2008), Hossain et al. (2009), Hossain & Das (2010), Ssegane et al. (2012), and Falconer et al. (2016).

At the end of the selection process, we obtained a final list of 12 studies carefully examined to synthesize the most relevant findings on using geotechnology tools and key factors to consider when selecting appropriate areas for inland aquaculture in ground-excavated ponds. These studies were analyzed and discussed with particular attention given to suitability factors and constraints, whose definitions are one of the most important steps during the site selection process, as it lays down the basis of the evaluation (Meaden & Aguilar-Manjarrez 2013). Suitability factors help define the degree of appropriateness of a study area as a continuous variable that increases or decreases site suitability; they are also known as decision variables or structural variables. A constraint, on the other hand, limits the alternatives under consideration, i.e. to define situations that hinder the selection of a certain location for the intended purpose (Salam 2000).

Suitability factors for aquaculture site selection in ground-excavated ponds

The analysis of suitability factors used for selecting aquaculture sites was subdivided into three criteria: soil

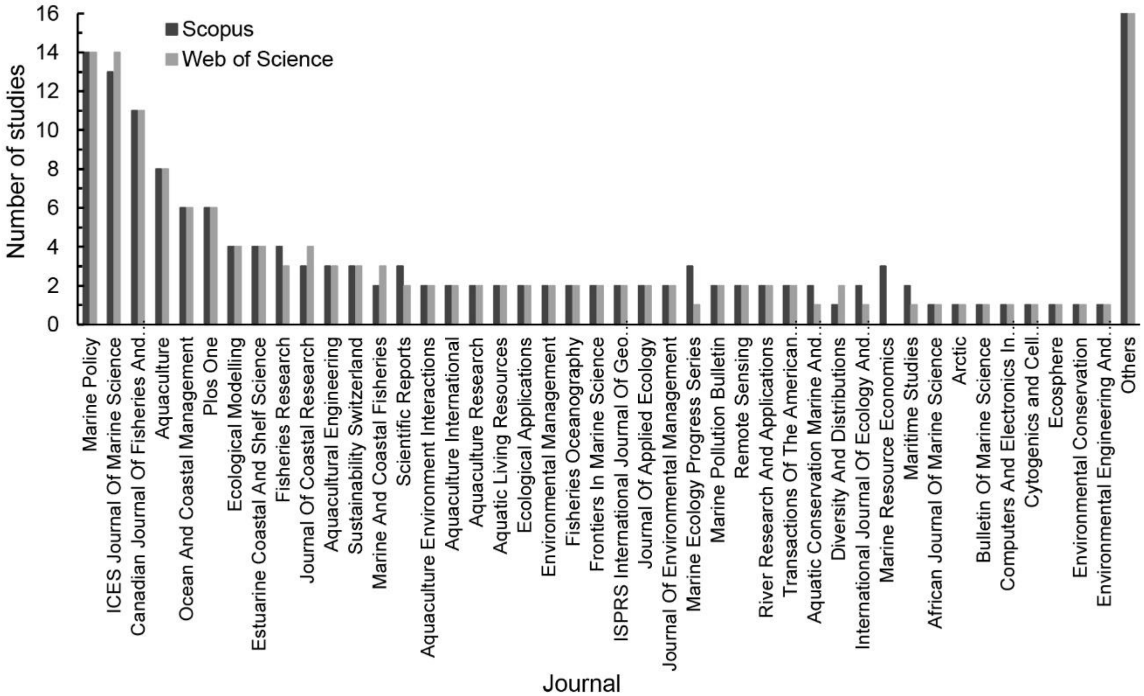

Figure 4. Number of studies organized by journal of publication.

suitability, socioeconomic and infrastructure suitability, and water quality and availability, with 11, 19, and 18 factors associated, respectively. All factors considered in the 12 studies evaluated are listed (Table 1).

Soil characteristics are an important aspect to consider for aquaculture site selection, operation, and management, as they significantly influence implementation costs, maintenance, and productivity (Coche 1985). Socioeconomic and infrastructure conditions are essential for properly assessing aquaculture sites and can benefit planning and decision-making (Giap et al. 2005, Hossain et al. 2007). On the other hand, water is a fundamental resource for aquaculture development; water quality and availability are crucial criteria that must be accounted for when selecting areas for this activity (Naylor et al. 2000).

The degree of suitability of each factor was ranked into four classes: highly suitable (HS), suitable (S), moderately suitable (MS), and unsuitable (US). Previously, Hossain et al. (2007, 2009), Hossain & Das (2010), and Nayak et al. (2014, 2018) had used a three-point scale to classify suitability, not including the "moderately suitable" category. On the other hand, Falconer et al. (2016) used a broader, five-point scale that included the "highly unsuitable" class.

As presented in Table 1, proximity to roads (83.3%), soil texture (75%), slope (66.7%), water temperature (66.7%), distance to local markets (66.7%), soil pH (58.3%), water pH (58.3%), dissolved oxygen (58.3%), distance to a water source (58.3%), land use and coverage (58.3%), and distance to the hatchery or fry source (58.3%) were the predominant factors considered in the literature.

Soil physical properties

The productivity of a pond depends upon the quality of its water and soil (Biggs et al. 2015). The physical properties of soil, such as texture, type, structure, porosity, and density, can affect many processes, such as infiltration, erosion, nutrient cycling, and biological activity. Soil texture and type were applied in the studies we analyzed.

Texture influences the ease with which soil can be worked, the amount of water and air it retains, and the rate at which water can enter and move through the soil, greatly impacting water balance in aquaculture systems (Coche 1985). Soil texture is determined by the relative proportion of particles of different sizes (granulometry): clay, silt, and sand. Clay content is important to hold water, but mineral content can impact water pH, hardness, and alkalinity, which affect plankton productivity (Lazur 2007). Different methodologies were used to classify soil texture, i.e. based on the texture classification or the soil's percentage clay content.

Table 1. Suitability factors are used for the selection of areas for aquaculture. HS: high suitable; S: suitable; MS: moderately suitable; US: unsuitable; N: number occurrences; RL: red latosols; RN: red nitosols; HN: haplic nitosols; HC: haplic cambisols; UC: humic cambisols; LN: litholic neosols; AG: agriculture; PA: pasture; FO: forest; PL: plantation; W: woodlands; S: shrub lands; G: grasslands; DA: dense agricultural high lands; LN: large natural forest; RB: rocky barren; AQ: aquaculture; PC: paddy cultivation; MO: mixed orchard; SV: seasonal vegetable; FF: fish farming; I: irrigation; NG: natural grass; H: household use; US: urban water supply: R: recreation; UD: urban waste discharge; SC: sugarcane; SH: shrub vegetation; M: mangrove; ME: hills and elevation; ST: stream corridor; UG: underground; GF: Gley fluvisols; EF: Eutric fluvisols; GS: gleyic solonchaks; GA: gleyic arenosols; RA: rangeland; SF: salt farm; T: tide; RF: rain fed.

Reference	Francisco et al. (2019)				Assefa & Abebe (2018)				Nayak et al. (2018)				Falconer et al. (2016)			
Study Area	Laranjeiras do Sul, Rio Bonito do Iguaçu and Porto Barreiro (Paraná State, Brazil)				Lake Tana basin (Amhara Regional State, northwest Ethiopia)				Nainital district of Uttarakhand (Kumaon region, India)				Mekong Delta (southern Vietnam)			
Cultivation	Fish farming				Aquaculture in general				Aquaculture in general				Aquaculture in general			
Classification criteria/factor	HS	S	MS	US	HS	S	MS	US	HS	S	MS	US	HS	S	MS	US
Soil suitability																
Soil texture (% clay content)					>80	50-80	20-50	0-20	>35	18-35	-	<18	30-40	40-60	25-30	<25
Slope (%)	<2	2-5	5-10	>10	<2	2-5	5-8	>8					0.5-2	2-5	0-0.5	>5
pH					6.5-8.5	5.5-6.5	4-5.5	1-4	6.5-8.5	5.5-6.5, 8.5-9	-	<5.5, >9				
Organic matter (% carbon)									<1	1-2	-	>2				
Type	RL	RN, HN	HC, UC	LN												
Elevation (m)																
Altitude (m)	<700	700-900	>900	-												
Nitrate (mg L^{-1})																
Phosphate (mg L^{-1})																
Salinity																
Soil thickness (m)																
Socioeconomics and infrastructure																
Dirt road proximity (km)					<5	5-10	10-15	>15	<0.5	0.5-1	-	>1	<0.5	0.5-1	1-1.5	>1.5
Local market center distance (km)					<5	5-10	10-15	>15	<2	2-4	-	>4				
Land use-land cover	AG, PA	-	FO, PL	-	W, S, G	-	DA	LN, RB								
Distance to hatchery/fry source (km)									<5	5-10	-	>10				
Distance to electricity (m)																
Population density (ind km^{-2})					150-300	25-250	1-25	<1, >300					<500	500-1000	1000-1500	>1500
All-weather motorable road proximity (km)																
Distance to urban areas (town) (km)													1-2	2-4	4-10	<1, >10
Labor availability (ind km^{-2})																
Road density (km km^{-2})					≥0.36	0.20-0,35	0.04-0.19	<0.04								
Animal wastes (1000 t)					>100	30-100	2-30	<2								
Cropland (t km^{-2})					80-100	50-79	20-49	<20								
Distance to a small village (km)																
Fish consumption per capita (g yr^{-1})					>1000	500-1000	200-500	<200								
Highway proximity (km)																
Inputs proximity (km)																
Literacy (ind km^{-2})																
Production experience (fishers/district)					>600	300-600	100-300	<100								
Railroad proximity (km)																
Water quality and availability																
Temperature (°C)					25-32	22-25	18-22	0-18	>20	10-20	-	<10				
Dissolved oxygen (mg L^{-1})					5-10	4-5	3-4	<3	>5	3.5-5	-	<3.5				
pH					6-8	5-6	4-5	<4	7-8.5	5.5-7, 8.5-10	-	<5.5, >10				
Water distance (km)					<1	1-2.5	2.5-3.5	>3.5	<0.5	0.5-1	-	>1	<0.5	0.5-1	1-1.5	>1.5
CO_2 (mg L^{-1})									0-5	5-20	-	>20				
Phosphate (mg L^{-1})									<0.25	0.25-0.4	-	>0.4				
Salinity													<0.2	0.2-0.4	-	>0.4
Transparency (cm)									30-60	15-30, 60-120	-	<15, >120				
Hardness (mg L^{-1})									50-200	20-50, 200-500	-	<20, >500				
Water source																
Annual rainfall (mm)					>1199	1000-1199	700-999	<700								
District perennial river density (km km^{-2})					≥ 0.36	0.2-0.35	0.04-0.2	<0.04								
Nitrate (mg L^{-1})									1	1-2	-	>2				
Nitrite (mg L^{-1})																
Total alkalinity (mg L^{-1})																
Total dissolved solids (mg L^{-1})																
Total suspended solids (mg L^{-1})																
Required drainage area (ha)																

Continuation

Reference	Nayak et al. (2014)				Ssgane et al. (2012)				Hossain & Das (2010)				Hossain et al. (2009)			
Study Area	Nainital district of Uttarakhand (Kumaon region, India)				Uganda				Companigonj Upazila (Noakhali district, Bangladesh)				Chittagong district (Bangladesh)			
Specie cultivation	Aquaculture in general				Tilapia and Clarias				Giant prawn				Aquaculture in general			
Classification criteria/factor	HS	S	MS	US	HS	S	MS	US	HS	S	MS	US	HS	S	MS	US
Soil suitability																
Soil texture (% clay content)	>35	18-35	-	<18	15-30	10-15, 30-40	5-10, 40-50	<5, >50	Clay loam	Sandy clay	-	Loam, sand	Clay loam	Sandy clay	-	Loam, sand
Slope (%)					<2	2-5	5-15	>15	0-5	5-15	-	>15	<2	2-5	-	>5
pH	6.5-8.5	5.5-6.5, 8.5-9	-	<5.5, >9					6-8	4-6, 8-9	-	<4, >9	6-8	4-6, 8-9	-	<4, >9
Organic matter (% carbon)	1	1-2	-	>2					<2	2-4	-	>4	<1	1-2	-	>2
Type																
Elevation (m)																
Altitude (m)																
Nitrate (mg L^{-1})									<0.1	0.1-0.2	-	>0.2				
Phosphate (mg L^{-1})									<0.1	0.1-0.2	-	>0.2				
Salinity																
Soil thickness (m)																
Socioeconomics and infrastructure																
Dirt road proximity (km)	<0.5	0.5-1	-	>1					<0.5	0.5-1	-	>1	<0.5	0.5-1	-	>1
Local market center distance (km)	<2	2-4	-	>4	<1	1-3	3-6	>6	<2	2-4	-	>4	<1	1-2	-	>2
Land use-land cover									AQ, G	PC	-	MO, SV	FF, I, NG	H, US, R	-	UD discharge
Distance to hatchery/fry source (km)	<5	5-10	-	>10					<2	2-4	-	>4	<2	2-4	-	>4
Distance to electricity (m)									<0.5	0.5-1	-	>1	<1	1-2	-	>2
Population density (ind km^{-2})																
All-weather motorable road proximity (km)																
Distance to urban areas (town) (km)																
Labor availability (ind km^{-2})									>100	50-100	-	<50	>100	50-100	-	<50
Road density (km km^{-2})																
Animal wastes (1000 t)																
Cropland (t km^{-2})																
Distance to a small village (km)																
Fish consumption per capita (g yr^{-1})																
Highway proximity (km)																
Inputs proximity (km)					<30	30-50	50-100	>100								
Literacy (ind km^{-2})																
Production experience (fishers/district)																
Railroad proximity (km)																
Water quality and availability																
Temperature (°C)	20-25	10-20	-	<10	28-32	24-28	20-24	<20, >32	25-32	12-25	-	<12, >32	25-35	15-25	-	<15, >35
Dissolved oxygen (mg L^{-1})	>8	5.5-8	-	<5.5					4-7	2.5-4	-	<2.5	>2	1-2	-	<1
pH	6.5-8.5	5-6.5, 8.5-10	-	<5, >10					6-8	4-6, 8-9	-	<4, >9	6-8	4-6, 8-9	-	<4, >9
Water distance (km)	<0.5	0.5-1	-	>1												
CO_2 (mg L^{-1})	0-5	5-20	-	>20					<1	1-2	-	>2				
Phosphate (mg L^{-1})	0.05-0.25	0.25-0.40	-	>0.4					<0.2	0.2-0.5	-	>0.5				
Salinity																
Transparency (cm)													30-40	40-50	-	>50
Hardness (mg L^{-1})	50-200	20-50, 200-500	-	<20, >500												
Water source																
Annual rainfall (mm)																
District perennial river density (km km^{-2})																
Nitrate (mg L^{-1})	1	1-2	-	>2												
Nitrite (mg L^{-1})									<0.1	0.1-0.2	-	>0.2				
Total alkalinity (mg L^{-1})	50-200	20-50, 200-500	-	<20, >500												
Total dissolved solids (mg L^{-1})									<0.3	0.3-0.5	-	>0.5				
Total suspended solids (mg L^{-1})									<0.3	0.3-0.5	-	>0.5				
Required drainage area (ha)					<5	5-20	20-100	>100								

Continuation

Reference	Völcker & Scot (2008)				Hossain et al. (2007)				Giap et al. (2005)				Salam et al. (2005)					
Study Area	São João basin (Rio de Janeiro State, Brazil)				Sitakunda Upazila (Chittagong district, Bangladesh)				Doson and Kienthuy districts (Haiphong Province, Vietnam)				Barhatta Upazilla (Netrakona District, Bangladesh)				n	%
Specie cultivation	Aquaculture in general				Nile tilapia				Shrimp				Carp					
Classification criteria/factor	HS	S	MS	US	HS	S	MS	US	HS	S	MS	US	HS	S	MS	US		
Soil suitability																		
Soil texture (% clay content)					Clay loam	Sandy clay	-	Loam sand	>35	18-35	<18	-					9	75.0
Slope (%)					0-5	5-15	-	>15	<2	2-5	5-10	>10					8	66.7
pH					6-8	4-6, 8-9	-	<4, >9	6-7	5-6	4-5, 7-8	<4, >8					7	58.3
Organic matter (% carbon)					<1	1-2	-	>2									5	41.7
Type	GPS1	GPa2	PVa4, PVd4	PAa2, PEe1					GF	EF	GS, GA	HC					3	50.0
Elevation (m)					0-5	5-10	-	>10	2-2.5	2.5-4, 1-2	4-5	>5, <1					2	16.7
Altitude (m)																	1	8.3
Nitrate (mg L^{-1})																	1	8.3
Phosphate (mg L^{-1})																	1	8.3
Salinity					<2	2-4	-	>4									1	8.3
Soil thickness (m)									>1	0.5-1	<0.5	-					1	8.3
Socioeconomics and infrastructure																		
Dirt road proximity (km)	<0.3	0.3-0.6	0.6-1	>1	<0.5	0.5-1	-	>1	<0.5	0.5-1	1-2	>2	<0.5	0.5-1	1-2	>2	10	83.3
Local market center distance (km)					<2	2-4	-	>4	1-2	<1, 2-4	>4	-					8	66.7
Land use-land cover	AG, PA	SC	SV	M, FL, ME	AQ, G	PC	-	MO, SV	AQ	RA, SF	AG	M, MO					7	58.3
Distance to hatchery/fry source (km)					<2	2-4	-	>4	<4	4-8	>8	-	<7	7-10	10-15	>15	7	58.3
Distance to electricity (m)					<0.2	0.2-0.5	-	>0.5					<0.2	0.2-0.5	0.5-0.75	>0.75	4	33.3
Population density (ind km^{-2})					<1000	1000-1500	-	>1500	<500	500-1000	1000-2000	>2000					4	33.3
All-weather motorable road proximity	<2.5	2.5-5	5-15	>15									<1	1-2	2-4	>4	2	16.7
Distance to urban areas (town) (km)													<5	5-7	7-10	>10	2	16.7
Labor availability (ind km^{-2})																	2	16.7
Road density (km km^{-2})																	1	8.3
Animal wastes (1000 t)																	1	8.3
Cropland (t km^{-2})																	1	8.3
Distance to a small village (km)													<2	2-3	3-5	>5	1	8.3
Fish consumption per capita (g yr^{-1})																	1	8.3
Highway proximity (km)													<1	1-3	3-5	>5	1	8.3
Inputs proximity (km)																	1	8.3
Literacy (ind km^{-2})													>150	150-100	100-80	<80	1	8.3
Production experience (fishers/district)																	1	8.3
Railroad proximity (km)													0.1-1	1-3	3-5	>5	1	8.3
Water quality and availability																		
Temperature (°C)	28-31	22-28, 31-33	18-22, 33-37	<18, >37	25-35	15-25	-	<15, >35									8	66.7
Dissolved oxygen (mg L^{-1})	7-10	5-7	4-5	3-4	>2	1-2	-	<1									7	58.3
pH	7-7.5	6.5-7, 7.5-8	5.5-6.5, 8-8.5	<5.5, >8.5	6-8	4-6, 8-9	-	<4, >9									7	58.3
Water distance (km)	<0.5	0.5-1	1-1.5	>1.5					<1	1-2	2-3	>3	<0.5	0.5-0.7	0.7-1	>1	7	58.3
CO_2 (mg L^{-1})																	3	25.0
Phosphate (mg L^{-1})																	3	25.0
Salinity	<1	1-2	2-10	>10	0-10	10-20	-	>20									3	25.0
Transparency (cm)					20-30	30-40	-	>40									3	25.0
Hardness (mg L^{-1})																	2	16.7
Water source					ST	I	-	UG	T	I	RF	-					2	16.7
Annual rainfall (mm)																	1	8.3
District perennial river density (km km^{-2})																	1	8.3
Nitrate (mg L^{-1})																	1	8.3
Nitrite (mg L^{-1})																	1	8.3
Total alkalinity (mg L^{-1})																	1	8.3
Total dissolved solids (mg L^{-1})																	1	8.3
Total suspended solids (mg L^{-1})																	1	8.3
Required drainage area (ha)																	1	8.3

Hossain et al. (2007, 2009) and Hossain & Das (2010) considered clay loam and sandy clay soils highly suitable, respectively. In contrast, loamy or sandy soils were considered unsuitable for pond construction. Giap et al. (2005) and Nayak et al. (2014, 2018) considered highly suitable areas with a clay content superior to 35%, as suitable those with a clay content between 18 and 35%, and as slightly suitable or unsuitable as those sites with a clay content of less than 18%. The remaining studies proposed different scales of soil suitability based on the percentage of clay content (Ssegane et al. 2012, Nayak et al. 2014, 2018, Falconer et al. 2016, Assefa & Abebe 2018).

For all the reasons mentioned, ensuring a suitable soil texture is of utmost importance for constructing and operating ground-excavated ponds. Clay soils with low permeability allow the construction of more stable dikes, which are more favorable to the construction of ponds. Sandy soils with a large amount of gravel generally have high infiltration, demand greater water use, are poorly stable and more susceptible to erosion, and become less suitable for ground-excavated ponds (Coche 1985, Hossain et al. 2007, Boyd 2015). Although some techniques are available to avoid excessive soil permeability, such as laying out soil blankets, synthetic membranes, or using concrete, implementing and operating these procedures are generally expensive. In addition, the soil may be compacted to control excessive water seepage.

The type of soil has a significant influence on pond water quality (Lazur 2007). The classification of the type of soil generally depends on the evaluation of different parameters, such as physical, morphological (color, consistency, texture, structure, and porosity), environmental (e.g. climate, vegetation, relief, original material, water conditions) and mineralogical data of the profile that represent it (Jhan et al. 2006). The type of soil classification varied among the analyzed studies, which may be linked to the different methodologies used to classify soil type and the availability of data from each study area.

Soil chemical properties

Pond water quality is a direct result of source water and soil type and chemical characteristics (Lazur 2007). Soil chemical properties affect biological activity, soil formation, nutrient cycling, pollutant fate, and erosion processes. These properties generally involve the evaluation of concentrations of specific chemicals (e.g. phosphorus, nitrogen, carbon, sulfur), pH, cations, organic matter, salinity, and electrical conductivity. In the studies evaluated, pH, nitrite, phosphate, salinity, and organic matter were used to classify the suitability of the soil for aquaculture in excavated ponds.

In all examined studies, appropriate soil pH values ranged between 4-6.5 or 8-9, while a highly suitable pH varied between 6-8 (Giap et al. 2005, Hossain et al. 2007, 2009, Hossain & Das 2010, Nayak et al. 2014, Assefa & Abebe 2018). Locations with a soil pH outside this range were considered suitable or unsuitable due to the costs and time spent in procedures to correct soil pH. Soil pH can affect nutrient availability, microorganism development, and pond water pH, impacting productivity (Tapader et al. 2017). A pH between 6-8 is favorable to many species cultivated in ground-excavated ponds. A soil pH that is too high or too low can render nutrients insoluble, limit their availability, and reduce the growth of microorganisms that serve as food for cultured fish. An extremely acidic or alkaline soil pH can compromise fish growth, reproduction, and health (Coche 1985, Salam 2000).

Soil organic matter affects its physicochemical relationships (e.g. pH, retaining pollutants, structure, porosity, infiltration), altering the availability of micronutrients and interactions between soil microorganisms (Dhaliwal et al. 2019). High organic matter in soils increases oxygen demand to bacteria break down organic matter and can increase the risk of toxicity from ammonia concentrations (Lazur 2007). Organic matter sources can include organic fertilizers, unconsumed feed, and faces of culture animals. High concentrations of organic matter in soil can deteriorate and negatively impact pond water quality. Hossain et al. (2007, 2009) and Nayak et al. (2014, 2018) considered less than 1 and 1-2% of organic matter highly suitable, respectively, whereas more than 2% were considered unsuitable for pond construction.

Some soil properties, such as elements concentrations (e.g. nitrogen and phosphorus) and salinity, can affect water quality for pond aquaculture. In most soils, it is necessary to apply based nitrogen and phosphorus fertilizers to promote plant growth (Boyd 2003). Hossain & Das (2010) considered nitrite and phosphate concentration in soils less than 0.1 mg L^{-1} to highly suitable sites, 0.1 to 0.2 mg L^{-1} to suitable, and above 0.2 mg L^{-1} unsuitable for aquaculture ponds. Soil salinity indicates salt concentration and affects soil's availability and transport of nutrients and pollutants. Hossain et al. (2007) evaluated highly suitable soil salinities below 2, suitable from 2 to 4, and unsuitable above 4.

Inclination

The slope is a decisive and limiting factor for successfully implementing aquaculture ponds, influencing pond construction, drainage, retention, water runoff, soil movement, and erosion (Ono & Kubitza 2005, Hossain et al. 2007, Falconer et al. 2016). Flat, softly waved terrains (<5% slope) are usually preferred to avoid heavy excavation and construction works, facilitate pond drainage, and lower the risk of erosion (Ono & Kubitza 2005, Pereira & Silva 2012, Ssegane et al. 2012). High slopes mainly make it difficult to build large ponds, as they require greater earth movement than smaller ponds (EMBRAPA 2013).

In the studies we analyzed, several authors recommend an inclination of up to 5% for a suitable aquaculture pond site, with slopes lower than 2% considered highly suitable by most studies analyzed (Giap et al. 2005, Hossain et al. 2009, Ssegane et al. 2012, Falconer et al. 2016, Assefa & Abebe 2018, Francisco et al. 2019). In these studies, an inclination higher than 5% was considered unsuitable or moderately suitable. Only Hossain et al. (2007) and Hossain & Das (2010) classified suitable slopes of up to 15% and up to 5% as highly suitable.

Elevation

The main water source for pond supply in aquaculture are springs and water bodies. The elevation relates to the need and difficulty pumping water to the pond location, impacting implementation and operation costs (Zacarkim 2018). Features such as the distance from the water catchment point, level difference, and required flow rate influence a water pumping system in aquaculture (EMBRAPA 2013). Higher elevations generally increase costs associated with landscaping, supply channels, and pumping station (Hossain et al. 2007, Zacarkim 2018).

Elevation suitability scales diverged in assessed studies (Giap et al. 2005, Hossain et al. 2007), which may be related to the features of the study area. However, we observed that the suitable locations were indicated as those with lower elevations.

Altitude

Altitude can be measured by the vertical distance between a point and a datum, usually sea level. The altitude and temperature of a site are normally inversely proportional. Francisco et al. (2019) considered locations with altitudes below 700 m as highly suitable, 700 to 900 m as suitable, and above 900 m as slightly suitable, indicating a change of 0.8°C for each 100 m altitude in the study area.

Transportation networks

Access to well-connected roads is a prerequisite for inland aquaculture and is required to receive the necessary goods and supplies or transport products to processors and markets. Transportation networks generally consist of three, two, or single-lane paved roads, dirt roads, and railways. Farm location can be influenced by distance to roads, given the need for regular transportation and supply of fish, feed, fertilizers, equipment, and services (Salam et al. 2005, Falconer et al. 2016, Nayak et al. 2018). Most studies addressing proximity to dirt roads for installing aquaculture ponds considered up to 0.5 km as highly suitable and a distance between 0.5 and 1 km as suitable (Giap et al. 2005, Salam et al. 2005, Hossain et al. 2007, 2009, Hossain & Das 2010, Nayak et al. 2014, 2018, Falconer et al. 2016). Some evaluated studies (Giap et al. 2005, Hossain et al. 2007, 2009, Hossain & Das 2010, Nayak et al. 2014, 2018, Falconer et al. 2016, Assefa & Abebe 2018) did not specify the types of roads considered. For these cases, we assumed distance to dirt roads (unpaved) as the variable measured. Völcker & Scott (2008) considered proximity to primary (paved) roads and proximity to secondary (unpaved) roads as separate factors. In addition, Salam et al. (2005) included controlled-access highways as a third factor. Assefa & Abebe (2018) also assessed road density, with a density above 0.36 for highly suitable sites and between 0.2 and 0.36 for suitable sites.

Market and resources proximity

Proximity means fast and easy access and reduced development costs compared to a more distant site (Salam 2000). Many factors associated with proximity/distance can affect aquaculture development, such as proximity to the market center, hatchery or fry sources, agents in the supply chain (feed, equipment, processing industries), electricity, and urban areas. These factors are especially important from a cost and travel time point of view.

Concerning distance to local markets, Hossain et al. (2007), Hossain & Das (2010), and Nayak et al. (2014, 2018) ranked sites less than 2 km from a market as highly suitable, at 2 to 4 km as suitable, and farther than 4 km as unsuitable. Other studies used different scales, which were probably influenced by the areas and topics under research in each study (Giap et al. 2005, Hossain et al. 2009, Ssegane et al. 2012, Nayak et al. 2018). Salam et al. (2005) and Falconer et al. (2016) considered the distance to urban areas (towns) but diverged in scales. Salam et al. (2005) additionally evaluated the proximity to a small village.

Hossain et al. (2007, 2009) and Hossain & Das (2010) evaluated distance to fry sources, highly suitable sites to distance less than 2 km, those at 2-4 km were deemed suitable, and those more than 4 km were considered unsuitable. Giap et al. (2005) and Salam et al. (2005) employed different scales. Nayak et al. (2014, 2018) accepted larger distances of up to 5, 5-10, and 10 km for each category, respectively.

Some activities in aquaculture may require electrical energy, such as water pumping and aeration systems (Lazur 2007). Far sites from the existing power grid can impose additional costs on implementing aquaculture. Salam et al. (2005) and Hossain et al. (2007) considered up to 0.2 km for electricity as highly suitable, a distance between 0.2 and 0.5 km suitable, and moderately suitable or unsuitable for installing aquaculture ponds for those more distant to 0.5 km.

Land use and coverage

Land use change is a primary anthropogenic perturbation (Foley et al. 2005). The composition and spatial arrangement of land uses has been mainly modified by deforestation to expand cropping and pasture activities worldwide (Zak et al. 2008). An evaluation of land use and coverage can provide useful information for aquaculture planning and management, supporting the organized and rational occupation of the physical environment and the effective use of its natural resources. Incorporating land use and coverage in site suitability assessments has proved important for preventing land use conflicts and guiding policy development (Salam 2000).

In the examined studies, the land use and coverage suitability classification was mainly based on current land activity. Local and regional characteristics and competition with other activities can be considered in suitability scales. The scales used diverged greatly between the studies (Giap et al. 2005, Hossain et al. 2007, 2009, Volcker & Scot 2008, Hossain & Das 2010, Assefa & Abebe 2018, Francisco et al. 2019), which may be related to the traditional activities of each study area and the researchers' interest. Even so, the most frequently indicated suitable sites for aquaculture were those occupied by agriculture, pasture, or that already have aquaculture activity.

Other socioeconomic and infrastructure factors

Socioeconomic and infrastructure factors are essential in the evaluation of areas for aquaculture, as they can enable better planning and decision-making (Giap et al. 2005, Hossain et al. 2007). Falconer et al. (2016) and Assefa & Abebe (2018) assessed the population density but diverged on scales. Population density can be associated with the availability of labor and services related to the aquaculture production chain, such as the management and maintenance of cultivation, topography, landscaping, and charge transport. In addition, it can also be associated with the possibility of a consumer market for aquaculture products.

Hossain et al. (2009) and Hossain & Das (2010) evaluated a scale of labor availability greater than 100 ind km^{-2} as highly adequate, from 50 to 100 ind km^{-2} adequate and inadequate for less than 50 ind km^{-2} availability. Assefa & Abebe (2018) also employed factors related to production experience, fish consumption per capita, animal wastes, and cropland.

Water source

Availability and good quality water are key factors for the success of a fish farm without risk of contamination by pollutants and in a minimum quantity to supply the demand of production. The main water sources used in fish farming are rivers, streams, lakes, dams, mines, wells, estuaries, and even the water collected from the rains (Salam 2000, Ono & Kubitza 2005). Pond water quality is directly affected by source water (Lazur 2007). The amount needed will depend on the area of the ponds, infiltration rates and evaporation, the cultivation system and the renewal required in the management of production, the strategies of reuse, the precipitation rates that will be incorporated into the ponds and supply reservoirs, among other factors (Ono & Kubitza 2005).

Some studies assessed different factors associated with water availability. Giap et al. (2005) and Hossain et al. (2007) considered the water source, but scales diverged accordingly to the study area characteristics. Assefa & Abebe (2018) evaluated the annual rainfall and district perennial river density with highly suitable sites for those with more than 1199 mm rainfall and 0.36 km km^{-2} perennial river density, as suitable from 1000 to 1199 mm and 0.2 to 0.35 km km^{-2} respectively. Ssegane et al. (2012) evaluated the required drainage area and considered less than 5 ha highly suitable for those with a critical drainage area between 5 and 20 ha.

Water proximity is a key factor regarding the water source. Longer distances increase implementation costs and water losses; therefore, water sources should be located near the fish farm and easy to access to save costs (Salam et al. 2005). In this sense, Salam et al. (2005), Volcker & Scott (2008), Nayak et al. (2014, 2018), and Falconer et al. (2016) considered distances shorter than 0.5 km as highly suitable and those between 0.5 and 1 km as suitable. Giap et al. (2005) and Assefa & Abebe (2018) employed a scale with greater distances, up to 1 km for a highly suitable aquaculture pond site and between 1 and 2-2.5 km for suitable sites, respectively.

Table 2. Limitation ratings of freshwater properties for pond aquaculture. Source: Hajek & Boyd (1994).

Property	Limiting rating			Restrictive feature
	Slight	Moderate	Severe	
Alkalinity (mg L^{-1} as $CaCO_3$)	50-200	20-50, 200-500	<20, >500	Low/high alkalinity
CO_2 (mg L^{-1})	0-5	5-20	>20	CO_2 toxicity
COD (mg L^{-1})	0-50	50-200	>200	Oxygen demand
Dissolved oxygen (mg L^{-1})	5-10	2-5, 10-15	<2, >15	Low/high oxygen
Hardness (mg L^{-1} as $CaCO_3$)	50-200	20-50, 200-500	<20, >500	Low/high hardness
Mineral activity (mg L^{-1} as $CaCO_3$)	0	0-10	>10	Mineral acidity
NH_3-N	<0.1	0.1-1	>1	Ammonia toxicity
NH_2-N	<0.5	0.5-2	>2	Nitrite toxicity
Orthophosphate	10-20	5-10, 20-200	<5, >200	Insufficient/excessive phytoplankton
pH	6.5-8.5	5-6.5	<5	Low/high pH
Salinity	15-25	5-15	<5	Osmoregulation
Total dissolved solids (mg L^{-1})	50-500	500-2000	>2000	Osmoregulation
Transparency (cm)	30-60	15-30, 60-120	<15, >120	Excessive/low phytoplankton
Turbidity (NTU)	<25	25-100	>100	Sedimentation, low light

Water quality

Fish survival and development depend on a well-balanced aquatic environment where water quality is central (Pereira & Silva 2012). Good water quality, with proper dissolved oxygen levels, pollution-free, and adequate temperature and pH, ensures favorable conditions for fish development (Assefa & Abebe 2018). For example, a nutrient-rich water source contributes to increasing pond water's nitrogen and phosphorus content and ammonia concentrations (Lazur 2007).

Suitable water parameter ranges varied greatly between assessed studies, including temperature, dissolved oxygen, pH, phosphate, nitrate, and salinity. Such variability was closely related to the fish species, local climate, and research interests specific to each study. Water quality value variation outside recommended ranges for the target species may be responsible for discrepancies in fish growth, cultivation cycle duration, or even mortality across farms (EMBRAPA 2013).

We have noted the difficulty in evaluating some important factors related to climate and water quality, mainly due to low variation and issues associated with the extrapolation of results from a small number of samples, as observed by Giap et al. (2005). However, these factors can be extremely useful in evaluating suitable sites for inland aquaculture. Table 2 summarizes some standardized limits of freshwater quality parameters for pond aquaculture proposed by Hajek & Boyd (1994). Boyd (2015) has a more in-depth discussion of water quality parameters.

Concerning the quality of the water source, the restrictions imposed by environmental legislation regarding the volume of water that can be captured and the quality of the effluents that can be returned to a particular source or body of water must be met (Ono & Kubitza 2005). Several water quality parameters can be corrected before and during cultivation, particularly with low water renewal or recirculation systems. On the other hand, water quality correction may be impractical in ponds with a high-water turnover rate due to the large volume of water that needs to be treated.

Table 3 summarizes the suitable and highly suitable scales for the factors most used in the selected studies.

Constraints on aquaculture site selection in ground-excavated ponds

Constraints result from criteria restricting or limiting the selection of specific geographic locations classified as suitable/unsuitable. Among the studies evaluated, 15 constraints were recognized, as shown in Table 4.

Hossain et al. (2009), Ssegane et al. (2012), and Falconer et al. (2016) did not consider restricted areas. It is important to note that Hossain et al. (2009) focused only on waterbodies in the urban area of Chittagong, Bangladesh. For that reason, the study did not include restricted areas. Falconer et al. (2016) concluded that identifying excluded areas where aquaculture must not and should not occur would also be useful for future studies. In addition, Assefa & Abebe (2018) excluded only the space occupied by Lake Tana from the study area.

Research topics, data availability, and accessibility generally influence restricted areas. Urban areas (58.3%), roads (50%), and forests (50%) were the most cited constraints in studies. Including constraint layers

Table 3. The suitable and highly suitable scales attributed to the factors most used in the selected studies. HS: highly suitable; S: suitable; MS: moderately suitable; US: unsuitable.

Classification criteria	Factor	HS	S	MS, US	Reference
Soil suitability	Soil texture (% clay content)	>35%	18-35%	<18%	Giap et al (2005), Nayak et al (2014, 2018)
	Slope (%)	>2	2-5%	>5%	Giap et al (2005), Hossain et al. (2009), Ssegane et al. (2012), Falconer et al (2016), Assefa & Abebe (2018), Francisco et al. (2019)
	Soil pH	6-8	4-6.5 or 8-9	<4 or >9	Giap et al. (2005), Hossain et al. (2007, 2009), Hossain & Das 2010, Nayak et al. (2014, 2018), Assefa & Abebe (2018)
Socioeconomics and infrastructure	Proximity to roads (km)	<0.5	0.5-1	>1	Giap et al (2005), Salam et al. (2005), Hossain et al. (2007, 2009), Hossain & Das (2010), Nayak et al. (2014, 2018), Falconer et al. (2016)
	Distance to local markets (km)	<2	2-4	>4	Hossain et al. (2007), Hossain & Das (2010), Nayak et al. (2014, 2018)
	Distance to fry source (km)	<2	2-4	>4	Hossain et al. (2007, 2009), Hossain & Das (2010)
Water availability	Water distance (km)	<0.5	0.5-1	>1	Salam et al. (2005), Völcker & Scott (2008), Nayak et al (2014, 2018), Falconer et al. (2016)

Table 4. Constraints on the selection of areas for aquaculture. N: number of occurrences.

Constraint	N	%	Reference											
			Francisco et al. (2019)	Assefa & Abebe (2018)	Nayak et al. (2018)	Falconer et al. (2016)	Nayak et al. (2014)	Ssgane et al. (2012)	Hossain & Das (2010)	Hossain et al. (2009)	Völcker & Scott (2008)	Hossain et al. (2007)	Giap et al. (2005)	Salam et al. (2005)
Urban areas	7	58.3	X		X		X		X		X	X	X	
Roads	6	50.0	X		X		X				X		X	X
Forests	6	50.0	X		X		X		X			X	X	
Rivers	4	33.3			X		X				X		X	
Streams	3	25.0			X		X				X			
Lakes	3	25.0		X	X		X							
Permanent preservation areas	2	16.7	X								X			
Railways	2	16.7	X											X
High rates of fecal coliforms areas	1	8.3									X			
Settlements	1	8.3												X
Embankments	1	8.3												X
Natural depressions	1	8.3												X
Mangrove forest	1	8.3										X		
Springs	1	8.3	X											
Ditches	1	8.3									X			

in the analysis is important as this enables results that better reflect the real conditions under study. In addition, buffer zones as an essential criterion for aquaculture zoning, especially to mitigate impacts on sensitive habitats, protected areas, and natural biodiversity (Aguilar-Manjarrez et al. 2017). Buffer zones may be ascribed based on legal requirements and regulations or the experience and interests of the researcher team.

Some of the examined studies applied buffers around some constrained areas as the exploitation of land for aquaculture could be hampered in these locations. Volker & Scott (2008) defined buffer strips of 30 m for rivers less than 10 m wide, 50 m strips for rivers with a width between 10 and 50 m, and strips of 100 m for rivers with a width between 50 and 200 m; a protection zone of 100 m around mangroves; a strip of 60 m on both sides of access roads, channels, and ditches; 1000 m for urbanized areas, 2000 m for areas with high levels of coliforms, and 3000 m around lagoons used for treating wastewater from ethanol production. Francisco et al. (2019), in compliance with applicable laws and regulations, defined 15 m strips on both sides of the EF-277 Railway, 40 m strips on both sides of the BR-277 highway, 30 m strips on both sides of the PR-158 highway, 20 m strips on both sides of the BR-565 highway; 15 m safety zones on both sides of rural roads and permanent preservation areas; 30 m strips on each side of rivers less than 10 m in width, 100 m strips on each side of rivers between 50 and 200 m in width; and a radius of 50 m around water springs, whose areas have been spatially identified and removed from the suitability classification map.

CONCLUSIONS

Geotechnologies provide powerful tools for spatial planning and management of aquaculture, able to assist them in the selection of suitable sites and allowing them to make more informed decisions.

Research on this topic has been increasing across the world. Most literature focused on marine or coastal environments, with few studies on inland aquaculture. We found studies devoted to this subject in more than 100 academic journals, indicating a wide range of opportunities for publication on the topic.

Around 48 suitability factors and 15 constraints were recognized in the literature, demonstrating that a broad range of data can be evaluated to inform the selection of suitable sites for aquaculture in ground-excavated ponds. The most discussed factors were proximity to rural roads, soil texture, slope, distance to local markets, water temperature, dissolved oxygen, water, soil pH, distance to a water source, and land use and coverage. Considering restricted areas and buffer zones is critical to identify places where aquaculture production should not occur, especially if motivated by legal requirements, which will enhance and strengthen suitability assessment outcomes.

The availability, quality, and access to the spatial data related to suitability factors and constraints are fundamental to using geotechnologies in aquaculture site selection-the need for appropriate data to limit the use of spatial tools or the results' quality.

Supplementary Files

A list of 189 and 165 articles, including authors' names, titles, journals, publication year, and citations, generated from a Boolean keyword search in the Scopus and Web of Science database between the earliest record and the end of 2020 is available (Supplementary Tables 1-2).

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Supplementary Table 1. List of 189 articles including authors, title, journal, publication year and DOI from Scopus database.

Authors	Title	Journal	Year	DOI
Andrews, S., Leroux, S.J. & Fortin, M.J.	Modelling the spatial-temporal distributions and associated determining factors of a keystone pelagic fish	ICES Journal of Marine Science	2020	10.1093/icesjms/fsaa148
Burić, M., Bavčević, L., Grgurić, S., Vresnik, F., Križan, J. & Antonić, O.	Modelling the environmental footprint of sea bream cage aquaculture in relation to spatial stocking design	Journal of Environmental Management	2020	10.1016/j.jenvman.2020.110811
Cahill, C.L., Anderson, S.C., Paul, A.J., Macpherson, L., Sullivan, M.G., Van Poorten, B., et al.	A spatial-temporal approach to modeling somatic growth across inland recreational fisheries landscapes	Canadian Journal of Fisheries and Aquatic Sciences	2020	10.1139/cjfas-2019-0434
D'Andrea, L., Parisi, A., Fiorentino, F., Garofalo G., Gristina, M., Cataudella, S. & Russo, T.	smartR: an R package for spatial modelling of fisheries and scenario simulation of management strategies	Methods in Ecology and Evolution	2020	10.1111/2041-210X.13394
Kumgumpol, H., Liu, Y., Pokavanich, T., Alabia, I.D., Yin, Z., Saitoh, S.I. & Tian, Y.	Environmental habitat mapping of green mussel: a GIS-based approach for sustainable aquaculture in the inner gulf of Thailand	Sustainability (Switzerland)	2020	10.3390/su122410643
Kyvelou S.S.I. & Ierapetritis, D.G.	Fisheries sustainability through soft multi-use maritime spatial planning and local development co-management: potentials and challenges in Greece	Sustainability (Switzerland)	2020	10.3390/su12052026
Li, M., Zhang, C., Xu, B., Xue, Y. & Ren, Y.	A comparison of GAM and GWR in modelling spatial distribution of Japanese mantis shrimp (*Oratosquilla oratoria*) in coastal waters	Estuarine, Coastal and Shelf Science	2020	10.1016/j.ecss.2020.106928
Martin, F.M., Jähnig, S.C., Domisch, S., Langhans, S.D., Hein, T., Borgwardt, F. & Kling, H.	Fish species distribution modelling in the upper Danube catchment - the size-dependency of spatial units	Wasserwirtschaft	2020	10.1007/s35147-020-0350-x
Mormede, S., Parker, S.J. & Pinkerton, M.H.	Comparing spatial distribution modelling of fisheries data with single-area or spatially-explicit integrated population models, a case study of toothfish in the Ross Sea region	Fisheries Research	2020	10.1016/j.fishres.2019.105381
Morzaria-Luna, H., Turk-Boyer, P., Polanco-Mizquez, E.I., Downton-Hoffmann, C., Cruz-Piñón, G., Carrillo-Lammens, T., et al.	Coastal and marine spatial planning in the northern Gulf of California, Mexico: consolidating stewardship, property rights, and enforcement for ecosystem-based fisheries management	Ocean & Coastal Management	2020	10.1016/j.ocecoaman.2020.105316
Morzaria-Luna, H.N., Turk-Boyer, P., Hernández, J.M.D., Polanco-Mizquez, E., Downton-Hoffmann, C., Cruz-Piñón, G., et al.	Fisheries management tools to support coastal and marine spatial planning: a case study from the northern Gulf of California, Mexico	MethodsX	2020	10.1016/j.mex.2020.101108
Palmer, S.C.J., Gernez, P.M., Thomas, Y., Simis, S., Miller, P.I., Glize, P. & Barillé, L.	Remote sensing-driven Pacific oyster (*Crassostrea gigas*) growth modeling to inform offshore aquaculture site selection	Frontiers in Marine Science	2020	10.3389/fmars.2019.00802
Psuty, I., Kulikowski, T. & Szymanek, L.	Integrating small-scale fisheries into Polish maritime spatial planning	Marine Policy	2020	10.1016/j.marpol.2020.104116
Reed, J.R., Lombard, A.T. & Sink, K.J.	A diversity of spatial management instruments can support integration of fisheries management and marine spatial planning	Marine Policy	2020	10.1016/j.marpol.2020.104089
Said, A. & Trouillet, B.	Bringing 'deep knowledge' of fisheries into marine spatial planning	Maritime Studies	2020	10.1007/s40152-020-00178-y
Schmidt, H., Radinger, J., Stoll, S. & Teschlade, D.	The role of spatial units in modelling freshwater fish distributions: comparing a subcatchment and river network approach using MaxEnt	Ecological Modelling	2020	10.1016/j.ecolmodel.2020.108937
Su, N.-J., Chang, C.-H., Hu, Y.-T., Chiang, W.-C. & Tseng, C.-T.	Modeling the spatial distribution of swordfish (*Xiphias gladius*) using fishery and remote sensing data: Approach and resolution	Remote Sensing	2020	10.3390/rs12060947
Switzer, T.S., Tyler-Jedlund, A.J., Keenan, S.F. & Weather, E.J.	Benthic habitats, as derived from classification of side-scan-sonar mapping data, are important determinants of reef-fish assemblage structure in the eastern Gulf of Mexico	Marine and Coastal Fisheries	2020	10.1002/mcf2.10106
Yunis, C.R.C., López, R.S., Cruz, S.M.O., Castillo, E.B., López, J.O.S., Trigoso, D.I. & Briceño, N.B.R.	Land suitability for sustainable aquaculture of rainbow trout (*Oncorhynchus mykiss*) in molinopampa (Peru) based on RS, GIS, and AHP	ISPRS International Journal of Geo-Information	2020	10.3390/ijgi9010028
zu Ermgassen, P.S.E., Mukherjee, N., Worthington, T.A., Acosta, A., Araujo, A.R.D., Beitl, C.M., et al.	Fishers who rely on mangroves: modelling and mapping the global intensity of mangrove-associated fisheries	Estuarine, Coastal and Shelf Science	2020	10.1016/j.ecss.2020.106975
Alós, J., Campos-Candela, A. & Arlinghaus, R.	A modelling approach to evaluate the impact of fish spatial behavioural types on fisheries stock assessment	ICES Journal of Marine Science	2019	10.1093/icesjms/fsy172

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Authors	Title	Journal	Year	DOI
Anand, A., Kantharajan, G., Krishnan, P., Abdul, Hakeem, K., Sai Santosh, K.S., Srinivasa Rao, C., et al.	Mapping the potential areas for enclosure fish culture in tropical reservoirs: geo-spatial solutions for sustainable aquaculture expansion	Spatial Information Research	2019	10.1007/s41324-019-00294-w
Bakker, Y.W., Koning, J. & Van Tatenhove, J.	Resilience and social capital: the engagement of fisheries communities in marine spatial planning	Marine Policy	2019	10.1016/j.marpol.2018.09.032
Chan, B., Sor, R., Ngor, P.B., Baehr, C. & Lek, S.	Modelling spatial and temporal dynamics of two small mud carp species in the Tonle Sap flood-pulse ecosystem	Ecological Modelling	2019	10.1016/j.ecolmodel.2018.11.007
Craig, R.K.	Fostering adaptive marine aquaculture through procedural innovation in marine spatial planning	Marine Policy	2019	10.1016/j.marpol.2019.103555
Francisco, H.R., Corrêia, A.F. & Feiden, A.	Classification of areas suitable for fish farming using geotechnology and multi-criteria analysis	ISPRS International Journal of Geo-Information	2019	10.3390/ijgi8090394
Guan, L., Jin, X., Wu, Q., Shan, X. & Bartolino, V.	Statistical modelling for exploring diel vertical movements and spatial correlations of marine fish species: a supplementary tool to assess species interactions	ICES Journal of Marine Science	2019	10.1093/icesjms/fsz033
Ji, Z., Zhao, K., Zhang, S. & Li, M.	Fine-grained fish image classification based on a bilinear network with spatial transformation	Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/Journal of Tianjin University Science and Technology	2019	10.11784/tdxbz201808040
Krumsick, K.J. & Fisher, J.A.D.	Spatial and ontogenetic variation in isotopic niche among recovering fish communities revealed by Bayesian modeling	Plos One	2019	10.1371/journal.pone.0215747
Sainz, J.F., Di, Lorenzo, E., Bell, T.W., Gaines, S., Lenihan, H. & Miller, R.J.	Spatial planning of marine aquaculture under climate decadal variability: a case study for mussel farms in Southern California	Frontiers in Marine Science	2019	10.3389/fmars.2019.00253
Tinlin-Mackenzie, A., Delany, J., Scott, C.L. & Fitzsimmons, C.	Spatially modelling the suitability, sensitivity, and vulnerability of data poor fisheries with GIS: a case study of the Northumberland lugworm fishery	Marine Policy	2019	10.1016/j.marpol.2019.103707
Trouillet, B.	Aligning with dominant interests: the role played by geo-technologies in the place given to fisheries in marine spatial planning	Geoforum	2019	10.1016/j.geoforum.2019.10.012
Trouillet, B., Bellanger-Husi, L., El, Ghaziri, A., Lamberts, C., Plissonneau, E. & Rollo, N.	More than maps: providing an alternative for fisheries and fishers in marine spatial planning	Ocean & Coastal Management	2019	10.1016/j.ocecoaman.2019.02.016
Wedding, L.M., Jorgensen, S., Lepczyk, C.A. & Friedlander, A.M.	Remote sensing of three-dimensional coral reef structure enhances predictive modeling of fish assemblages	Remote Sensing in Ecology and Conservation	2019	10.1002/rse2.115
Zhu, H., Li, K., Wang, L., Chu, J., Gao, N. & Chen, Y.	Spectral characteristic analysis and remote sensing classification of coastal aquaculture areas based on GF-1 Data	Journal of Coastal Research	2019	10.2112/SI90-007.1
Žužul, I., Šegvić-Bubić, T., Talijančić, I., Džoić, T., Lepen-Pleić, I., Beg, Paklar, G., et al.	Spatial connectivity pattern of expanding gilthead seabream populations and its interactions with aquaculture sites: a combined population genetic and physical modelling approach	Scientific Reports	2019	10.1038/s41598-019-51256-z
Assefa, W.W. & Abebe, W.B.	GIS modeling of potentially suitable sites for aquaculture development in the Lake Tana basin, northwest Ethiopia	Agriculture and Food Security	2018	10.1186/s40066-018-0222-0
Chong, S., Park, C., Lee, K.R. & An, K.G.	Modeling summer hypoxia spatial distribution and fish habitat volume in artificial estuarine waterway	Water (Switzerland)	2018	10.3390/w10111695
Coccoli, C., Galparsoro, I., Murillas, A., Pınarbaşı, K. & Fernandes, J.A.	Conflict analysis and reallocation opportunities in the framework of marine spatial planning: a novel, spatially explicit Bayesian belief network approach for artisanal fishing and aquaculture	Marine Policy	2018	10.1016/j.marpol.2018.04.015
Dragon, A.-C., Senina, I., Hintzen, N.T. & Lehodey, P.	Modelling South Pacific jack mackerel spatial population dynamics and fisheries	Fisheries Oceanography	2018	10.1111/fog.12234

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Authors	Title	Journal	Year	DOI
Frelat, R., Orio, A., Casini, M., Lehmann, A., Mérigot, B., Otto, S.A., et al.	Contribution to the symposium: 'sustainable use of Baltic Sea resources' original article a three-dimensional view on biodiversity changes: spatial, temporal, and functional perspectives on fish communities in the Baltic Sea	ICES Journal of Marine Science	2018	10.1093/icesjms/fsy027
Gimpel, A., Stelzenmüller, V., Töpsch, S., Galparsoro, I., Gubbins, M., Miller, D., et al.	A GIS-based tool for an integrated assessment of spatial planning trade-offs with aquaculture	Science of the Total Environment	2018	10.1016/j.scitotenv.2018.01.133
Harborne, A.R., Green, A.L., Peterson, N.A., Beger, M., Golbuu, Y., Houk, P., et al.	Modelling and mapping regional-scale patterns of fishing impact and fish stocks to support coral-reef management in Micronesia	Diversity and Distributions	2018	10.1111/ddi.12814
James, M., Mendo, T., Jones, E.L., Orr, K., McKnight, A. & Thompson, J.	AIS data to inform small scale fisheries management and marine spatial planning	Marine Policy	2018	10.1016/j.marpol.2018.02.012
Janßen, H., Bastardie, F., Eero, M., Hamon, K.G., Hinrichsen, H.-H., Marchal, P., et al.	Integration of fisheries into marine spatial planning: *quo vadis*?	Estuarine, Coastal and Shelf Science	2018	10.1016/j.ecss.2017.01.003
Lester, S.E., Stevens, J.M., Gentry, R.R., Kappel, C.V., Bell, T.W., Costello, C.J., et al.	Marine spatial planning makes room for offshore aquaculture in crowded coastal waters	Nature Communications	2018	10.1038/s41467-018-03249-1
Muška, M., Tušer, M., Frouzová, J., Mrkvička, T., Ricard, D., Seďa, J., et al.	Real-time distribution of pelagic fish: combining hydroacoustics, GIS and spatial modelling at a fine spatial scale	Scientific Reports	2018	10.1038/s41598-018-23762-z
Nayak, A.K., Kumar, P., Pant, D. & Mohanty, R.K.	Land suitability modelling for enhancing fishery resource development in Central Himalayas (India) using GIS and multi-criteria evaluation approach	Aquacultural Engineering	2018	10.1016/j.aquaeng.2018.10.003
Shaari, N.R. & Mustapha, M.A.	Predicting potential *Rastrelliger kanagurta* fish habitat using MODIS satellite data and GIS modeling: A case study of exclusive economic zone, Malaysia	Sains Malaysiana	2018	10.17576/jsm-2018-4707-03
Vianna, L.F.D.N. & Filho, J.B.	Spatial analysis for site selection in marine aquaculture: An ecosystem approach applied to Baía Sul, Santa Catarina, Brazil	Aquaculture	2018	10.1016/j.aquaculture.2017.12.039
Anderson, K.R., Chapman, D.C., Wynne, T.T. & Paukert, C.P.	Assessment of phytoplankton resources suitable for bigheaded carps in Lake Michigan derived from remote sensing and bioenergetics	Journal of Great Lakes Research	2017	10.1016/j.jglr.2017.03.005
Bastardie, F., Angelini, S., Bolognini, L., Fuga, F., Manfredi, C., Martinelli, M., et al.	Spatial planning for fisheries in the Northern Adriatic: working toward viable and sustainable fishing	Ecosphere	2017	10.1002/ecs2.1696
Galaiduk, R., Radford, B.T., Wilson, S.K. & Harvey, E.S.	Comparing two remote video survey methods for spatial predictions of the distribution and environmental niche suitability of demersal fishes	Scientific Reports	2017	10.1038/s41598-017-17946-2
Hasim, H., Koniyo, Y. & Kasim, F.	Suitable location map of floating net cage for environmentally friendly fish farming development with geographic information systems applications in Lake Limboto, Gorontalo, Indonesia	AACL Bioflux	2017	
Jentoft, S.	Small-scale fisheries within maritime spatial planning: knowledge integration and power	Journal of Environmental Policy and Planning	2017	10.1080/1523908X.2017.1304210
Kallasvuo, M., Vanhatalo, J. & Veneranta, L.	Modeling the spatial distribution of larval fish abundance provides essential information for management	Canadian Journal of Fisheries and Aquatic Sciences	2017	10.1139/cjfas-2016-0008
Lin, Y., Ji, H., Nico, S. & Ye, Q.	Optimization of ELM classification model for remote sensing image based on artificial fish-swarm algorithm	Nongye Jixie Xuebao/Transactions of the Chinese Society for Agricultural Machinery	2017	10.6041/j.issn.1000-1298.2017.10.019
Mandal, R.N., Das, S., Sarker, M.M.H., Kundu, G.K., Faruque, M.H., Paul, B. & Islam, M.M.	Aquaculture habitat suitability assessment in Gazipur district, Bangladesh using geo-spatial technology	International Journal of Ecology and Development	2017	
Montalto, V., Martinez, M., Rinaldi, A., Sarà, G. & Mirto, S.	The effect of the quality of diet on the functional response of *Mytilus galloprovincialis* (Lamarck, 1819): Implications for integrated multitrophic aquaculture (IMTA) and marine spatial planning	Aquaculture	2017	10.1016/j.aquaculture.2016.10.030

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Murray, A.G. & Salama, N.K.G.	Modelling disease in aquatic systems that are spread by processes operating at different temporal and spatial scales: examples from salmon aquaculture	CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources	2017	10.1079/PAVSNNR201712032
Qian, H., Chu, L., Zhu, R., Cai, Y.-J. & Yan, Y.-Z.	Spatial patterns of fish assemblages based on classification strengths in the rivers of Chaohu basin	Chinese Journal of Ecology	2017	10.13292/j.1000-4890.201710.023
Schmiing, M., Fontes, J. & Afonso, P.	Predictive mapping of reproductive fish habitats to aid marine conservation planning	Canadian Journal of Fisheries and Aquatic Sciences	2017	10.1139/cjfas-2015-0538
Bonetti, R.M., Reinfelds, I.V., Butler, G.L., Walsh, C.T., Broderick, T.J. & Chisholm, L.A.	A multi-scale GIS and hydrodynamic modelling approach to fish passage assessment: Clarence and Shoalhaven Rivers, NSW Australia	Geomorphology	2016	10.1016/j.geomorph.2015.06.015
Breen, P., Brown, S., Reid, D. & Rogan, E.	Modelling cetacean distribution and mapping overlap with fisheries in the northeast Atlantic	Ocean & Coastal Management	2016	10.1016/j.ocecoaman.2016.09.004
Cao, Y., Hinz, L., Metzke, B., Stein, J. & Holtrop, A.	Modeling and mapping fish abundance across wadeable streams of Illinois, USA, based on landscape-level environmental variables	Canadian Journal of Fisheries and Aquatic Sciences	2016	10.1139/cjfas-2015-0343
Costa, M.D.P., Possingham, H.P. & Muelbert, J.H.	Incorporating early life stages of fishes into estuarine spatial conservation planning	Aquatic Conservation: Marine and Freshwater Ecosystems	2016	10.1002/aqc.2584
Ducharme-Barth, N.D. & Ahrens, R.N.M.	Classification and analysis of VMS data in vertical line fisheries: incorporating uncertainty into spatial distributions	Canadian Journal of Fisheries and Aquatic Sciences	2016	10.1139/cjfas-2016-0181
Hynes, S., Gerritsen, H., Breen, B. & Johnson, M.	Discrete choice modelling of fisheries with nuanced spatial information	Marine Policy	2016	10.1016/j.marpol.2016.07.004
Pattrick, P., Strydom, N.A., Harris, L. & Goschen, W.S.	Predicting spawning locations and modelling the spatial extent of post hatch areas for fishes in a shallow coastal habitat in South Africa	Marine Ecology Progress Series	2016	10.3354/meps11901
Péron, C., Welsford, D.C., Ziegler, P., Lamb, T.D., Gasco, N., Chazeau, C., et al.	Modelling spatial distribution of Patagonian toothfish through life-stages and sex and its implications for the fishery on the Kerguelen Plateau	Progress in Oceanography	2016	10.1016/j.pocean.2015.12.003
Rubec, P.J., Lewis, J., Reed, D., Lashley, C. & Versaggi, S.	Linking oceanographic modeling and benthic mapping with habitat suitability models for pink shrimp on the West Florida shelf	Marine and Coastal Fisheries	2016	10.1080/19425120.2015.1082519
Sanchez-Jerez, P., Karakassis, I., Massa, F., Fezzardi, D., Aguilar-Manjarrez, J., Soto, D., et al.	Aquaculture's struggle for space: the need for coastal spatial planning and the potential benefits of Allocated Zones for Aquaculture (AZAs) to avoid conflict and promote sustainability	Aquaculture Environment Interactions	2016	10.3354/aei00161
Valentini, E., Filipponi, F., Xuan, A.N., Passarelli, F.M. & Taramelli, A.	Earth observation for maritime spatial planning: measuring, observing and modeling marine environment to assess potential aquaculture sites	Sustainability (Switzerland)	2016	10.3390/su8060519
Zhao, J., Gu, Z., Shi, M., Lu, H., Li, J., Shen, M., et al.	Spatial behavioral characteristics and statistics-based kinetic energy modeling in special behaviors detection of a shoal of fish in a recirculating aquaculture system	Computers and Electronics in Agriculture	2016	10.1016/j.compag.2016.06.025
Anderson, K.R., Chapman, D.C., Wynne, T.T., Masagounder, K. & Paukert, C.P.	Suitability of Lake Erie for bigheaded carps based on bioenergetic models and remote sensing	Journal of Great Lakes Research	2015	10.1016/j.jglr.2015.03.029
Bartelings, H., Hamon, K.G., Berkenhagen, J. & Buisman, F.C.	Bio-economic modelling for marine spatial planning application in North Sea shrimp and flatfish fisheries	Environmental Modelling and Software	2015	10.1016/j.envsoft.2015.09.013
Bastardie, F., Nielsen, J.R., Eigaard, O.R., Fock, H.O., Jonsson, P. & Bartolino, V.	Competition for marine space: modelling the Baltic Sea fisheries and effort displacement under spatial restrictions	ICES Journal of Marine Science	2015	10.1093/icesjms/fsu215
Colloca, F., Garofalo, G., Bitetto, I., Facchini, M.T., Grati, F., Martiradonna, A., et al.	The seascape of demersal fish nursery areas in the North Mediterranean Sea, a first step towards the implementation of spatial planning for trawl fisheries	Plos One	2015	10.1371/journal.pone.0119590

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Authors	Title	Journal	Year	DOI
Dapueto, G., Massa, F., Costa, S., Cimoli, L., Olivari, E., Chiantore, M., et al.	A spatial multi-criteria evaluation for site selection of offshore marine fish farm in the Ligurian Sea, Italy	Ocean & Coastal Management	2015	10.1016/j.ocecoaman.2015.06.030
Filgueira, R., Guyondet, T., Bacher, C. & Comeau, L.A.	Informing Marine Spatial Planning (MSP) with numerical modelling: A case-study on shellfish aquaculture in Malpeque Bay (Eastern Canada)	Marine Pollution Bulletin	2015	10.1016/j.marpolbul.2015.08.048
Gimpel, A., Stelzenmüller, V., Grote, B., Buck, B.H., Floeter, J., Núñez-Riboni, I., et al.	A GIS modelling framework to evaluate marine spatial planning scenarios: co-location of offshore wind farms and aquaculture in the German EEZ	Marine Policy	2015	10.1016/j.marpol.2015.01.012
Kavadas, S., Maina, I., Damalas, D., Dokos, I., Pantazi, M. & Vassilopoulou, V.	Multi-criteria decision analysis as a tool to extract fishing footprints: Application to small scale fisheries and implications for management in the context of the maritime spatial planning directive	Mediterranean Marine Science	2015	10.12681/mms.1087
Metcalfe, K., Vaz, S., Engelhard, G.H., Villanueva, M.C., Smith, R.J. & Mackinson, S.	Evaluating conservation and fisheries management strategies by linking spatial prioritization software and ecosystem and fisheries modelling tools	Journal of Applied Ecology	2015	10.1111/1365-2664.12404
Naranjo-Madrigal, H., Van, Putten, I. & Norman-López, A.	Understanding socio-ecological drivers of spatial allocation choice in a multi-species artisanal fishery: a Bayesian network modeling approach	Marine Policy	2015	10.1016/j.marpol.2015.09.003
Vafaie, F., Hadipour, A. & Hadipour, V.	GIS-based fuzzy multi-criteria decision making model for coastal aquaculture site selection	Environmental Engineering and Management Journal	2015	10.30638/eemj.2015.258
Bastardie, F., Nielsen, J.R. & Miethe, T.	Displace: a dynamic, individual-based model for spatial fishing planning and effort displacement - integrating underlying fish population models	Canadian Journal of Fisheries and Aquatic Sciences	2014	10.1139/cjfas-2013-0126
Boyd, C., Woillez, M., Bertrand, S., Castillo, R., Bertrand, A. & Punt, A.E.	Bayesian posterior prediction of the patchy spatial distributions of small pelagic fish in regions of suitable habitat	Canadian Journal of Fisheries and Aquatic Sciences	2014	10.1139/cjfas-2014-0234
Campbell, M.S., Stehfest, K.M., Votier, S.C. & Hall-Spencer, J.M.	Mapping fisheries for marine spatial planning: gear-specific vessel monitoring system (VMS), marine conservation and offshore renewable energy	Marine Policy	2014	10.1016/j.marpol.2013.09.015
Chalmers, R., Oosthuizen, A., Götz, A., Paterson, A. & Sauer, W.H.H.	Assessing the suitability of commercial fisheries data for local-scale marine spatial planning in South Africa	African Journal of Marine Science	2014	10.2989/1814232X.2014.979228
Costa, B., Taylor, J.C., Kracker, L., Battista, T. & Pittman, S.	Mapping reef fish and the seascape: using acoustics and spatial modeling to guide coastal management	Plos One	2014	10.1371/journal.pone.0085555
Eide, A.	Modelling spatial distribution of the Barents Sea cod fishery	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	2014	10.1007/978-3-319-11520-7_30
Filgueira, R., Grant, J. & Strand, Ø.	Implementation of marine spatial planning in shellfish aquaculture management: modeling studies in a Norwegian Fjord	Ecological Applications	2014	10.1890/13-0479.1
Jentoft, S. & Knol, M.	Marine spatial planning: risk or opportunity for fisheries in the north sea?	Maritime Studies	2014	10.1186/2212-9790-12-13
Lin, Y., Liu, S.X., Guan, D.M., Zhang, Z.D. & Wen, Q.	GIS-based Japanese scallop (*Patinopecten yessoensis*) aquaculture suitability assessment: A case study with the islands of Dachangshan and Xiaochangshan, North Yellow Sea, China	Shengtai Xuebao	2014	10.5846/stxb201301250158
Long, J.M., Liang, Y., Shoup, D.E., Dzialowski, A.R. & Bidwell, J.R.	GIS-based rapid-assessment of bighead carp *Hypophthalmichthys nobilis* (Richardson, 1845) suitability in reservoirs	Management of Biological Invasions	2014	10.3391/mbi.2014.5.4.07

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Maar, M., Rindorf, A., Møller, E.F., Christensen, A., Madsen, K.S. & Van Deurs, M.	Zooplankton mortality in 3D ecosystem modelling considering variable spatial-temporal fish consumptions in the North Sea	Progress in Oceanography	2014	10.1016/j.pocean.2014.03.002
Petitgas, P., Doray, M., Huret, M., Massé, J. & Woillez, M.	Modelling the variability in fish spatial distributions over time with empirical orthogonal functions: Anchovy in the Bay of Biscay	ICES Journal of Marine Science	2014	10.1093/icesjms/fsu111
Wijenayake, W.M.H.K., Gunaratne, A.B.A.K., Silva, S.S. & Amarasinghe, U.S.	Use of geographical information system and remote sensing techniques for planning culture-based fisheries in non-perennial reservoirs of Sri Lanka	Lakes and Reservoirs: Research and Management	2014	10.1111/lre.12071
Yang, L., Koo, D.-H., Li, D., Zhang, T., Jiang, J., Luan, F., et al.	Next-generation sequencing, FISH mapping and synteny-based modeling reveal mechanisms of decreasing dysploidy in Cucumis	Plant Journal	2014	10.1111/tpj.12355
Du, Y., Wu, D., Liang, F. & Li, C.	Integration of case-based reasoning and object-based image classification to classify SPOT images: a case study of aquaculture land use mapping in coastal areas of Guangdong Province, China	GIScience and Remote Sensing	2013	10.1080/15481603.2013.842292
Falconer, L., Hunter, D.-C., Scott, P.C., Telfer, T.C. & Ross, L.G.	Using physical environmental parameters and cage engineering design within GIS-based site suitability models for marine aquaculture	Aquaculture Environment Interactions	2013	10.3354/aei00084
Ospina-Álvarez, A., Bernal, M., Catalán, I.A., Roos, D., Bigot, J.-L. & Palomera, I.	Modeling fish egg production and spatial distribution from acoustic data: a step forward into the analysis of recruitment	Plos One	2013	10.1371/journal.pone.0073687
Pascual, M., Borja, A., Galparsoro, I., Ruiz, J., Mugerza, E., Quincoces, I., et al.	Total fishing pressure produced by artisanal fisheries, from a marine spatial planning perspective: a case study from the Basque Country (Bay of Biscay)	Fisheries Research	2013	10.1016/j.fishres.2013.06.010
Saul, S.E., Walter, J.F., Die, D.J., Naar, D.F. & Donahue, B.T.	Modeling the spatial distribution of commercially important reef fishes on the West Florida Shelf	Fisheries Research	2013	10.1016/j.fishres.2013.01.002
Van Wynsberge, S., Andréfouët, S., Gilbert, A., Stein, A. & Remoissenet, G.	Best management strategies for sustainable giant clam fishery in French Polynesia Islands: answers from a spatial modeling approach	Plos One	2013	10.1371/journal.pone.0064641
Clark, M.R. & Dunn, M.R.	Spatial management of deep-sea seamount fisheries: balancing sustainable exploitation and habitat conservation	Environmental Conservation	2012	10.1017/S0376892912000021
Jennings, S., Lee, J. & Hiddink, J.G.	Assessing fishery footprints and the trade-offs between landings value, habitat sensitivity, and fishing impacts to inform marine spatial planning and an ecosystem approach	ICES Journal of Marine Science	2012	10.1093/icesjms/fss050
Juntunen, T., Vanhatalo, J., Peltonen, H. & Mäntyniemi, S.	Bayesian spatial multispecies modelling to assess pelagic fish stocks from acoustic- and trawl-survey data	ICES Journal of Marine Science	2012	10.1093/icesjms/fsr183
Nutters, H.M. & Pinto da Silva, P.	Fishery stakeholder engagement and marine spatial planning: lessons from the Rhode Island Ocean SAMP and the Massachusetts Ocean management plan	Ocean & Coastal Management	2012	10.1016/j.ocecoaman.2012.05.020
Edwards, C.T.T. & Plagányi, E.E.	Protecting old fish through spatial management: is there a benefit for sustainable exploitation?	Journal of Applied Ecology	2011	10.1111/j.1365-2664.2011.01961.x
El-Shaarawi, A.H., Backus, S., Zhu, R. & Chen, Y.	Modelling temporal and spatial changes of PCBs in fish tissue from Lake Huron	Environmental Monitoring and Assessment	2011	10.1007/s10661-010-1408-5
Goethel, D.R., Quinn, T.J. & Cadrin, S.X.	Incorporating spatial structure in stock assessment: movement modeling in marine fish population dynamics	Reviews in Fisheries Science	2011	10.1080/10641262.2011.557451
Hamilton, S.L., Wilson, J.R., Ben-Horin, T. & Caselle, J.E.	Utilizing spatial demographic and life history variation to optimize sustainable yield of a temperate sex-changing fish	Plos One	2011	10.1371/journal.pone.0024580
Knudby, A., Roelfsema, C., Lyons, M., Phinn, S. & Jupiter, S.	Mapping fish community variables by Integrating field and satellite data, object-based image analysis and modeling in a traditional Fijian fisheries management area	Remote Sensing	2011	10.3390/rs3030460
Kopti, M., Aps, R., Fetissov, M. & Suursaa, Ü.	Integration of fishery management into the process of maritime spatial planning	WIT Transactions on Ecology and the Environment	2011	10.2495/RAV110181
Navas, J.M., Telfer, T.C. & Ross, L.G.	Spatial modeling of environmental vulnerability of marine finfish aquaculture using GIS-based neuro-fuzzy techniques	Marine Pollution Bulletin	2011	10.1016/j.marpolbul.2011.05.019

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Authors	Title	Journal	Year	DOI
Nichols, O.C., Lind, H., Baldwin, J., Jackett, A.R., Borrelli, M. & Small Jr., P.A.	Site selection for sustainable shellfish aquaculture development: a practical mapping approach	Journal of Ocean Technology	2011	
Radiarta, I.N., Saitoh, S.I. & Yasui, H.	Aquaculture site selection for Japanese kelp (*Laminaria japonica*) in southern Hokkaido, Japan, using satellite remote sensing and GIS-based models	ICES Journal of Marine Science	2011	10.1093/icesjms/fsq163
Reddy, G.P., Reddy, M.N., Sontakki, B.S. & Kumar, K.V.	A framework of participatory geo-spatial information system for micro level planning - a case study in aquaculture	Indian Journal of Agricultural Economics	2011	
Saitoh, S.I., Mugo, R., Radiarta, I.N., Asaga, S., Takahashi, F., Hirawake, T., et al.	Some operational uses of satellite remote sensing and marine GIS for sustainable fisheries and aquaculture	ICES Journal of Marine Science	2011	10.1093/icesjms/fsq190
Silva, C., Ferreira, J.G., Bricker, S.B., DelValls, T.A., Martín-Díaz, M.L. & Yáñez, E.	Site selection for shellfish aquaculture by means of GIS and farm-scale models, with an emphasis on data-poor environments	Aquaculture	2011	10.1016/j.aquaculture.2011.05.033
Woodford, D.J., Cochrane, T.A., McHugh, P.A. & McIntosh, A.R.	Modelling spatial exclusion of a vulnerable native fish by introduced trout in rivers using landscape features: a new tool for conservation management	Aquatic Conservation: Marine and Freshwater Ecosystems	2011	10.1002/aqc.1209
Berkenhagen, J., Döring, R., Fock, H.O., Kloppmann, M.H.F., Pedersen, S.A. & Schulze, T.	Decision bias in marine spatial planning of offshore wind farms: problems of singular versus cumulative assessments of economic impacts on fisheries	Marine Policy	2010	10.1016/j.marpol.2009.12.004
Druon, J.N.	Habitat mapping of the Atlantic bluefin tuna derived from satellite data: its potential as a tool for the sustainable management of pelagic fisheries	Marine Policy	2010	10.1016/j.marpol.2009.07.005
Hobday, A.J., Hartog, J.R., Timmiss, T. & Fielding, J.	Dynamic spatial zoning to manage southern bluefin tuna (*Thunnus maccoyii*) capture in a multi-species longline fishery	Fisheries Oceanography	2010	10.1111/j.1365-2419.2010.00540.x
Kiyofuji, H.	Investigating relationships between fisheries, fisheries resources and environment from a modeling approach-introduction of a spatial ecosystem and population dynamics model (SEAPODYM)	Nippon Suisan Gakkaishi (Japanese Edition)	2010	10.2331/suisan.76.990
Klein, C.J., Steinback, C., Watts, M., Scholz, A.J. & Possingham, H.P.	Spatial marine zoning for fisheries and conservation	Frontiers in Ecology and the Environment	2010	10.1890/090047
Kleisner, K.M., Walter, J.F., Diamond, S.L. & Die, D.J.	Modeling the spatial autocorrelation of pelagic fish abundance	Marine Ecology Progress Series	2010	10.3354/meps08667
Norse, E.A.	Ecosystem-based spatial planning and management of marine fisheries: why and how?	Bulletin of Marine Science	2010	
Tao, J., Ai, W., Gong, Y., Chen, Z., Li, S., Xie, Q., et al.	Assessment of fish abundance and distribution using fisheries acoustics and GIS modeling in the Nanxi River of Wenzhou City	Shengtai Xuebao/ Acta Ecologica Sinica	2010	
Chen, Z., Xu, S., Qiu, Y., Lin, Z. & Jia, X.	Modeling the effects of fishery management and marine protected areas on the Beibu Gulf using spatial ecosystem simulation	Fisheries Research	2009	10.1016/j.fishres.2009.08.001
Douglas, J., Hunt, T., Abery, N. & Allen, M.	Application of GIS modelling to quantify fish habitats in lakes	Lakes and Reservoirs: Research and Management	2009	10.1111/j.1440-1770.2009.00400.x
Islam, M.M., Ahmed, M.K., Shahid, M.A., Hoque, S. & Islam, D.	Determination of land cover changes and suitable shrimp farming area using remote sensing and GIS in Southwestern Bangladesh	International Journal of Ecology and Development	2009	
Lewy, P. & Kristensen, K.	Modelling the distribution of fish accounting for spatial correlation and overdispersion	Canadian Journal of Fisheries and Aquatic Sciences	2009	10.1139/F09-114
Radiarta, I.N. & Saitoh, S.-I.	Biophysical models for Japanese scallop, *Mizuhopecten yessoensis*, aquaculture site selection in Funka Bay, Hokkaido, Japan, using remotely sensed data and geographic information system	Aquaculture International	2009	10.1007/s10499-008-9212-8
Schubert, M.	Legal questions of maritime spatial planning - Under special consideration of fisheries	Natur und Recht	2009	10.1007/s10357-009-1777-0

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Wanganeo, A., Chandran, V.R. & Kumar, A.	Aquaculture site selection in midnapur district (West Bengal) using remote sensing and GIS	Pollution Research	2009	
Burgos, J.M. & Horne, J.K.	Characterization and classification of acoustically detected fish spatial distributions	ICES Journal of Marine Science	2008	10.1093/icesjms/fsn087
Clark, J.S., Rizzo, D.M., Watzin, M.C. & Hession, W.C.	Spatial distribution and geomorphic condition of fish habitat in streams: An analysis using hydraulic modelling and geostatistics	River Research and Applications	2008	10.1002/rra.1085
Fock, H.O.	Fisheries in the context of marine spatial planning: defining principal areas for fisheries in the German EEZ	Marine Policy	2008	10.1016/j.marpol.2007.12.010
Longdill, P.C., Healy, T.R. & Black, K.P.	An integrated GIS approach for sustainable aquaculture management area site selection	Ocean & Coastal Management	2008	10.1016/j.ocecoaman.2008.06.010
McCleary, R.J. & Hassan, M.A.	Predictive modeling and spatial mapping of fish distributions in small streams of the Canadian Rocky Mountain foothills	Canadian Journal of Fisheries and Aquatic Sciences	2008	10.1139/F07-161
Mollot, L.A. & Bilby, R.E.	The use of geographic information systems, remote sensing, and suitability modeling to identify conifer restoration sites with high biological potential for anadromous fish at the cedar river municipal watershed in Western Washington, U.S.A	Restoration Ecology	2008	10.1111/j.1526-100X.2007.00340.x
Pérez-Ruzafa, A., Martín, E., Marcos, C., Zamarro, J.M., Stobart, B., Harmelin-Vivien, M., et al.	Modelling spatial and temporal scales for spill-over and biomass exportation from MPAs and their potential for fisheries enhancement	Journal for Nature Conservation	2008	10.1016/j.jnc.2008.09.003
Radiarta, I.N., Saitoh, S.I. & Miyazono, A.	GIS-based multi-criteria evaluation models for identifying suitable sites for Japanese scallop (*Mizuhopecten yessoensis*) aquaculture in Funka Bay, southwestern Hokkaido, Japan	Aquaculture	2008	10.1016/j.aquaculture.2008.07.048
Sims, M., Cox, T. & Lewison, R.	Modeling spatial patterns in fisheries bycatch: Improving bycatch maps to aid fisheries management	Ecological Applications	2008	10.1890/07-0685.1
Webster, R.A., Pollock, K.H., Ghosh, S.K. & Hankin, D.G.	Bayesian spatial modeling of data from unit-count surveys of fish in streams	Transactions of the American Fisheries Society	2008	10.1577/T06-138.1
De Freitas, D.M. & Tagliani, P.R.A.	Spatial planning of shrimp farming in the Patos Lagoon Estuary (southern Brazil): an integrated coastal management approach	Journal of Coastal Research	2007	10.2112/1551-5036-47.sp1.136
Hossain, M.S., Chowdhury, S.R., Das, N.G. & Rahaman, M.M.	Multi-criteria evaluation approach to GIS-based land-suitability classification for tilapia farming in Bangladesh	Aquaculture International	2007	10.1007/s10499-007-9109-y
Karpouzi, V.S., Watson, R. & Pauly, D.	Modelling and mapping resource overlap between seabirds and fisheries on a global scale: a preliminary assessment	Marine Ecology Progress Series	2007	10.3354/meps06860
Longdill, P.C., Healy, T.R., Black, K.P. & Mead, S.T.	Integrated sediment habitat mapping for aquaculture zoning	Journal of Coastal Research	2007	
Moreno, G., Josse, E., Brehmer, P. & Nøttestad, L.	Echotrace classification and spatial distribution of pelagic fish aggregations around drifting fish aggregating devices (DFAD)	Aquatic Living Resources	2007	10.1051/alr:2008015
Berman, M.	Modeling spatial choice in ocean fisheries	Marine Resource Economics	2006	10.1086/mre.21.4.42629522
Charo-Karisa, H., Komen, H., Reynolds, S., Rezk, M.A., Ponzoni, R.W. & Bovenhuis, H.	Genetic and environmental factors affecting growth of Nile tilapia (*Oreochromis niloticus*) juveniles: modelling spatial correlations between hapas	Aquaculture	2006	10.1016/j.aquaculture.2005.11.041
Chaumot, A., Milioni, N., Abdoli, A., Pont, D. & Charles, S.	First step of a modeling approach to evaluate spatial heterogeneity in a fish (*Cottus gobio*) population dynamics	Ecological Modelling	2006	10.1016/j.ecolmodel.2006.03.024
Close, C.H. & Hall, G.B.	A GIS-based protocol for the collection and use of local knowledge in fisheries management planning	Journal of Environmental Management	2006	10.1016/j.jenvman.2005.04.027
Koubbi, P., Loots, C., Cotonnec, G., Harlay, X., Grioche, A., Vaz, S., et al.	Spatial patterns and GIS habitat modelling of *Solea solea*, *Pleuronectes flesus* and *Limanda limanda* fish larvae in the eastern English Channel during the spring	Scientia Marina	2006	10.3989/scimar.2006.70s2147

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Mukhopadhyay, B. & Bhattacharyya, R.	Modelling a single-species closed habitat fishery with spatial heterogeneity and time delay	Journal of Applied Mathematics and Computing	2006	10.1007/BF02832048
Buitrago, J., Rada, M., Hernández, H. & Buitrago, E.	A single-use site selection technique, using GIS, for aquaculture planning: choosing locations for mangrove oyster raft culture in Margarita Island, Venezuela	Environmental Management	2005	10.1007/s00267-004-0087-9
Eikaas, H.S., Kliskey, A.D. & Mcintosh, A.R.	Spatial modeling and habitat quantification for two diadromous fish in New Zealand streams: a GIS-based approach with application for conservation management	Environmental Management	2005	10.1007/s00267-004-0208-5
Karthik, M., Suri, J., Saharan, N. & Biradar, R.S.	Brackish water aquaculture site selection in Palghar Taluk, Thane district of Maharashtra, India, using the techniques of remote sensing and geographical information system	Aquacultural Engineering	2005	10.1016/j.aquaeng.2004.05.009
Pérez, O.M., Telfer, T.C. & Ross, L.G.	Geographical information systems-based models for offshore floating marine fish cage aquaculture site selection in Tenerife, Canary Islands	Aquaculture Research	2005	10.1111/j.1365-2109.2005.01282.x
Holland, D.S.	Spatial fishery rights and marine zoning: a discussion with reference to management of marine resources in new England	Marine Resource Economics	2004	10.1086/mre.19.1.42629417
Joy, M.K. & Death, R.G.	Predictive modelling and spatial mapping of freshwater fish and decapod assemblages using GIS and neural networks	Freshwater Biology	2004	10.1111/j.1365-2427.2004.01248.x
Valavanis, V.D., Georgakarakos, S., Kapantagakis, A., Palialexis, A. & Katara, I.	A GIS environmental modelling approach to essential fish habitat designation	Ecological Modelling	2004	10.1016/j.ecolmodel.2004.02.015
Pérez, O.M., Ross, L.G., Telfer, T.C. & Barquin, L.M.	Water quality requirements for marine fish cage site selection in Tenerife (Canary Islands): predictive modelling and analysis using GIS	Aquaculture	2003	10.1016/S0044-8486(02)00274-0
Salam, M.A., Ross, L.G. & Beveridge, C.M.	A comparison of development opportunities for crab and shrimp aquaculture in southwestern Bangladesh, using GIS modelling	Aquaculture	2003	10.1016/S0044-8486(02)00619-1
Bjorge, A., Bekkby, T., Bakkestuen, V. & Framstad, E.	Interactions between harbour seals, *Phoca vitulina*, and fisheries in complex coastal waters explored by combined Geographic Information System (GIS) and energetics modelling	ICES Journal of Marine Science	2002	10.1006/jmsc.2001.1137
Filipe, A.F., Cowx, I.G. & Collares-Pereira, M.J.	Spatial modelling of freshwater fish in semi-arid river systems: a tool for conservation	River Research and Applications	2002	10.1002/rra.638
McLeod, I., Pantus, F. & Preston, N.	The use of a geographical information system for land-based aquaculture planning	Aquaculture Research	2002	10.1046/j.1355-557x.2001.00667.x
Pauly, D.	21 Spatial modelling of trophic interactions and fisheries impacts in coastal ecosystems: a case study of Sakumo Lagoon, Ghana	Large Marine Ecosystems	2002	10.1016/S1570-0461(02)80043-X
Pérez, O.M., Telfer, T.C., Beveridge, M.C.M. & Ross, L.G.	Geographical Information Systems (GIS) as a simple tool to aid modelling of particulate waste distribution at marine fish cage sites	Estuarine, Coastal and Shelf Science	2002	10.1006/ecss.2001.0870
Gupta, M.C., Krishnarajan, V.P. & Nayak, S.	Brackish water aquaculture site selection in coastal track of Cannanore (Kerala) using remote sensing and GIS techniques	Journal of the Indian Society of Remote Sensing	2001	10.1007/BF02989917
Arnold, W.S., White, M.W., Norris, H.A. & Berrigan, M.E.	Hard clam (*Mercenaria* spp.) aquaculture in Florida, USA: geographic information system applications to lease site selection	Aquacultural Engineering	2000	10.1016/S0144-8609(00)00042-X
Chakravorty, U. & Nemoto, K.	Modeling the effects of area closure and tax policies: a spatial-temporal model of the Hawaii longline fishery	Marine Resource Economics	2000	10.1086/mre.15.3.42629301
Campbell, H.F. & Hand, A.J.	Modeling the spatial dynamics of the U.S. purse-seine fleet operating in the western Pacific tuna fishery	Canadian Journal of Fisheries and Aquatic Sciences	1999	10.1139/f99-009
Silva, C.G., Rodolfo, Olivarí, M. & Yany, G.	Aquaculture site selection using a geographical information system	Investigaciones Marinas	1999	10.1577/1548-8659
Liu, Z., Karsi, A. & Dunham, R.A.	Development of polymorphic EST markers suitable for genetic linkage mapping of catfish	Marine Biotechnology	1999	10.1007/PL00011800

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Liu, Z., Li, P., Kucuktas, H., Argue, B.J. & Dunham, R.A.	Development of amplified fragment length polymorphism (AFLP) markers suitable for genetic linkage mapping of catfish	Transactions of the American Fisheries Society	1999	
Anneville, O., Cury, P., Le Page, C. & Treuil, J.P.	Modelling fish spatial dynamics and local density-dependence relationships: detection of patterns at a global scale	Aquatic Living Resources	1998	10.1016/S0990-7440(98)80001-6
Giske, J., Huse, G. & Fiksen, Ø.	Modelling spatial dynamics of fish	Reviews in Fish Biology and Fisheries	1998	10.1023/A:1008864517488
Dreyling, M.H., Olopade, O.I. & Bohlander, S.K.	Generation of small insert genomic fish probes with high signal intensity suitable for deletion mapping	Cytogenetic and Genome Research	1997	10.1159/000134549
Hallam, T.G. & Lika, K.	Modeling the effects of toxicants on a fish population in a spatially heterogeneous environment: I. Behavior of the unstressed, spatial model	Nonlinear Analysis, Theory, Methods and Applications	1997	10.1016/S0362-546X(97)00050-3
LePage, C. & Cury, P.	Population viability and spatial fish reproductive strategies in constant and changing environments: an individual-based modelling approach	Canadian Journal of Fisheries and Aquatic Sciences	1997	10.1139/f97-132
Rijnsdorp, A.D. & Pastoors, M.A.	Modelling the spatial dynamics and fisheries of North Sea plaice (*Pleuronectes platessa*) based on tagging data	ICES Journal of Marine Science	1995	10.1006/jmsc.1995.0092
Ruth, M.	A system dynamics approach to modeling fisheries management issues: Implications for spatial dynamics and resolution	System Dynamics Review	1995	10.1002/sdr.4260110305
Ross, L.G., Mendoza, E.A. & Beveridge, M.C.M.	The application of geographical information systems to site selection for coastal aquaculture: an example based on salmonid cage culture	Aquaculture	1993	10.1016/0044-8486(93)90442-2
Sudarshana, R., Bhan, S.K., Siddiqui, M.S., Vohra, T.P., Prasad, P.N., Bhat, U.G. & Neelakantan, B.	Experiments in site selection for coastal aquaculture using Indian remote sensing satellite: IRS-1 A	International Journal of Remote Sensing	1993	10.1080/01431169308954036
Kogeler, J. & Dahle, S.	Remote sensing of sea surface temperatures for aquaculture planning in northern Norway	Arctic	1991	10.14430/arctic1568

Supplementary Table 2. List of 165 articles including authors, title, journal, publication year and DOI from Web of Science database.

Authors	Title	Journal	Year	DOI
Aguado, S.H., Segado, I.S. & Vidal, M.E.S.	Towards a multidimensional spatial approach to monitor geographical change in sustainable fisheries: a case study in the Campo de Cartagena-Mar Menor	Boletín de la Asociación de Geógrafos Españoles	2020	10.21138/bage.2899
Andrews, S., Leroux, S.J. & Fortin, M.J.	Modelling the spatial-temporal distributions and associated determining factors of a keystone pelagic fish	ICES Journal of Marine Science	2020	10.1093/icesjms/fsaa148
Buric, M., Bavcevic, L., Grguric, S., Vresnik, F., Krizan, J. & Antonic, O.	Modelling the environmental footprint of sea bream cage aquaculture in relation to spatial stocking design	Journal of Environmental Management	2020	10.1016/j.jenvman.2020.110811
Cahill, C.L., Anderson, S.C., Paul, A.J., Macpherson, L., Sullivan, M.G., Van Poorten, B., et al.	A spatial-temporal approach to modeling somatic growth across inland recreational fisheries landscapes	Canadian Journal of Fisheries and Aquatic Sciences	2020	10.1139/cjfas-2019-0434
D'Andrea, L., Parisi, A., Fiorentino, F., Garofalo, G., Gristina, M., Cataudella, S. & Russo, T	smartR: an r package for spatial modelling of fisheries and scenario simulation of management strategies	Methods in Ecology and Evolution	2020	10.1111/2041-210X.13394
Friedrichs-Manthey, M., Langhans, S.D., Hein, T., Borgwardt, F., Kling, H., Jahnig, S.C. & Domisch, S	Fish species distribution modelling in the upper Danube catchment- the size-dependency of spatial units	Wasserwirtschaft	2020	
Kumgumpol, H., Liu, Y., Pokavanich, T., Alabia, I.D., Yin, Z.X., Saitoh, S.I. & Tian, Y.J.	Environmental habitat mapping of green mussel: a GIS-based approach for sustainable aquaculture in the Inner Gulf of Thailand	Sustainability	2020	10.3390/su122410643
Kyvelou, S.S.I. & Ierapetritis, D.G.	Fisheries sustainability through soft multi-use maritime spatial planning and local development co-management: potentials and challenges in Greece	Sustainability	2020	10.3390/su12052026
Li, M., Zhang, C., Xu, B., Xue, Y. & Ren, Y.	A comparison of GAM and GWR in modelling spatial distribution of Japanese mantis shrimp (*Oratosquilla oratoria*) in coastal waters	Estuarine, Coastal and Shelf Science	2020	10.1016/j.ecss.2020.106928
Mormede, S., Parker, S.J. & Pinkerton, M.H.	Comparing spatial distribution modelling of fisheries data with single-area or spatially-explicit integrated population models, a case study of toothfish in the Ross Sea region	Fisheries Research	2020	10.1016/j.fishres.2019.105381
Morzaria-Luna, H.N., Turk-Boyer, P., Hernandez, J.M.D., Polanco-Mizquez, E., Downton-Hoffmann, C., Cruz-Pinon, G., et al.	Fisheries management tools to support coastal and marine spatial planning: a case study from the Northern Gulf of California, Mexico	Methods	2020	10.1016/j.mex.2020.101108
Morzaria-Luna, H.N., Turk-Boyer, P., Polanco-Mizquez, E.I., Downton-Hoffmann, C., Cruz-Pinon, G., Carrillo-Lammens, T., et al.	Coastal and marine spatial planning in the Northern Gulf of California, Mexico: consolidating stewardship, property rights, and enforcement for ecosystem-based fisheries management	Ocean & Coastal Management	2020	10.1016/j.ocecoaman.2020.105316
Mota-Ferreira, M., Filipe, A.F., Magalhaes, M.F., Carona, S. & Beja, P.	Spatial modelling of temporal dynamics in stream fish communities under anthropogenic change	Diversity and Distributions	2020	10.1111/ddi.13189
Palmer, S.C.I., Gornez, P.M., Thomas, Y., Simis, S., Miller, P.I., Glize, P. & Barille, L.	Remote sensing-driven Pacific oyster (*Crassostrea gigas*) growth modeling to inform offshore aquaculture site selection	Frontiers in Marine Science	2020	10.3389/fmars.2019.00802
Psuty, I., Kulikowski, T. & Szymanek, L.	Integrating small-scale fisheries into Polish maritime spatial planning	Marine Policy	2020	10.1016/j.marpol.2020.104116
Reed, J.R., Lombard, A.T. & Sink, K.J.	A diversity of spatial management instruments can support integration of fisheries management and marine spatial planning	Marine Policy	2020	10.1016/j.marpol.2020.104089
Said, A. & Trouillet, B.	Bringing 'deep knowledge' of fisheries into marine spatial planning	Maritime Studies	2020	10.1007/s40152-020-00178-y
Schmidt, H., Radinger, J., Teschlade, D. & Stoll, S.	The role of spatial units in modelling freshwater fish distributions: comparing a subcatchment and river network approach using MaxEnt	Ecological Modelling	2020	10.1016/j.ecolmodel.2020.108937
Su, N.J., Chang, C.H., Hu, Y.T., Chiang, W.C. & Tseng, C.T.	Modeling the spatial distribution of swordfish (*Xiphias gladius*) using fishery and remote sensing data: approach and resolution	Remote Sensing	2020	10.3390/rs12060947
Switzer, T.S., Tyler-Jedlund, A.J., Keenan, S.F. & Weather, E.J.	Benthic habitats, as derived from classification of side-scan-sonar mapping data, are important determinants of reef-fish assemblage structure in the Eastern Gulf of Mexico	Marine and Coastal Fisheries	2020	10.1002/mcf2.10106
Yunis, C.R.C., López, R.S., Cruz, S.M.O., Castillo, E.B., López, J.O.S., Trigoso, D.I. & Briceño, N.B.R.	Land suitability for sustainable aquaculture of rainbow trout (*Oncorhynchus mykiss*) in Molinopampa (Peru) based on RS, GIS, and AHP	ISPRS International Journal of Geo-Information	2020	10.3390/ijgi9010028

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Authors	Title	Journal	Year	DOI
Zu-Ermgassen, P.S.E., Mukherjee, N., Worthington, T.A., Acosta, A., Araujo, A.R.D., Beitl, C.M., et al.	Fishers who rely on mangroves: modelling and mapping the global intensity of mangrove-associated fisheries	Estuarine Coastal and Shelf Science	2020	10.1016/j.ecss.2020.106975
Alos, J., Campos-Candela, A. & Arlinghaus, R.	A modelling approach to evaluate the impact of fish spatial behavioural types on fisheries stock assessment	ICES Journal of Marine Science	2019	10.1093/icesjms/fsy172
Anand, A., Kantharajan, G., Krishnan, P., Hakeem, K.A., Santosh, K.S., Rao, C.S., et al.	Mapping the potential areas for enclosure fish culture in tropical reservoirs: geo-spatial solutions for sustainable aquaculture expansion	Spatial Information Research	2019	10.1007/s41324-019-00294-w
Bakker, Y.W., De Koning, J. & Van Tatenhove, J.	Resilience and social capital: the engagement of fisheries communities in marine spatial planning	Marine Policy	2019	10.1016/j.marpol.2018.09.032
Chan, B., Sor, R., Ngor, P.B., Baehr, C. & Lek, S.	Modelling spatial and temporal dynamics of two small mud carp species in the Tonle Sap flood-pulse ecosystem	Ecological Modelling	2019	10.1016/j.ecolmodel.2018.11.007
Craig, R.K.	Fostering adaptive marine aquaculture through procedural innovation in marine spatial planning	Marine Policy	2019	10.1016/j.marpol.2019.103555
Francisco, H.R., Correia, A.F. & Feiden, A.	Classification of areas suitable for fish farming using geotechnology and multi-criteria analysis	ISPRS International Journal of Geo-Information	2019	10.3390/ijgi8090394
Guan, L.S., Jin, X.S., Wu, Q. & Shan, X.J.	Statistical modelling for exploring diel vertical movements and spatial correlations of marine fish species: a supplementary tool to assess species interactions	ICES Journal of Marine Science	2019	10.1093/icesjms/fsz033
Krumsick, K.J. & Fisher, J.A.D.	Spatial and ontogenetic variation in isotopic niche among recovering fish communities revealed by Bayesian modeling	Plos One	2019	10.1371/journal.pone.0215747
Rubec, P.J., Santi, C., Ghile, Y. & Chen, X.J.	Modeling and mapping to assess spatial distributions and population numbers of fish and invertebrate species in the Lower Peace River and Charlotte Harbor, Florida	Marine and Coastal Fisheries	2019	10.1002/mcf2.10086
Sainz, J.F., Di Lorenzo, E., Bell, T.W., Gaines, S., Lenihan, H. & Miller, R.	Spatial planning of marine aquaculture under climate decadal variability: a case study for mussel farms in Southern California	Frontiers in Marine Science	2019	10.3389/fmars.2019.00253
Tinlin-Mackenzie, A., Delany, J., Scott, C.L. & Fitzsimmons, C.	Spatially modelling the suitability, sensitivity, and vulnerability of data poor fisheries with GIS: a case study of the Northumberland lugworm fishery	Marine Policy	2019	10.1016/j.marpol.2019.103707
Trouillet, B.	Aligning with dominant interests: the role played by geo-technologies in the place given to fisheries in marine spatial planning	Geoforum	2019	10.1016/j.geoforum.2019.10.012
Trouillet, B., Bellanger-Husi, L., El Ghaziri, A., Lamberts, C., Plissonneau, E. & Rollo, N.	More than maps: providing an alternative for fisheries and fishers in marine spatial planning.	Ocean & Coastal Management	2019	10.1016/j.ocecoaman.2019.02.016
Tsai, C.T. & Yi, C.H.	Taiwan comparison of law of the sea approaches between 2012-2016 and 2016-2018: implementation of the ocean affairs council, strict regulation of distant water fisheries agency, and progress on marine spatial planning	Asia-Pacific Journal of Ocean Law and Policy	2019	10.1163/24519391-00401009
Wedding, L.M., Jorgensen, S., Lepczyk, C.A. & Friedlander, A.M.	Remote sensing of three-dimensional coral reef structure enhances predictive modeling of fish assemblages	Remote Sensing in Ecology and Conservation	2019	10.1002/rse2.115
Zhu, H.C., Li, K.Q., Wang, L., Chu, J.L., Gao, N. & Chen, Y.L.	Spectral characteristic analysis and remote sensing classification of coastal aquaculture areas based on GF-1 data	Journal of Coastal Research	2019	10.2112/SI90-007.1
Zuzul, I., Segvic-Bubic, T., Talijancic, I., Dzoic, T., Pleic, I.L., Paklar, G.B., et al.	Spatial connectivity pattern of expanding gilthead seabream populations and its interactions with aquaculture sites: a combined population genetic and physical modelling approach	Scientific Reports	2019	10.1038/s41598-019-51256-z
Chong, S., Park, C., Lee, K.R. & An, K.G	Modeling summer hypoxia spatial distribution and fish habitat volume in artificial estuarine waterway	Water	2018	10.3390/w10111695
Coccoli, C., Galparsoro, I., Murillas, A., Pinarbasi, K. & Fernandes, J.A.	Conflict analysis and reallocation opportunities in the framework of marine spatial planning: a novel, spatially explicit Bayesian belief network approach for artisanal fishing and aquaculture	Marine Policy	2018	10.1016/j.marpol.2018.04.015

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Authors	Title	Journal	Year	DOI
Dragon, A.C., Senina, I., Hintzen, N.T. & Lehodey, P.	Modelling South Pacific jack mackerel spatial population dynamics and fisheries	Fisheries Oceanography	2018	10.1111/fog.12234
Gimpel, A., Stelzenmuller, V., Topsch, S., Galparsoro, I., Gubbins, M., Miller, D., et al.	A GIS-based tool for an integrated assessment of spatial planning trade-offs with aquaculture	Science of the Total Environment	2018	10.1016/j.scitotenv.2018.01.133
Harborne, A.R., Green, A.L., Peterson, N.A., Beger, M., Golbuu, Y., Houk, P., et al.	Modelling and mapping regional-scale patterns of fishing impact and fish stocks to support coral-reef management in Micronesia	Diversity and Distributions	2018	10.1111/ddi.12814
James, M., Mendo, T., Jones, E.L., Orr, K., Mcknight, A. & Thompson, J.	AIS data to inform small scale fisheries management and marine spatial planning	Marine Policy	2018	10.1016/j.marpol.2018.02.012
Janssen, H., Bastardie, F., Eero, M., Hamon, K.G., Hinrichsen, H.H., Marchal, P., et al.	Integration of fisheries into marine spatial planning: *quo vadis*?	Estuarine Coastal and Shelf Science	2018	10.1016/j.ecss.2017.01.003
Lester, S.E., Stevens, J.M., Gentry, R.R., Kappel, C.V., Bell, T.W., Costello, C.J., et al.	Marine spatial planning makes room for offshore aquaculture in crowded coastal waters	Nature Communications	2018	10.1038/s41467-018-03249-1
Muska, M., Tuser, M., Frouzova, J., Mrkvicka, T., Ricard, D., Seda, J., et al.	Real-time distribution of pelagic fish: combining hydroacoustics, GIS and spatial modelling at a fine spatial scale	Scientific Reports	2018	10.1038/s41598-018-23762-z
Nayak, A.K., Kumar, P., Pant, D. & Mohanty, R.K.	Land suitability modelling for enhancing fishery resource development in Central Himalayas (India) using GIS and multi-criteria evaluation approach	Aquacultural Engineering	2018	10.1016/j.aquaeng.2018.10.003
Shaari, N.R. & Mustapha, M.A.	Predicting potential *Rastrelliger kanagurta* fish habitat using MODIS satellite data and GIS modeling: a case study of exclusive economic zone, Malaysia	Sains Malaysiana	2018	10.17576/jsm-2018-4707-03
Vianna, L.F.D. & Bonetti, J.	Spatial analysis for site selection in marine aquaculture: An ecosystem approach applied to Baia Sul, Santa Catarina, Brazil	Aquaculture	2018	10.1016/j.aquaculture.2017.12.039
Bastardie, F., Angelini, S., Bolognini, L., Fuga, F., Manfredi, C., Martinelli, M., et al.	Spatial planning for fisheries in the Northern Adriatic: working toward viable and sustainable fishing	Ecosphere	2017	10.1002/ecs2.1696
Ducharme-Barth, N.D. & Ahrens, R.N.M.	Classification and analysis of VMS data in vertical line fisheries: incorporating uncertainty into spatial distributions	Canadian Journal of Fisheries and Aquatic Sciences	2017	10.1139/cjfas-2016-0181
Hastari, I.F., Kurnia, R. & Kamal, M.M	Suitability analysis of floating cage culture of grouper fish using gis in ringgung waters of lampung	Jurnal Ilmu Dan Teknologi Kelautan Tropis	2017	10.28930/jitkt.v9i1.17926
Jentoft, S.	Small-scale fisheries within maritime spatial planning: knowledge integration and power	Journal of Environmental Policy & Planning	2017	10.1080/1523908X.2017.1304210
Kallasvuo, M., Vanhatalo, J. & Veneranta, L.	Modeling the spatial distribution of larval fish abundance provides essential information for management	Canadian Journal of Fisheries and Aquatic Sciences	2017	10.1139/cjfas-2016-0008
Mandal, R.N., Das, S., Sarker, M.M.H., Kundu, G.K., Faruque, M.H., Paul, B. & Islam, M.M.	Aquaculture habitat suitability assessment in Gazipur District, Bangladesh using geo-spatial technology	International Journal of Ecology & Development	2017	
Montalto, V., Martinez, M., Rinaldi, A., Sara, G. & Mirto, S.	The effect of the quality of diet on the functional response of *Mytilus galloprovincialis* (Lamarck, 1819): implications for integrated multitrophic aquaculture (IMTA) and marine spatial planning	Aquaculture	2017	10.1016/j.aquaculture.2016.10.030
Schmiing, M., Fontes, J. & Afonso, P.	Predictive mapping of reproductive fish habitats to aid marine conservation planning	Canadian Journal of Fisheries and Aquatic Sciences	2017	10.1139/cjfas-2015-0538
Bonetti, R.M., Reinfelds, I.V., Butler, G.L., Walsh, C.T., Broderick, T.J. & Chisholm, L.A.	A multi-scale GIS and hydrodynamic modelling approach to fish passage assessment: Clarence and Shoalhaven rivers, NSW Australia	Geomorphology	2016	10.1016/j.geomorph.2015.06.015
Breen, P., Brown, S., Reid, D. & Rogan, E.	Modelling cetacean distribution and mapping overlap with fisheries in the northeast Atlantic	Ocean & Coastal Management	2016	10.1016/j.ocecoaman.2016.09.004

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Authors	Title	Journal	Year	DOI
Cao, Y., Hinz, L., Metzke, B., Stein, J. & Holtrop, A.	Modeling and mapping fish abundance across wadeable streams of Illinois, USA, based on landscape-level environmental variables	Canadian Journal of Fisheries and Aquatic Sciences	2016	10.1139/cjfas-2015-0343
Hynes, S., Gerritsen, H., Breen, B. & Johnson, M.	Discrete choice modelling of fisheries with nuanced spatial information	Marine Policy	2016	10.1016/j.marpol.2016.07.004
Li, Y., Jiao, Y. & Browder, J.A.	Assessment of seabird bycatch in the US Atlantic pelagic longline fishery, with an extra exploration on modeling spatial variation	ICES Journal of Marine Science	2016	10.1093/icesjms/fsw088
Malcolm, H.A., Jordan, A., Schultz, A.L., Smith, S.D.A., Ingleton, T., Foulsham, E., et al.	Integrating seafloor habitat mapping and fish assemblage patterns improves spatial management planning in a marine park	Journal of Coastal Research	2016	10.2112/SI75-259.1
Rubec, P.J., Lewis, J., Reed, D., Lashley, C. & Versaggi, S.	Linking oceanographic modeling and benthic mapping with habitat suitability models for pink shrimp on the West Florida shelf	Marine and Coastal Fisheries	2016	10.1080/19425120.2015.1082519
Sanchez-Jerez, P., Karakassis, I., Massa, F., Fezzardi, D., Aguilar-Manjarrez, J., Soto, D., et al.	Aquaculture's struggle for space: the need for coastal spatial planning and the potential benefits of Allocated Zones for Aquaculture (AZAs) to avoid conflict and promote sustainability	Aquaculture Environment Interactions	2016	10.3354/aei00161
Valentini, E., Filipponi, F., Xuan, A.N., Passarelli, F.M. & Taramelli, A.	Earth observation for maritime spatial planning: measuring, observing and modeling marine environment to assess potential aquaculture sites	Sustainability	2016	10.3390/su8060519
Zhao, J., Gu, Z.B., Shi, M.M., Lu, H.D., Li, J.P., Shen, M.W., et al.	Spatial behavioral characteristics and statistics-based kinetic energy modeling in special behaviors detection of a shoal of fish in a recirculating aquaculture system	Computers and Electronics in Agriculture	2016	10.1016/j.compag.2016.06.025
Bartelings, H., Hamon, K.G., Berkenhagen, J. & Buisman, F.C.	Bio-economic modelling for marine spatial planning application in North Sea shrimp and flatfish fisheries	Environmental Modelling & Software	2015	10.1016/j.envsoft.2015.09.013
Bastardie, F., Nielsen, J.R., Eigaard, O.R., Fock, H.O., Jonsson, P. & Bartolino, V.	Competition for marine space: modelling the Baltic Sea fisheries and effort displacement under spatial restrictions	ICES Journal of Marine Science	2015	10.1093/icesjms/fsu215
Boyd, C., Woillez, M., Bertrand, S., Castillo, R., Bertrand, A. & Punt, A.E.	Bayesian posterior prediction of the patchy spatial distributions of small pelagic fish in regions of suitable habitat	Canadian Journal of Fisheries and Aquatic Sciences	2015	10.1139/cjfas-2014-0234
Colloca, F., Garofalo, G., Bitetto, I., Facchini, M.T., Grati, F., Martiradonna, A., et al.	The seascape of demersal fish nursery areas in the north Mediterranean Sea, a first step towards the implementation of spatial planning for trawl fisheries	Plos One	2015	10.1371/journal.pone.0119590
Dapueto, G., Massa, F., Costa, S., Cimoli, L., Olivari, E., Chiantore, M., et al.	A spatial multi-criteria evaluation for site selection of offshore marine fish farm in the Ligurian Sea, Italy	Ocean & Coastal Management	2015	10.1016/j.ocecoaman.2015.06.030
Filgueira, R., Guyondet, T., Bacher, C. & Comeau, L.A.	Informing marine spatial planning (MSP) with numerical modelling: a case-study on shellfish aquaculture in Malpeque Bay (Eastern Canada)	Marine Pollution Bulletin	2015	10.1016/j.marpolbul.2015.08.048
Gimpel, A., Stelzenmuller, V., Grote, B., Buck, B.H., Floeter, J., Nunez-Riboni, I., et al.	A GIS modelling framework to evaluate marine spatial planning scenarios: co-location of offshore wind farms and aquaculture in the German EEZ	Marine Policy	2015	10.1016/j.marpol.2015.01.012
Kavadas, S., Maina, I., Damalas, D., Dokos, I., Pantazi, M. & Vassilopoulou, V.	Multi-criteria decision analysis as a tool to extract fishing footprints: application to small scale fisheries and implications for management in the context of the maritime spatial planning directive	Mediterranean Marine Science	2015	10.12681/mms.1087
Metcalfe, K., Vaz, S., Engelhard, G.H., Villanueva, M.C., Smith, R.J. & Mackinson, S.	Evaluating conservation and fisheries management strategies by linking spatial prioritization software and ecosystem and fisheries modelling tools	Journal of Applied Ecology	2015	10.1111/1365-2664.12404
Naranjo-Madrigal, H., Van Putten, I. & Norman-Lopez, A.	Understanding socio-ecological drivers of spatial allocation choice in a multi-species artisanal fishery: a Bayesian network modeling approach	Marine Policy	2015	10.1016/j.marpol.2015.09.003
Vafaie, F., Hadipour, A. & Hadipour, V.	GIS-based fuzzy multi-criteria decision making model for coastal aquaculture site selection	Environmental Engineering and Management Journal	2015	10.30638/eemj.2015.258

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Authors	Title	Journal	Year	DOI
Bastardie, F., Nielsen, J.R. & Miethe, T.	Displace: a dynamic, individual-based model for spatial fishing planning and effort displacement - integrating underlying fish population models	Canadian Journal of Fisheries and Aquatic Sciences	2014	10.1139/cjfas-2013-0126
Campbell, M.S., Stehfest, K.M., Votier, S.C. & Hall-Spencer, J.M.	Mapping fisheries for marine spatial planning: gear-specific vessel monitoring system (VMS), marine conservation and offshore renewable energy	Marine Policy	2014	10.1016/j.marpol.2013.09.015
Chalmers, R., Oosthuizen, A., Gotz, A., Paterson, A. & Sauer, W.H.H.	Assessing the suitability of commercial fisheries data for local-scale marine spatial planning in South Africa	African Journal of Marine Science	2014	10.2989/1814232X.2014.979228
Costa, B., Taylor, J.C., Kracker, L., Battista, T. & Pittman, S.	Mapping reef fish and the seascape: using acoustics and spatial modeling to guide coastal management	Plos One	2014	10.1371/journal.pone.0085555
Filgueira, R., Grant, J. & Strand, O.	Implementation of marine spatial planning in shellfish aquaculture management: modeling studies in a Norwegian fjord	Ecological Applications	2014	10.1890/13-0479.1
Long, J.M., Liang, Y., Shoup, D.E., Dzialowski, A.R. & Bidwell, J.R.	GIS-based rapid-assessment of bighead carp *Hypophthalmichthys nobilis* (Richardson, 1845) suitability in reservoirs	Management of Biological Invasions	2014	10.3391/mbi.2014.5.4.07
Nayak, A.K., Pant, D., Kumar, P., Mahanta, P.C. & Pandey, N.N.	GIS-based aquaculture site suitability study using multi-criteria evaluation approach	Indian Journal of Fisheries	2014	
Petitgas, P., Doray, M., Huret, M., Masse, J. & Woillez, M.	Modelling the variability in fish spatial distributions over time with empirical orthogonal functions: anchovy in the Bay of Biscay	ICES Journal of Marine Science	2014	10.1093/icesjms/fsu111
Yang, L.M., Koo, D.H., Li, D.W., Zhang, T., Jiang, J.M., Luan, F.S., et al.	Next-generation sequencing, fish mapping and synteny-based modeling reveal mechanisms of decreasing dysploidy in Cucumis	Plant Journal	2014	10.1111/tpj.12355
Du, Y.Y., Wu, D., Liang, F.Y. & Li, C.	Integration of case-based reasoning and object-based image classification to classify SPOT images: a case study of aquaculture land use mapping in coastal areas of Guangdong Province, China	Giscience & Remote Sensing	2013	10.1080/15481603.2013.842292
Falconer, L., Hunter, D.C., Scott, P.C., Telfer, T.C. & Ross, L.G.	Using physical environmental parameters and cage engineering design within GIS-based site suitability models for marine aquaculture	Aquaculture Environment Interactions	2013	10.3354/aei00084
Ospina-Alvarez, A., Bernal, M., Catalan, I.A., Roos, D., Bigot, J.L. & Palomera, I.	Modeling fish egg production and spatial distribution from acoustic data: a step forward into the analysis of recruitment	Plos One	2013	10.1371/journal.pone.0073687
Pascual, M., Borja, A., Galparsoro, I., Ruiz, J., Mugerza, E., Quincoces, I., et al.	Total fishing pressure produced by artisanal fisheries, from a marine spatial planning perspective: a case study from the Basque Country (Bay of Biscay)	Fisheries Research	2013	10.1016/j.fishres.2013.06.010
Van Wynsberge, S., Andrefouet, S., Gilbert, A., Stein, A. & Remoissenet, G.	Best management strategies for sustainable giant clam fishery in French Polynesia islands: answers from a spatial modeling approach	Plos One	2013	10.1371/journal.pone.0064641
Clark, M.R. & Dunn, M.R.	Spatial management of deep-sea seamount fisheries: balancing sustainable exploitation and habitat conservation	Environmental Conservation	2012	10.1017/S0376892912000021
Jennings, S., Lee, J. & Hiddink, J.G.	Assessing fishery footprints and the trade-offs between landings value, habitat sensitivity, and fishing impacts to inform marine spatial planning and an ecosystem approach	ICES Journal of Marine Science	2012	10.1093/icesjms/fss050
Juntunen, T., Vanhatalo, J., Peltonen, H. & Mantyniemi, S.	Bayesian spatial multispecies modelling to assess pelagic fish stocks from acoustic- and trawl-survey data	ICES Journal of Marine Science	2012	10.1093/icesjms/fsr183
Nutters, H.M. & Da Silva, P.P.	Fishery stakeholder engagement and marine spatial planning: lessons from the Rhode Island Ocean SAMP and the Massachusetts Ocean Management Plan	Ocean & Coastal Management	2012	10.1016/j.ocecoaman.2012.05.020
Edwards, C.T.T. & Plaganyi, E.E.	Protecting old fish through spatial management: is there a benefit for sustainable exploitation?	Journal of Applied Ecology	2011	10.1111/j.1365-2664.2011.01961.x
El-Shaarawi, A.H., Backus, S., Zhu, R. & Chen, Y.L.	Modelling temporal and spatial changes of PCBs in fish tissue from Lake Huron	Environmental Monitoring and Assessment	2011	10.1007/s10661-010-1408-5
Goethel, D.R., Quinn, T.J. & Cadrin, S.X.	Incorporating spatial structure in stock assessment: movement modeling in marine fish population dynamics	Reviews in Fisheries Science	2011	10.1080/10641262.2011.557451

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Authors	Title	Journal	Year	DOI
Hamilton, S.L., Wilson, J.R., Ben-Horin, T. & Caselle, J.E.	Utilizing spatial demographic and life history variation to optimize sustainable yield of a temperate sex-changing fish	Plos One	2011	10.1371/journal.pone.0024580
Knudby, A., Roelfsema, C., Lyons, M., Phinn, S. & Jupiter, S.	Mapping fish community variables by integrating field and satellite data, object-based image analysis and modeling in a traditional Fijian fisheries management area	Remote Sensing	2011	10.3390/rs3030460
Navas, J.M., Telfer, T.C. & Ross, L.G.	Spatial modeling of environmental vulnerability of marine finfish aquaculture using GIS-based neuro-fuzzy techniques	Marine Pollution Bulletin	2011	10.1016/j.marpolbul.2011.05.019
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