

**Marine Aquaculture in the context of
sustainable coastal development**

What influences decision-making processes
in Israel and Germany?

Dissertation

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Michael Schultz

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Referent: Prof. Dr. Horst Sterr
Korreferent: Prof. Dr. Carsten Schulz
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Prof. Dr. Lutz Kipp (Der Dekan)

VORWORT:

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The SPAMA Project Team – Final Project Meeting, University of Haifa, 14th of October 2010. From left to right:
Shirra Freemann, Peter Krost, Eran Vigoda-Gadot, Horst Sterr, Elisabeth Goldschmidt, Michael Schultz, Dror Angel.

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Abbreviations

AHP	Analytical Hierarchy Process
ASC	Aquaculture Stewardship Council
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMVEL	Federal Ministry of Consumer Protection, Food and Agriculture
CFP	Common Fisheries Policy
DBT	Deutscher Bundestag
DPSIR	Driver-Pressure-State-Impact-Response Framework
EC	European Commission
EIA	Environmental Impact Assessment
EMP	Environmental Monitoring Programme
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FEAP	Federation of European Aquaculture Producers
FGU	Fish Growers Union
GIF	German Israeli Foundation
GIS	Geographical Information Systems
ICZM	Integrated Coastal Zone Management
MoAG	Ministry of Agriculture and Rural Development
MSP	Maritime Spatial Planning
NGO	Non-Governmental Organisation
NIMBY	Not In My Backyard
NPM	New Public Management
OECD-DAC	Development Assistance Committee of the Organisation for Economic Co-operation and Development
PBC	Perceived Behavioural Control
SPAMA	Socio-Political Aspects of Marine Aquaculture
SPSS	Statistics Package for Social Science
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
WFD	Water Framework Directive
WTP	Willingness to pay

Summary

The import and consumption of fish and aquaculture products in Israel and Germany has been steadily increasing over the past years. However, there is little interest in increasing the domestic production of those products. According to several international studies and based on the experience gained from this study, it can be stated that public attitudes and stakeholder interactions play an important role in determining the social acceptability of aquaculture. Environmental and social aspects raised several concerns about the aquaculture industry in the past. Furthermore, environmental impacts and their negative feedbacks on this sector often influence governance and political will regarding aquaculture, especially mariculture. Hence, one of the key factors for the future expansion of mariculture in many coastal regions seems to be the awareness and acceptance of the importance and benefits of this sector.

In order to improve the understanding of the socio-political aspects of marine aquaculture in Israel and Germany, in 2008 the German-Israeli SPAMA (**S**ocio-**P**olitical **A**spects of **M**arine **A**quaculture) project was launched, funded by the German Israeli Foundation (GIF). The comparative research within the framework of this project aimed at improving the understanding of local factors influencing attitude formation and inter-relationships as well as gaining significant results for policy, business, environmental NGOs and other stakeholders. The main questions of the project can be summarised as follows:

- What are the perceptions of the Israeli and German public towards marine aquaculture?
- What are the factors that have shaped the public perceptions and are affecting these now?
- Which lessons can be learned from each other by a cross-country comparison of public perceptions?

In addition to the quantitative studies carried out in the context of the SPAMA project in Israel and Germany, a further postal survey within the German research area was conducted in order to hone the results. Furthermore, selected stakeholders and decision-makers were interviewed in order to identify their attitudes towards and perception of marine aquaculture, their criteria for further development and their estimation of the future development of this sector in Israel and Germany. Based on the main questions of the SPAMA project further research questions for this thesis are:

- What is the attitude of the major stakeholder groups and policy makers towards marine aquaculture?
- Which key factors determine policy-making towards marine aquaculture most?

- How do awareness and perception of mariculture benefits influence stakeholders' decisions to enhance the future development of this sector and the future expansion of mariculture sites?
- How do stakeholders' attitudes influence the political will and governance related to mariculture?

With regard to the research questions of the project and this thesis, different hypotheses were tested within the quantitative study by means of a survey (closed questions) administered to 422 people in Israel and to 727 in Germany. The results reveal that local factors strongly influence attitude formations of the wider public. In this context the divergent environment-aquaculture results were especially interesting since in both countries, the primary concern regarding aquaculture expansion were possible environmental impacts. Closer inspection of the survey results revealed that this relationship might have been influenced by the orientation of environmental concerns in each population. The German public focus on depletion of wild stocks and the Israelis on cage effluent and marine pollution. Furthermore, the found tourism-mariculture relationship indicates potential synergies between two sectors relying on the coastal zone that should be taken into account by planning authorities. The study identified not only the public attitudes towards mariculture, but also the relationships between public attitudes, behaviors and preferences related to marine aquaculture. The results provide an important baseline for assessing the levels of knowledge, perceptions and attitudes needed to inform policies and planning for future mariculture activities. In this regard, another significant result is the relatively low level of knowledge/understanding about the aquaculture sector among the general public. Therefore, a dual challenge exists both for policy-makers and planners: Against the background of broad support for expanding sustainable aquaculture, there is also a need for improved communication of scientific information on aquaculture-environment interactions as well as on the quality and safety of mariculture products.

The qualitative research was carried out by means of qualitative interviews in Israel and Germany during May to December 2010. The study involved the following types of stakeholder: scientists; economists; environmental NGOs; fish, algae and mussel farmers; politicians and potential competing users within the research areas. In Germany a total of 15 and in Israel a total of 13 representatives of identified institutions and organisations were interviewed, who have or might have a voice in a potential mariculture planning process. The results of the survey indicate that almost all stakeholders view aquaculture as an important sector with a high potential for solving future world food problems on a global level, especially in the context of overfishing and the growing demand for seafood. Differences in

the attitudes towards aquaculture thus become more obvious when it comes to aquaculture on a national level. Here, especially in Germany a kind of NIMBY effect could be observed.

Within the qualitative study not only the awareness and perception of mariculture's benefits but also their influence on the political will and mariculture governance were identified. In this context, the concept of sustainability was used to identify environmental, economic and socio-political sustainability barriers in Israel and Germany.

A main barrier for the development and expansion of aquaculture in Israel and Germany is the availability of appropriate sites. This often depends on the outcome of the competition between different sectors claiming space along the coastal zones. Hence, as long as stakeholders, especially in Germany, are not fully aware of the economic potential and benefits of the mariculture sector on regional level political will and support will be negative and, consequently, the availability of suitable places will be low. In general, the potential for further development of the mariculture sector is given in both research areas, but not only technical improvements but also awareness raising based on collaborations and information exchanges between the different stakeholder groups are essential for the future development of this sector in Israel and especially in Germany.

Furthermore, in both countries the estimation of the potential was often linked to the negative evaluation of the national fishery sector and the increasing demand for seafood. Fish markets are international; however, consumer receptiveness to aquaculture products is largely influenced by local factors. Hence, domestic productions have potential advantages in adapting to local market conditions. In order to strengthen a sustainable fish and seafood supply, both the fishery and the mariculture sector should not be seen as competing uses. In this context, the reform of the Common Fisheries Policy on European level provides a good opportunity to improve the regulatory framework regarding mariculture within the German research area.

Additionally, the use of planning tools such as Maritime Spatial Planning (MSP) or Integrated Coastal Zone Management (ICZM) combined with adjustments in legislation as well as political priorities and political support is indispensable for the future development of the mariculture sector. In this regard, the main DPSIR factors driver, pressure, state, impact and response were identified within this thesis. The results show that good governance as well as tools such as MSP or ICZM are crucial for a sustainable future mariculture development in order to meet the interests of the stakeholders and the public. According to the results of the quantitative and qualitative studies, sustainable development of mariculture requires

improved governance and changes in the perspective of the main stakeholders to focus increasingly on long-term outcomes. These include:

- improved collection and sharing of information as well as a better understanding of the economic, social and environmental benefits and costs of well-planned and managed mariculture;
- better communication and understanding of the physical, ecological and social carrying capacity of the region regarding mariculture production;
- integration of mariculture management into coastal area management;
- consideration of the mariculture sector as an equal competitor in terms of space. This implies solving potential conflicts with other users & using synergies with other activities;
- strong and more transparent political framework (role of national and regional authorities, better implementation of EU legislation);
- reduction of the administrative burden
- precise catalogue of requirements as well as standards for applications;
- closer participation of all stakeholders in the mariculture management process;
- strong monitoring systems of control and enforcement;
- financial and information support, e.g., for new investors.

Furthermore, virtual tool such as Geographical Information Systems (GIS) and ecosystem modelling should be used to identify and illustrate environmental, spatial and temporal effects of mariculture. Combined with the Environmental Impact Assessment (EIA) and an Environmental Monitoring Programme (EMP) such indicators can avoid problems and spatial conflicts in this regard and hence improve the site selection for mariculture farms.

In general, the potential for the growth of mariculture in both countries is higher than was expected at the beginning of this thesis, but the future of mariculture in Israel and Germany is still undetermined.

Abstract

Die Aquakultur ist derzeit der am schnellsten wachsende Lebensmittelsektor weltweit. Das explosive Wachstum stellt die Wissenschaft und die Politik immer wieder vor neue Herausforderungen. Gerade in den dichtbesiedelten Küstenbereichen ist v.a. die marine Aquakultur mit einer Vielzahl von Nutzungskonkurrenzen konfrontiert. Zudem begegnet sie oft einer negativen Wahrnehmung und einer mangelnden Akzeptanz, die eine weitere Entwicklung verhindern, bevor das eigentliche Potential ausgeschöpft werden kann.

Die Untersuchung dieser soziopolitischen Aspekte der marinen Aquakultur war ein entscheidender Forschungsschwerpunkt des deutsch-israelischen Projektes SPAMA „socio-political aspects of marine aquaculture“, welches durch die German Israeli Foundation (GIF) gefördert wurde. Diese Untersuchungen bildeten die Basis für weitere Studien, die im Rahmen dieser Dissertation durchgeführt wurden.

Die Ergebnisse zeigen, dass die Wahrnehmung bzw. die Einstellung eine wichtige Rolle für das zukünftige Potential des Marikultursektors spielen. Die Einstellung zur Marikultur ist wiederum stark anhängig von lokalen Rahmenbedingungen und der sektorenübergreifenden Wahrnehmung (Umwelt, Ernährung, Job, Tourismus, ...). In Deutschland konnte hier eine überwiegend unvorbelastete und positive Einstellung zur marinen Aquakultur identifiziert werden. Prinzipiell ergab die Prüfung verschiedener Hypothesen, dass die Marikultur in Deutschland und Israel als „neuer“ Wirtschaftszweig akzeptiert wird, und seine Produkte überwiegend als hochwertig und gesund betrachtet werden. Überdies zeigte die Studie aber auch einen mangelnden Wissensstand in der breiten Öffentlichkeit bezüglich Aquakultur/Marikultur.

Eine der Hauptbarrieren für die Weiterentwicklung und den Ausbau der marinen Aquakultur in Israel und Deutschland scheint die Verfügbarkeit von geeigneten Nutzungsflächen zu sein. Leider werden zum Teil potenzielle Eignungsgebiete aufgrund von Nutzungskonkurrenzen mit anderen Küstennutzungen als solche gar nicht wahrgenommen bzw. oft kategorisch ausgeschlossen. Gerade in dicht besiedelten Küstenregionen ist es diesbezüglich wichtig, Synergieeffekte zu suchen und zu nutzen. Eine wichtige Voraussetzung dafür ist die Wahrnehmung des ökonomischen Potenzials der marinen Aquakultur, denn ohne sie wird sowohl der politische Wille zum Ausbau, als auch die daraus resultierende Unterstützung und Stärkung des Marikultursektors eher verhalten bleiben.

Von entscheidender Bedeutung für eine nachhaltige Entwicklung des Marikultursektors ist, neben der Anpassung der politischen Rahmenbedingungen und Prioritäten, in diesem Zusammenhang auch der Einsatz von Planungsinstrumenten und Strategien wie der Marinen Raumplanung und des Integrierten Küstenzonenmanagements. Zudem ist es essentiell, die politischen Rahmenbedingungen zu verbessern und transparenter zu gestalten. Die Reduzierung administrativer Barrieren sowie die Erstellung eines präzisen

Anforderungskataloges und eines standardisierten Antragsverfahrens sind diesbezüglich genauso wichtig wie das frühzeitige und enge Einbinden entscheidender Interessenvertreter in den Planungsprozess und die Etablierung eines adäquaten Monitoring-Systems.

Weiterhin sollten virtuelle Werkzeuge, wie z.B. Geographische Informationssysteme und die Ökosystem-Modellierung verwendet werden, um umweltspezifische, räumliche und zeitliche Effekte von Marikulturanlagen zu identifizieren und graphisch darzustellen. In Verbindung mit der Umweltverträglichkeitsprüfung und dem Umwelt-Monitoring können so Indikatoren herausgearbeitet werden, die dazu beitragen, zukünftige Raumnutzungskonflikte zu reduzieren und somit die Identifizierung von Eignungsflächen zu erleichtern.

Die Ergebnisse der gesamten Studie zeigen deutlich, dass das Potenzial für den Ausbau der Marikultur in beiden Ländern höher ist, als vor Beginn der Studie vermutet wurde. Zudem ermöglichen die Untersuchungsergebnisse ein besseres Verständnis von den Zusammenhängen zwischen lokalen Faktoren, der Bildung von Wahrnehmungsmustern sowie den Wechselbeziehungen zwischen Öffentlichkeit, Wirtschaft, Umwelt und Politik, und liefern damit eine wichtige Grundlage für zukünftige Planungen im Marikulturbereich sowohl auf politischer, ökonomischer und ökologischer Ebene.

Kurzfassung

In den letzten Jahrzehnten hat sich die Aquakultur zu dem am schnellsten wachsenden Lebensmittelsektor weltweit entwickelt und auch in Israel und Deutschland ist der Import und Verbrauch von Fisch und anderen Aquakulturprodukten im Verlauf der letzten Jahre stark angestiegen.

In Zeiten von Überfischung und wachsender Nachfrage nach ‚Sea Food‘ stellt das explosive Wachstum des Aquakultursektors die Wissenschaft, die Wirtschaft und die Politik immer wieder vor neue Herausforderungen. Die starke Nutzung der Meere sowie die dicht besiedelten Küstenbereiche bilden vor allem für die Entwicklung der marinen Aquakultur (Marikultur) eine schwierige Ausgangslage. Neben einer Vielzahl von Umweltauflagen und Nutzungskonflikten steht dieser Sektor oftmals auch einer negativen Wahrnehmung und mangelnder Akzeptanz gegenüber, die eine weitere Entwicklung verhindern, bevor das eigentliche Potential ausgeschöpft werden kann. Verschiedene internationale Studien belegen, dass die öffentliche Einstellung sowie die Interaktion zwischen der Öffentlichkeit, den verschiedenen Interessenvertretern und Entscheidungsträgern eine entscheidende Rolle im Hinblick auf die soziale und politische Akzeptanz des Aquakultursektors einnehmen.

Diverse wirtschaftliche und umweltpolitische Aspekte haben in der Vergangenheit zu kontroversen Diskussionen über die Aquakulturindustrie geführt. Insbesondere negative Erfahrungen, wie z.B. der Einsatz von Antibiotika in einigen Produktionsregionen, beeinträchtigen nicht selten langfristig die Politikgestaltung und den politischen Willen gegenüber diesem Wirtschaftszweig. Darüber hinaus prägen vor allem negative Presse- und Medienkampagnen nachhaltig die Wahrnehmung und Akzeptanz der Öffentlichkeit sowie verschiedener Entscheidungsträger.

Auch wenn die Aquakultur in den Ingenieur- und Biowissenschaften bereits ein sehr gut untersuchtes Feld ist, so blieben ihre sozialpolitischen Aspekte bis heute größtenteils unerforscht. Während sich ein Großteil der Studien auf die technischen Aspekte der Aquakultur, die Optimierung von Zucht- und Fütterungsbedingungen, die Vermarktung und den Handel konzentrieren, so blieb der Bereich der öffentlichen und politischen Wahrnehmung diesem Sektor gegenüber bis dato weitestgehend unberührt.

Die Untersuchung dieser soziopolitischen Aspekte der marinen Aquakultur war ein entscheidender Forschungsschwerpunkt des deutsch-israelischen Projektes SPAMA „socio-political aspects of marine aquaculture“, welches durch die German Israeli Foundation (GIF) gefördert wurde. Zusätzlich zu den quantitativen Untersuchungen, die im Zusammenhang des SPAMA-Projektes in Israel und Deutschland durchgeführt wurden, ist im Rahmen dieser Dissertation eine weitere postalische Befragung innerhalb des deutschen

Forschungsgebiets, der Region Kieler Förde, durchgeführt worden, um die Aussagekraft der Ergebnisse weiter zu schärfen. Ziel der Untersuchungen war es, die Informationen für Entscheidungsträger, Planer und Investoren bezüglich der öffentlichen Wahrnehmung der Marikultur und ihrer Produkte zu verbessern. Darüber hinaus wurden Einblicke in die Einstellungen und Handlungsweisen geschaffen, die für die breite soziale Akzeptanz des Aquakultursektors in Deutschland und Israel wichtig sind. Hierzu wurden spezifische Faktoren identifiziert, welche die Einstellungen und Handlungsweisen der Öffentlichkeit beeinflussen, und untersucht, wie diese im Hinblick auf Aquakultur-Aktivitäten aufeinander wirken. Der Fokus der quantitativen Befragung richtete sich dabei auf die Wahrnehmung bzw. das Verhalten der Bevölkerung in Bezug auf den Aquakultursektor sowie den Bereichen Umwelt, Tourismus, Gesundheit/Lifestyle, Wirtschaft/Beschäftigung, persönliches politisches/privates Engagement. Im Anschluss wurde der Zusammenhang zwischen der persönlichen Einstellung zu den genannten Schwerpunktthemen und der Einstellung zur Aquakultur/Marikultur untersucht. Im Hinblick auf die Ziele dieser Teilstudie wurden folgende Hypothesen untersucht:

- **H1:** Positive Beziehung zwischen Job-Sicherheit und Unterstützung von Marikultur.
- **H2:** Negative Beziehung zwischen Umweltbedenken und der Einstellung zur Marikultur.
- **H3:** Positive Beziehung zwischen Gesundheit und der Einstellung zur Marikultur.
- **H4:** Positive Beziehung zwischen Unterstützung des Tourismus und der Einstellung zur Marikultur

Die Beziehung zwischen Job-Sicherheit und Marikultur wurde gewählt, da dieser Sektor (inkl. Verarbeitung, Transport und Vermarktung) potentiell neue Arbeitsplätze generiert, insbesondere im Vergleich zu dem schrumpfenden Fischereisektor (v.a. auf regionaler Ebene). Zudem zeigen verschiedene Studien, dass Personen, die Sorge um ihren Beruf haben, dazu tendieren, Sektoren, die neue Jobs schaffen können, zu unterstützen.

Der Zusammenhang zwischen der Einstellung zur Umwelt und der Marikultur ist von entscheidender Bedeutung, da gerade Marikulturen oft in Verbindung mit Umweltverschmutzung (z.B. durch Nährstoffeinträge) gebracht werden. In Israel war dies der Anstoß für ein gerichtliches bzw. politisches Verfahren gegen Marikulturanlagen im Roten Meer, die in der Konsequenz, wenn auch noch aus anderen Gründen, entfernt werden mussten. Umfangreiche Medien- und Pressekampagnen in diesem Zusammenhang waren zumeist negativ, ähnlich wie in Deutschland in Bezug auf die Marikulturen in Norwegen. Deshalb wurde in der vorliegenden Arbeit auch untersucht, wie nachhaltige negative Medien- und Pressekampagnen die Einstellung der breiten Öffentlichkeit diesem Sektor gegenüber beeinflussen.

Bezüglich Hypothese H3 ist ein starker Zusammenhang zwischen Gesundheit und Ernährung gegeben. Im Hinblick auf die Verbesserung der Qualität und der Dauer des Lebens ist die Ernährung von entscheidender Bedeutung. Deshalb wurde untersucht, inwieweit Fisch als Bestandteil einer gesunden Ernährung angesehen wird und ob gezüchteter Fisch qualitativ gleichwertig zu gefangenem Fisch angesehen wird.

Die Untersuchungen bezüglich der Korrelation zwischen Tourismus und Marikultur waren essentiell, da in der Vergangenheit viele Konflikte zwischen diesen beiden Wirtschaftszweigen bestanden und der Tourismus in den Untersuchungsräumen von großer Bedeutung ist.

Auf der Grundlage der im Rahmen der quantitativen Untersuchungen erhobenen Daten wurden mittels statistischer Verfahren die vier Hypothesen untersucht. In diesem Zusammenhang wurden 422 Personen in Israel und insgesamt 727 Personen in Deutschland befragt. Die Ergebnisse zeigen, dass lokale Faktoren stark die Meinungsbildung und Einstellung beeinflussen.

In Bezug auf Hypothese H1 zeigt sich nur eine geringe Unterstützung in Israel. Dennoch deuten die Ergebnisse gleichzeitig darauf hin, dass die befragten Personen in Israel, die prinzipiell Sorge um Jobsicherheit haben, den Marikultursektor eher unterstützen. In Deutschland konnte diesbezüglich keine Tendenz festgestellt werden. Die Gründe hierfür liegen sehr wahrscheinlich in der geringen Vertrautheit mit diesem Sektor und der geringen Wahrnehmung des ökonomischen Potentials, welches in Bezug auf die Schaffung neuer Arbeitsplätze (noch) nicht/kaum gesehen wird. Diese Ergebnisse decken sich auch mit den Ergebnissen einer Studie von Whitmarsh and Wattage (2006), die diesbezüglich eine signifikante Unterstützung in den Regionen zeigt, wo der Marikultursektor stärker ausgebaut ist.

Ein besonders interessanter Aspekt der Untersuchungen zeigte sich darin, dass die Hypothese einer negativen Beziehung zwischen der Einstellung zur Küstenumwelt und der Einstellung zur Marikultur (H2) lediglich in Israel, nicht aber in Deutschland unterstützt wurde. Obwohl prinzipiell Umweltbedenken bezüglich Marikulturanlagen in beiden Ländern gegeben sind, konnte nur in Israel eine negative Korrelation zwischen der Einstellung zur (Meeres)Umwelt und der Einstellung zur Marikultur identifiziert werden, welche zum Teil durch die Medienkampagnen rund um die Anlagen in Eilat noch verstärkt wurde. Eine nähere Betrachtung der Ergebnisse im deutschen Untersuchungsraum, der Kieler Förde, führten zu dem Ergebnis, dass hier die Aquakultur als Alternative zur traditionellen Fischerei gesehen wird, mit der man die aktuell in den Medien sehr präsenten Problematiken, wie z.B. die Überfischung und die Zerstörung des Meeresbodens durch Schleppnetzte, zukünftig vermeiden kann. Prinzipiell führen die verschiedenen Interessenschwerpunkte in Israel und

Deutschland zu einer unterschiedlichen Wahrnehmung des Risikos und somit zu einer divergenten Einstellung dem Sektor gegenüber. Einer negativen Korrelation zwischen Umweltbelastung und Einstellung zur Marikultur in Israel steht hierbei eine positive Korrelation zwischen der Vermeidung von Überfischung und der Einstellung zur Marikultur in Deutschland gegenüber. Nichtsdestotrotz ist eine generelle Unterstützung der marinen Aquakultur bei der Mehrheit der israelischen (>60%) und deutschen (>70%) Befragten gegeben.

In Bezug auf die Ergebnisse zur Hypothese H3 konnte lediglich in Deutschland eine positive Korrelation zwischen der Einstellung zur Gesundheit und der Einstellung zur Marikultur gefunden werden. In Israel war diese Beziehung statistisch nicht signifikant, tendenziell aber eher positiv. Die unterschiedlichen Ergebnisse werden vor allem durch den unterschiedlichen Wissensstand und die unterschiedliche Wahrnehmung der Anlagen und Produkte bedingt. In Deutschland wurden diesbezüglich überwiegend die Kontrollmöglichkeiten und damit die potentielle Qualität und Sicherheit der Produkte betont. Gleichzeitig halten jedoch auch 31,4 % der Befragten in Deutschland die Produkte (v.a. Fisch) aus Marikultur für nicht so gesund wie freilebende Organismen. In diesem Zusammenhang bleibt jedoch zu Bedenken, dass, obwohl ein großer Anteil des konsumierten Fisches in beiden Ländern aus Fischfarmen kommt, es ungewiss ist, ob die Konsumenten sich dessen bewusst sind. Im Allgemeinen werden Zuchtfisch bzw. Meeresfrüchte jedoch als wichtige Bestandteile der Ernährung angesehen. Zudem ist die Zahlungsbereitschaft für ökologisch produzierten Fisch in beiden Ländern sehr hoch. Nachhaltig betriebene Marikulturanlagen können hier besonders in Deutschland die wachsende Nachfrage nach qualitativ hochwertigen, regionalen Produkten bedienen. Obwohl keines der beiden Länder ein großer Aquakulturproduzent ist, besteht somit ein gewisses Potential, welches sich u.a. auch im Interesse von Betreibern/Investoren widerspiegelt. Zudem wächst die Nachfrage nach Fisch in beiden Ländern stetig.

Bezüglich Hypothese H4 konnte sowohl in Deutschland als auch in Israel eine positive Korrelation zwischen Küstentourismus und Marikultur ermittelt werden. Von Seiten der Öffentlichkeit wird demnach kaum Konfliktpotential zwischen beiden Sektoren gesehen. In Deutschland sehen lediglich 10% der Befragten eine Beeinträchtigung der Schönheit der Küsten und Meere durch Marikulturanlagen. Damit sind die Bedenken der Bevölkerung bezüglich des Tourismussektors eher gering und damit zweitrangig. Dieses Ergebnis steht im Widerspruch zu Erfahrungen in anderen europäischen Staaten und Nordamerika, wo Tourismus und Marikultur in direktem Konflikt standen. Als Resultat dieser Konflikte mussten Fischfarmen oftmals zurückgebaut oder in den Offshore-Bereich verlagert werden (FAO). Die deutsch-israelischen Ergebnisse der Umfrage zeigen potentiell eher Synergien, wie im Asiatisch-Pazifischen Raum, wo Marikulturprojekte in den Tourismus eingebunden werden (z.B. Attraktion, Ernährung etc.).

Anhand der quantitativen Teilstudie wurde nicht nur die öffentliche Einstellung zur Marikultur sondern auch der Zusammenhang zwischen Wahrnehmung, Einstellung und Handlungsweisen verschiedener, für die Marikultur relevante Sektoren identifiziert.

Die Ergebnisse zeigen, dass die Wahrnehmung eine wichtige Rolle für das zukünftige Potential des Marikultursektors spielt. Die Einstellung zur Marikultur ist wiederum stark abhängig von lokalen Rahmenbedingungen und sektorenübergreifenden Wahrnehmung (Umwelt, Ernährung, Job, Tourismus, ...). Vor allem in Deutschland konnte hier eine überwiegend unvorbelastete und positive Einstellung zur marinen Aquakultur identifiziert werden. Prinzipiell ergab die Prüfung der Hypothesen allgemeine Ähnlichkeit zwischen den Ergebnissen in beiden Ländern, abgesehen von der Korrelation zwischen Umwelteinstellungen und Marikultur (H2). Damit zeigt sich, dass die Marikultur in beiden Ländern/Untersuchungsräumen als „neuer“ Wirtschaftszweig akzeptiert wird, und seine Produkte überwiegend als hochwertig und gesund betrachtet werden. Überdies zeigte die Studie aber auch einen mangelnden Wissensstand in der breiten Öffentlichkeit bezüglich Aquakultur/Marikultur.

Fischmärkte sind international aber nationale/regionale und lokale Gegebenheiten und Interessenschwerpunkte beeinflussen die Einstellung diesem Sektor gegenüber jedoch stark. Die vorliegende Studie liefert eine wichtige Grundlage für die Einschätzung des Wissensstandes, die Wahrnehmung und die Einstellung der Öffentlichkeit. Die ermittelten Ergebnisse sind damit sowohl für die Politik, als auch für die Wirtschaft, NGOs und andere Entscheidungsträger von Relevanz. Es werden potentielle Synergien zwischen verschiedenen Sektoren (z.B. Tourismus und Marikultur) aufgezeigt, jedoch auch Problematiken, wie der mangelnde Wissensstand der breiten Öffentlichkeit bezüglich Aquakultur und Marikultur. Hieraus ergibt sich für die Planung zukünftiger Anlagen eine Doppelherausforderung:

Vor dem Hintergrund der Bedeutung einer breiten öffentlichen Unterstützung für den Ausbau einer nachhaltigen (regionalen) Marikultur im Küstenbereich, zeigt sich der Bedarf nach einer verbesserten Kommunikation der wissenschaftlichen Informationen und Erkenntnisse über Aquakultur sowie über die Qualität und Sicherheit von Aquakultur-Produkten. Zudem zeigen die Ergebnisse eine deutliche Diskrepanz zwischen der Wahrnehmung der Öffentlichkeit in Bezug auf die unterschiedlichen Küstennutzungen und der Meinung der diesbezüglichen Interessenvertreter (z.B. Tourismus).

Zusätzlich zu den quantitativen Untersuchungen wurden im Rahmen dieser Dissertation ausgewählte Interessenvertreter und Entscheidungsträger in Deutschland und Israel

interviewt, um deren Einstellung und Wahrnehmung gegenüber der Marikultur, ihre Kriterien für einen weiteren Ausbau und ihrer Bewertung der zukünftigen Entwicklung dieses Sektors in Israel und Deutschland zu identifizieren. Befragt wurden Stakeholder der folgenden Gruppen: Wissenschaftler, Wirtschafts- und Interessenverbände, Umweltverbände, Fisch - Algen - und Miesmuschel-Züchter, Politiker und potenziell konkurrierende Nutzer innerhalb der Forschungsgebiete. Aufbauend auf den Zielen des SPAMA-Projektes standen hierbei u.a. folgende Forschungsfragen im Fokus:

1. Wie ist die Einstellung und Wahrnehmung der verschiedenen Interessenvertretergruppen und Entscheidungsträger bezüglich der marinen Aquakultur?
2. Welche Schlüsselfaktoren beeinflussen die Politikgestaltung in Bezug auf die Marikultur?
3. Inwieweit beeinflussen das Bewusstsein und die Wahrnehmung von Vor- und Nachteilen der marinen Aquakultur die Entscheidungen im Hinblick auf die zukünftige Entwicklung und den Ausbau dieses Sektors?

Im Hinblick auf eine nachhaltige Entwicklung des Marikultursektors konnten so umweltpolitische, soziopolitische und wirtschaftliche Barrieren in Deutschland und Israel identifiziert und kategorisiert werden.

Die Ergebnisse der Studie zeigen, dass fast alle Stakeholder die Marikultur als einen wichtigen Sektor mit einem hohen Entwicklungspotenzial sehen, zumindest als verlässliche Nahrungsquelle für die wachsende Weltbevölkerung, insbesondere im Zusammenhang mit der weltweiten Überfischung und der steigenden Nachfrage nach Fisch und Meeresfrüchten. Unterschiede in den Einstellungen zur Marikultur werden erst offensichtlich, wenn es um die Entwicklung der Marikultur auf nationaler Ebene geht. Besonders in Deutschland kann diesbezüglich eine Art NIMBY-Effekt (= not in my back yard) beobachtet werden.

Eine der Hauptbarrieren für die Weiterentwicklung und den Ausbau der marinen Aquakultur in Israel und Deutschland scheint diesbezüglich die Verfügbarkeit von geeigneten Nutzungsflächen zu sein. Leider werden potenzielle Eignungsgebiete aufgrund von Nutzungskonkurrenzen mit anderen Küstennutzungen als solche teilweise gar nicht wahrgenommen bzw. oft kategorisch ausgeschlossen. Gerade in dicht besiedelten Küstenregionen ist es diesbezüglich wichtig, Synergieeffekte zu suchen und zu nutzen. Eine wichtige Voraussetzung dafür ist die Wahrnehmung des ökonomischen Potenzials der marinen Aquakultur, denn ohne sie wird sowohl der politische Wille zum Ausbau, als auch

die daraus resultierende Unterstützung und Stärkung des Marikultursektors eher verhalten bleiben.

Im Allgemeinen ist das zukünftige Entwicklungspotenzial des Marikultursektors in den Untersuchungsgebieten also nicht nur von zucht- und umwelttechnischen Verbesserungen sondern auch von der Zusammenarbeit und dem Informationsaustausch zwischen den verschiedenen Interessenvertretern und Entscheidungsträgern abhängig.

Wie die Ergebnisse der qualitativen Untersuchungen zeigen, sind sich viele Stakeholder der sozialen, wirtschaftlichen und umweltpolitischen Möglichkeiten der Aquakultur nicht bewusst. In Israel, wo eine Stärkung des Aquakultursektors eher angestrebt wird als in Deutschland, ist dies voranging auf das Streben nach einer Unabhängigkeit von Nahrungsmittelimporten zurückzuführen. Nichtsdestotrotz hängt die Einschätzung des Potenzials aber auch von der aktuellen Situation in der Fischerei ab. Angesichts der negativen Entwicklungen im Fischereisektor und der stetig steigenden Nachfrage nach Fisch und Meeresfrüchten wird diesbezüglich in den nächsten Jahren ein Umdenken zu erwarten sein. Um eine nachhaltige sea food Versorgung sichern zu können, dürfen v.a. der Marikultur- und der Fischereisektor nicht als konkurrierende Nutzungen betrachtet werden. Aktuell bietet diesbezüglich die Reform der Gemeinsamen Fischereipolitik die Möglichkeit, die politischen Rahmenbedingungen für den Ausbau der Marikultur und die Verknüpfung mit der Fischerei zu stärken.

Von entscheidender Bedeutung für eine nachhaltige Entwicklung des Marikultursektors ist, neben der Anpassung der politischen Rahmenbedingungen und Prioritäten, in diesem Zusammenhang auch der Einsatz von Planungsinstrumenten und Strategien wie der Marinen Raumplanung und des Integrierten Küstenzonenmanagements. Deshalb wurden im Rahmen dieser Dissertation auch die wichtigsten DPSIR-Faktoren (driver, pressure, state, impact and response) identifiziert. Die Ergebnisse zeigen, dass die genannten Instrumentarien erforderlich sind, um die Interessen aller relevanten Stakeholder und der breiten Öffentlichkeit zu vertreten. Zudem wird deutlich, dass für eine langfristige und nachhaltige Entwicklung der Marikultur folgende Aspekte von besonderer Relevanz sind:

- Ein verbesserter Informationsaustausch zwischen relevanten Stakeholdergruppen für ein besseres Verständnis des ökonomischen, ökologischen und ökonomischen Potenzials gut geplanter und geführter Marikulturen
- Die Integration des Marikultursektors in das Küstenzonenmanagement

- Die Anerkennung des Marikultursektors als einen gleichwertigen Nutzungskonkurrenten. Dies impliziert auch ein verbessertes Konfliktmanagement und die Nutzung potentieller Synergien mit anderen Küstennutzungen.
- Die Schaffung verbesserter und transparenterer politischer Rahmenbedingungen
- Die Reduzierung administrativer Barrieren
- Die Erstellung eines präzisen Anforderungskataloges und eines standardisierten Antragsprozedere
- Eine frühzeitige und enge Einbindung entscheidender Interessenvertreter in den Planungsprozess
- Die Etablierung eines adäquaten Monitoring-Systems
- Eine stärkere Unterstützung potenzieller Investoren

Weiterhin sollten virtuelle Werkzeuge, wie z.B. Geographische Informationssysteme und die Ökosystem-Modellierung verwendet werden, um umweltspezifische, räumliche und zeitliche Effekte zu identifizieren und graphisch darzustellen. In Verbindung mit der Umweltverträglichkeitsprüfung und dem Umwelt-Monitoring können so Indikatoren herausgearbeitet werden, die zukünftige Raumnutzungskonflikte reduzieren und somit die Identifizierung von Eignungsflächen erleichtern können.

Die Ergebnisse der gesamten Studie machen deutlich, dass das Potenzial für den Ausbau der Marikultur in beiden Ländern höher ist, als vor der Untersuchung erwartet. Zudem ermöglichen die Untersuchungsergebnisse ein besseres Verständnis von den Zusammenhängen zwischen lokalen Faktoren, der Bildung von Wahrnehmungsmustern sowie den Wechselbeziehungen zwischen Öffentlichkeit, Wirtschaft, Umwelt und Politik, und liefern damit eine wichtige Grundlage für zukünftige Planungen im Marikulturbereich sowohl auf politischer, ökonomischer und ökologischer Ebene.

1 INTRODUCTION

Even though the practice of aquaculture originated over four thousand years ago in China, Hawaii and the Middle East, its contribution to the global human food supply only became significant during the past 30 or 40 years, when aquaculture production started to increase exponentially. Today, aquaculture is the fastest-growing animal-food-producing sector with an average annual growth rate of 6.6 per cent (FAO 2010). Aquaculture products currently account for more than 40% of all fish and seafood in world markets (on average), while for species such as seabream, salmon and tilapia, the percentage is estimated even much higher.

The massive increase in aquaculture production of finfish is related to the levelling off of marine fisheries landings, as many stocks have become overexploited. Due to an increasing awareness of the positive effects of fish consumption on human health and well-being and to many of the problems associated with conventional livestock production (e.g., mad cow disease, avian flu, etc.), it is projected that the importance of aquaculture as a protein source in the food sector is bound to grow much further. Omega-3 fatty acids, which are prevalent in fish, have been well established worldwide as essential for the healthy development of children. Diets rich in fish are not only important for children but considered healthy for all age groups.

The aquaculture sector is also expected to fulfil an important socio-economic role by contributing to the income and livelihood of substantial portions of the global population, including many of poverty stricken regions.

Marine aquaculture serves as an alternative to many of the common traditional, yet environmentally harmful, fishing practices. Within the last few years this has been demonstrated in a variety of integrated pond configurations for the co-cultivation of marine finfish, seaweeds, bivalves and abalone. The bulk of marine finfish are reared in cages or net pens in coastal waters, and in recent years several groups have explored and demonstrated the feasibility of cultivating bivalves and macro-algae alongside the caged fish.

However, whereas marine aquaculture (mariculture) is a well-developed research field in the life sciences, its socio-political aspects have largely been overlooked. One of the poorly studied aspects of mariculture is the role of citizens' and stakeholders' perception in policy-making and planning processes regarding future development of mariculture at the state level. While most studies focused on the practical aspects of mariculture and its effects on environment, food consumption, trade and commerce, as well as health advantages and disadvantages, the field of policy-making remains understudied.

The thesis combines significant scientific outputs from the SPAMA project with additional results from detailed research on mariculture developments in Israel but mainly in Germany.

1.1 The SPAMA project

The idea of understanding and investigating the field of public awareness, perception and attitudes towards mariculture and their role in the context of policy and decision-making processes arose by reason of an example in Israel where the government, after a long-term conflict between the tourism sector and mariculture farms, decided to close down sea-cage farms on the basis of controversial environmental concerns and to remove them from the Gulf of Eilat in 2008.

In order to focus on socio-political aspects of this case and marine aquaculture in Israel and Germany in general, in 2008 the German-Israeli project SPAMA (**Socio-Political Aspects of Marine Aquaculture**), funded by the German Israeli Foundation (GIF), was launched.

The SPAMA project addresses those aspects of marine aquaculture that have been neglected so far in aquaculture-related research. The overall goal of the project was to explore public attitudes towards marine mariculture. In detail, the project aimed at improving the general understanding of the public perception of aquaculture, but especially mariculture. Furthermore, the project intended to reveal the influence of public perception on policy-making. Last, but not least, it should provide insights into the social, political and ecological factors which guide the decision-making processes in the post-materialistic era in Israel and in Germany. In approaching these issues the following questions needed to be addressed:

1. To what extent is marine aquaculture currently an issue of public debate in Israel and Germany?
2. What are the perceptions of the Israeli and German public towards marine aquaculture?
3. What are the factors that have shaped the public perceptions and are affecting these now?
4. What is the potential for altering these perceptions and improving the negative attitudes that some groups might have towards marine aquaculture?
5. What lessons can be learned from each other by a cross-country comparison of public perceptions?

The study involved 3 scientists and 1 (master) student at the University of Haifa and 2 scientists and 1 student at Kiel University, plus one local external expert (from the company Coastal Research and Management, CRM). The study areas in focus were Kiel Fjord on the German side, and the Gulf of Eilat as well as the Mediterranean coast on the Israeli side. The project was carried out in a three-year continuous process of intensive binational cooperation and communication. In order to ensure that insights into these issues are comparable between the two countries the scientific methods to be chosen and applied were extensively discussed and closely coordinated between the two research teams. During the quantitative

research an extensive public survey was carried out in parallel in each country; results were extracted on both sides by statistical and thematic analysis and methodically compared.

The perceptions of the aquaculture sector in general might even be associated with positive connotations if ecologic preconditions such as water quality standards are observed and the negative effects of overfishing are taken into consideration. This differentiated view of the public is able to influence mariculture-related policy-making. Under certain circumstances, existing reservations about stimulating the mariculture sector or supporting related entrepreneurship could be changed towards more favourable policies. In this respect, the preconditions are quite different between Israel and Germany, because in the latter region (German Baltic coast) a tradition or longer-term experience with the mariculture sectors does not yet exist.

The SPAMA project follows a truly integrative approach, as its results combine ecologically relevant findings with detailed insights into environmental, social and political attitudes of Israeli and German citizens. In addition, it sheds light on policy formation and decision-making at local, regional and national level in these countries. Thus, the project fosters:

1. the advancement of knowledge about policy formation of mariculture ventures;
2. knowledge of cross-cultural differences in this field;
3. promotion of new marine agriculture plans;
4. new thinking about the socio-political determination of mariculture evolvement and

Furthermore, the SPAMA studies may assist modern societies, beyond Israel and Germany, in adjusting basic policy-making attitudes towards issues under conflict.

1.2 Objectives and conceptual framework of the thesis

In addition to the aims of the SPAMA project, this thesis focuses on stakeholders' attitudes towards marine aquaculture, their awareness and perception of this sector as well as the influences on policy-making in this regard in Germany and Israel. In this context, experts on marine aquaculture – both stakeholders and policy makers – were identified on both sides and interviews carried out with them, which were based on the findings of the public surveys. Furthermore, in addition to the quantitative studies carried out within the context of the SPAMA project in Israel and Germany, a second postal survey within the German research area was conducted in order to hone the results. Comparable to the SPAMA project the approach of this thesis is integrative as well. The results also combine ecologically and economically relevant findings with detailed insights into environmental, social and political attitudes of Israeli and German citizens and stakeholders. Hence, this thesis not only expands the results of the SPAMA project but also provides a more holistic view on the mariculture sector in Israel and Germany.

Political science and public administration theory suggest that the process of policy-making is highly influenced by powerful interest groups, tradition and culture in the studied states, as well as the individual and organised activities of citizens and citizenry communities and groups. This thesis aims to shed light on the role of these players in shaping a strategic national-level policy regarding marine aquaculture.

Bringing together theories and ideas from social sciences (i.e. political science, public administration and public policy, management, and sociology) and natural sciences (i.e. marine studies, mariculture, health sciences) has profound interdisciplinary motifs that can work to advance this field in many ways. The addition of a cross-cultural aspect will allow a comparison of tradition and social processes in at least two countries – Israel and Germany – that have some similarities in terms of social tradition and level of modernity, but are also quite different in terms of geographical location, policy-formation procedures, and diversity of public opinion.

Besides the country comparison regarding perception and awareness of mariculture, this thesis further focuses on the political framework regarding this sector in Germany, especially Schleswig-Holstein, as well as its further economic and ecological sustainable development in this region. Thus, the results might be used to advance knowledge on policy-making processes towards mariculture in Israel and in Germany.

In addition to the above-mentioned objectives of the SPAMA project the main questions of this thesis are:

1. How does the public perceive the mariculture operations and management in Germany?
2. How does public perception of the aquaculture sector affect the political process?
3. What is the attitude of the major stakeholder groups and policy makers towards marine aquaculture?
4. Which key factors determine policy making towards marine aquaculture most?
5. Which trade-offs exist between mariculture and other stakeholders in the study areas?
6. How are the importance for food supply and the future (economic) development of mariculture viewed and judged by local stakeholders and decision makers as well as the wider public in Israel and Germany respectively?

7. How do awareness and perception of mariculture benefits influence stakeholders' decisions to enhance the future development of this sector and future expansion of mariculture sites?
8. How do stakeholders' attitudes influence the political will and governance related to mariculture?
9. Which lessons can be learned from each other by a cross-country comparison of public and expert perceptions?
10. Is there a potential to increase marine aquaculture as a regional economic sector without harming the ecological conditions of coastal waters in Israel and Germany?

Furthermore, this thesis offers several potential contributions such as:

- adding a client-based perspective on marine aquaculture, based on citizens' perspectives and their effect on governmental policies;
- integrating a principle-agent theory to the study of marine aquaculture, and thus enriching it with interdisciplinary economic and behavioural perspectives;
- establishing a cross-cultural study of policy-making in a field that has a growing share in national and international trade and commerce;
- exploring an alternative pattern of policy-making at the state-level of modernised states, and possibly exporting this knowledge to other fields of policy-making and citizenry-oriented governance; and finally,
- pointing to some practical implications as to the role of citizens in policy-making, based on the marine aquaculture example and variations across cultures and nations such as Israel and Germany,
- developing new strategies for collaboration among governance, citizens, and the business community in this respect.

1.3 Structure of the thesis

Starting with a short introduction covering the main idea of the SPAMA project this thesis continues with an overview of the aims and objectives. Afterwards the study areas in Israel and Germany as well as the economic and ecological background of both countries will be described in detail in Chapter 1.4.

Section 2 of this thesis will deal with the historical development of the aquaculture sector as well as the future potential in order to highlight the growing importance of this sector. Further, the current political framework in both countries as well as their status quo in mariculture development will be pointed out. The theoretical background of this study will be described in section 3 covering the main concepts and models, which are the scientific base for this thesis. In addition to that, the role of public and stakeholders perceptions in planning

processes will be discussed. After a detailed description of the main methodological approach in section 4 covering both the quantitative and qualitative analysis, in section 5 the core of this study will be presented in two articles.

The main purpose of the first article “Public Attitudes Toward Marine Aquaculture: A Comparative Analysis of Germany and Israel” was to examine attitudes and behaviours related to mariculture and their relationship with attitudes and behaviours related to employment, governance institutions, civic involvement, health and lifestyle, the tourism sector, environmental quality and the economy.

The second article “Marine Aquaculture in Israel and Germany: A comparative analysis of stakeholders’ perception, governance and future development” deals with stakeholders and decision makers’ perception of and attitudes towards the mariculture sector due to the fact that government plays an important role in aquaculture decision making.

Afterwards the key findings will be summarised in section 6 followed by the overall analysis of the results.

1.4 The study areas in Germany and Israel

The research for this thesis was carried out in Israel and Schleswig-Holstein, Germany. Differences not only in the mariculture history but also in development strategy and political framework were the trigger for a cross-country analysis regarding public and stakeholders’ awareness and perception as well as their possible influences on the future development and/or expansion of mariculture in both countries.

The surveys conducted done in 3 different coastal areas in Israel and Germany. While in Germany the focus was on a rather small area covering mainly the Kiel Fjord, in Israel the research area was extended to the whole coastal strip of the Mediterranean Sea and the Red Sea.

1.4.1 The German study area

Germany is located in central Europa and borders the Baltic Sea in the northeast and the North Sea in the northwest, separated by the federal state of Schleswig-Holstein and has a total coastline of 2,398 km.

The German study area is located in the federal state Schleswig-Holstein in the northern part of Germany, at 54°20’ north latitude and 10°08’ east longitude, and borders the southwestern part of the Baltic Sea. With a population of 252,992 and a population density of 1,826 people per km² this research area is densely populated (Statistisches Amt für Hamburg und Schleswig-Holstein 2011). Furthermore, it is an intensively used industrial area. The whole area is dominated by marine industries such as cruise shipping & shipbuilding, sailing and tourism.

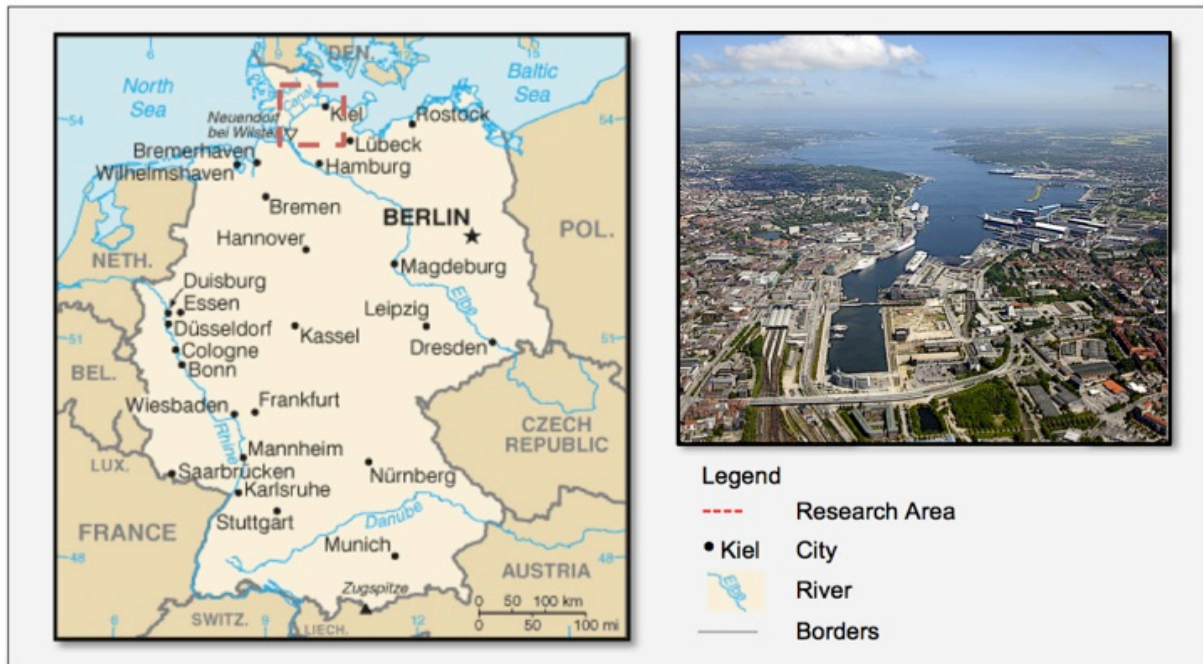


Figure 1-1. Research Area in Germany, the Kiel Fjord. Modified from CIA (2012) and Lühr (2010).

1.4.1.1 Climate and ecological characteristics

According to the Köppen classification system, the climate of the German study area is within the Cfb climate, which means a marine-influenced warm climate that is temperate, fully humid and with warm summers (Fig. 1-2). Today, the Kiel Fjord has a length of 17 km, a minimum width of 1 km and a maximum depth of 19 meters. Along the Kiel Fjord and Kiel Bay several nature protection areas such as Natura2000 were established within the last few decades. In those areas mussels, herring spawning grounds as well as breeding areas for seabirds can be found (Fig. 1-3).

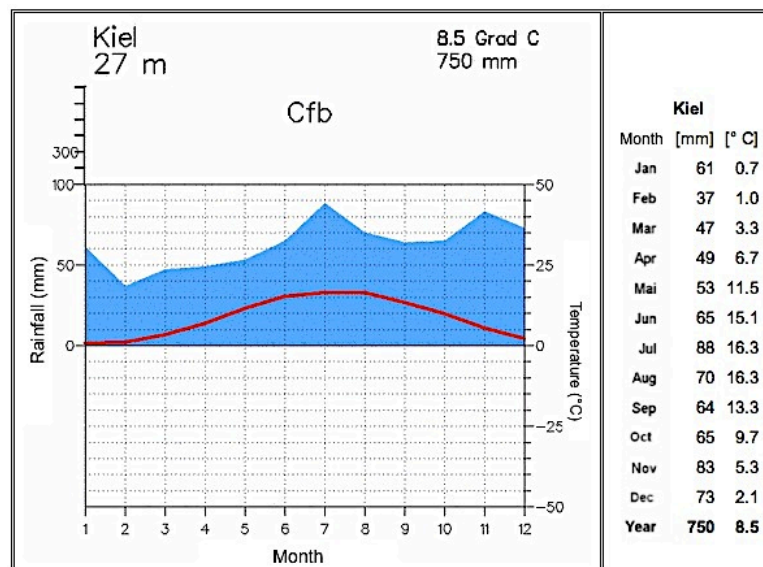


Figure 1-2. Climate data of Kiel. Modified from Mühr (2007).

Even if there are numerous protected areas, biotopes and habitats in this region, especially the Kiel Fjord is not only dominated by marine industries but also by several other coastal uses such as tourism and sailing. Hence, the landscape along this area is predominantly shaped by human impact. The intensive uses of the fjord have strongly influenced the overall appearance of the landscape (see Chapter 1.4.1.2) as well as the water body, which can be characterised according to the European Water Framework Directive as heavily modified water body (see Chapter 2.6.2). A more detailed economic characteristic of the Kiel Fjord can be found in next chapter.

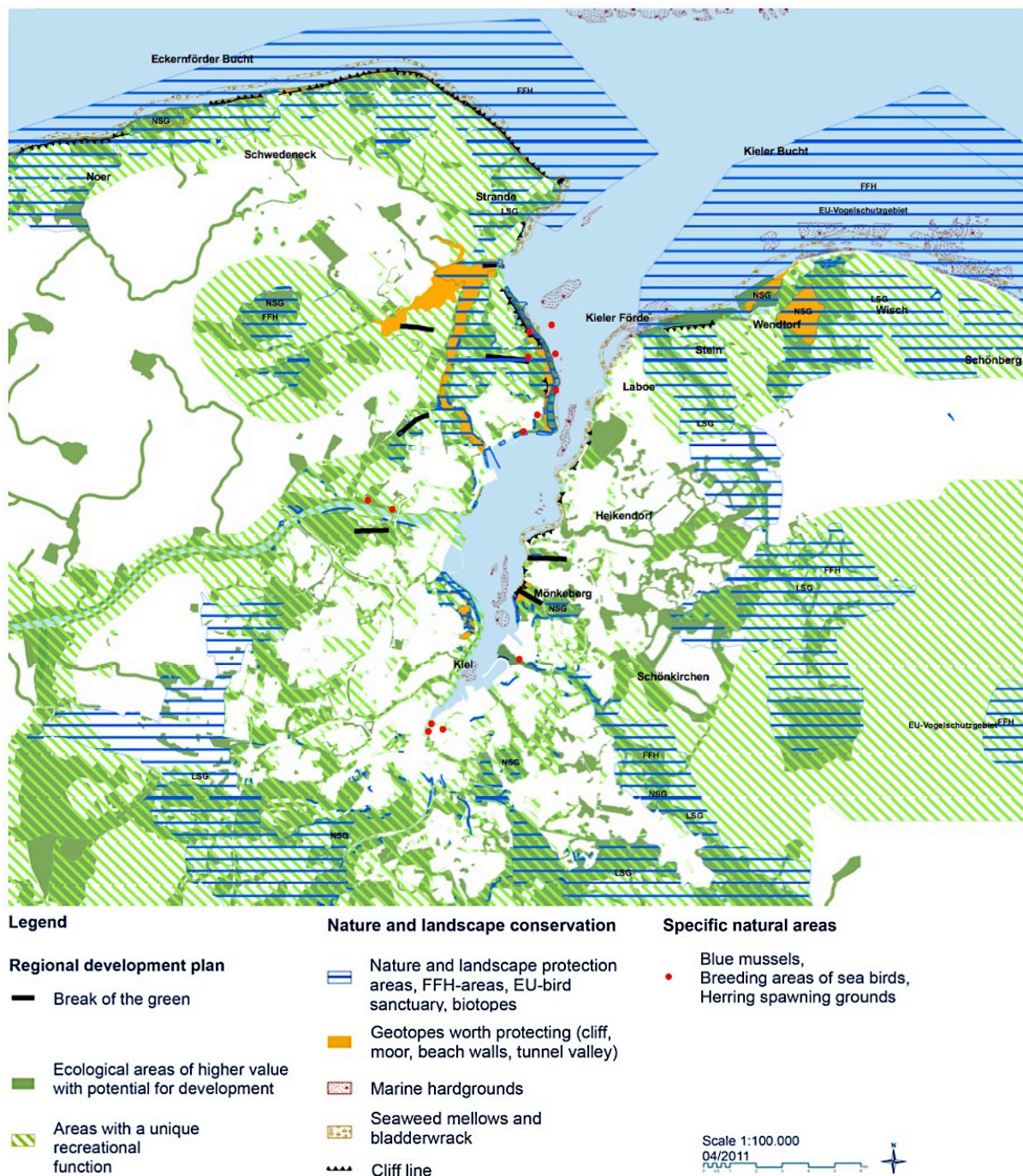


Figure 1-3. Protected areas, biotopes & habitats along the Kiel Fjord. Modified from Landeshauptstadt Kiel (2011).

1.4.1.2 Economic characteristics

As mentioned before, the whole Kiel Fjord is dominated by marine industries. In the past the economic development of Kiel was closely connected to the development of the marine and shipyard industry. Hence, the economic structure of Kiel was traditionally marked by these sectors. Today, Kiel is not only an important seaport but also an attractive location for science and research as well as numerous private and public service sectors such as finances, renting and gastronomy. One of the main sunrise industries in Kiel is maritime technology, which includes the whole maritime cluster such as:

- Shipping
- Maritime traffic
- Shipbuilding
- Marine engineering
- Communication engineering
- Ocean science
- Fishery and **aquaculture**
- Offshore technology
- Coastal and nature protection
- Recreation and tourism sector

Even though they are mentioned in the list, fishery and aquaculture are currently ranked lower than other maritime sectors, but are seen as sectors with potential growth in the future. In this regard, especially the breeding or farming of high-quality sea fish as well as the production of organic and renewable marine resources for medical science are interesting sectors. Further future prospects are seen in the production of algae for the food and cosmetic industry. In this context, the Competence Network Mariculture of Schleswig-Holstein was established aiming at combining scientific and producer knowledge in order to strengthen the future development of this sector (Landeshauptstadt Kiel 2004).

However, the future development of Kiel is mainly focused on strengthening the port structures, sailing events as well as the public service sector in order to realise the growth potential. A further focus is set on the development of a sustainable (ecological, economic, cultural and social) urban and coastal tourism.

Due to the small size of Kiel compared to the numerous space-consuming activities performed in and around it (Fig. 1-4), it seems quite obvious that additional uses cause additional conflicts. Hence, it will probably be quite difficult to establish new sectors such as marine aquaculture. This fact will be part of the analysis and discussed further in Chapters 5, 6 and 7.

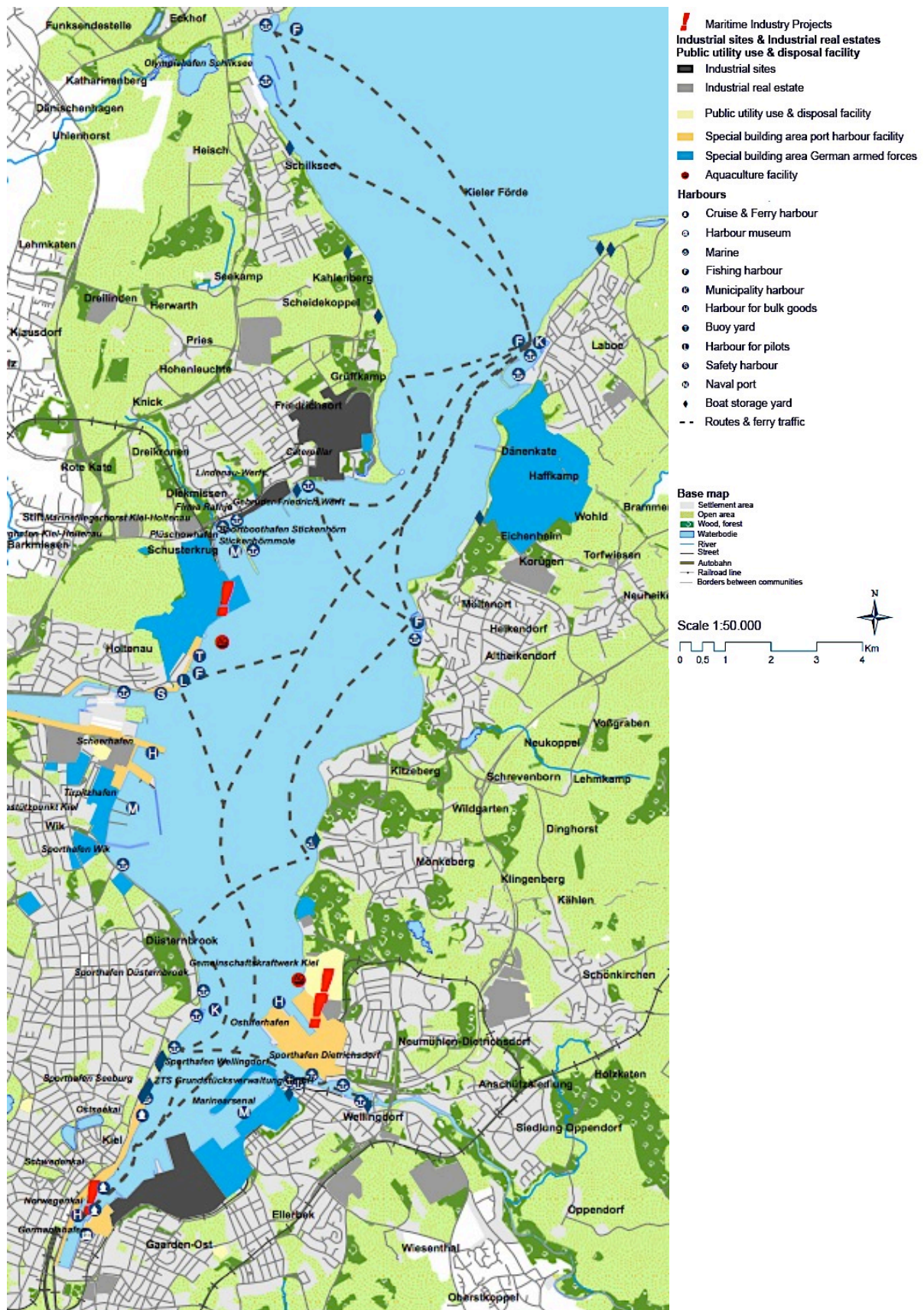


Figure 1-4. Marine industry projects, industrial sites and industrial real estates, public utility uses and disposal facilities in Kiel. Modified from Landeshauptstadt Kiel (2011).

1.4.2 The study areas in Israel

Israel is located on the eastern end of the Mediterranean Sea and the northern end of the Red Sea, at 29°30'–33°30' north latitude and 34°15'–35°30' east longitude, and has a length of 424 km from the north to the south. Excluding the occupied territories Israel's area is approximately 20,700 km² and borders Lebanon in the north, the Syrian Arab Republic and Jordan (and the West Bank) in the east and Egypt in the southwest.

The Israeli study area was divided into two different sub-areas: the Mediterranean Sea and the Red Sea. The first sub-area covers a coastal strip of 94 km along the Mediterranean Sea from Haifa in the north to Tel Aviv in the south. With a population of about 3 million and an average population density of 1955 people per km² this area is as densely populated as the German research area. Furthermore, the cities Tel Aviv and Haifa are also intensively used industrial areas (World Gazetteer 2012).



Figure 1-5. Research areas in Israel, Haifa, Tel Aviv. Modified from CIA (2012) and Kämmerer (2008).

Contrary to the research area along the Mediterranean coastline the second sub-area, the Red Sea, only covers a very short coastal strip of 12 km bordered by Egypt in the west and Jordan in the east. Nevertheless, this area is densely populated with a population of 915,513 and a population density of 1061 people per km². This area is intensively used by the tourism sector. Within the following sub-chapters the study areas will be explained in detail concerning geography, climate and ecological characteristics as well as their economic characteristics.

1.4.2.1 Climate and ecological characteristics

Even though Israel is a rather small state, according to Köppen classification system, the climate of Israel is very diverse. Most of the country is located in a semi-arid zone, with distinct short and wet winter and long dry summer seasons, and a low annual rainfall of around 500 mm (an overall multi-annual average); Israel can still be subdivided into further climatic regions. Based on Israel's location the climate ranges from the subtropical humidity of the Levant and Eastern Mediterranean (Fig. 1-2) and the subtropical aridity of the Sahara and the Arabian deserts (Fig. 1-3).

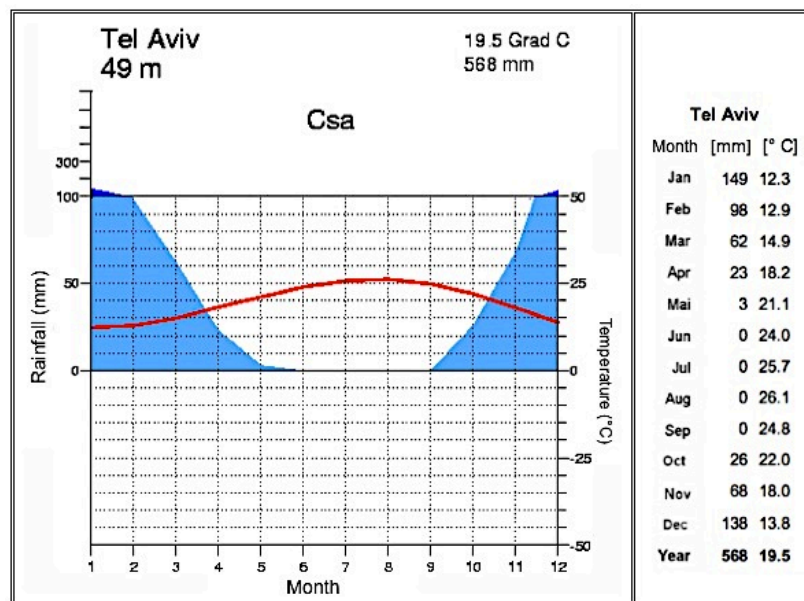


Figure 1-6. Climate data of Tel Aviv. Modified from Mühr (2007).

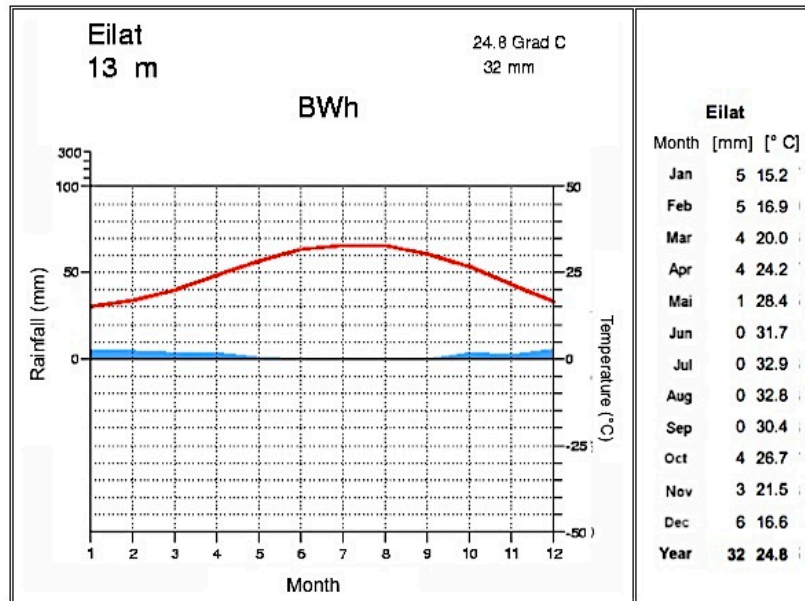


Figure 1-7. Climate data of Eilat. Modified from Mühr (2007).

The Mediterranean Coastline

The Mediterranean coastline of Israel spans 194 km from the cliffs of Rosh Hanikra in the north to the Gaza strip in the south and is characterised by a variety of landscapes and historical sites and by a rich biodiversity. The study area along the Mediterranean coast is part of the Nile littoral cell, and its morphology is largely based on sand transport from the Nile Delta (Bar-Or and Matzner 2010).

Due to the fact that the Mediterranean Sea is a closed sea it is more susceptible to pollution. Therefore, similar to other countries around the Mediterranean Sea, Israel's attention is directed toward preventing land-based pollution from the direct discharge of wastewater to the sea as well as from its discharge to the sea through rivers.

However, the Mediterranean Sea is a rich habitat for a wide variety of fish and other species and, hence, the protection of the marine environment enables wise use of this resource for fishing. Within the last year several factors such as marine pollution, climate change and invasive species have been responsible for a change of the Mediterranean Sea's marine environment. These factors may cause negative impacts on the fishing sector and require the adoption of a sustainable development approach, even if a clear trend over past decade cannot be discerned (Bar-Or and Matzner 2010).

Eilat/ Gulf of Aqaba

Eilat, the most southern town of Israel is located at the Gulf of Aqaba at the northern end of the Red Sea. The Red Sea coastline of Israel spans 11 km from Egypt in the east to Jordan in the west (Fig. 1-8). This part of the Red Sea is the northernmost tropical sea ecosystem of the world. Its oxygen-rich water has a constant temperature of 21-24 degrees. Further, the

coral reef habitat of the Gulf of Aqaba embodies an important, complex and rich ecosystem, which is currently being threatened. The population of the Gulf includes more than 100 species of corals, 800 species of fish and hundreds of species or crustaceans and molluscs in a fragile environmental equilibrium.



Figure 1-8. Research areas in Israel, Eilat. Modified from CIA (2012).

However, the region's delicate ecosystem is endangered by uncontrolled development in the region. Even if future tourism depends partly on preserving the unspoiled landscapes and spectacular seascapes, the highly sensitive Gulf area is greatly threatened by various activities including tourism and sport fishing, commercial fishing, shipping of oil and other hazardous material, wastewater and solid waste disposal, mariculture and coastal industrial development. Furthermore, sewage treatment is a major environmental problem in Eilat. Past practices have endangered coral reefs in the Eilat area. (Israel Ministry of Foreign Affairs 2012).

1.4.2.2 Economic characteristics

Israeli coastline of the Mediterranean Sea as well as the Red Sea is short, crowded and full of competing uses. Furthermore, Israel is one of the most densely populated countries in the world. A significant portion resides along the coastal plain, exerting major pressure on the environment in the coastal area. Hence, in the future it will be necessary to reduce the pressure, especially in the densely populated regions in order to protect open areas and provide space for ecological corridors such as river strips (Israel Ministry of Foreign Affairs 2012). Economic activity has a significant impact on the environment, whether in terms of energy and industrial production or consumption patterns of households and businesses. On the one hand, environmental degradation has been linked to unsustainable production and consumption patterns. On the other hand, economic development and quality of life are dependent on the quality of the environment (Bar-Or and Matzner 2010).

The growth in energy consumption, which is based on the growth of population and production in Israel, leads to a further decrease in already limited energy sources and to environmental degradation and pollution. A further reason for environmental degradation, including damage to natural resources, is the fact that most of Israel's energy consumption is based on non-renewable sources and hence economic development and growth have been accompanied by air pollution and greenhouse gas emissions (Bar-Or and Matzner 2010).

The Mediterranean Coastline

The Mediterranean coastline, especially the study area between Tel Aviv and Haifa, is a heavily used coastal strip. Coastal uses within this area include infrastructures such as ports, water-cooled power plants, army facilities, buoys for the supply of fuel, gas and chemicals, and seawater desalination plants. In addition, this coastal area is a major source for leisure and tourism and national parks and nature reserves abound along it. Efforts are currently being made to declare nature reserves in areas more distant from the coast in the deep water (Israel Ministry of Foreign Affairs 2012).

Eilat/ Gulf of Aqaba

While measures are being taken to protect the marine ecosystem in the Gulf of Aqaba, increased urbanisation and development is overloading the natural resource base of the area and hence its ability for sustainable development. This is particularly a problem in the tourism sector, which relies largely on clean water, air, beaches and coral reefs. The tourism sector in Eilat is the city's main source of income (Bar-Or and Matzner 2010). Further activities such as transportation and conveyance installations (oil, phosphates) as well as other industrial activities along the Gulf shores can potentially endanger tourism development in the entire

Red Sea area. In fact, Eilat and Aqaba are principal ports with major oil terminals moving millions of tons of oil every year and, in addition, phosphate, potash and bromide. Further export facilities, naval bases, commercial ports, marinas and pleasure boats, bathing beaches and water sports constitute extra stress on the Gulf's ecosystem, threatening to irreparably damage this precious asset (Bar-Or and Matzner 2010).

2 AQUACULTURE – global and regional development

With regard to the main objectives and research areas of this thesis, this section deals with background information regarding the aquaculture sector as well as its development, future potentials and political framework. According to a definition of the FAO aquaculture is:

“...the farming of aquatic organisms: fish, molluscs, crustaceans, aquatic plants, crocodiles, alligators, turtles, and amphibians. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms which are exploitable by the public as a common property resource, with or without appropriate licences, are the harvest of capture fisheries” (FAO 2012).

Depending on the culture environments aquaculture can be subdivided into the following different sectors: freshwater culture, brackish water culture and mariculture. This thesis deals predominantly with mariculture, which is defined by the FAO as follows:

“By mariculture is understood that the cultivation of the end product takes place in seawater, such as fjords, inshore and open waters and inland seas in which the salinity generally exceeds 20‰. Earlier stages in the life cycle of these aquatic organisms may be spent in brackish water or freshwater” (FAO 2012).

In this thesis talking about *aquaculture* implies the whole aquaculture sector including all common land- and sea-based farming methods whereas *marine aquaculture* or *mariculture* in particular refers only to aquaculture farms in open waters, e.g., fish net cages in fjords.

2.1 Historical development of aquaculture

The story of cultivating fish can be traced back more than 4000 years. The first evidence of aquaculture can be seen on Egyptian wall paintings, which can be dated to 2000 BC. According to the Food and Agriculture Organisation of the United Nations (FAO 1988) there are 4 different theories regarding the development of aquaculture:

Oxbow Theory

The Oxbow Theory states that rivers, which are meandering due to natural topography and physiography of the area, can be long, winding oxbows of varying sizes. After several years of varying flood levels, such rivers can change their courses leaving behind these oxbows,

which are still filled with fish and other living organisms. Seasonal flooding restocked them with fish in a high quantitative as well as qualitative way. Hence, during the dry season the human population living along the rivers and oxbows could use the fish grown in oxbows as a food source. Taking full advantage of this occurrence, people began to improve the embankments, enclosing such oxbow areas. Subsequently, in addition to the seasonal natural stock of fish that enter the modified oxbows, additional stock may be planted, thus starting aquaculture management in them. This was continued until the complete aquaculture management was attained. Development of this type of aquaculture is exemplified by extensive low-lying level areas, which have a network of rivers and a distinct monsoonal, annual rainy and dry period (e.g., Bangladesh).

Catch-and-hold theory

The catch-and-hold theory is based on the idea that the early rulers of large empires held fish and other aquatic products in high esteem, e.g., in water areas, which were used as a source of water, recreation, or as a defence around castles. Such water areas were not really intended for rearing fish but, regardless of the season, some rulers demanded fish so the practice developed of stocking fish caught from natural waters into the water areas constructed around castles or communities. Over the years, the species that survived and grew such as the common carp were selected for this catch-and-hold system of providing fish. Furthermore, stocking the right amount and kind of fish and feeding them when necessary also developed resulting in aquaculture practice. This type of venue for aquaculture development was done inter alia by monasteries in Europe and the palaces of emperors.

Concentration Theory

In monsoon areas where strong rains caused rivers to flood the surrounding marshland, aquatic organisms, including fish, could find wide and favourable habitats for growth and reproduction during the flood season. In dry seasons when the water gradually receded only deep spots and the rivers were still filled with water. As a result, there was a concentration of fish in these spots of deep water that had been growing and reproducing during the wet season and could then be caught by fishermen from the surrounding communities. In the course of time, aquaculture management, which began through the concentration version, started with regard to size or type.

Trap-and-crop theory

Compared with the first 3 versions, which describe developments from inland freshwater areas, development according to the trap-and-crop theory is characteristic for brackish and marine areas affected by tidal fluctuations.

Coves, lagoons, permanent ponds, enclosed swamps or even depressions which were periodically watered and fully or partially drained during ordinary or extreme low tides are usual for this type of coastal area. During a flooding period they were regularly stocked with finfish, crustaceans and even molluscs and other economic aquatic resources commonly found in these waters. Afterwards, installed water traps and other barriers blocked the exit of these fish and crustaceans. Over time, more and more fishermen started with this primitive form of aquaculture. Later on, a better aquaculture management was developed consisting of providing the necessary dikes for the watered area, excavating and levelling the area to provide more space for stocking additional finfish or crustacean seeds to augment the trapped fish and crustaceans brought in by the tide. This chronology of development probably began in Indonesia and spread to the Philippines, and later into Thailand, Malaysia, India and other areas of the world.

2.2 Current development of aquaculture

Since the early 1960s aquaculture has experienced a significant quantitative boom with an average annual growth rate of 6.6%, which can be traced back to improved farming conditions (e.g., stocking rate) as well as optimized fertiliser, chemicals and drugs (Uthoff 1999; FAO 2010; Hilge and Hanel 2008). Hence, aquaculture is among the fastest-growing food-production sectors worldwide, with a per-capita supply increasing from 0.7 kg in 1970 to 7.8 kg in 2008. From a market share of less than 10% in the 1970s, aquaculture products currently account for over 40% of all fish and seafood in world markets (FAO 2010a).

While aquaculture production (excluding aquatic plants) was less than 1 million tonnes per year in the early 1950s, production had increased to 52.5 million tonnes in 2008. Aquatic plant production by aquaculture in 2008 amounted to 15.8 million tonnes (alive weight equivalent), representing an average annual growth rate in terms of weight of almost 8% since 1970. Thus, if aquatic plants are included, the total global aquaculture production in 2008 amounted to 68.3 million tonnes with a first-sale value of US\$106 billion. Hence, aquaculture is set to overtake capture fisheries as a source of food fish (FAO 2010a).

Figure 2-1 illustrates the increasing growth of aquaculture since 1981 and, furthermore, the loss in importance of fishery regarding the fish supply (Uthoff 1999; Schulz et al. 2005). Nevertheless, more than 90% of global aquaculture farms are “small and geographically dispersed” (Varadi et al. 2001, p.397).

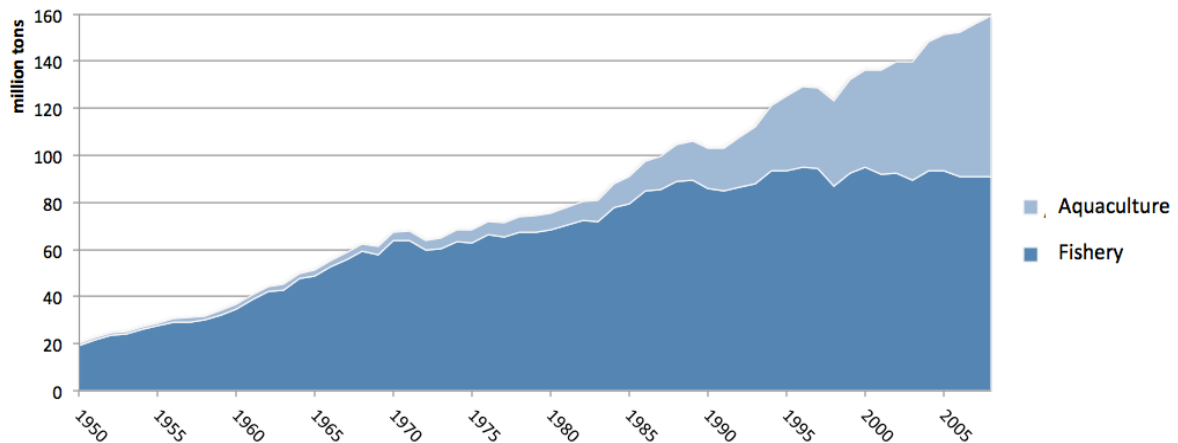


Figure 2-1. Global harvest from fishery and aquaculture between 1950 and 2008. Modified from FAO (2010b).

As mentioned before, the increasing growth of aquaculture started in the early 1980s when the global share of seafood supply reached more than 10% for the first time. Since then aquaculture has become more and more important as a contributor to the seafood market and the global share in the seafood supply increased to 43% in 2008 (Fig. 2-2).

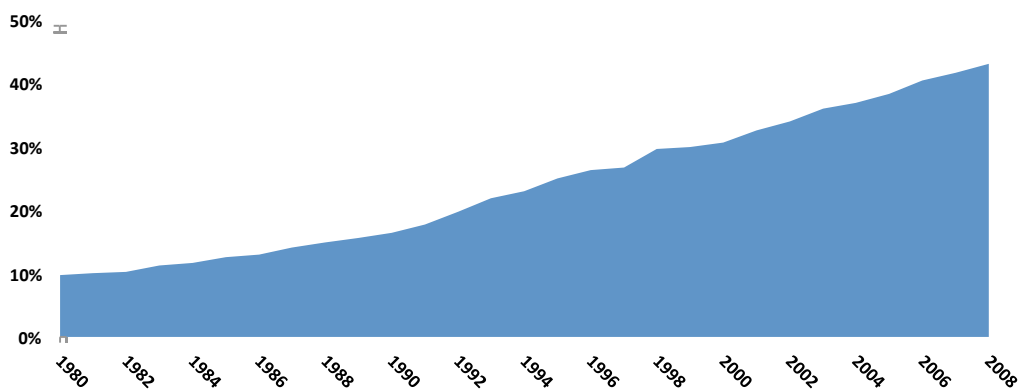


Figure 2-2. Global aquaculture share in seafood production between 1980 and 2008. Modified from FAO (2010b).

In 2008, most aquaculture products were produced in Asia (91.4 %; 62.4 million tonnes) with China as the biggest producer (62.4 %; 42.6 million tonnes) as shown in Figure 2-3 (FAO 2010b). Within the European Union only 3.61% (1.2 million tonnes) of global aquaculture products were produced. Furthermore, with Chile (7th place) and Norway (9th place) only two of the top 10 producers are not from Asia (FAO 2009). In 2008, the developing countries generated 90.8 % of all aquaculture products worldwide, whereas the industrial countries generated only 6.40%.

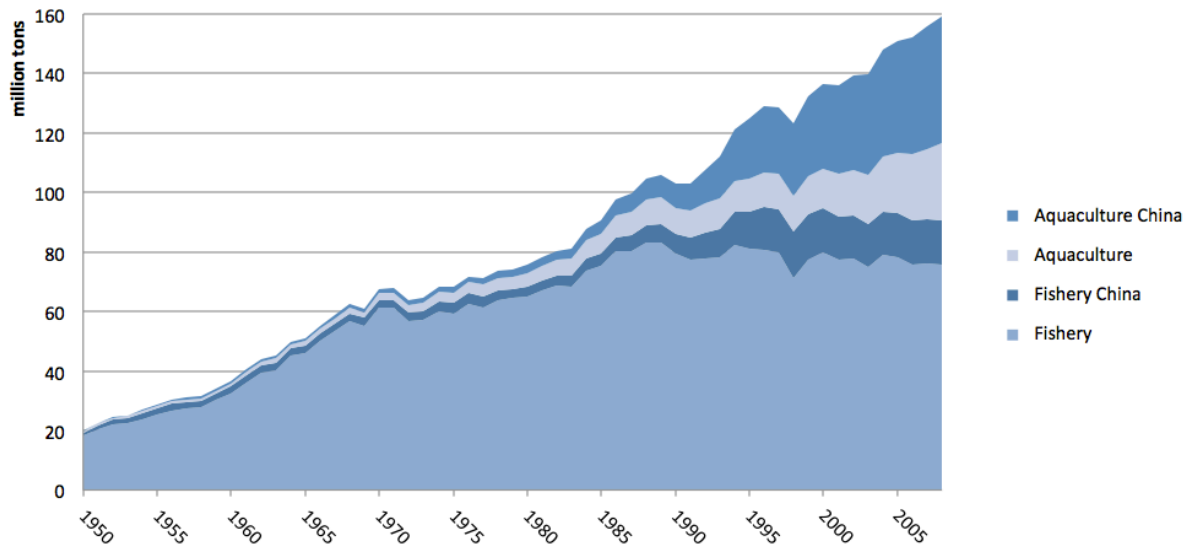


Figure 2-3. Global harvest from fishery and aquaculture between 1950 and 2008. Modified from FAO (2010b).

The reasons for the increasing growth of global aquaculture are not only improved farming conditions, but also from the increasing demand of the growing world population. The per-capita consumption of fish increased from 9 kg in 1961 (FAO 2007) to 16.4 kg in 2005 (FAO 2009). While in 1950 the world's population of about 2.5 billion people demanded 19.8 million tonnes of fish, in 2008 6.6 billion people demanded 159.1 million tonnes. With a prognosticated world population of 8 billion people in 2030, fish production has to be increased to 29 million tonnes in order to satisfy the current per-capita consumption (Hilge 2008 and Cressey 2009).

Prognoses from the FAO are confirming this trend by presuming a further increase of the global fish production to 179 million tonnes by 2015 (FAO 2007). Furthermore, the contribution of aquaculture will increase to 74 million tonnes, of which 75% will be used for food production.

However, especially in China as well as in Asia in general the aquaculture sector is still growing whereas the average annual growth of aquaculture production in Europe since 2000 has slowed substantially (Fig. 2-4) although the EU is one of the main seafood markets and EU waters have the capacity to hold (much) more aquaculture production than currently takes place (FAO 2010a).

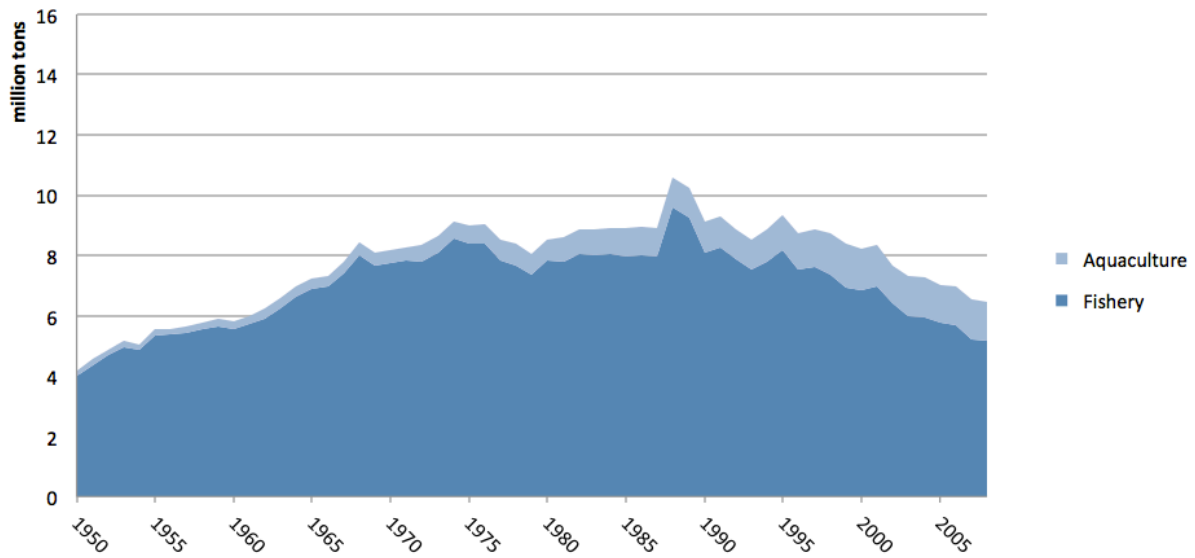


Figure 2-4. European Union harvest from fishery and aquaculture between 1950 and 2005. Modified from FAO (2010b).

Moreover, the demand for seafood is still increasing while the wild-fish stocks are being depleted and, hence, the commercial capture fisheries landings are declining (Ojeda 2010). The once-leading countries in aquaculture development in Europe such as France and Spain have shown falling production during the last decade. While the world aquaculture production will continue to grow in the coming decade, it is expected that the rate of increase in most regions will slow (FAO 2010a) due to several problems, which will be further explained and described in the following chapters.

2.3 Ecological and socio-economic effects of aquaculture

According to the FAO (2010a) it is advisable to distinguish between *ecological and social* type of issues speaking about general effects of aquaculture on the environment. Especially an ecological assessment is important for providing information on ecological issues related to aquaculture processes, considering inputs, resource use and outputs (Fig. 2-6). Nevertheless, these ecological issues often influence the surrounding communities and hence social life. Therefore, a parallel assessment of the socio-economic well-being should be carried out in order to avoid unforeseen consequences. Furthermore, both, ecological and socio-economic issues, are influenced by socio-political factors, which again include governance and institutional factors (Fig. 2-5). Therefore, this chapter predominantly concentrates on the general positive and negative effects of aquaculture on the ecological and socio-economic environment. The socio-political issues regarding aquaculture, e.g., governance, will be addressed and discussed in detail in the following chapters.

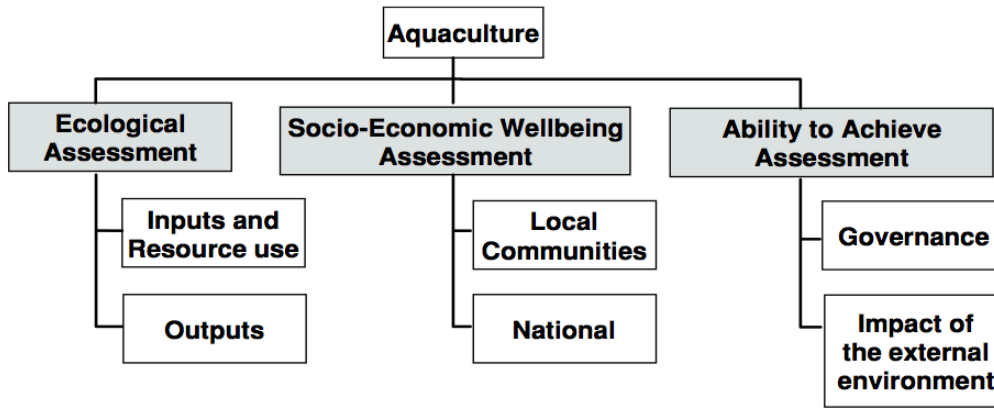


Figure 2-5. Assessing ecological, socio-economic and “ability to achieve” issues of aquaculture. FAO (2010a).

Due to the increasing growth of the aquaculture sector, especially marine aquaculture farms, there have been several discussions regarding the negative and positive impacts of this sector during the last few decades, especially regarding ecological and socio-economic well-being issues. In order to identify the different impacts of aquaculture, it is important to distinguish between different parts of aquaculture production process. Figure 2-5 demonstrates the main issues affecting ecological and socio-economic well-being associated with the main parts of the process. Further, the different inputs and outputs with regard to aquaculture as well as the mainly used resources are shown (FAO 2010a).

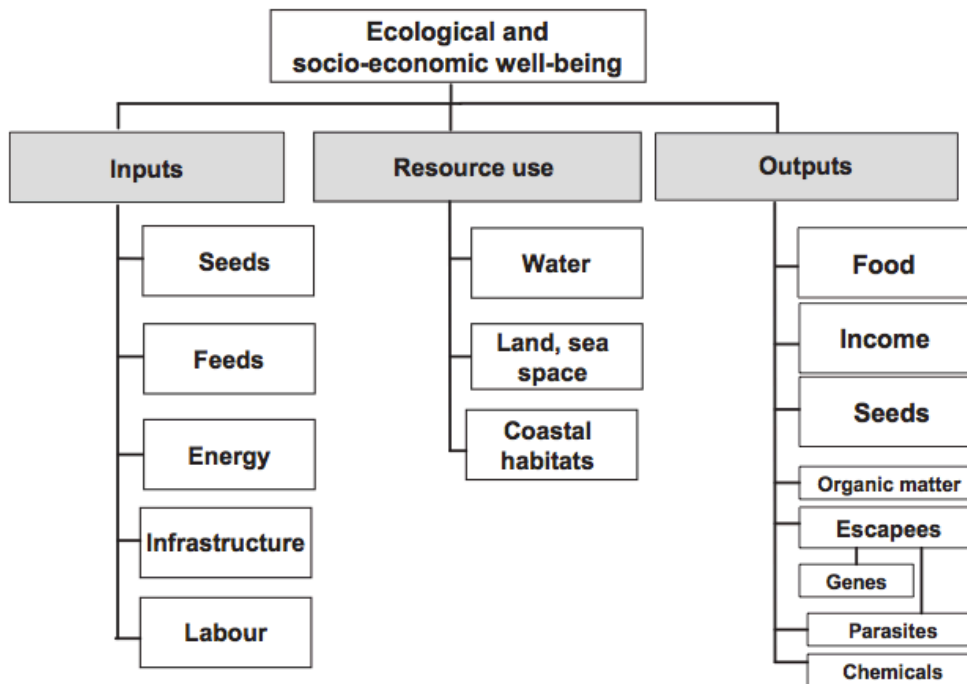


Figure 2-6. Schematic tree to identify issues of the ecological and socio-economic nature related to different parts of the aquaculture production process. FAO (2010a).

Based on Figure 2-6, the FAO (2010a) summarised the following often-mentioned negative first-order impacts of aquaculture:

- increasing demand of fisheries for fish meal and fish oil
- alteration of inland and coastal habitats for the construction of aquaculture systems (e.g., ponds, net cages)
- nutrient and organic enrichment of recipient waters
- eutrophication of waterways and coastal zones
- release of chemicals used to control water conditions and diseases
- competition for and depletion of resources
- negative effects from escaped farmed organisms
- restructuring of biological and/or social environment

However, besides the often-discussed negative impacts of aquaculture on the environment some important positive aspects have been identified. The most significant are:

- Production of food
- Reliable food source for the growing global population
- Economic boost in coastal areas which are only weakly developed
- Creation of new jobs

“An ecosystem approach to the sector should ensure that such positive effects are not overridden by negative impacts in the short, medium and long term” (FAO 2010a, p. 18).

Within the European Union suitable laws can prevent most of the mentioned negative impacts (see Chapter 2.6). However, even if the restrictions in Europe mostly protect the environment regarding above-mentioned impacts, the increasing imports of cheap seafood from third and threshold countries aggravate the impacts in these regions. The increasing growth of aquaculture in third and threshold countries combined with a lack of adequate knowledge, lack of training, and insufficient legislation frameworks often causes an unsustainable development of the aquaculture sector and hence negative press and media coverage. Further, the worldwide-observed negative impacts mainly resulted in negative attitudes towards and awareness of aquaculture.

2.4 Aquaculture in Israel

2.4.1 History of aquaculture in Israel

All countries in the Middle East are poor in fish production. Even though Israel is regarded as one of the most privileged countries, national production covered only 37% of the fish demand in 2003; the rest was obtained by imports. However, Israel is one of the largest seafood markets in the Middle East, with an annual consumption of over 70,000 metric tonnes (Barak et al. 2004). The development of aquaculture in Israel started in the late 1920s with the import of carp (Hulata and Simon 2011). After 20 years of experiments and setbacks in 1948 more than 70 percent of the fish consumed in Israel was produced by aquaculture. Between 1950 and 1980 further fish species were investigated as potential aquaculture candidates such as mullet, tilapia and rainbow trout. During the 1980s water-usage problems drove out many of the small fish farmers. Nevertheless, since 1983, yields have steadily increased.

Commercial-scale marine cage aquaculture in Israel has been practised since the late 1980s. Mariculture consists mainly of seabream/ seabass production at 2 large farms in the northern Gulf of Aqaba and at a few small farms along the Mediterranean coast (FAO 2005). The development of aquaculture production in Israel can be seen in Tables 2-1 and 2-2.

Table 2-1. Aquaculture production and gross income in the last decade in Israel. Shapiro (2011).

Year	No. of farms	Area (ha)	Yield (MT)	Yield (MT/ha)	Value of yield (USD)	Average value (USD/MT)
2000	73	3 095	17 184	555	54 685	3 182
2001	73	3 095	18 157	587	57 944	3 191
2002	73	3 095	19 200	620	45 480	2 369
2003	73	3 090	17 667	572	42 725	2 418
2004	65	2 848	18 949	665	45 546	2 404
2005	55	2 808	19 208	684	53 875	2 805
2006	55	2 808	19 382	690	55 028	2 839
2007	55	2 808	19 168	683	61 458	3 206
2008	45	2 808	17 731	632	63 714	3 719
2009	45	2 693	18 442	685	60 986	3 307

Table 2-2. Aquaculture yields by species in the last decade (in tonnes) in Israel. Shapiro (2011).

Year	Carp	Tilapias	Mullet	Silver & grass carp	Trout	Hybrid striped bass	Red drum & seabass	Barramundi	Seabream	Other
2000	6 281	7 059	1 661	744	605	302	–	–	–	532
2001	6 208	8 217	1 633	718	448	378	313	48	–	44
2002	7 748	7 819	1 824	616	374	495	146	66	–	17
2003	7 339	6 826	1 705	713	352	385	250	–	–	97
2004	5 765	9 270	1 792	903	331	292	503	15	–	78
2005	6 413	7 404	2 108	1 607	424	453	488	90	181	40
2006	6 560	8 235	2 087	1 102	449	290	472	115	72	–
2007	6 737	7 973	1 983	1 135	431	147	–	100	17	645
2008	6 448	6 751	2 121	1 022	428	182	573	67	139	–
2009	5 892	7 789	2 048	1 094	379	–	–	–	–	1 240

At the beginning, aquaculture in Israel was a strictly monoculture, extensive system concentrating on carp. It quickly became apparent that this form of farming did not efficiently utilize the limited water resources available in the country. Today, polyculture is the major culture system practised in Israel with a variety of species used, e.g., carps, tilapia, grey mullet, to increase the production per unit culture area (Hulata and Simon 2011).

Between 1995 and 2003 approximately 4.7% of the country's livestock production and 4 percent of the total value were contributed by aquaculture. Today, the local aquaculture sector faces strong competition from imports of frozen fish products (approximately 65 percent of all fish consumed) and other major livestock production sectors, which are partially subsidised (FAO 2005).

2.4.2 Trends and future development of aquaculture in Israel

As shown in Figure 2-7 the aquaculture sector in Israel has been growing over the past 50 years and this is expected to continue. Aquaculture production will continue to play a dominant role in the Israeli market for fish products. In 1996, Mires stated that Israeli population is expected to have grown by approximately 56% by 2020 and fish consumption by 23%. Furthermore, he indicated that in this context, facing the dramatic decline of fish imports from the Atlantic Ocean, which make up the bulk of imported fish products in Israel, the decreasing availability of imported fish will cause a price increase for imported products and, hence, support the aquaculture sector (Mires 1996). The continuing growth of the population and of fish and seafood consumption as well as the mentioned surrounding parameters can be proofed using statistical data for 2011.

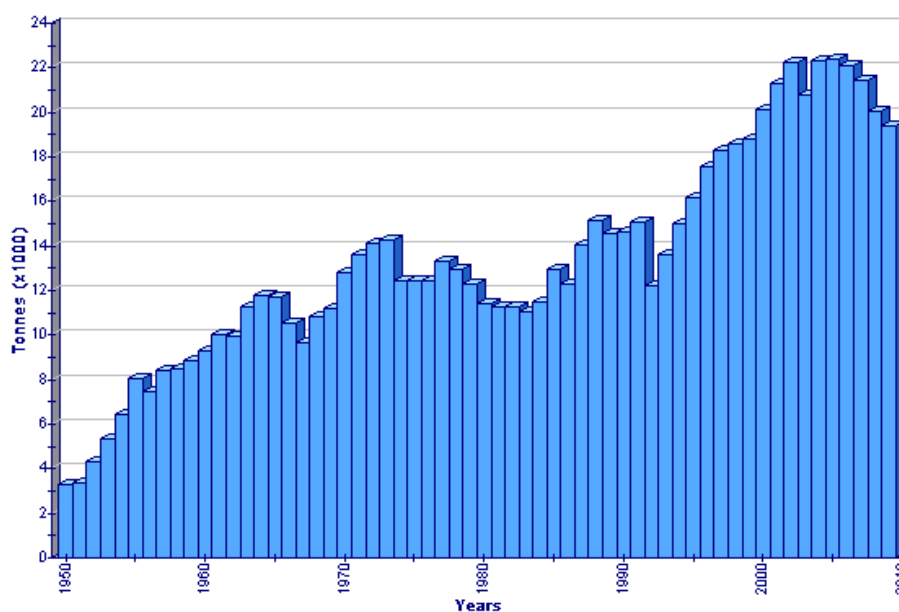


Figure 2-7. Reported aquaculture production in Israel (from 1950). FAO (2011).

However, within the last few years the development of aquaculture in Israel has as well been influenced by ecological concerns for water quality, e.g., due to the dry local climate as well as high water consumption. As a recent example in this context, environmental problems concerning a mariculture farm in Red Sea can be cited. In this case, in the wake of an extended media campaign against fish farms located in the Gulf of Aqaba and a subsequent prolonged and closely followed court case, the Israeli government decided to close down these sea-cage farms on the basis of controversial environmental concerns and to remove them from the Gulf of Eilat in 2008.

This case is generally believed to have negatively biased Israeli public opinion about aquaculture practises, at least among people living near the Red Sea. However, along the Mediterranean coast, farms continue to operate and the sector is profitable, producing fish both for the local market and for export.

2.5 Aquaculture in Germany

2.5.1 History of aquaculture in Germany

The aquaculture industry in Germany is very small, practiced only in a few specifically suited areas. In 2005 the overall production reached a total volume of roughly 44 685 tonnes (FAO 2005). Historically, pond aquaculture in Germany can be traced back to the 11th century and hence has a long tradition (Geldhauser and Gerstner 2003). However, between the 17th and 19th centuries, the importance of carp pond culture decreased due to the fact that the fast-growing human population during this time led to an alternative usage of former pond areas for the production of cereals. A second peak of carp pond culture occurred between 1880 and 1980; however, it has been under consistent pressure over the last two decades mainly as a result of unfavourable economic conditions e.g., the high costs for energy, manpower, nature conservation constraints, low-priced imports and a decreasing demand by consumers (FAO 2005). In 2005 production reached 16,711 tonnes. Only 1,000 tonnes came from species other than carp such as pike, zander and tench.

Marine aquaculture mainly focuses on blue mussels in the North Sea and some finfish species like turbot, European seabass and macroalgae like *Laminaria saccharina*, which are cultured in recirculation systems near the shore but mainly still on an experimental scale (FAO 2005). Commercial-scale marine finfish farming in Germany was never developed, except a few very small mariculture sites, e.g., in the Kiel Fjord research area. However, there is currently evidence for interest on the side of potential fish farmers, but also for opposition from local stakeholders. In the past, the general German public's attitude regarding mariculture was expected to be negative, though the population has not been polled to quantify this attitude. This attitude was largely related to the early attempts to rear

salmon in Scandinavian and East German farms during the early 1980s, which were performed with little or no regard to environmental protection. Since then, technological and environmentally friendly improvements have been made in the mariculture industry, and various scientific evidence shows that the benthic impacts are limited to the area around the cages. Nevertheless, mariculture is still an easy target for environmental problems that are actually caused by other, financially more robust, enterprises.

2.5.2 Trends and future development of aquaculture in Germany

Today, the most important cultured species in Germany is the rainbow trout, which was introduced to Germany from North America in 1880. Over the last 30–40 years production figures for this species have increased annually reaching almost 24 000 tonnes in 2003 and a production value of €113 million in 2005 (FAO 2005). As shown in Figure 2-8 the aquaculture production in Germany had its peak in the early 1980s and 1990s and has been continuously decreasing ever since.

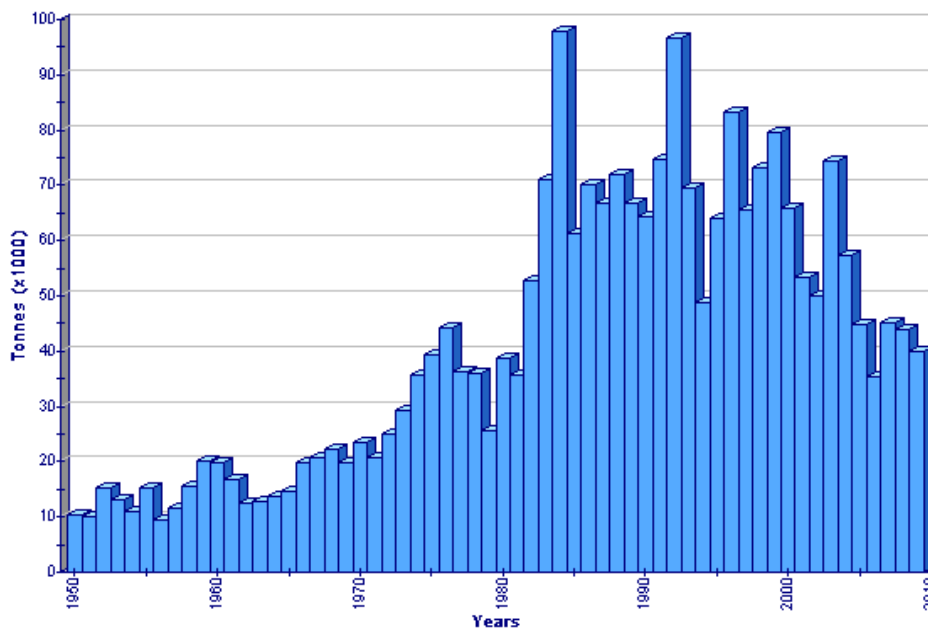


Figure 2-8. Reported aquaculture production in Germany (from 1950). FAO (2011).

However, Germany has some major fish markets, namely in cities nearby the coast like Hamburg and Kiel, where aquaculture products are marketed in very different ways depending on species, region and the size of the producing company or unit. Larger aquaculture farms in Germany usually sell most of their production via wholesale traders; medium-sized and small-scale farms supply retail traders, restaurants, fish shops and end consumers. The German market for aquaculture products was, is and will be dominated by imports.

In 2005 a total of 172 264 tonnes were imported, with salmon accounting for more than 116 000 tonnes. Compared to this, exports reached only 43 324 tonnes and about 180 000 tonnes were consumed in Germany (FAO 2005).

Marine aquaculture is a small fringe activity along the German coast and compared with other EU member countries its overall production is negligible – other than for mussel farming. This development is expected to continue over the next decade. At present, Germany, compared to other neighbouring maritime countries, has not yet invested in the full potential of commercial marine aquaculture. There is only one offshore mariculture facility near Helgoland, and small pilot farms in the Baltic Sea. Reasons for this include:

- a) complicated and sometimes contradictory legislative issues,
- b) environmental concerns (e.g., from politicians, NGOs and residents)
- c) zoning issues, which include a multitude of marine protected areas of different political and protection status, and
- d) hydrographical conditions (North Sea) which make the selection of suitable mariculture sites difficult.

However, potential sites for farming in Germany exist in the North Sea and Baltic Sea. Although the country is currently not a large-scale producer of farmed fish, it is likely that the business will expand. Today, within the German study area, the Kiel Fjord, a small-scale rainbow trout fish farm, a small mussel farm as well as a small algae farm are located.

2.6 Political framework regarding aquaculture in Israel, Europe and Germany

2.6.1 Political framework in Israel

The lead government agency in charge of administrative control of aquaculture in Israel is the Division of Fisheries and Aquaculture, Ministry of Agriculture and Rural Development (MoAG), operating under the Fisheries Ordinance 1973.

The division operates under the authority of the Director General of MoAG and consists of four departments:

1. inland water aquaculture
2. mariculture
3. marine fisheries
4. fishing ports and inspection (Hulata and Simon 2011)

The department of inland water aquaculture is ultimately responsible for the monitoring and management of the freshwater aquaculture. The mariculture department is responsible for the monitoring and management of brackish water and marine aquaculture.

Further roles and activities of his division are:

- *“supervising and preventing transgressions of the Fisheries Ordinance;*
- *coaching, promoting and developing the inland and marine aquaculture industries;*
- *preventing the invasion of fish species that might damage the fish and the natural environment;*
- *introducing new species in quarantined areas;*
- *veterinary service to the aquaculture sector;*
- *assisting in prescribing medications for the use of farmers;*
- *promoting fisheries and aquaculture research;*
- *issuing export and import permits;*
- *coaching and training different and diverse model fish farms;*
- *collecting data regarding the fisheries and aquaculture agriculture industries, and publishing it in an annual report;*
- *providing professional support to entrepreneurs and investors;*
- *managing a fishing interface in the Mediterranean Sea, Eilat Bay and Lake Kinneret;*
- *issuing individual fishing permissions and for fishing boat owners;*
- *restoring and maintaining the fishing ports.”* (FAO 2005)

In 2004, the Department of Inland Aquaculture, in cooperation with the Extension Service, completed and published (in Hebrew) “aquaculture production protocols” that govern all aspects of aquaculture in the country.

Health control of fish and fish farming is regulated by the basic law “The Animal Diseases Ordinance [New Version]” 1985. Furthermore, the National Food Service in the Ministry of Health is responsible for the inspection and marketing of fishery products within Israel (Hulata and Simon 2011). Further relevant regulations include:

- the “Business Licensing law 1968”,
- the “Business Licensing Regulations (hygienic conditions for transportation of meat, fish, poultry and their products) 1971”, and
- the “Business Licensing Regulations (sanitary conditions for food-manufacturing businesses) 1972”.

For some of these regulations, only a Hebrew text is available. Penalties and fines provided by law, in cases of non-observance, are detailed in the relevant regulations and are updated from time to time (Hulata and Simon 2011). The establishment of mariculture, which took place initially in the Gulf of Eilat at Aqaba and later along the Mediterranean coast, has been a direct result of the work and research performed by a government-owned company. The Fish Growers Union (FGU) organizes most of the fish farms. This Union has assumed many

governmental-like functions, e.g., price control and species management. However, the status of the FGU has been downgraded recently, with the emphasis placed on free market trade and the appearance of independent farms, to one of a purely professional non-profit organisation specialising in technical training and insurance (FAO 2005).

2.6.2 Political framework on European level

In Europe the political framework regarding aquaculture is very comprehensive like in most of the food-production sectors. Hence, there are a lot of regulations and directives (see annex 1) for this sector. Reflecting this regulatory framework it seems obvious that getting approved new aquaculture farms is a quite difficult and time-consuming process. Further, it is arguable if, especially near shore, fish farms will still be approvable in the future.

Within the last few years recirculation systems were discussed as an alternative to this kind of aquaculture. However, even recirculation systems have been criticised by the fact that fish farming in such systems will depend on external input and high energy, which make the production much more cost-intensive. Further in the directive EC No 710/2009 of the European Commission it is stated that “due to the principle that organic production should be as close as possible to nature the use of such systems should not be allowed for organic production until further knowledge is available”.

With the regulation (EC) No 710/2009 the EU Commission has regulated ecological and biological production, marking and control of products of the agriculture and aquaculture and repeals the regulation No. 2092/91/EEC. This European regulation regarding the production of aquaculture organic products has become a novelty even though there is a lot criticism concerning the many compromises with the conventional industry (e.g., Naturland 2009). However, within the next few years there will be a growing need for quality intensification in the context of a successful and long-term aquaculture development. This regulation could create new European-wide basic conditions even if not all aquaculture farms will be able to produce in an ecological and organic manner.

A further important directive regarding aquaculture, especially mariculture, as well as fishery on the European level is the water framework directive 2000/60/EC, which came into force on 23rd of October 2000 and had to be transferred into national law in all European countries afterwards. The water framework directive mainly aims at establishing a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which:

- *“prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;*

- *promotes sustainable water use based on a long-term protection of available water resources;*
- *aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances;*
- *ensures the progressive reduction of pollution of groundwater and prevents its further pollution, and*
- *contributes to mitigating the effects of floods and droughts” (EC 2000)*

Hence, the water framework directive contributes to a significant reduction in pollution and protection of territorial and marine waters. Even for artificial and heavily modified water bodies this directive aims at achieving good surface water status by 2015. Furthermore, all member states shall protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status. A water body is defined as artificial or heavily modified when a change to the hydromorphological characteristics of that body, which would be necessary for achieving good ecological status, would have significant adverse effects on:

- the wider environment;
- navigation, including port facilities, or recreation;
- activities for the purposes of which water is stored, such as drinking-water supply, power generation or irrigation;
- water regulation, flood protection, land drainage, or
- other equally important sustainable human development activities (EC 2000)

The detailed description of the definitions for maximum, good and moderate ecological potential for heavily modified or artificial water bodies can be seen in “Directive 2000/60/EC of the European Parliament and of the Council”.

According to the water framework directive the Kiel Fjord is classified as a heavily modified water body. Due to the economic and social use of this area it is almost impossible to ensure a progressive reduction of the pollution. Hence, for these water bodies not the general admitted condition of the water framework directive but suitable conditional factors have to be used in order to enhance the ecological potential within the scope of the existing possibilities. Otherwise, the water framework directive would have serious economic effects on the existing uses, such as the shipping industry, sailing and recreational uses in the Kiel Fjord.

2.6.3 Political framework at national level in Germany

In Germany, the federal government is responsible for the jurisdiction within the marine area beyond the 12-nautical-mile zone and the federal states for the coastal water up to the 12-nautical-mile border. Further, the Federal Ministry of Consumer Protection, Food and Agriculture (Bundesministerium für Verbraucherschutz, Ernährung und Landwirtschaft – BMVEL) is the authority responsible for fisheries and aquaculture at the federal government level and ensures that the production of freshwater and seawater fish strictly respects environmental sustainability and the priority of consumer protection. In addition, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit – BMU) deals with the following tasks relevant to aquaculture:

- protection of inland waters and the maritime zones,
- groundwater protection,
- wastewater treatment,
- pollutant in food and
- landscape planning (FAO 2005).

However, on national level there are numerous existing laws regulating the farming and selling of fish and aquatic products. Further, within the last decade several European regulations and directives effecting the development of aquaculture had to be transferred into national law. Therefore, the approval of marine aquaculture farms depends on numerous factors, such as type of farm, farmed products, size and location as well as prospective environmental impacts.

The government system in Germany is divided into the federal (national) level, the *Länder* (federal states, provinces, or regional level), and municipalities (local level). Hence, marine aquaculture farm construction projects are facing several national laws on different levels.

At federal level:

- German federal building code (Baugesetzbuch)
- Federal Waterway Act (Bundeswasserstrassengesetz)
- Federal Nature protection law and impact regulation (Naturschutzgesetz, Eingriffsregelung)
- Federal Water Act and Waste Water Ordinance (Wasserhaushaltsgesetz & Abwasserverordnung)
- Laws on protection of animals (Tierschutzgesetz, Tierschutz-Schlachtverordnung, Tierschutztransportverordnung, Tierseuchengesetz, Fischseuchen-Verordnung, Tierimpfstoff-Verordnung)

- Laws on Food, Food Contact Materials, Consumer Products, and Animal Feed (Futtermittelgesetz, Futtermittelherstellungsverordnung, Verfütterungsverbotsgesetz und -Verordnung, Futtermittel-Verwertungsverbotverordnung,
- Food laws (Nahrungsmittelgesetz, Lebensmittelrecht, Fischetikettierungsverordnung Veterinärsgesetz Fischhygiene-Verordnung, Lebensmittel-Transportbehälter-Verordnung, Lebensmittelhygiene-Verordnung)
- Pharmaceutical law (Arzneimittelgesetz)

At state level:

- State Water Law (Landeswassergesetz)
- Nature protection law and impact regulation on state level (Landesnaturenschutzgesetz)
- Fishery State Law (Landesfischereirecht)
- Coastal regulations (Küstenverordnung)
- State Building Code (Landesbauordnung)
- State Laws on Food (Lebensmittelrecht)
- Environmental Impact Assessment (Umweltverträglichkeitsprüfung)
- Planning Approval Procedures (Plangestellungs- und Plangenehmigungsverfahren)

(modified and amended after DBT 2008 and Teufel et al. 2005)

Based on the laws, regulations and directives mentioned in Chapter 2.3, it seems quite understandable that the number of marine aquaculture farms is declining in Germany. Even if European laws, e.g., the water framework directive, combined with the national laws are an important step to avoid negative environmental impacts (see Chapter 2.2) of mariculture farms, the fact that there is no single authority responsible for aquaculture seems to be a serious problem for this sector. The list above shows that there are several authorities concerned with aquaculture matters, such as the authorities in charge of water management, nature protection or construction. Unfortunately, this often results in uncertainties regarding the competent jurisdiction. Due to the tight control measures (some of which have cost implications which make it difficult for inland and near-coast fish farmers to maintain economic viability) the future development of sustainable aquaculture farms, especially near coast mariculture, does not look promising as well (FAO 2005).

Even mussel farming, which is considered to be an extensive, environmental friendly farming activity, is facing increased regulatory difficulties that does not allow an expansion despite the fact that the demand for aquatic products is continuously increasing (Rosenthal et al. 2000). However, the aim to foster a sustainable aquaculture development cannot only be regulated by suitable laws but should also be supported by appropriate governance and management tools, which will be described in the next chapter.

3 THEORETICAL BACKGROUND

3.1 Concept of sustainability

As described earlier in Chapter 2.6 aquaculture is one of the most regulated food-production sectors in Europe. However, in some regions the explosive growth of this sector has exceeded the pace at which the governmental framework has been adapted. Therefore, in the context of a further development of aquaculture a great deal of literature is dealing with and many aquaculture experts are referring to the *concept of sustainability*, which has been developed due to difficulties in characterising sustainability. The Development Assistance Committee of the Organisation for Economic Co-operation and Development (OECD-DAC) defines sustainability as:

“The continuation of benefits from a development intervention after major assistance has been completed, the probability of continued long term benefits, and the resilience to risks of the net benefit flows over time.” (OECD-DAC Working Group on Aid Effectiveness 2002)

Most of the definitions of the *concept of sustainability* are focussing on the sustainability of activities that depend on the maintenance of environmental functions, directly and indirectly, and contribute to human welfare. However, often the emphasis of the definitions of sustainability or sustainable development depends on what people or organisations are focusing on, e.g., talking with environmental NGOs sustainability often means ‘ecological sustainability’ or with economists ‘economic sustainability’. In general, within the last few decades it was very popular to describe sustainability as a wide range of attempts to correlate economic activities with the maintenance of ecological capacity and values. Nevertheless, the popularity of this term, of course, do not guarantee that its broad acceptability might not be reached due to a lack of specific meaning. However, widespread thoughts, discussions, and the organisation of activities around the term “sustainable development” do reflect widely shared concerns about how human and environmental welfare can be maintained and improved (Lemmons et al. 1995, Kastenholz et al. 1996). According to these facts, the approach of the *concept of sustainability* is based on 3 different spheres: the environmental, the economic and the social sphere. Hence, using the term sustainability in this regard means a careful balance of ecological and economic and social sustainability (Fig. 3-1).

Today, especially larger companies have integrated those sustainability aspects into their business concepts (Jovane et al. 2008). The industries rank energy and climate-related issues as important, whereas in earlier times, these topics mattered only to environmentalists.

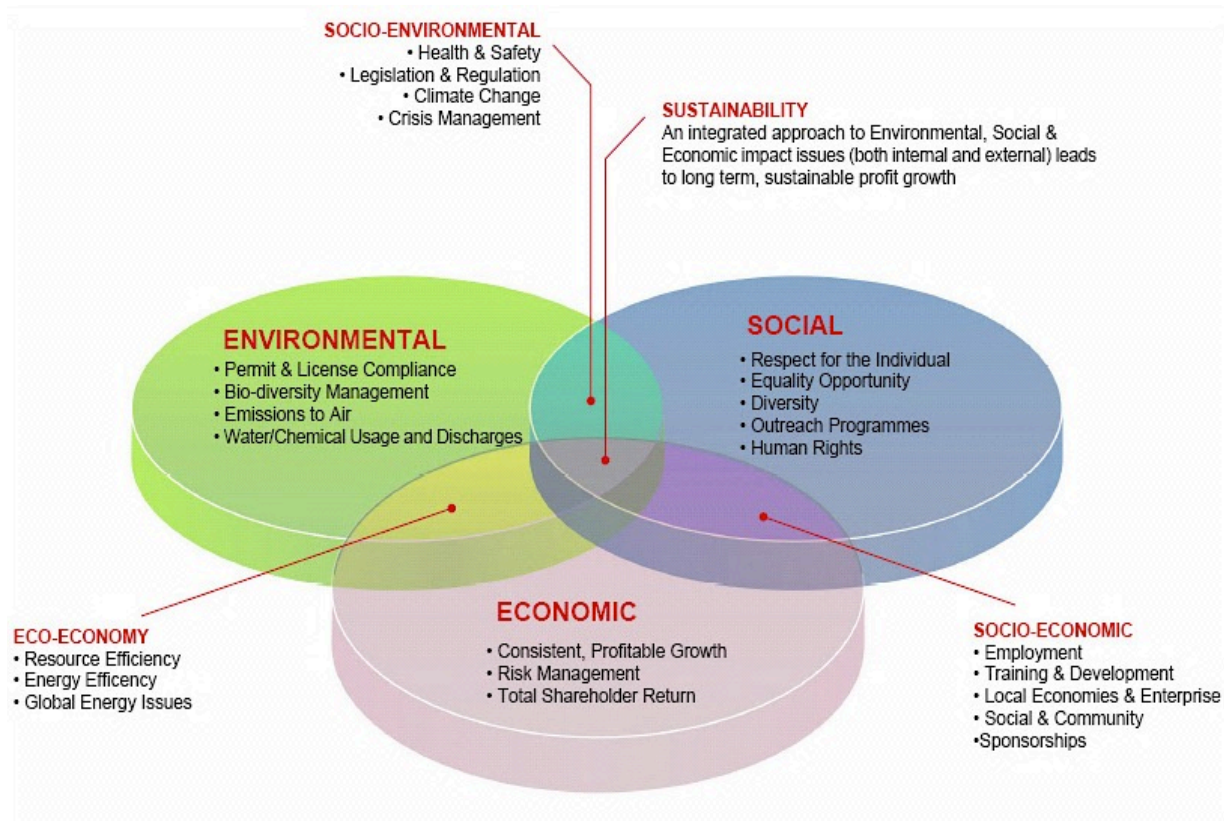


Figure 3-1. The three spheres of sustainability. Verify Technologies Limited (2008).

To achieve economic and environmental objectives simultaneously became a major challenge. Hence, within the last few decades there has been a shift in the context of sustainability from a distant, environmentally oriented ideology to an imperative factor for competitiveness (Schönsleben et al. 2010). Today, “the *concept of sustainability* is seen by many researchers as a solution in order to attack the possible limitation of the economic growth due to the increasing environmental load caused by the human community on the nature” (Coatanéa et al. 2006)

What does the concept of sustainability mean in the context of aquaculture?

As described in Chapter 2 there has been an increasing growth of mariculture within the last few decades in order to compensate the loss of importance of fishery (e.g., due to overfishing) and to supply the increasing demand of the growing world population regarding seafood.

Furthermore, within the last few years consumers have been developing an increasing interest in food produced in a sustainable way. In order to meet not only the interests of the consumer but also the requirements of the political framework regarding sustainability and hence, to change the often negative perception of mariculture several ideas and adaptations have been developed as, for example, shown in Figure 3-2. The main idea in this context, according to the *concept of sustainability*, is to make mariculture environmentally acceptable,

while also considering social and economic sustainability. Therefore, several indicators and certification systems have been developed in order to evaluate the use of resources' efficiency and sustainability in aquaculture (Boyd et al. 2007). Regarding the *ecological* effects of aquaculture, especially mariculture, there are several risks for the environment, e.g., eutrophication, organic pollution, contamination, genetic risk of escaped cultured animals and depletion of wild fish stocks due to the problem of feeding farmed fish with wild fish (Leung and Dudgeon 2008; Phillips and Subasinghe 2008). In order to quantify and assess all these factors the formerly used concept of ecological footprint of aquaculture, which was first applied to pond culture of Tilapia (Kautsky et al. 1997), has to be adapted. Today, ecological quality of mariculture can be assessed with respect to environmental impact on biodiversity, quality of surrounding water, effect on soil and groundwater, area used, and the amount of wild-caught fish needed to produce cultured fish. Except for the biodiversity, all mentioned indicators can be measured as impact per kg of fish produced or consumed (Bosma and Verdegem 2011)

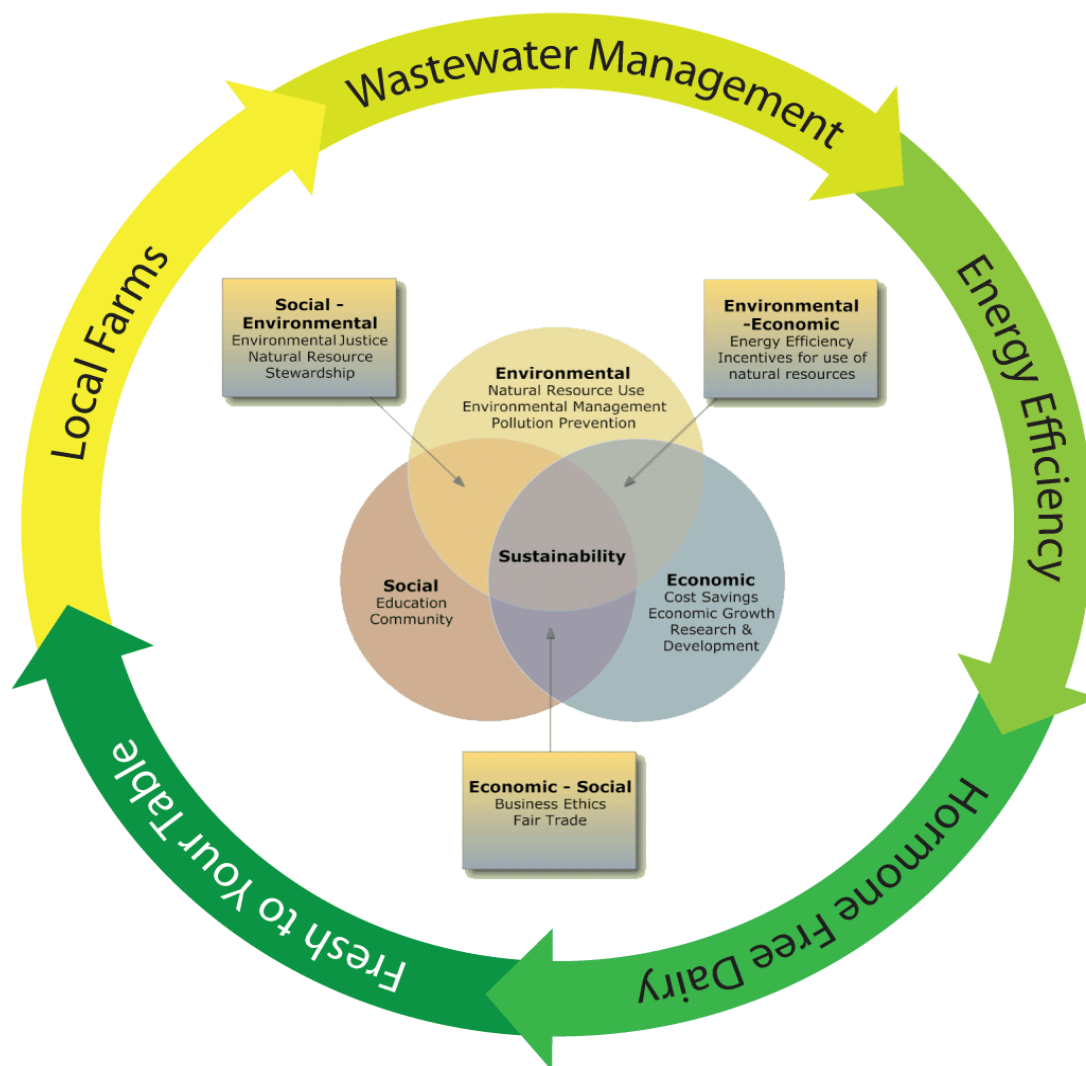


Figure 3-2. The three spheres of sustainability modified for sustainable farming practices. Sierra Nevada (2011).

In the context of *economic* sustainability regarding aquaculture, of course the balance between investments and market prices of the products are of importance, because it implies the efficiency of the production. In this regard circulation systems in particular are still in the fledgling stages due to high energy demands as well as high investment costs compared to mariculture systems. Therefore, the main indicators for ecological sustainable aquaculture include the awareness, perception, acceptance and demand for those products combined with the population density and income of the target group. In addition quality, cost, delivery reliability, and flexibility towards customer needs as well as the institutional support, the scale of production, and the risks of crop failure are of importance (Bosma and Verdegem 2011).

Besides the ecological and economic sustainability of aquaculture the *social sustainability* is the third pillar of the *concept of sustainability*. Here, the indicators focus on household capabilities (Sen 1981) and entitlements to resources (Leach et al. 2009). Issues such as education, social status and access to institutions define household capabilities with a clear link between social vulnerability (non-sustainability) and the access to institutions, resources and markets (Bosma and Verdegem 2011). Especially small mariculture farmers selling their products through retailers or supermarkets often have a reduced gain compared with direct marketing. Within the study areas this phenomenon can be mainly explained by high production costs compared with cheap seafood imports from, e.g., Asia.

Whereas the ecological and economic sustainability issues of mariculture are a well-studied research field, the socio-environmental and socio-political aspects of sustainability in this context were rather neglected. Therefore, this thesis is mainly dealing with such aspects as well as concerns about the aquaculture sector generated within the last few years (Nobre et al. 2010; Allsopp et al. 2008; 2001; Gibbs 2009; Islam 2005; Kaiser and Stead 2002).

The development of aquaculture, especially mariculture, was often limited before its potential is fully used due to the fact that governance, political will and public awareness were influenced by negative feedbacks on this sector (Nobre et al. 2010; Gibbs 2009). Therefore, in addition to the commonly used 3-pillar concept of sustainability (ecological, economic and social) a better approach regarding sustainable aquaculture would be to consider a fourth pillar: (Good) governance. Javier Ojeda described good governance as a distinct key for sustainability of aquaculture and the lack of good governance as the main barrier for aquaculture development in the European Union and other countries (Ojeda 2010). He argued that good governance is the most modern paradigm for successfully driving aquaculture into the 21st century.

3.2 Concept of good governance

According to the United Nations Development Programme, governance is a process of decision-making and the process by which decisions are implemented or not implemented (UNDP 1997). Hence, governance focuses not only on the formal and informal actors involved in decision-making processes and the implementation of the decisions but also on the formal and informal structures that have been set in place to arrive at and implement the decision. Besides the government, which is one important actor in governance, other actors, which are further involved in such processes, depend on the level of government that is under discussion (UNDP 1997).

Generally speaking, governance is seen as the management of resources and policy-making by the authority. This management includes different instruments for policy- and decision-makers in order to achieve ecological, economic, political, cultural and social aims. It includes finding solutions to problems, creating opportunities and guiding the development of sectors towards specific aims (FAO 2009). The difference between the current governance approach and the former government approach can be seen in Table 3-1.

Table 3-1. Government and governance perspectives. Bruns (2010) modified from Benz (2004).

	Former Government Perspective	Governance Perspective
Polity	Focus on state	Institutional structure combining different forms of coordination
	Hierarchy as the most important institution	Important institutions: networks and cooperation
Politics	Conflict settlement through decisions of the responsible authority	Conflicts and hearings Adaptation of institutional regulating systems
Policy	Law, focus on programmes, plans...	Communication, compromises, network management

Today, the *concept of good governance* has become regular tool used in political science and public administration as well as regional development. It is responsive to the present and future needs of the society and comes along with terms like democracy, participation and sustainable development. Nevertheless, the concept can be criticised for vagueness due to the fact that

“...there is no single agreed-upon definition good governance. In fact, the vagueness of its meaning is one reason why this term has increasingly been utilised, as it can convey a slightly different meaning depending on who uses it”
(Aubut 2004, p. 8).

Even if there is still no generally accepted definition of this concept several major characteristics strengthen good governance in any society. It assures that corruption is minimised, the views of minorities are taken into account and that the voices of the most vulnerable in society are heard in decision-making (OECD 2001). The UNDP put these major characteristics into five principles of good governance:

1. Legitimacy and Voice

- *Participation – all men and women should have a voice in decision-making.*
- *Consensus orientation – good governance mediates differing interests to reach a broad consensus on what is in the best interest of the group.*

2. Direction

- *Strategic vision – leaders and the public have a broad and long-term perspective on good governance and human development.*

3. Performance

- *Responsiveness – institutions and processes try to serve all stakeholders.*
- *Effectiveness and efficiency – processes and institutions produce results that meet needs while making the best use of resources.*

4. Accountability

- *Accountability – decision-makers in government, the private sector and civil society organisations are accountable to the public, as well as to institutional stakeholders.*
- *Transparency – transparency is built on the free flow of information.*

5. Fairness

- *Equity – all men and women have opportunities to improve or maintain their well-being.*
- *Rule of Law – legal frameworks should be fair and enforced impartially, particularly the laws on human rights (Graham et al. 2003).*

These major characteristics, especially ‘transparency’ and ‘participatory’ gain confidence and acceptance among policy-setters and planners, as well as with community groups and civil society (Cooke and Kothari 2001; Lovan et al. 2004; Kim et al. 2005; Ribot and Larson 2005). For the European Union these principles are outlined in the European Governance White Paper (COM 2001). Further components of good governance, especially in participatory spatial planning, combined by McCall and Dunn, are illustrated in Figure 3-3.

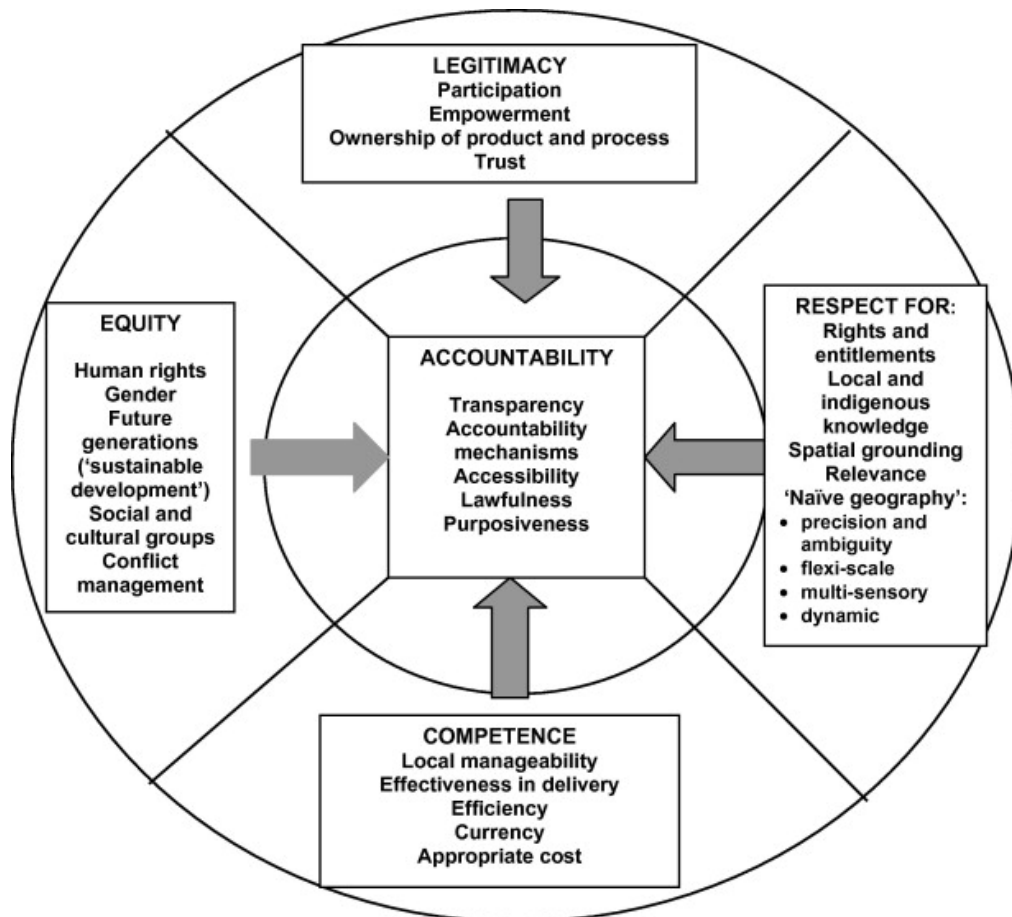


Figure 3-3. Components of good governance in participatory spatial planning. McCall and Dunn (2011).

What does good governance mean in the context of aquaculture and mariculture?

Unfortunately, the wide-ranging literature regarding governance does not always distinguish between governance and good governance (e.g., Aubut 2004; van Kersbergen and van Waarden 2001; Kim et al. 2005). Nevertheless, within the last few years there have been several scientific papers dealing with good governance in the context of aquaculture. Natural-resource-related activities, such as mariculture, cause environmental problems in many areas. Besides the environmental pressures generated directly by the activities themselves, e.g., water pollution, there are often land-use conflicts, namely when facilities are located in regions with high ecological value, or near areas where other human activities, such as urban development or tourism, take place (Santos et al. 2006).

Especially in those areas the involvement of the stakeholders in the policy development process is very important in order to strengthen the regulating system and hence the policy instruments. These are rather difficult and challenging tasks, not only from an environmental point of view, but also within social and economic dimensions (see, for example, Weersink et al. 1998; Romstad 2003). Scherer (2005) described a reference framework for regional

governance, which can be adapted in this context and regarding a further development of mariculture in the research areas.

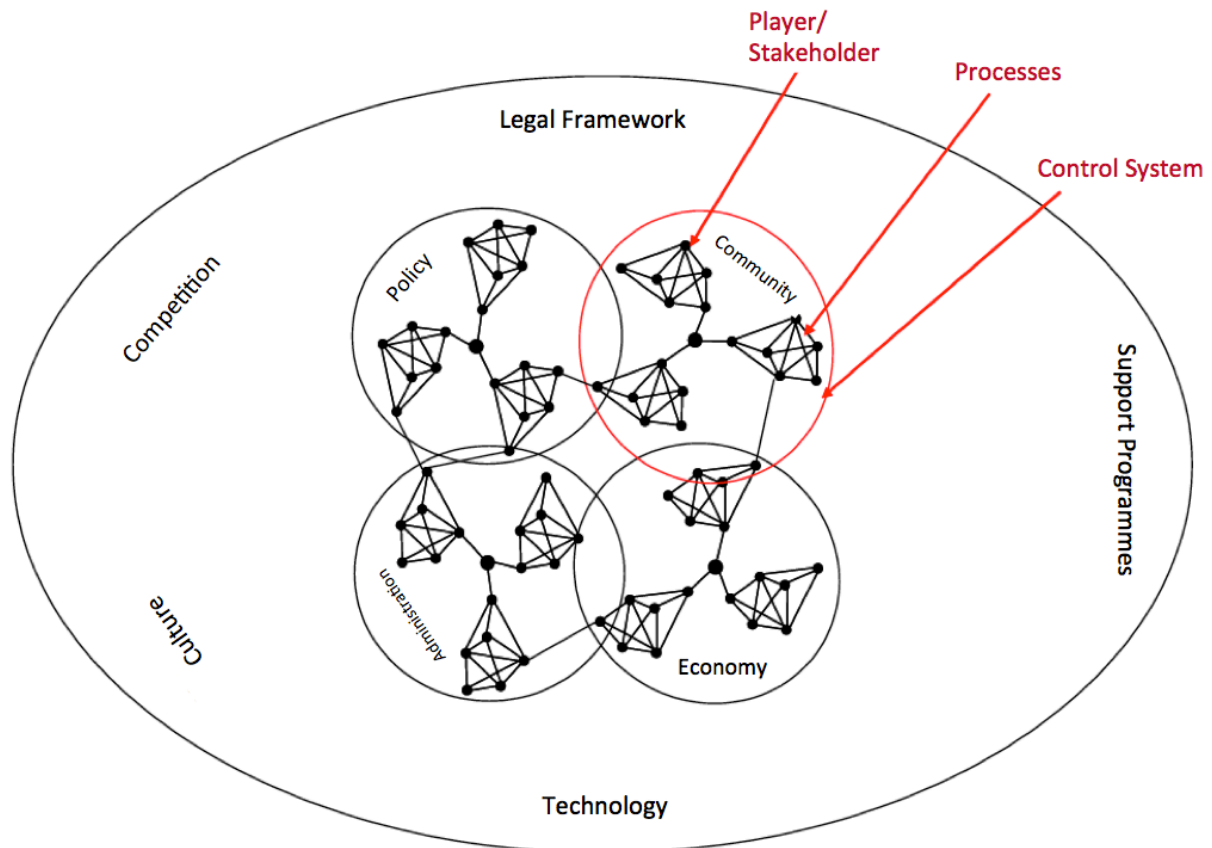


Figure 3-4. Regional governance. Modified after Scherer (2005).

In Figure 3-4 governance can be seen as the generic term for the coordination of different activities, such as hierarchy, market and civil society, and hence, as a form of government with involvement of the civil society. In the context of spatial processes in coastal areas regarding mariculture, governance implies mandatory regulations, such as spatial and land use planning, combined with a participation and monitoring system for the civil society, e.g., through networks.

Additionally, on the Aquaculture Europe Conference 2010 in Porto, Javier Ojeda from the Federation of European Aquaculture Producers (FEAP) pointed out that *Good Governance* needs rules of law and an adequate legislative framework. In this regard, the official rules and regulations (hard laws) should be more transparent, equitable, predictable and enforceable. Furthermore, in order to develop a sustainable aquaculture sector in Europe, other indirect instruments (soft laws) are important to support and encourage entrepreneurship, such as

- “Levelling of the playing field,
- Integrated zone management,
- Vigilance of fair competition (value chain),
- Mitigation policies against market failures and
- Implementation of compulsory labelling.

Good governance requires intelligent planning, coordination and constructive work. Poor governance is the result of political idleness and uncoordinated administration.” (Ojeda 2010).

3.3 Integrated coastal zone management

Since 1995 the European Union is developing the Integrated Coastal Zone Management (ICZM) due to concerns about the state of its coastlines. A number of demonstration projects, providing the EU Commission with arguments to make recommendations to all member states for adopting an ICZM strategy, resulted in the “Recommendations of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe (2002/413/EC)”. Further the European Parliament stated:

“Our coastal zones are facing serious problems of habitat destruction, water contamination, coastal erosion and resource depletion. This depletion of the limited resources of the coastal zone (including the limited physical space) is leading to increasingly frequent conflict between uses, such as between aquaculture and tourism. Coastal zones also suffer from serious socio-economic and cultural problems, such as weakening of the social fabric, marginalisation, unemployment and destruction of property by erosion. Given the coast’s critical value and its potential, these problems must be solved.” (EC 2000)

One of the difficulties of coastal management has always been the absence of policy elements, which comprehensively tackle the area between the sea and the land boundary (Skourtos et al. 2005). The ICZM is a continuous, proactive and adaptive process of resource management for sustainable development in coastal areas covering the sea and the land boundary. Today, ICZM is generally recognised as the most effective tool for incorporating conservation and sustainable use of marine and coastal biodiversity aspects into the planning of coastal areas (Pickaver et al. 2004). The principles of ICZM are largely defined by the general principles adopted for a sustainable coastal development, such as the Holistic Approach, the Ecosystem Approach and the Good Governance.

The initial concept of ICZM is based on horizontal and vertical integration. Furthermore, there are a number of dimensions of integration that need to be taken into consideration within the ICZM process (Fig. 3-5). These include:

vertical – integration among institutions and administrative levels within the same sector;

horizontal – integration among various sectors at the same administrative level;

systemic – the need to ensure that all important interactions and issues are taken into consideration;

functional – interventions by management bodies which must be harmonised with the coastal area management objectives and strategies;

spatial – integration between the land and marine components of the coastal zone;

policy – coastal area management policies, strategies and plans which need to be incorporated into broader-scale (including national) development policies, strategies and plans;

science management – integration among different scientific disciplines and the transfer of science for use by end-users and decision-makers;

planning – plans at various spatial scales should not have conflicting objectives, strategies or planning proposals; and

temporal – coordination among short-, medium- and long-term plans and programmes.

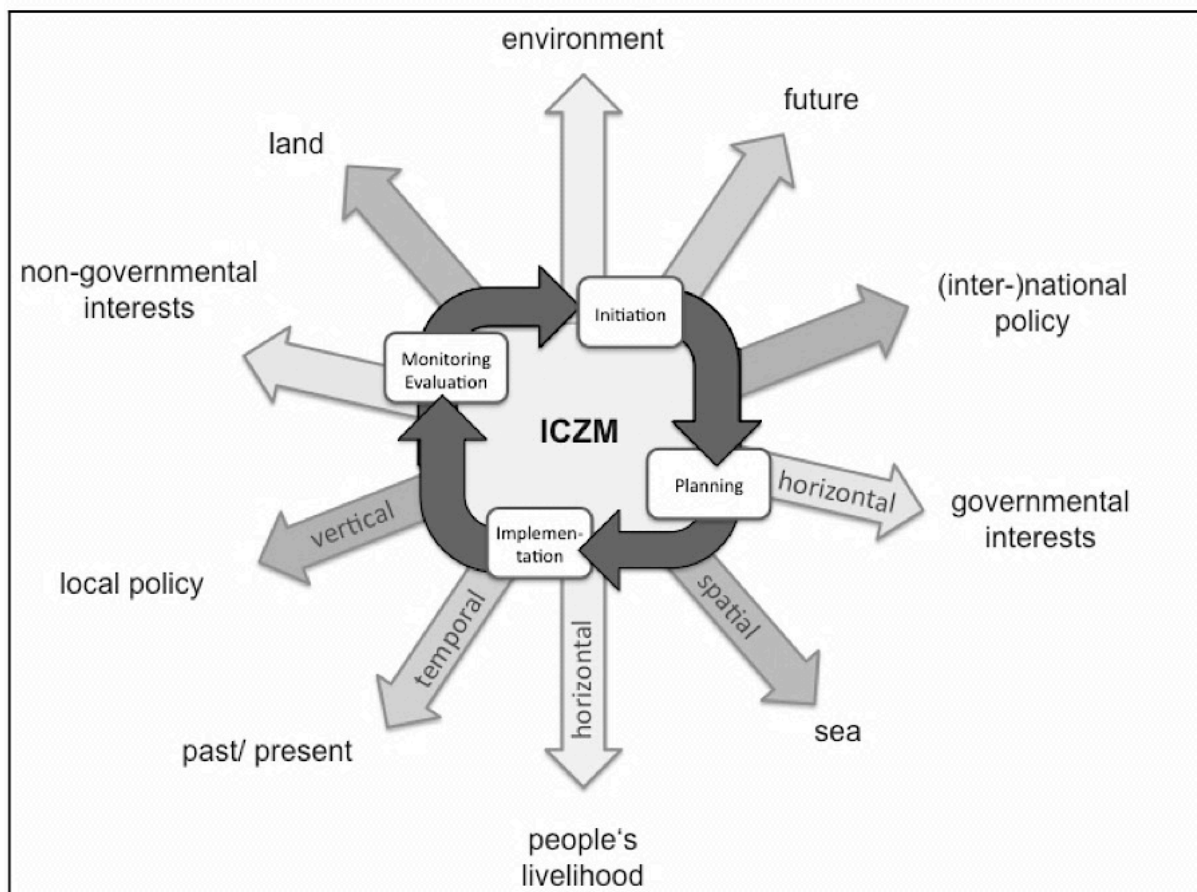


Figure 3-5. The four phases of the ICZM process (inner circle) and the most important levels of integration. Sterr and Maack (2010) modified after Kannen (2000).

These integrations suggest that projects promoting ICZM need to be adapted to each specific cultural, natural and political context. Further, active public participation as an essential component of the ICZM process should take priority in planning and coastal decision-making (UN 1992, EC 2000, Santoro 2009) in order to achieve overall social, economic and environmental benefits (Fig. 3-6).

Table 3-2. Benefits of an integrated coastal zone management. UNEP (2009).

SOCIAL BENEFITS	ECONOMIC BENEFITS	ENVIRONMENTAL BENEFITS
Provides diverse opportunities for recreation, leisure and cultural activities and thus improves the quality of life	Supports sustainable economic activities and thereby ensures income in the long run	Ensures integrity of the coastal environment and biodiversity as a natural system
Helps resolve conflicts	Allows better zoning and use allocation	Ensures the sustainable use of natural resources
Strengthens institutional frameworks and enforces cooperation among stakeholders on the basis of shared objectives	Improves management (legal framework, risks, help to the decision-making process) and thus permits gains in efficiency and time	Preserves and improves natural areas (habitats, species and biodiversity)
Provides security from natural hazards and risks	Develops new economic instruments to finance environmental protection	Improves pollution control
Raises public awareness and favours information exchange on sustainable development and environmental issues	Promotes environmentally-friendly technologies and cleaner production for the markets of tomorrow	Improves beachfronts and soil alteration management
Encourages broader public participation	Adds value to products through eco-labelling schemes	Integrates river basin management

As mentioned before, ICZM aims to preserve coastal resources, their ecological functioning and ultimately their values by applying adequate land and sea use planning within a social, institutional and economic context. In practice, a reasonably good understanding of the approaches, key principles and guidelines, as well as frameworks and techniques for organising and implementing programmes have been developed. The ICZM is also beginning to benefit from collective experiences. Nevertheless, it is still facing a rather extensive list of challenges that must be overcome if ICZM is to produce the desired outcomes that are needed in coastal zones (UNEP 2009).

According to Pickaver, measuring the progress of the implementation of the ICZM cycle alone will not necessarily be indicative of how successful ICZM is in reversing the decline in Europe's coastal regions. In order to ensure that the ICZM cycle is actually leading to the sustainable use of coastal resources he pointed out that it will also be necessary, to concomitantly measure whether there has been any improvement in the state of the coast. Only then, with any degree of certainty it can be stated that enhanced implementation of ICZM is leading towards sustainability on a local regional and national level (Pickaver et al. 2004).

As stated before, an essential component of the ICZM process is the public participation in planning processes. Public participation has been proposed in order to open the debate, contribute to policy formulation, increase government accountability, build support for agency programmes, reduce community tensions and increase the sustainability of the actions. Ernoul analysed the success of three different ICZM projects based on 8 process and result indicators. He pointed out that public participation does neither seem to have an impact on the overall project objective nor on the sustainability indicators. Furthermore, he stated that long-term sustainability and natural resource management can only be achieved when the projects and activities are adapted to meet the reality on the field (Ernoul 2010).

In fact, ICZM is hard to teach in terms of inter- and trans-disciplinary perspectives, which are necessary to acquire a holistic understanding of the coastal system, on the one hand, and deal with institutional practice and policy frameworks on the other.

In this regard Garriga and Losada stated that the advanced ICZM practice in Europe requires education and training efforts that respond to:

- “Capacity requirements based on a thorough assessment of existing capacities in ICZM as well as emerging needs that could be resolved through education and/or training (following the simple equation of “what I have and what I need”); this assessment should embrace both public and private sectors at all levels – from local to national.
- Based on the outcomes of the needs assessments, educational and training programmes should better respond to the specific needs of different types of coastal practitioners and policy makers.
- In order to avoid a fragmentation of efforts as well as to efficiently use existing capacities in the region, strategies on education and training for ICZM should be embedded in a broader Plan of Action for capacity building in Europe, that coordinates initiatives across the whole region to enhance not only ‘human’, but also ‘institutional’ capacities across Europe, in support of current or future implementation of ICZM initiatives.” (Garriga and Losada 2010).

The Integrated Coastal Zone Management in the context of mariculture.

Besides the idea of future mariculture farming in offshore wind farms, today mariculture sites are often close to the waterfront, especially in order to protect them from wave energy. Furthermore, they need good water quality as well as suitable conditions for the biological requirements of the farmed fish, mussel or algae. Along the crowded coastal zones of the European Union and Israel it is difficult to access such suitable sites for mariculture farming, e.g., due to competing uses.

	Offshore wind farms	Marine protected areas	Fisheries	The sea as a public good	Cables	Tourism	Shipping routes	Harbours and ports	Agriculture/run-off	Sand and gravel extraction	Oil and gas exploration	Dumping of dredged material	Aqua- and mariculture	coastal service centres	nature conservation	coastal protection	Military use
Offshore wind farms		x	x	x			x			x	x	x					x
Marine protected areas	x	x	x	x	x	x	x	x	x	x	x	x	x				x
Fisheries	x	x	x	x	x		x		x	x			x				x
The sea as a public good	x	x	x				x			x	x	x	x				x
Cables		x	x				x		x	x	x	x				x	
Tourism		x													x	x	x
Shipping and shipping routes	x	x	x	x	x					x	x	x	x				x
Harbour and ports		x											x		x		
Agriculture/run-off		x	x	x									x		x		
Sand and gravel extraction	x	x	x	x	x		x			x	x	x	x		x	x	
Oil and gas exploration	x	x		x	x		x			x	x	x	x				x
Dumping of dredging material	x	x		x	x		x			x	x	x	x				
Aqua- and mariculture		x	x	x			x	x	x	x	x	x	x		x		x
Coastal service centres															x		
Nature conservation					x	x		x	x	x			x	x		x	x
Coastal protection						x				x					x		x
Military use	x	x	x	x		x	x				x		x		x	x	

x = incompatible
 X = conditionally compatible
 Blank field = compatible

Figure 3-7. Estimation of the compatibility of individual forms of use on coasts and seas. Kannen et al. (2010) modified after Gee et al. (2006). For easy analysis, the table only considers spatial compatibility and does not take any social or aesthetic criteria into account. As such, incompatibility simply indicates that two forms of use cannot occupy the same coastal or marine space but does not exclude co-existence per se, for instance as 'peaceful neighbours'.

There are several competing marine activities, which have to be considered with regard to further development of mariculture, such as fisheries, shipping, harbours, marine recreation as well as water quality, biodiversity and nature conservation. Hence, a multiple-use management according to the principles of an ICZM is necessarily bringing together not only the different uses but also the various government sectors. In Figure 3-7 Gee et al. (2006) estimated the compatibility of individual forms (including aquaculture and mariculture sites) of use on coasts and seas.

Additionally, the wider diffusion of information about marine conditions and activities to coastal communities and visitors is also essential. With regard to a future development of mariculture, it is important to strengthen the knowledge about impacts, costs and benefits of this sector in order to strengthen the acceptability of new mariculture sites. However, finding suitable sites for mariculture farming within the European Union is not only problematic due

to competing uses or a lack of acceptance. The political procedures are cumbersome, long and expensive with an involvement of numerous public offices (Ojeda 2010). Furthermore, Ojeda stated that the mounting problems in this regard are:

- Lengthy biological cycles require lengthy leases
- Inadequate relations between administrations
- One-stop shop is not enough
- Widespread ignorance about aquaculture in general
- Authorities give in with respect to other interests

Additionally, not only in the context of a further development of mariculture, the NIMBY (Not In My Backyard) can be observed (Ojeda 2010). Hence, according to an ICZM, all actors involved in use and management of the marine resources have to be involved in the ICZM participatory and decision-making processes and should be consulted in a transparent way. Hereby, choices and decisions have to take all regulations, relevant national, international and customary laws into consideration (Simard 2011). Further, the selection of suitable sites has to be done through a participatory process involving all relevant components of the society. Besides the participatory approach a further important principle of ICZM is the combination of instruments. In particular, the integration of the EU policy and ICZM recommendations, the water framework directive (WFD) and the Marine strategy directive provide opportunities for a complex coastal zone management facing a future development of near-shore mariculture (Fig. 3-8).

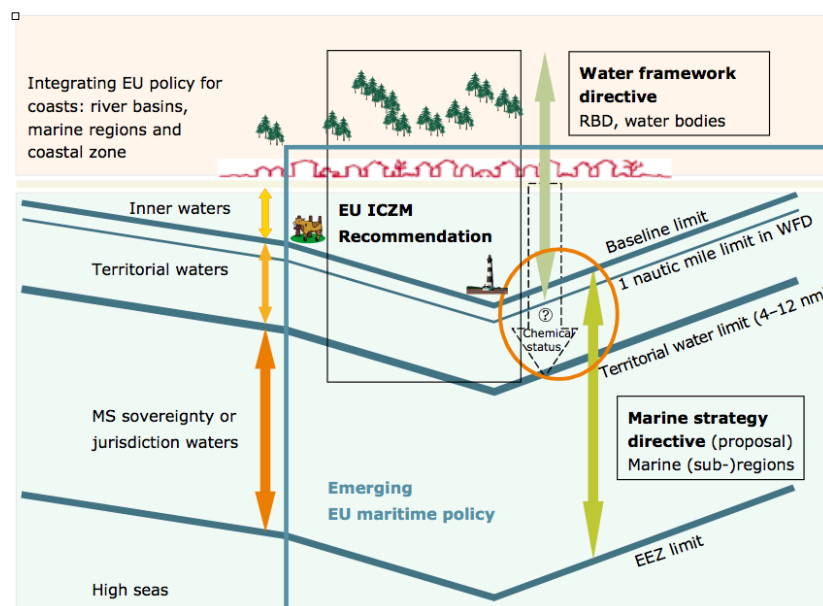


Figure 3-8. Integration model of river basins, marine regions and coastal zones. European Environment Agency (2006).

Considering the long-term perspective and local implications of ICZM a further important issue with respect to the development of mariculture throughout the world is the concept of “carrying capacity”. Inglis et al. (2000) divided carrying capacity into four functional categories:

- physical carrying capacity – the total area of marine farms that can be accommodated in the available physical space,
- production carrying capacity – the stocking density of bivalves at which harvests are maximised,
- ecological carrying capacity – the stocking or farm density which causes unacceptable ecological impacts,
- social carrying capacity – the level of farm development that causes unacceptable social impacts.

Based on these categories McKindsy et al. (2006) proposed a hierarchical approach to determine the carrying capacity of an area (Fig. 3-9). At the first level, the physical carrying capacity of the site is determined by available natural conditions and the needs of the culturing or farming process. Secondly, the production carrying capacity of the available area is calculated based on efforts and results. Third, the ecological carrying capacity of the area is estimated by evaluating the range of possible outcomes for production estimates varying between no production (and/or the current level) and maximum production calculated as the production carrying capacity.

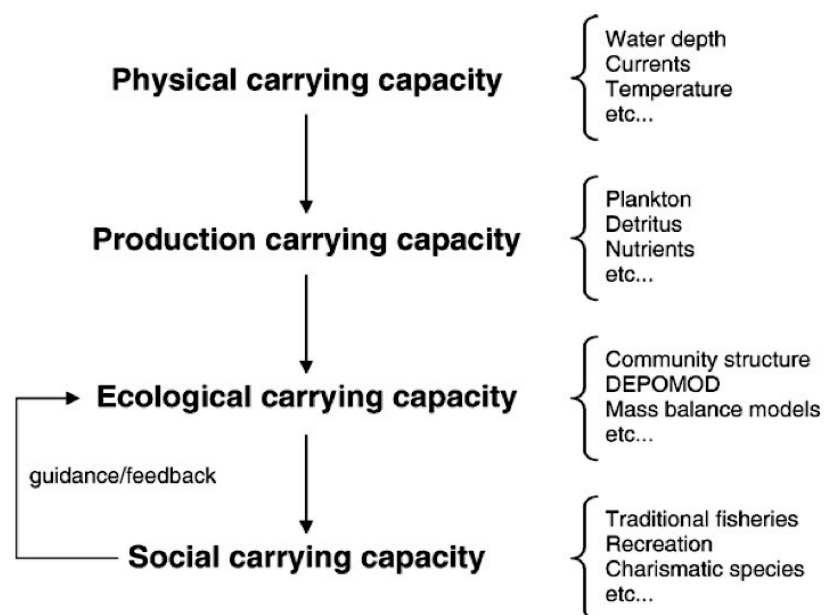


Figure 3-9. Hierarchical structure to determine carrying capacity of a given area. McKindsy et al. (2006). Note that social carrying capacity feeds back directly to ecological carrying capacity to provide guidance to choose pertinent response variables to measure.

Based on their research results McKindsy et al. (2006) suggested that more studies must be done to better understand the environmental interactions (positive and negative). Furthermore, existing models should be modified in order to be spatially explicit and temporal variations must be built into existing models. This is especially true with respect to harvesting and other seasonal activities.

Good governance using tools like ICZM is essential for a sustainable development of mariculture. Nevertheless, involving different stakeholders as well as the wider public in planning and decision-making processes also means dealing with different attitudes concerning this sector and its products. The correlation between attitudes towards a sector and action tendencies (behaviour) with respect to it will be discussed in the next chapter.

3.4 Attitude-behaviour models

Economic behaviour is a set of actions that is determined by clearly defined preferences held by agents/actors/individuals and is consistent with an overall objective of maximising welfare/utility/well-being of the individual. The formation of preference and the interaction between attitudes and economic behaviour is addressed within the field of economic psychology. Nine separate categories used in economic psychology were classified by Lea (1992). These draw most heavily on theories of cognitive psychology. These theories again focus on the attitudes underlying behaviour, including economic behaviour and in particular, the extent to which behaviour is congruent with attitudes. Attitudes are the natural source of 'soft' data on preferences that are the complement of behaviour. In general, economic behaviours are readily observed in market and quasi-market settings. This is not the case for attitudes and an important dimension of research is the identification of attitudes that can be readily measured and used as predictors of behaviour (Etzioni 1991). Druckman and Lupia (2000) addressed the issue of preference formation in political science, and classify models that describe individuals' preference formation as either online models or memory-based models.

In online models individuals form and maintain in their minds a running 'evaluation counter' of certain objects. This evaluation counter contains affects related to objects. When an individual encounters new information and new stimuli about an object, she or he recalls this evaluation counter into working memory and updates it with that new information. Afterwards, the evaluation counter is no longer connected to that information and the information is forgotten. Online models are applicable when people believe that a judgement will probably be required in the future.

The idea behind memory-based models is that people base their evaluations on information that they retrieve from their long-term memory. Each individual recalls relevant information and integrates it into an overall evaluation (e.g., Fishbein and Ajzen 1975). According to memory-based models, individuals engage large amounts of computation when they form their preferences.

The development of these models has in turn led to models that describe preference formation assuming less computation. Those models point out that only some accessible or salient considerations or beliefs will be retrieved from the memory when forming a preference. In an extreme case, when there is no motivation or ability to engage a memory search, a person bases her or his evaluation on whatever information happens to be accessible (Fazio 1990). The most accessible considerations are likely to be the most recent ones.

The **Theory of Planned Behaviour** (TPB) is a memory-based model explaining individual evaluations and behaviour. It is based on a long research tradition in social psychology focusing on attitudes as predictors of behaviour (i.e. an attitude-behaviour framework). Since its inception in the early 1900s, attitudes have been used to explain behaviour. Fishbein and Ajzen (1975) defined an attitude as a disposition to respond favourably or unfavourably to a commodity or event. Early attitude-behaviour studies simply tested the assumption that attitudes toward objects create the behavioural predisposition underlying any action with respect to that object. Historical perspectives on this body of theory can be found in McGuire (1985) and Ajzen and Fishbein (1980).

An alternative to this simple attitude-behaviour approach takes a multicomponent view according to which attitudes are regarded as a system of three components:

- a. a person's beliefs about the object (cognition);
- b. his or her feelings about the object (affect); and
- c. his or her action tendencies with respect to the object (behaviour).

In the expectancy value model of attitude, a person's belief that the object of the attitude has certain attributes is known as an expectation and his or her evaluation of the object is the value. The affective component of an attitude is a function of the products of these expectancies and values (Fishbein 1963). The attitude model of Fishbein (1963) was originally developed to predict and explain attitudes towards objects, but was reformulated to predict attitudes toward behaviour. A precursor to the TPB is Ajzen and Fishbein's (1975) **Theory of Reasoned Action** (TRA). It is an attitude model that is one of the most frequently applied social psychological theories of human behaviour. It has dominated attitude research in consumer psychology and has been extensively used to predict market purchases. It has also been applied to research in forest management (Young and Reichenbach 1987). Sheppard et al. (1988) provided a meta-analysis of this body of research. TRA was developed to predict individual volitional behaviour. According to TRA, actual behaviour is preceded by behavioural intentions. In the causal chain, behavioural intention is a composite of subjective norms and attitudes towards this specific behaviour. Ajzen and Fishbein (1980) suggested that attitudes are viewed as overall evaluations. They contended that an attitude toward any concept "...is simply a person's general feeling of favourableness or unfavourableness of that concept". In the TRA the concept of interest is the implementation of a specific behaviour; that is, the object of the attitude and the prediction of this behaviour. The theory includes an additive model in which attitude (A) is formed as a summative belief index that is composed of n salient beliefs about the outcomes of specific behaviour and the evaluations of those outcomes. A subjective norm deals with the influence of the social environment on intentions and behaviour. A subjective norm (SN) refers to a person's perception of whether people who are important to him think she/he should or should not

perform the behaviour in question. SN is directly proportional to the sum of the products of normative beliefs and motivations to comply for salient referents that are important for the individual. The TRA incorporates a feedback mechanism, reflecting the fact that attitudes, beliefs, norms and expectations are influenced by behavioural experiences. The incorporation of this process of dynamic adjustment makes predicting behaviour under novel conditions or predicting a unique type of behaviour more difficult than predicting customary behaviour. The theory of planned behaviour (TPB) expands the applicability of TRA to behaviours that may not dependent on volitional control alone (Ajzen and Madden 1986, Ajzen 1991). TPB includes a new control factor in explaining behavioural intention: **perceived behavioural control** (PBC). PBC is the actor's evaluation of the perceived ease or difficulty of carrying out a specific action. It often reflects past experience and anticipated impediments and obstacles based on second-hand information. PBC is proportional to the summation of control beliefs as well as to the perceived power of the control factor. Thus, in addition to including components of the theory of reasoned action, attitude (*A*) and subjective norm (*SN*), the theory of planned behaviour also includes perceived behavioural control (*PBC*) as a determinant of behavioural intention (*BI*). Therefore, as shown in Figure 3-10, behavioural intention is formed as a weighted combination of attitudes, subjective norms and perceived behavioural control,

$$BI = f(A, SN, PBC)$$

According to the theory of planned behaviour as well as to the theory of reasoned action, an attitude is determined as a function of the strength of beliefs and the evaluations associated with the attributes. The theory of planned behaviour has been applied, for example, to explain environmentally oriented behaviour (e.g., Lynne et al. 1995, Moisander 1996, Taylor and Todd 1997, Harland and Staats 1999, Cheung et al. 1999, Trumbo and O'Keefe 2001) and nature-related leisure behaviour (e.g., Hrubes et al. 2001, Ajzen and Driver 1992).

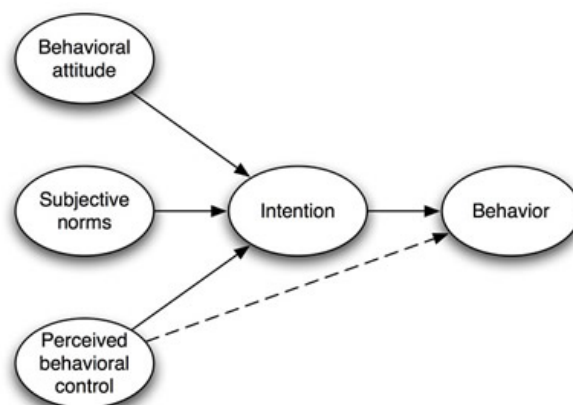


Figure 3-10. Attitude-behaviour model. Ajzen (1991).

Research in organisational social, psychology and political behaviour point to the major role of attitudes in shaping behaviours in various situations (Lewin 1936; Rokeach 1968; Randolph 1985). For example, in Human Resource Management, the notion that employees with positive workplace attitudes will exhibit better performance and higher contribution to the organisation's productivity is widely accepted (Mowday, 1985). In political science citizens' attitudes toward government are known to influence electoral behaviour and political participation (Philip and Angell 1987; Phillips 1991; Verba et al. 1995).

What do attitude, perception and behaviour mean in the context of mariculture?

There is little systematic research into public knowledge, perceptions, attitudes, preferences and behaviours related to mariculture.

Social research related to mariculture began to shed light on factors that influence people's attitudes and behaviors and how these interact in the context of mariculture activities (Mazur et al. 2005). In particular, it has been used to answer the questions:

1. How does the public perceive the business operations and management within the sector?
2. How knowledgeable are people with respect to the ecosystems on which mariculture depends?
3. How are the trade-offs between mariculture and other stakeholders in the coastal zone perceived?

One of the largest studies of community perceptions regarding mariculture was conducted in Australia over a period of three years and involved an extensive review of existing literature, stakeholder interviews and mail surveys conducted in two areas on the country's southern coast (Mazur and Curtis 2008). One of the motivating factors behind this study was the insufficient attention paid to risk perceptions and communication among the general public and its negative consequences for the industry. One of the foci of the survey was therefore the way that perceptions of risk informed people's concerns about the aquaculture industry. Respondents were asked about their level of knowledge, interest and contact with the aquaculture sector; their opinions about the sector's social and environmental risks and benefits; their level of trust in government and industry and the nature of their risk perceptions. The survey found that while overall a high percentage of respondents ranked their level of knowledge as low, self-rankings and actual knowledge varied considerably regionally. Knowledge about different levels of government involvement with the industry was ranked particularly low while most respondents placed high value on public input in the policy-making process. Respondents with high exposure to the industry also had the highest

level of awareness of its socio-economic benefits. Those with less direct exposure demonstrated greater concern for environmental sustainability. Moreover, a majority of respondents showed strong environmental interests.

This last finding is broadly consistent with a number of studies suggesting that the broad public favours environmental preservation over a range of economic interests in decisions that involve trade-offs between the two (Connelly and Knuth 2002; Nancarrow and Syme 2001; Tarrant et al. 2003). The environment-economy trade-off was refined in the context of aquaculture by Whitmarsh and Palmieri (2008) and Whitmarsh and Wattage (2006) who found that economic benefits of the sector are more highly ranked by individuals having direct contact and involvement in aquaculture. Both these studies used the Analytical Hierarchy Process (AHP) to rank respondents' preferences. Both studies used the output of the AHP to study respondents' *willingness to pay* (WTP) a premium for salmon farmed using environmentally sustainable methods, finding that in general respondents are willing to pay more for fish that they believe is farmed in a sustainable manner. This finding is consistent with other studies indicating a willingness to pay 5-10% more for sustainably cultivated products (Barrington et al. 2009; Seafood Choices Alliance 2003).

Trust in industry and policy makers is also an important determinant of levels for social acceptability of aquaculture and development of the sector (Kaiser and Stead 2002; DFO 2005). In a study by Barrington et al. (2009) many respondents indicated that they are not adequately informed about the seafood available to them.

3.5 The role of public and stakeholders' attitudes and perceptions in a sustainable mariculture development

Based on the different concepts it is obvious that public and stakeholder involvement in decision-making processes regarding mariculture development are a very important issue. New instruments are required to handle sustainability issues not only in agriculture and rural industries (Mech and Young 2001) but also in the aquaculture sector. In principle, the adoption of mixed approaches, combining governmental regulation with economic incentives and voluntary schemes, is seen as a promising route, likely to result in the best environmental, marketplace and social outcomes (Weersink et al. 1998). Participation in the development of public policies is seen as a good/one way to gain the support of stakeholders: the more they feel that they have a voice in decisions affecting them, the more likely they will comply with the new requirements (Bryner 2001).

In general, citizens' involvement and political participation has been one of the most studied concepts in political science. Verba, Scholzman, and Brady (1995) argued that "citizen participation is at the heart of democracy" and that "democracy is unthinkable without the ability of citizens to participate freely in the governing process". Barner-Barry and Rosenwein (1985) suggested that democratic values are in essence participatory values, emphasising that the heart of democratic theory is the involvement of people in the process of governing. One common definition of political participation was proposed by Verba et al. (1971):

"Political participation is the means by which the interests, desires and demands of the ordinary citizen are communicated... all those activities by private citizens that are more or less directly aimed at influencing the selection of governmental personnel and/or the decisions that they make" (p. 9).

Another, more recent definition, by Verba et al. (1995), refers to

"activity that has the intent or effect of influencing governmental action – either directly by affecting the making or implementation of public policy or indirectly by influencing the selection of people who make those policies" (p.38).

Further, citizens' involvement in governmental decision-making became part of New Public Management (NPM) doctrine, and a substantial bank of knowledge has already been accumulated in this arena, especially about its contribution to advanced policy-making strategies (e.g., Berman 2002; Bouckaert and Peters 2002; Halachmi 2002; Wright-Muldrow 2002). These dynamics have intensified and expanded across North America, Europe, and other parts of the world during the late 1980s, 1990s and on into the twenty-first century.

They have created a much more demanding environment for evolving bureaucracies, stressing the clear need for higher level of citizens' involvement in governmental activities. With the development of economic, financial, legal, and behavioural Performance Indicators (PIs) several formats for objective evaluations, especially from the point of view of citizens as clients or customers, have taken root in public administration literature and practice.

Within the last few years, this development has resulted in a more active participation of stakeholders and citizens in decision-making processes. Involving citizens and stakeholders in decision-making processes regarding a sustainable coastal development also includes different perceptions, especially regarding mariculture. In general, perceptions are necessary in order to define persons or activities we know in relation to us. In case of mariculture development, perceptions as well as attitudes are often linked to their perceived environmental impact. Further relevant factors are past experience, not only directly but also through media and press, as well as own motivation.

Especially, when attitudes and perceptions are based on obsolete data and facts, inadequate media campaigns or a lack of knowledge, self-focused and political behaviour as well as planning and decision-making processes can be influenced negatively.

Up to now there is little systematic research into public knowledge, perceptions, attitudes, preferences and behaviours related to mariculture. However, in order to develop a sustainable mariculture sector in the context of good governance and ICZM it is essential to analyse these issues and utilise the findings.

The relationship between attitudes, perceptions and behaviours among aquaculture and mainly mariculture stakeholders as well as the wider public was discussed in Chapter 3.4 and 3.5. The methodological approach about the identification and measurement of the attitudes and perception of the wider public as well as the stakeholders will be described in Chapter 4.

4 METHODOLOGICAL APPROACH

With regard to the research questions of this thesis, two different methodological approaches were used, the quantitative and the qualitative analysis. In Figure 4-1 the schematic overview of the overall research model, including both approaches complementing each other with regard to the analysis of socio-political aspects of mariculture, is illustrated.

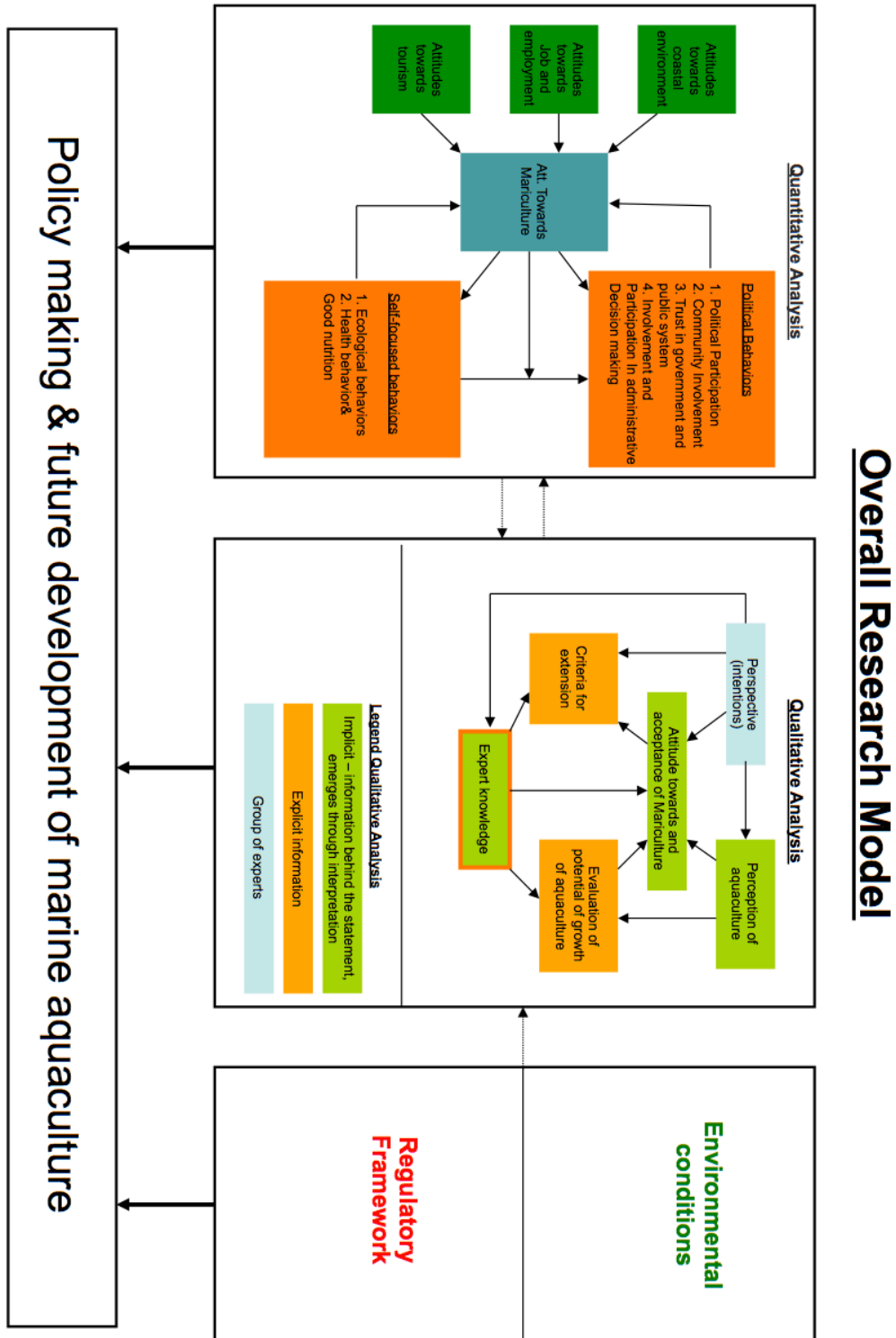


Figure 4-1. The overall research model.

Within the quantitative analysis the relationship between public attitudes towards mariculture was identified and compared to attitudes and behaviours in four domains such as employment, environment, tourism and lifestyle. Each domain was chosen either because of evidence of a similar relationship found in prior research or from observations in the field. Furthermore, in Israel and Germany different stakeholders and levels of government play an important role in mariculture decision-making. Therefore, selected stakeholders and decision-makers were interviewed in order to identify their attitudes towards and perception of marine aquaculture, their criteria for further development and their estimation of the future development of this sector in Israel and Germany.

4.1 Quantitative analysis

The quantitative analysis is a process of presenting and interpreting numerical data and contains descriptive and inferential statistics. According to the main questions of this thesis, a measurement method was developed to empirically identify the public attitudes towards mariculture in Israel and in Germany. This measure was based on the Mazur and Curtis (2006) model that was used to study public attitudes towards mariculture in Australia. The development of this measure was needed because a study of this sort had never been carried out before in Israel and Germany. In addition, it was defined which factors influence the 'formation of attitudes' toward mariculture in both countries, which are: health behaviour, environmental concern, job insecurity and tourism attitudes. These variables were selected on the basis of previous studies about mariculture. The relationships identified were related to the effects of mariculture on employment, environment, health and tourism, ultimately leading to positive or negative attitudes towards mariculture. The working hypotheses that were examined included:

1. a positive relationship between job security and support to mariculture
2. a negative relationship between concern for the environment and attitudes towards mariculture
3. a positive relationship between care for health and attitudes towards mariculture.
4. a positive relationship between support to tourism and attitudes towards mariculture.
5. a positive relationship between political behaviour and attitudes towards mariculture.

The hypotheses were tested by means of a survey (closed questions) that was administered to 422 people in Israel and to 727 people in Germany. Figure 4-2 shows the quantitative research model.

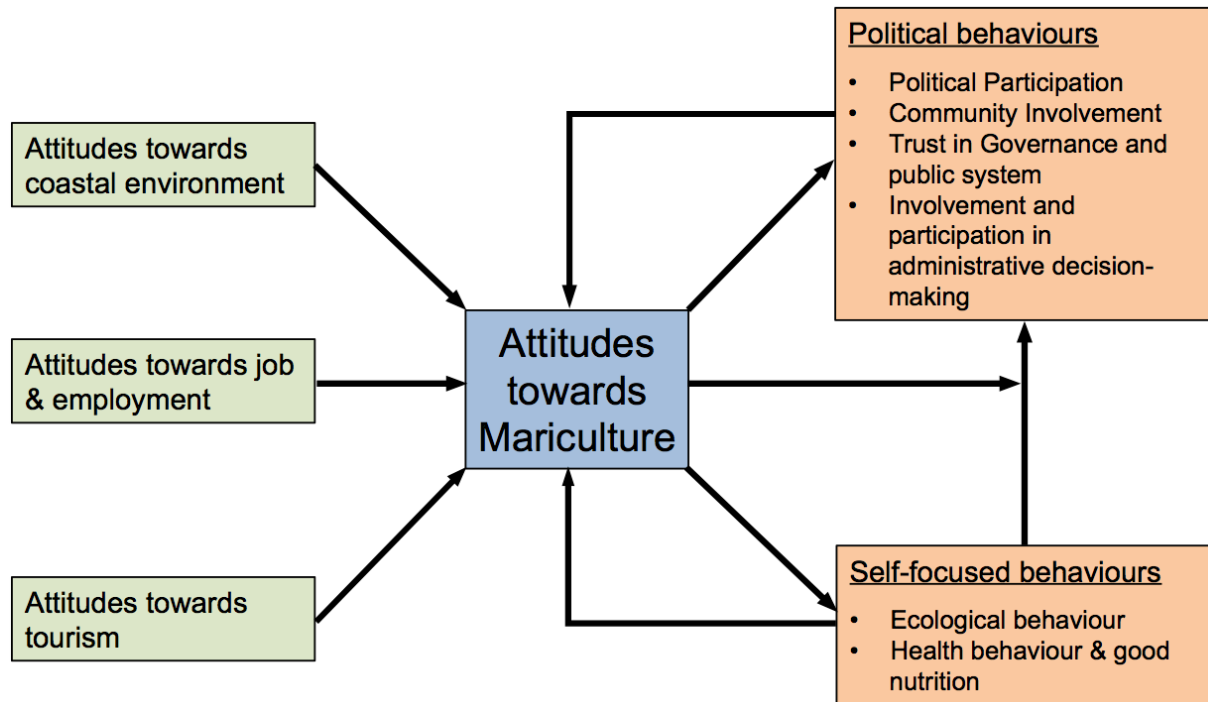


Figure 4-2. The quantitative research model.

4.1.1 Survey and questionnaire development

Not only national attributes but also the different levels of prior knowledge were very important for designing the questions and for the understanding of the certain results, especially divergent ones (see Chapter 6.1).

The questionnaire was developed in order to investigate public attitudes towards and perception of aquaculture, especially mariculture. In Israel as well as in Germany the data were collected by means of public surveys and in-person interviews. In addition, in Germany a postal survey was conducted. The self-completion questionnaires consisted of 93 questions in Israel and of 73 questions in Germany. The differences between the questionnaires in both countries can be explained by concerns that in Germany low levels of awareness might hinder respondents' ability to answer questions about mariculture. In order to ensure the comparison between the German and Israeli surveys, at least two questions within each category were identical. The questionnaires in both countries were divided into 7 common categories, which will be explained in Chapter 4.1.1.4. Furthermore, they included a number of questions with the same information content but different structure to test whether the answers elicited were invariant to the question structure.

4.1.1.1 Types of questionnaire questions

Within the questionnaire several different types of questions were used. The first type is questions using a 5-point Likert scale ranging from “strongly disagree” to “strongly agree” (Fig. 4-3). The Likert scale gives the respondents the opportunity to select the desired level of agreement or disagreement towards a given statement. The 5-point scale was chosen in order to have a mid-point of 3=neutral and hence the position of ‘neither agree nor disagree’ to the statement. This type of questions was used for the sections dealing with environment and environmental protection, tourism, regional politics, employment, future development and the main question regarding the future extension and advancements of marine aquaculture under ecological supervision in the region.

Environment Protection	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I think that investments in environmental protection should be financed from the (local) government budget.	1	2	3	4	5
I think that investments in environment protection should also be financed by the private economic sector.	1	2	3	4	5
I think that investments should also come from private citizens on a voluntarily basis.	1	2	3	4	5
I would be willing to pay increased taxes in order to achieve environmental improvements.	1	2	3	4	5

Figure 4-3. The 5-point Likert scale.

The second type of questions used in the questionnaire was a 3-point scale ranging over “never”, “was true in the past but not currently” and “is currently the case” (Fig. 4-4). With this scale changes in behaviour regarding different private, environmental and political aspects were identified. This type of questions was used for the sections dealing with lifestyle and political commitment.

Life style	Never	In the past	Today
I go to the beach/ I swim in the sea / I go snorkelling or diving	1	2	3
I do water sports (sailing, surfing, etc.)	1	2	3
I prefer to buy groceries with an eco-certificate.	1	2	3
If possible, I use public transportation, I go by bicycle or by foot.	1	2	3

Figure 4-4. The 3-point scale questions.

The willingness to pay more was based on a payment card in order to get a better overview of the amount people would pay more for environmentally farmed mariculture products (Fig. 4-5).

Additional cost for 1 kilo of salmon filet

0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
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Figure 4-5. The payment card.

Contrary to the Israeli questionnaire the German version had an additional section dealing with often mentioned advantages and disadvantages of marine aquaculture, especially mariculture (Fig. 4-6). This section was only included in the German questionnaire due to the fact that the German public does not have direct experience with mariculture such as in Israel.

Advantages of marine aquaculture (ONLY EXAMPLES)	Please mark with a cross	Disadvantages of marine aquaculture (ONLY EXAMPLES)	Please mark with a cross
No overfishing of natural stocks and no unwanted by-catch		Additional degradation and contamination of water and sea bottom	
No mechanical destruction of natural habitats by fishing gears (as in traditional fishery)		Loss of employment (e.g. in the regional fisheries sector)	
Production of healthy food		Fish farms disturb the natural beauty of the coasts and thus harm the tourism sector	
Creation of new jobs /employment		Deployment of fish meal and fish oil	
Reliable food source for the growing global population		Fish and products from aquaculture facilities are not as healthy as from free-living organisms	
Economic boost in coastal areas which are only weakly developed		There are ethical concerns about intensive livestock farming	

Figure 4-6. Advantages and disadvantages of marine aquaculture.

In Germany most of the experience in the context of mariculture is based on press and media. The answers within this section of the questionnaire were measured using a binary (Yes/No) format allowing respondents to emphasise 4 prioritised choices from among 12 options.

Finally, using multiple-choice questions the socio-demographics aspects as well as the level of knowledge and consumer behaviour were assessed (Fig. 4-7).

- **I buy fish or seafood:**
 (0) never (1) several times a year (2) once a month (3) once a week (4) several times a week
- **My salary allows me to spend extra money for a healthy and environmentally conscious living.**
 (1) never (2) sometimes (3) often (4) always
- **How well informed do you feel about the ecological production of food and other products?**
 (1) deficiently (2) insufficiently (3) sufficiently (4) satisfactory (5) good (6) very good

Figure 4-7. Multiple-choice questions.

The whole questionnaire including all questions as well as explanations of aquaculture and mariculture can be seen in Annex 2.

4.1.1.2 Structure of the questionnaire

The survey started with a short introduction explaining the background of the study as well as the questionnaire. The questionnaire itself was divided into different sections. The first section was dealing with general questions about attitudes towards the environment and environmental protection. Furthermore, in Germany this section was subdivided into general environmental questions and further specific questions to the marine environment. In addition, a category of questions on respondents' views about the future was included. However, the Israeli environmental attitudes section was not subdivided but most questions concerned the coast as well. No questions about the future were asked.

The next sections were dealing with questions regarding tourism and tourism development within the respective areas; trust in regional politics and political commitment; employment; lifestyle and statements concerning the future of environmental degradation, resources, fishery and agriculture.

The relationship between tourism and mariculture was chosen because of the large number of stakeholder conflicts between these sectors in coastal zones. This relationship was also of interest because of a large literature showing that attitudes toward tourism and other activities perceived to impact the tourism sector are strongly related (either positively or negatively) (Andereck and Vogt 2000; Lindberg and Johnson 1997; Liu and Var 1986). Public opinion research on the issue does not universally support the notion that tourists and residents view the mariculture and tourism sectors as conflicting. Mazur and Curtis (2006) found out that only 11% of respondents regard mariculture as damaging to tourism. Tango-Lowy and Robertson (2000) found that the majority of tourists see no conflicts between their activities and mariculture and 89% support the notion of developing the sector.

In the case of the relationship between employment and mariculture, fish farming and related activities (e.g. processing, transport and marketing) have been shown to create jobs and rejuvenate communities that were formerly reliant on capture fisheries (Paquette and Lacroix 1997; Commission of European Communities 2002). Research by Whitmarsh and Wattage (2006) showed that people in areas that economically dependent on mariculture showed the greatest support for the sector. Klanderman and van Vuuren's (1999) observed that people most concerned about employment issues also tend to support undertakings that they believe will contribute to employment. Taken together with evidence showing a positive relationship between concerns about employment and support of mariculture (Mazur and Curtis, 2006; Mazur et al. 2005; Burbridge et al. 2001), we concluded that testing the hypothesis that higher concerns about employment are positively correlated with attitudes toward mariculture was appropriate for Israel and Germany.

The health dimension draws on the research of Maiman et al. (1977), Ajzen and Timko (1986) and Brown et al. (2003) and assumes that individuals are willing to engage in a range

of activities aimed at reducing disease and improving the quality and length of life. Nutrition is the key to this concept and our third hypothesis addresses two elements: The first is the belief that fish is an important part of a healthy diet (von Schacky et al. 1999) and the second is that the safety and quality of farmed fish is at least as high as wild-caught fish (Halwart et al. 2007).

The section on mariculture in the Israeli questionnaire contained three types of questions. The first was designed to elicit general opinions, for example, by asking respondents whether they think that mariculture's advantages outweigh its disadvantages. The second set of questions focused on the potential conflicts and complementarities between mariculture and tourism. The third focused on the conflicts and complementarities between mariculture and capture fisheries. The reason for the breakdown was to capture general perceptions and check their consistency with more directed inquiries.

In the German questionnaire the section on mariculture was slightly different due to concerns that low levels of awareness might hinder the respondents' ability to answer questions about mariculture. Besides several questions regarding the future expansion of mariculture as well as their 'sea food'-consuming behaviour, the respondents were provided with a table listing 6 possible advantages and 6 possible disadvantages of marine aquaculture and asked to choose the four most important points out of the 12. The mariculture issues were chosen in consultation with experts including representatives of environmental organisations and of the regional economy. The mariculture category in both countries' surveys included a sub-section on respondents' willingness to pay a premium for farmed fish raised in an environmentally friendly manner.

After a final question regarding the future extension and advancements of marine aquaculture under ecological supervision in the region the respondents were asked to answer some socio-demographic questions.

4.1.2 Pilot test

Numerous procedures were used to pre-test the questionnaire. Quantitative researchers use the pilot test before the actual data collection starts in order to have a small-scale replica of the main study to identify potential administrative and organisational problems and trends. Hence, the aims of pilot studies are:

- to calculate the costs and duration of the main study
- to test the suitability of research methods and instruments
- to estimate the response rate and
- to discover weaknesses and limitations

In Israel, 50 students from the Department of Political Science were surveyed and in Germany the survey was tested on 45 students from the Department of Geography and 25 employed residents of Kiel. Based on the results of the German pilot study, the questions on income and employment were modified since most of the respondents were unwilling to provide precise income figures. Therefore, in the German questionnaire the respondents were asked if their salary was high enough to allow them to spend extra money for fish farmed in an environmentally sustainable manner. No major changes were made to the Israeli questionnaire as a result of the pilot study.

4.1.3 Data collection

The data was collected within the study areas described in Chapter 1.4 by using in-person interviews and postal surveys (see Chapter 4.1.1). After the pilot survey was completed, the public survey in Israel was performed in the city of Eilat and in the centre and north of Israel. The city of Eilat was chosen since it was the site of Israel's earliest cage mariculture operations and hence, the anticipated high level of awareness about the sector in this city would provide an opportunity to examine attitudes among respondents with high levels of prior knowledge. In the centre and north of Israel the surveys were conducted in trains on the main rails route Haifa, Tel Aviv at various times and approximately half of these were drawn from weekday travellers. The trains were chosen because train travel is heavily used by all segments of the Israeli population and hence a broadly representative sample could be obtained by sampling travellers.

At the same time surveys were conducted in Kiel, on the German Baltic Sea coast. As mentioned before this is an area where mariculture development has been proposed and small-scale fish, mussel and an algae farm exist. In total, 363 in-person surveys were conducted at different locations around the city, e.g., Kiel Fjord ferry. The Kiel Fjord ferries were chosen because they are heavily used by all segments of the Kiel population. Further, as well as in the Israeli trains the respondents on the ferries had enough time to fill in the questionnaire.

Additionally, in Germany 364 postal surveys were conducted. The questionnaires were distributed evenly within the different districts of Kiel in order to get a homogeneous set of opinions. The postal survey was carried out in order to identify differences in using different survey methods and to get a more representative picture of the overall attitudes towards and awareness of mariculture.

The surveys were conducted within the years 2009 and 2010 and the researcher gave each participant the following items: an explanation of the study; a statement of confidentiality; instructions for completing the study instruments; the survey instruments; and a self-addressed stamped envelope for returning the completed instruments (postal survey).

Further, participants of the postal survey were asked to submit their responses within three weeks. Participants were told that by completing the survey, they agreed to take part in the study.

In order to increase the rate of response numerous potential influences on the response rates in both postal and in-person surveys were concerned, including survey length, respondent contacts, design issues and research affiliation.

4.1.4 Data analyses

The data analysis was conducted using SPSS© (Statistics Package for Social Science) 15.5 and 18.0 in two stages. The first stage determined the within-category consistency of each group of scales and the correlation among scales. Within-group consistency was measured using Cronbach's alpha test and collinearity was checked using Pearson's Correlation Coefficient. The second stage of analyses consists of regressions to test the hypotheses and possible socio-economic factors underlying attitudes and behaviours. All of the analyses were completed for each site individually and in the context of comparative analyses.

Hence the data analyses consisted of descriptive and correlation analyses as well as factor analyses and regression analysis. To answer the research questions, means and standard deviations were calculated between the different section, such as mariculture-related questions and the demographic variables. The descriptive analysis is a univariate analysis, which consists of frequency tables, diagrams, measures of central tendency (arithmetic mean, median, and mode) and measures of dispersion (Bryman and Bell 2003).

The reliability of each set of scales was measured by using Cronbach's Alpha (α). Since all the within-group scores were above $\alpha=0.6$, each group was treated as a single scale for the purpose of the correlation analysis. In Israel, for example, the mean value of the nine scales in the Attitudes Toward Aquaculture category was used to indicate weak support for the sector.

The Pearson correlation analysis examines the relationships between variables describing the direction and degree of association between them. A correlation matrix includes the values of the correlation coefficients for the variables involved (Robson, 2002). A correlation is very low if the coefficient has a value (of) under 0.20, low between 0.21 and 0.40, moderate between 0.41 and 0.70, high between 0.71 and 0.91 and very high if it is over 0.91 (Pfeifer, 2000). The Pearson's Correlation Coefficient (r) was used for between-group correlations for all scale groups, subgroups and relevant individual scales. The coefficient provides two important types of information: First, it gives a preliminary indication of the level of support for the four research hypotheses. Second, it indicates potential collinearities

among independent variables that need to be accounted for when regression analyses are conducted.

The factor analysis is a multivariate technique used in order to discern the underlying dimensions or regularity in phenomena. The advantage of using a factor analysis lies in summarising the information contained in a large number of variables into a smaller number of factors (Rummel 1967). Hence, in the context of this thesis the factor analysis was used to reduce the various amounts of items to a more manageable number. The technique attempts to determine the amount and nature of the underlying factors affecting the relationship between the sets of variables. Furthermore, the factor analysis is a statistical technique used for a large number of variables to establish interrelationships between variables.

The regression analysis was used to examine the relationship between variables especially on the extent to which a dependent variable is a function of one or more independent variables. It was used to analyse the relationship between a single dependent variable and several independent variables. Further, multiple the regression analysis was used to examine the proposed research hypotheses.

4.2 Qualitative analysis of content

The qualitative analysis of content is one of the most extensively employed analytical tools today and can be defined as

- “A research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns” (Hsieh & Shannon 2005, p.1278),
- “An approach of empirical, methodological controlled analysis of texts within their context of communication, following content analytic rules and step by step models, without rash quantification” (Mayring, 2000 p.2), and
- “Any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings” (Patton 2002, p.453).

Hence, the qualitative analysis of content emphasises an integrated view of speech/texts and their specific contexts. Further, the qualitative analysis of content goes “beyond merely counting words or extracting objective content from texts to examine meanings, themes and patterns that may be manifest or latent in a particular text. It allows researchers to understand social reality in a subjective but scientific manner.” (Zhang and Wildemuth 2009)

According to the main questions of this thesis the research was carried out by means of qualitative interviews in Israel and Germany during May 2010 to December 2010. In Germany, a total of 15 and in Israel total of 13 representatives of identified institutions and organisations were interviewed, who have or might have a voice in a potential planning process. Figure 4-8 shows the qualitative research model.

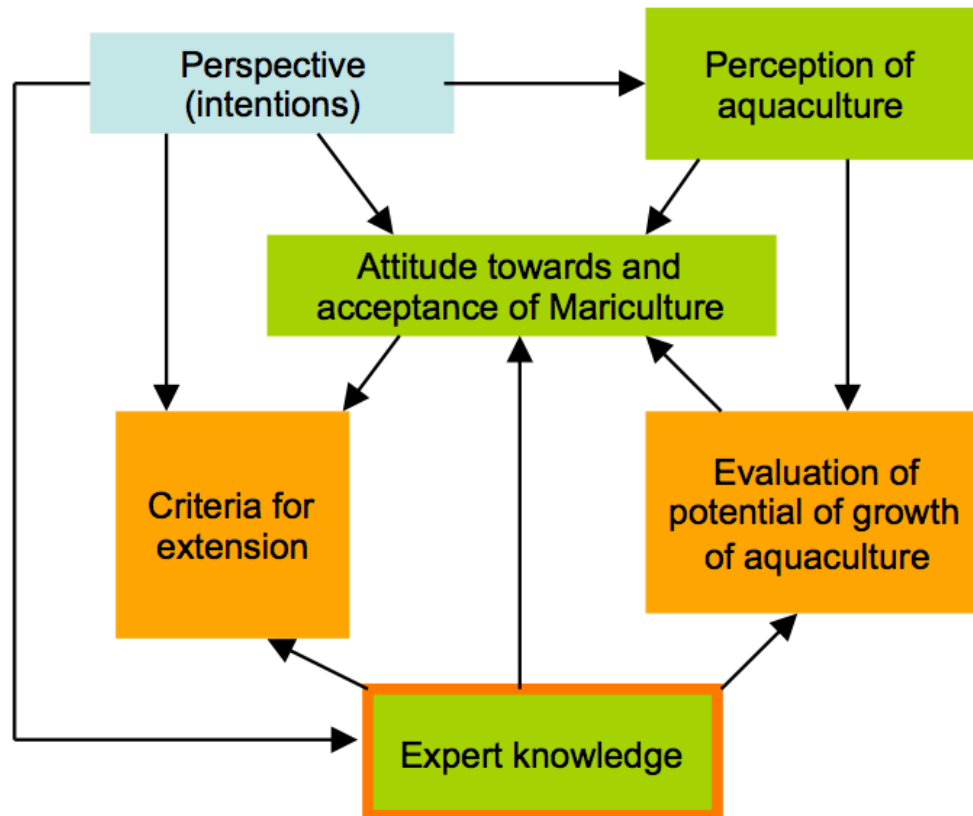


Figure 4-8. The qualitative research model.

For the analysis of the qualitative interviews a mixture of methodologies has been adopted, which guarantees an appropriate approach to the data material with regard to the central research questions.

The first methodology, the Grounded Theory, can be described as a conventional qualitative content analysis, in which coding categories were derived directly and inductively from the raw data. Compared to this approach the second methodology, the Qualitative or Direct Content Analysis, aims at starting initial coding based on a theory or relevant research findings. During the data analysis, the researchers immerse themselves in the data and allow themes to emerge from the data. The purpose of this approach is usually to validate or extend a conceptual framework or theory (Zhang and Wildemuth 2009).

The different approaches of both methodologies were taken into account and a new, modified approach was developed, which was again influenced by thoughts about the expert interview.

4.2.1 The grounded theory

The Grounded Theory was developed by Glaser and Strauss and aims in guiding from a qualitative data collection to a detailed data analysis (Glaser and Strauss 1967). This research tool enables to seek out and to conceptualise the latent social patterns and structures of an area of interest through the process of constant comparison. Hence, the Grounded Theory can be defined as:

“The discovery of theory from data systematically obtained from social research” (Glaser and Strauss 1967)

Further, Glaser (1978) stated that this methodology gets *“through and beyond conjecture and preconception to exactly the underlying processes of what is going on, so that professionals can intervene with confidence to help resolve the participant's main concerns”*.

Therefore, it is an ideal tool for exploring integral social relationships and the behaviour of groups where has been little exploration of the contextual factors that affect individuals lives (Crooks 2001). Within the last decades several versions of the Grounded Theory have been developed. Nevertheless, there are a number of features that all versions have in common, such as (Charmaz 1990, 2002)

- the collection and the analysis of data has to be conducted simultaneously
- the development of open codes and categories has to be done from the data and not by pre-existing conceptualisations
- the discovery of basic social processes in the data
- an inductive construction of abstract categories
- writing of analytical memos
- the integration of categories into a theoretical framework

The purpose of Grounded Theory is not to make truth statements about reality, but rather to elicit fresh understandings about patterned relationships between social actors and how these relationships and interactions actively construct reality (Glaser & Strauss 1967). Hence, the Grounded Theory does not aim at testing hypotheses about reality, but rather to make statements about how actors interpret reality. The Grounded Theory should be

adopted when no explicit hypotheses exist to be tested, or if such existing hypotheses are too abstract to be tested in a logical, deductive manner (Martin and Turner 1986).

An overall Grounded Theory research model developed by Fernandez (2004) is shown in Figure 4-9.

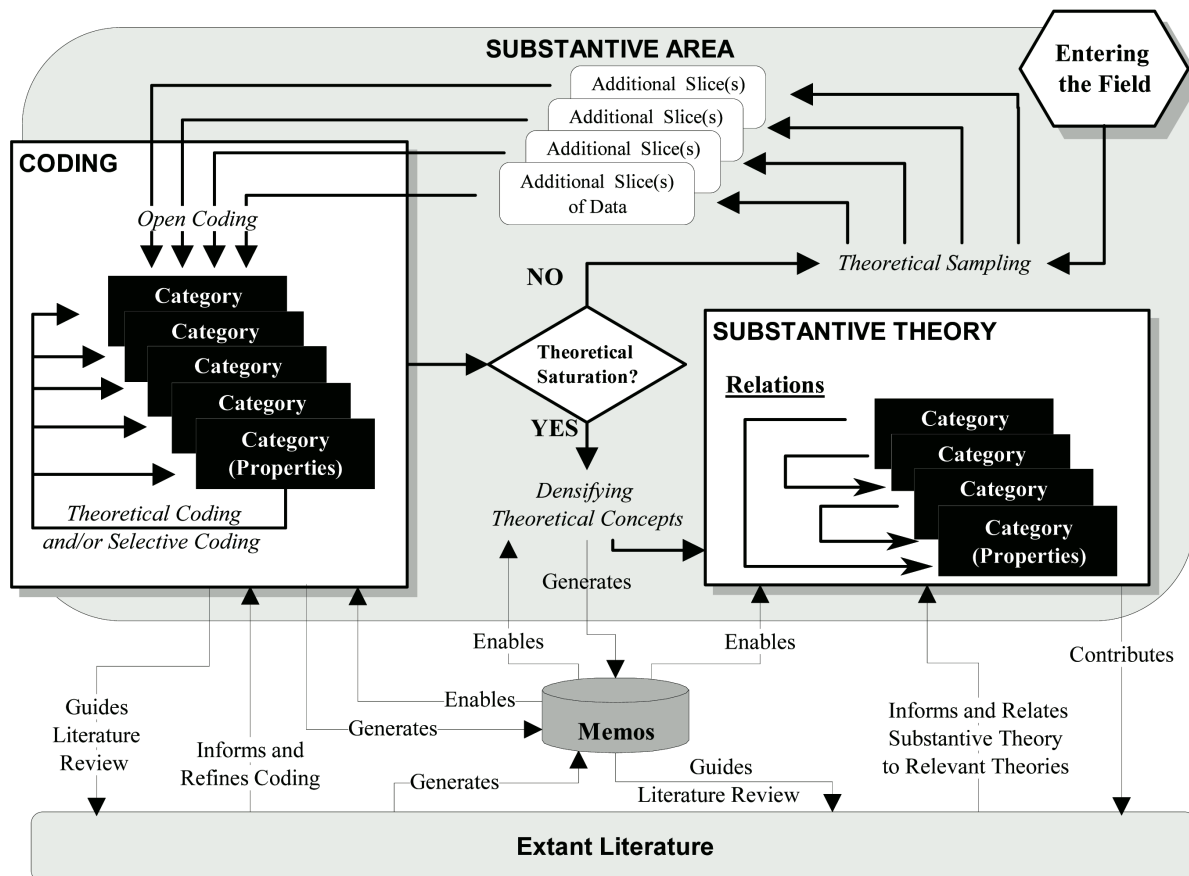


Figure 4-9. Grounded Theory research model. Fernandez (2004).

4.2.2 The qualitative content analysis

The qualitative content analysis consists of a bundle of techniques for systematic text analyses which were developed approximately 20 years ago by Mayring in a longitudinal study about the psycho-social consequences of unemployment (Ulich et al. 1985).

Furthermore, Mayring (2000) stated that qualitative content analysis aims at preserving the advantages of quantitative content analysis for a more qualitative text interpretation. In this context the advantages are:

- *“Fitting the material into a model of communication: It should be determined on what part of the communication inferences shall be made, to aspects of the*

communicator (his experiences, opinions feelings), to the situation of text production, to the socio-cultural background, to the text itself or to the effect of the message.

- *Rules of analysis: The material is to be analysed step by step, following rules of procedure, devising the material into content analytical units.*
- *Categories in the centre of analysis: The aspects of text interpretation, following the research questions, are put into categories, which were carefully founded and revised within the process of analysis (feedback loops).*
- *Criteria of reliability and validity: The procedure has the pretension to be inter-subjectively comprehensible, to compare the results with other studies in the sense of triangulation and to carry out checks for reliability. For estimating the inter-coder reliability we use in qualitative content analysis.” (Mayring 2000)*

Regarding the qualitative content analysis there are two different approaches, an inductive (mainly Grounded Theory) and a deductive approach (mainly qualitative content analysis). The main idea of the inductive approach is to

“formulate a criterion of definition, derived from theoretical background and research question, which determines the aspects of the textual material taken into account”, whereas the main idea of the deductive approach is seen in giving “explicit definitions, examples and coding rules for each deductive category, determining exactly under what circumstances a text passage can be coded with a category.” (Mayring 2000) (Fig. 4-10 and 4-11).

However, compared to the Grounded Theory the qualitative content analysis, developed by Mayring, can be seen as a more step-by-step on-going analysis. Nevertheless, Mayring pointed out that the qualitative content analysis could be combined with other qualitative procedures. The research question and the characteristics of the material should have the priority in the decision about adopted methods.

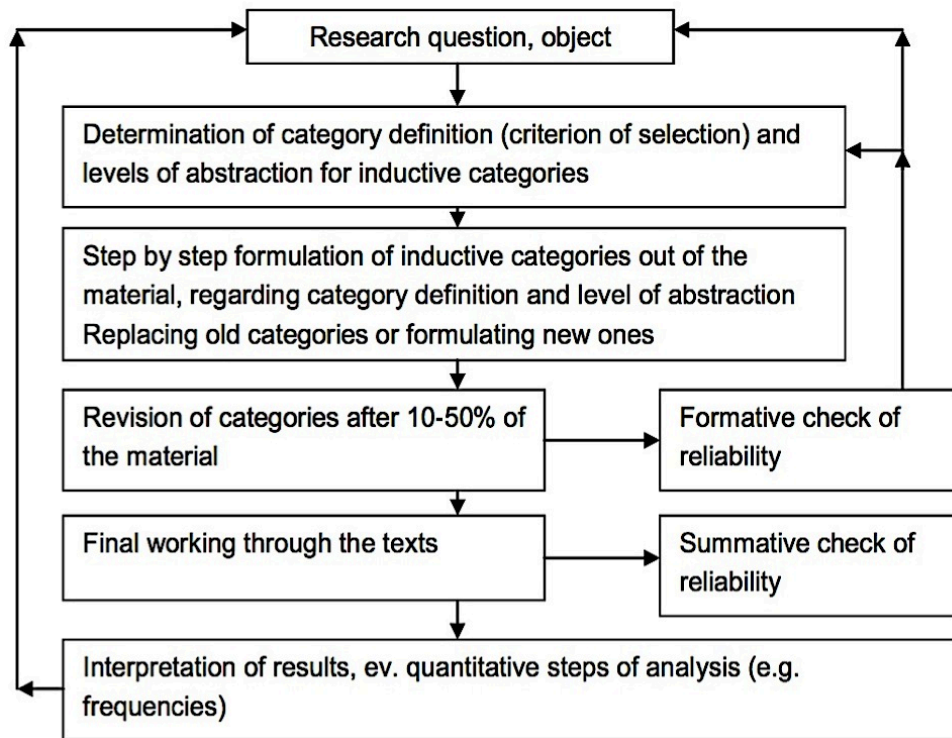


Figure 4-10. Step model of inductive category development. Mayring (2000).

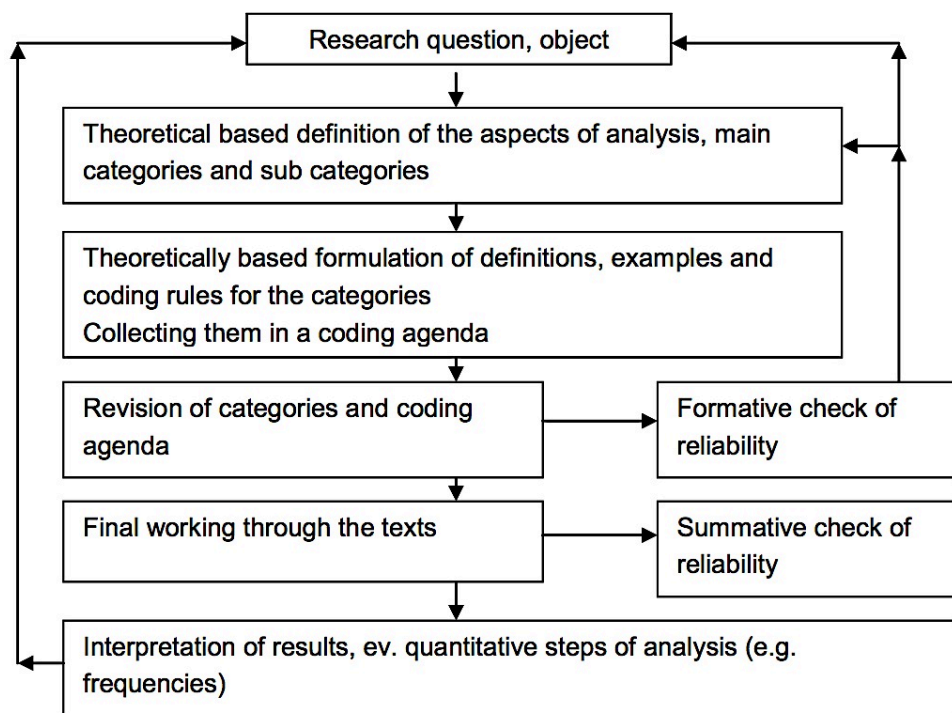


Figure 4-11. Step model of deductive category application. Mayring (2000).

4.2.3 Applied methodology

The analysis of the qualitative data in this thesis was carried out using Grounded Theory (Glaser & Strauss) combined with qualitative content analysis (Mayring). This enables the researcher to reduce and structure the large amount of interview material to handy units through the processes of coding and summarising as well as extractions of raw data.

It was decided to work with both, deductive and inductive category building. According to the qualitative content analysis, as described before, codes and core categories were developed based on theoretical assumptions and the research questions. Those deductive codes mirror the main interests of the study. Due to the fact that the code-building of the qualitative content analysis does not allow any modification of the once developed codes, the analysis was combined with the Grounded Theory, which allows adjusting the code system during the whole analytical process.

With this inductive approach codes were generated directly from the data without any assumptions from the researcher. This data-driven approach allows generating novel theoretical ideas or hypotheses from the data as opposed to testing theories specified beforehand. The coding was not only descriptive but rather categorical, analytic and on a theoretical level, which includes the interpretation of what the interviewees say.

An essential tool of the Grounded Theory is writing memos, by which the development of the analytic thinking is recorded. Furthermore, memos were used to note rules for adopting the codes by describing the nature of each code and of what text should be linked to that particular code. For developing a hierarchical code system and analysing the data the software MaxQDA was used (see Chapter 4.2.6).

After structuring the interviews by codes the cross-case analysis (see Chapter 4.2.7) was conducted in order to identify the latent content hidden in the manifest statements. Following the approach of Thematic Coding (Strauss), which is based on the Grounded Theory as well, the German and Israeli interviewees were considered in their respective field of interests. This means, the participants are grouped concerning their field of work, e.g., NGOs, producers or scientists. Some of the interviewees belong to more than one group, e.g., two of the German scientists are also aquaculture producers.

In order to find differences and similarities as well as irregularities within and between the interest groups, the statements were examined in groups. By comparing the groups' similarities and differences with each other it is possible to reveal the spectrum of the stakeholders' views on the research field and to look for certain patterns among interest groups. To gain a better overview of all statements the interviews were (additionally to the

coding) paraphrased and ordered in a table. The findings of the cross-case analysis were written down in form of hypotheses.

4.2.4 Conducting interviews with experts

In addition to the before mentioned approaches, the Grounded Theory and qualitative content analysis, the idea of the expert interview (Meuser/Nagel) was taken into account. The expert interview is a specific form of a semi-structured interviews focussing on interviewees expertise in a certain field of activity. The intention is to reconstruct the knowledge of experts. According to Meuser & Nagel (2002), who have developed the expert interview, an expert is a:

- Person who is responsible for the development, implementation or control of solutions/strategies/policies
- Person who has privileged access to information about groups of persons or decision processes

Furthermore, an expert can be defined as a "...person who has a high degree of skill and knowledge in a certain domain, field or industry due to long experience and has status, power to act and decision-making opportunities based on these skills and knowledge" (Belting 2008). Advantages of the expert interview approach are mainly the fast access to new or unknown field as well as a quick way to obtain specific information. Furthermore, experts:

- Have high insight in aggregated and/or specific knowledge
 - Processes, group behaviours, strategies, etc.
 - Information difficult to explored by other methods
- Often are networked person
 - Easily leads to other interviewees
- Motivated persons
 - Often willing to cooperate and exchange
 - Problems of influencing less problematic (Van Audenhove 2007)

With regard to the focus of the stakeholder interviews in this thesis the knowledge had to be considered as well. According to Van Audenhove (2007) this knowledge can be structured as follows:

- Technical knowledge
 - Very specific knowledge in the field
 - Details on operations, laws, etc. influencing field
- Process knowledge
 - Info on routines, specific interactions, processes
 - Expert has knowledge as she/he is directly involved
- Explanatory knowledge
 - Subjective interpretations of relevance, rules, beliefs
 - Ideas and ideologies and their inconsistencies
 - Interviewee him/herself and his/her routines/thoughts focus of interview

However, qualitative interviews are a key venue for exploring the ways in which the interviewees experience and understand the issue. For the interviews in this thesis expert interview techniques were used such as 'semi-structured', 'problem-centred' (Witzel 2000) and 'face-to-face', which are used for Grounded Theory and qualitative content analysis as well.

A semi-structured interview neither means an open conversation nor a closed questionnaire. It allows the interviewees to answer in their own terms without losing the comparability. Furthermore, less structure or unstructured interviews would imply less comparison. Hence, it is neither strictly structured nor entirely 'non-directive'. It is up to the interviewees to bring forth the dimensions they find important in this context and to make clear their own point of view (Witzel 2000).

The basic idea of problem-centred interviews is methodologically borrowed largely from the theory-generating procedure of Grounded Theory after Glaser and Strauss. In the case of this thesis, this means that the interviewer makes use of the formerly noted objective conditions of the observed orientations and actions in order to understand the interviewees' explanations and continue the problem-centred questioning and re-questioning (Witzel 2000).

Within this study the semi-structured, problem-centred and face-to-face interviews were conducted individually with 15 stakeholders in Germany and 13 stakeholders in Israel. The study involved stakeholders from the following sectors: scientists; economists; environmental NGOs; fish, algae and mussel farmers; politicians and potential competing users within the research areas. Focus group interviews could not be used due to the fact that the data had to be collected anonymously.

The questionnaire for the interviews included different questions about mariculture in general and on national level, the status quo and the potential of growth of mariculture, its chances & risks in the respective areas and stakeholders' criteria for a further development. In order to

ensure the comparability of the results in Israel and Germany, the questionnaire for the interviews were almost similar. Only minor adjustments, depending on the stakeholder group the interviewee belonged to, were done.

Further, the questionnaire consists of two different types of questions; guiding or core questions and check questions (see Annex 2). The core questions in the left column have a relatively open character in order to follow the red line (the problem) and, at the same time, to enable the interviewee to speak openly about the topic. These questions were asked in any case. The order of the questions was variable. The questions in the right column of the questionnaires were used to check if the interviewee mentioned all information about the issues. These questions were only asked in case the interviewee does not come up with own ideas about the issue. Leading questions as well as yes-no questions were avoided.

Almost all interviews were recorded, after asking the interviewee, in order to ensure the storage of more information than would be possible when making notes of the interview. Only one interviewee declined. While the interviews were conducted some notes about nonverbal behaviour and your personal impression of the interview were written down as well as first ideas for interpretation.

Within the literature, the transcription, coding and analysis of expert interviews refer to the aforementioned approaches, the Grounded Theory (Chapter 4.2.1) as well as the qualitative content analysis (Chapter 4.2.2) and can include the inductive category development, the deductive category application as well as the axial coding. The analysis used in this thesis is explained in detail in Chapter 4.2.3 "Own Methodology" and the following chapters 4.2.6 "Transcription and coding with MaxQDA" and 4.2.7 "Cross-Case Analysis".

4.2.5 Stakeholder identification

The stakeholders interviewed in the context of this thesis were identified and chosen by different aspects. First, the stakeholders were divided into two groups: primary and secondary stakeholders. The first group consists of stakeholders who depend on certain resources, the ecosystem and the service such as aquaculture producers and tourism entrepreneurs. The second group consists of stakeholders with an interest in the resources, the ecosystem and the service such as people and decision-makers from the nature conservation sector, administration and scientists. Further stakeholders identified to be important were those who:

- have sufficient political clout to draw in officials with public authority to make decisions
- have a legal standing and therefore the potential to block a decision
- control resources necessary for implementation of a decision

- may not be sufficient organised to pose a relevant threat today, but maybe in the future
- hold necessary information (modified from FAO 2010a)

According to the research questions of this thesis as well as to the identified stakeholders the following relevant issues and questions were used to develop the guiding questionnaires:

- What are the current and future interests of the stakeholders in the use and management of the resource (e.g., coastal area)?
- What are their needs and expectations?
- How do they use the resource and what benefits do they derive from it?
- What are their rights and responsibilities (both formal and informal)?
- What institutions and networks they are part of?
- What are the social and environmental impacts, both positive and negative, of their past and current uses of and relationships with the resource?
- How is this relationship changing or being modified due to the aquaculture practices?
- How ready and willing are they to participate in and contribute to an integrated management approach?
- What are the potential areas of agreement and shared interests upon which consensus and collaboration can be developed?
- What human, technical and financial resources they have access to in order to contribute to an integrated management process? (Adapted from FAO 2010, modified from the Caribbean Natural Resources Institute 2004)

Based on the above-mentioned criteria and the main issues and in the context of the main questions of this research the following stakeholders or stakeholder groups were chosen to represent the perspectives of all involved in the decision making process:

- Fish, mussel and algae farmers
- Tourism entrepreneurs
- Environmentalists (local, regional, national, international)
- Scientists
- Local economists
- Authorities and politicians (local, regional, national)
- Potential competing users

4.2.6 Transcription and coding with MAXQDA

The interviews were transcribed verbatim and entered into the computer software MaxQDA 2007 to assist data handling. Afterwards the transcripts were analysed line by line and coded. This process involved different coding strategies, which will be explained in detail later in this chapter. In general, the coding includes identifying and recording of one or more passages of text and linking them with a label – the code. The codes indicate concepts that will later be part of the theory.

The codes themselves provide meaning to the text and were created by the researcher, or taken from the text itself. From the initial interviews, a list of codes emerges and this list was used to code subsequent interviews. So all the text about the same issue is coded with the same label/code. At the end of the sampling process a large number of codes had emerged.

Hence, coding is a way of indexing or categorising the text in order to establish a framework of thematic ideas about it. They form a focus for thinking about the text and its interpretation. The coding enables the researcher to:

- retrieve all text coded with the same label to combine passages that are examples of the same phenomenon
- use the list of codes to examine further kinds of analytic questions, such as relationships between codes

Figure 4-12, best viewed from the bottom up, illustrates that the data is progressively refined to arrive at categories, themes, and theories. The generalisations in this illustration are meant to broadly describe stages of the coding process while recognising and upholding the vibrant differences between various qualitative methods.

Following the description of the initial or open coding at the beginning of this chapter, now the focused coding as well as the axial/thematic coding will be explained (see Fig. 4-2). The focused coding is the process of integrating and refining the theory. During this stage the core categories were identified. These core categories acted as a hub for all other identified categories appearing/that appear frequently in the data.

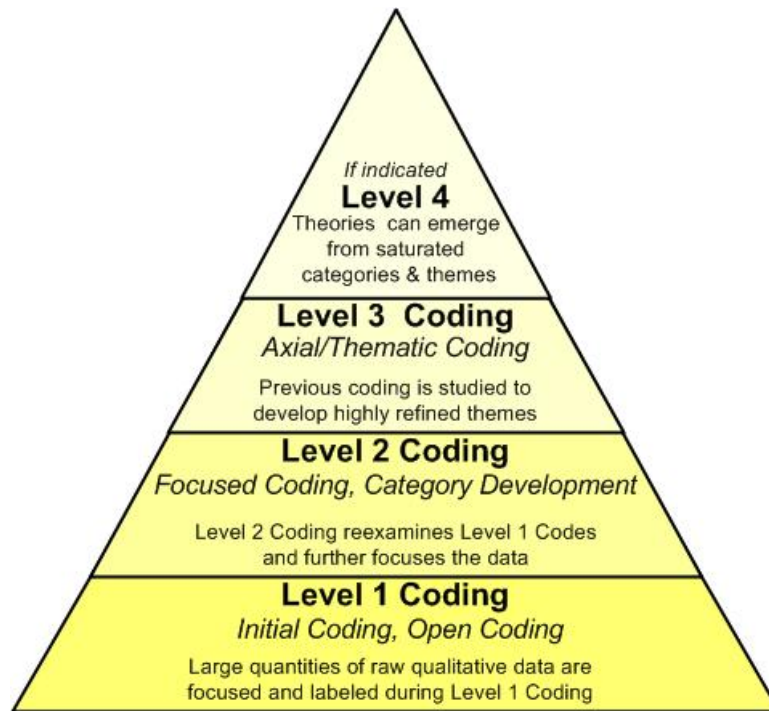


Figure 4-12. Qualitative coding levels. Hahn (2008).

The axial or thematic coding is the process of relating categories to their subcategories. This is termed axial because coding occurs around the axis of a category, linking categories to subcategories at the level of properties and dimensions. This involves documenting category properties and dimensions from the open coding phase; identifying the conditions, actions and interactions associated with a phenomenon and relating categories to subcategories (Coleman and O'Connor 2007).

According to the Grounded Theory in this context the memoing is an important process. Memoing is *“the ongoing process of making notes and ideas and questions that occur to the analyst during the process of data collection and analysis”* (Schreiber 2001). Ideas are recorded during the coding process (=memos) support the process of fleshing out the theory as it emerges. Memos take the form of statements, hypotheses and questions (Coleman and O'Connor 2007). Hence, memos were an important way of recording the development of the analytic thinking and to note the nature of a certain code together with the thinking that lies behind it. Further, it explains how the code was applied or what kind of text was linked to that code. The final code theory model is shown in Figure 4-13.

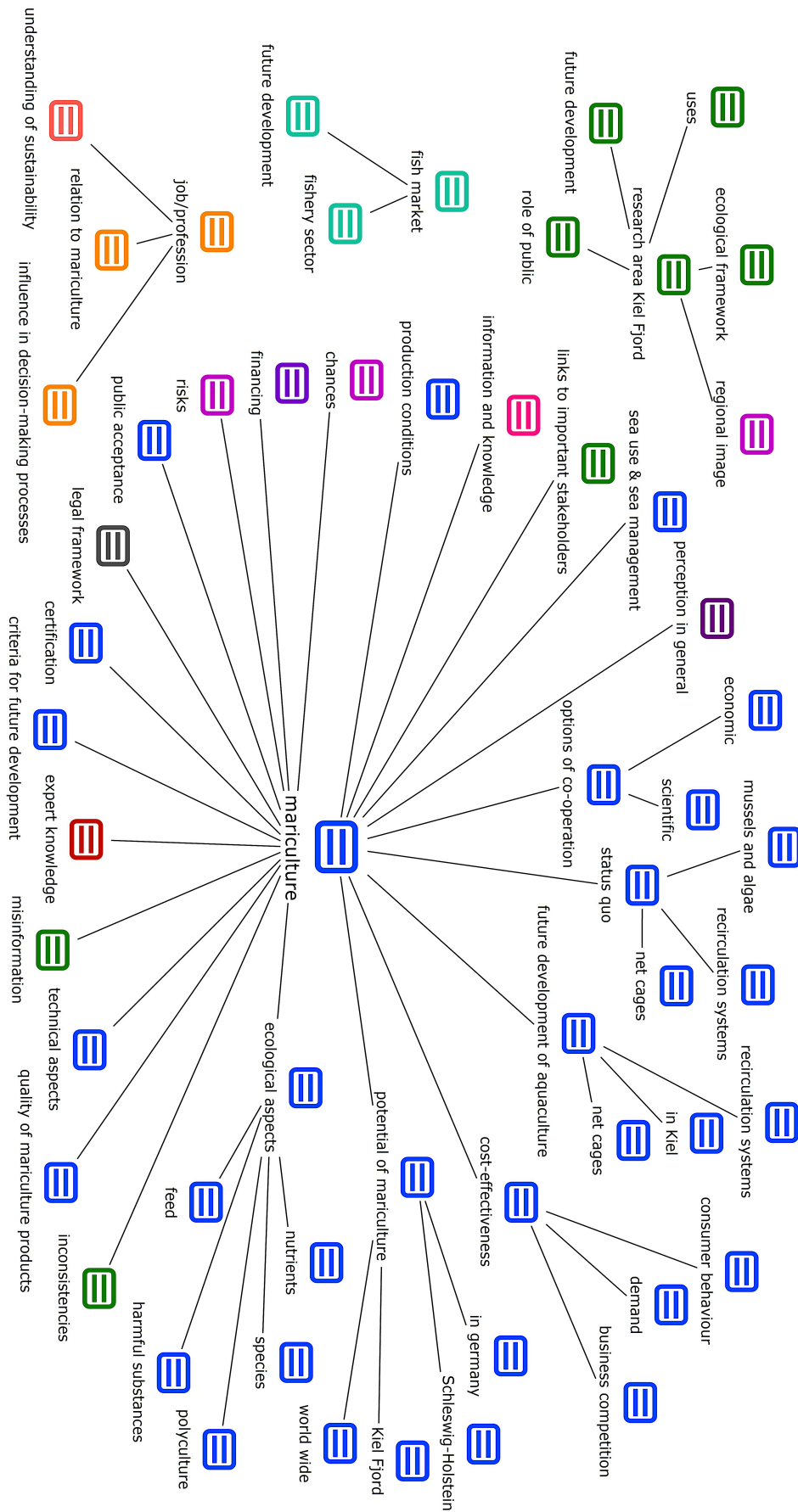


Figure 4-13. The code theory model.

According to the question and criteria in Chapter 4.2.5 the focus of the SPAMA analysis can be summarised as follows:

- the attitude towards and acceptance of mariculture
- individual perspective of the stakeholders/groups on mariculture
- personal/ professional political influence
- relevant factors (criteria) for the planning process
- personal/professional opinion
- approach of the stakeholders to the problem
- aspects that influence decisions of stakeholders

The following Table 4-1 gives an impression of the connection of the foci and the matching main codes. Statements coded with a certain code offered valuable clues to the respective focus.

Table 4-1. Focus-Code-Connection (2011).

Focus	Codes
<i>Criteria for further development/extension</i>	<ul style="list-style-type: none"> • Ecological aspects • Spatial problems • Efficiency → Concrete arguments
<i>Evaluation of potential of growth of mariculture</i>	<ul style="list-style-type: none"> • Potential (Eilat/Israel; in general) • Technical aspects • Future development • Current situation • Acceptance of population • Statements about other stakeholder (information flow/contacts) • Quality of products • Cooperation possibilities • Development of fish market • Regulatory framework
<i>Perception of mariculture</i>	<ul style="list-style-type: none"> • General estimation of perception by looking at the argumentation and evaluation of the potential → interpretation of according statements • Criteria for further development/extension also reveal the expert's knowledge
<i>Attitude towards and acceptance of mariculture</i>	<ul style="list-style-type: none"> • Becomes apparent through looking at the perception and the potential of mariculture • Evaluation of the future development of mariculture • Result of the analysis, summing up all findings (general attitude, evaluation of future development, criteria)- is connected to the <i>perspective</i> and the <i>expert's knowledge</i> • Regulatory Framework

4.2.7 Cross-case analysis

As described before, the analysis consisted of different parts, which were linked to each other (Fig. 4-6). In addition to the parts of the qualitative analysis the cross-case analysis was conducted. The advantage of the cross-case analysis is the ability to identify similarities and differences inside each group as well as between the individual statements, considering the (professional) perspective and trying to identify the opinion of each group. Hence, after the coding of the individual transcripts the interviewees were considered in their respective interest group (e.g., producer, retailer, scientist...). Afterwards the statements were examined in groups. By doing so, the coherence of each group could be identified. Subsequently the groups were compared with each other in order to find out similarities and differences inside one group as well as between different groups. The outcome of this analysis reveals the answer to the central question. Furthermore, a closer examination of codes and sub-codes was done and the coherence between different codes was analysed, e.g., criteria for further development always comes along with ecological aspect. With this last step of the analysis additional abnormalities as well as regularities could be identified. In Figure 4-14 the cross-case analysis combined with the former steps of the analysis is illustrated.

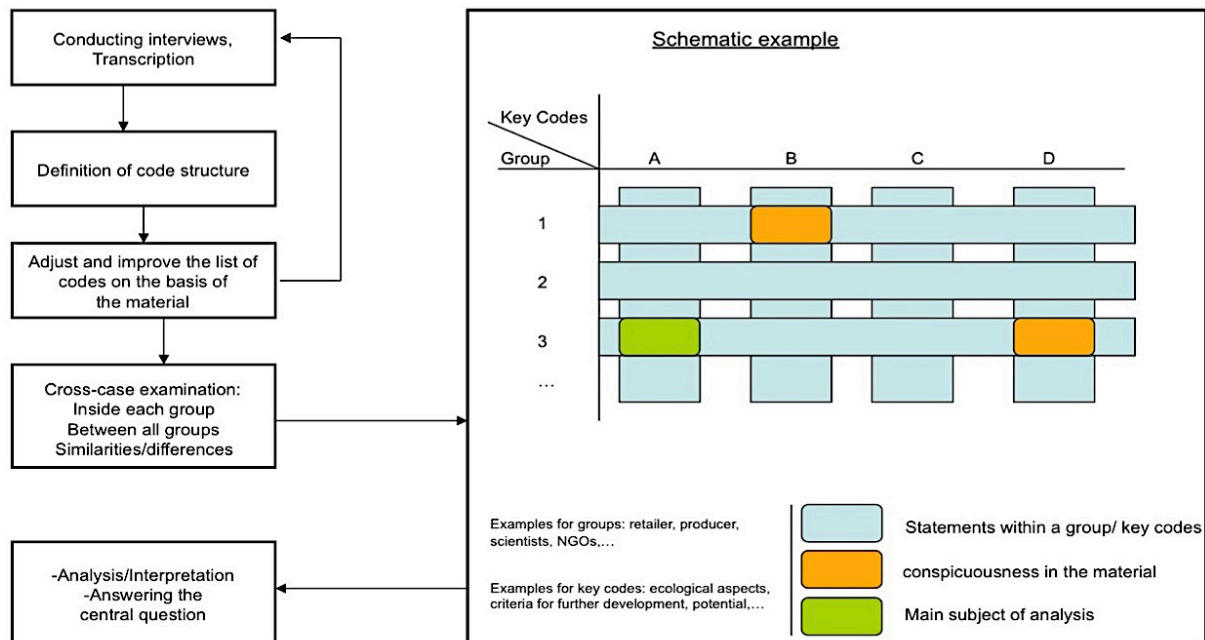


Figure 4-14. The cross-case analysis.

5 RESULTS

The author of this thesis did the whole research within the German study area as well as partly in the Israeli study area. Furthermore, both papers are provided in their original form including all journal specific formats.

Article 1:

Shirra Freeman, Eran Vigoda-Gadot, Horst Sterr, Michael Schultz, Irina Korchenkov, Peter Krost, Dror Angel. 2012. Public Attitudes Toward Marine Aquaculture: A Comparative Analysis of Germany and Israel. *Environmental Science and Policy*, submitted manuscript.

Article 2:

Michael Schultz, Elisabeth Goldschmidt, Horst Sterr, Peter Krost, Eran Vigoda-Gadot, Noam Cohen, Shirra Freeman, Dror Angel. 2012. The future potential of Marine Aquaculture: Stakeholders' perception, governance and policy-making in Germany and Israel. *Marine Policy*, submitted manuscript.

**Public Attitudes Toward Marine Aquaculture:
A Comparative Analysis of Germany and Israel¹**

Shirra Freeman^{a*}, Eran Vigoda-Gadot^b, Horst Sterr^c, Michael Schultz^c, Irina Korchenkov^b, Peter Krost^d, Dror Angel^a

*corresponding author

- a. Recanati Institute of Maritime Studies, University of Haifa, Mt. Carmel, Haifa, Israel 31905;
Tel: +972 4 828 8130, Electronic Addresses:
Shirra Freeman*: shirra.freeman@gmail.com; Dror Angel: ardor@research.haifa.ac.il
- b. School of Political Science, University of Haifa, Mt. Carmel, Haifa, Israel, 31905
Tel: 972-4-8240709 Fax: 972-4-8257785 Electronic Addresses:
Eran Vigoda-Gadot: eranv@poli.haifa.ac.il; Irina Korchenkov: irina1kor@gmail.com
- c. Institute of Geography, Christian-Albrechts University Kiel, Ludewig-Meyn-Str. 14, 24098
Kiel, Germany; Phone: +49 (0)431 880-2946, Fax: +49 (0)431 880-4658,
Electronic Addresses: Horst Sterr : hsterr@geographie.uni-kiel.de; Michael Schultz :
m.schultz@geographie.uni-kiel.de
- d. CRM, Coastal Research and Management, Tiessenkai 12, Kiel, Germany;
Phone: +49 431 3645880; e-mail: peter.krost@crm-online.de

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ABSTRACT

We report on binational (Germany-Israel) research on relationships between public attitudes, behaviours and preferences related to marine aquaculture. Aquaculture's world-wide market share accounts for over half of all aquatic products. In many places, the sector's explosive growth has outstripped scientific knowledge and governance provisions. Small producers such as Israel and Germany seeking to expand domestic production must address environmental challenges posed by fish farming, stakeholder competition in crowded coastal zones and public/consumer receptiveness. Based on survey data obtained in both countries, correlation analysis (Pearson's *r*-statistic) was used to test four hypotheses. Of these, one (positive relationship between coastal tourism and aquaculture attitudes) was supported in both countries. The hypothesis of positive relationships between lifestyle (environment/health) behaviours and aquaculture attitudes was supported only in Germany and the hypothesis of negative relationships between concern for the environment and aquaculture attitudes was supported only in Israel.

These results are significant for policy, business, NGO and other stakeholders. Moreover, they point to the importance of this type of comparative research in improving our understanding of local factors influencing attitude-formation and inter-relationships. First, the tourism-aquaculture relationship found indicates potential synergies between two sectors reliant on the coastal zone that should be taken into account by planning authorities. The divergent environment-aquaculture results were especially interesting since in both countries, the primary concern regarding aquaculture expansion was environmental impacts. Closer inspection of the survey results revealed that this relationship may have been influenced by the orientation of environmental concerns in each population. Germans focus on depletion of wildstocks and Israelis on cage effluent and marine pollution. Another significant result is the relatively low level of knowledge/understanding about the aquaculture sector among the general public. There is therefore a dual challenge for policy-makers and planners: Against the background of broad support for expanding sustainable aquaculture, there is also a need for improved communication of scientific information on aquaculture-environment interactions as well as on the quality and safety of aquacultured products.

Keywords: aquaculture, public perceptions, public attitudes and behaviours, socioeconomics

1 INTRODUCTION

Aquaculture is an ancient practice, believed to have originated over two thousand years ago in China. Artisanal fish farming has been documented for hundreds, if not thousands of years throughout the world. It is only within the last 30-40 years that commercial practice has become widespread and currently, aquaculture is among the fastest growing food production sectors worldwide. From a market share of under 10% in the 1970's, aquacultured products currently account for upwards of 50% of all fish and seafood in world markets. For species such as seabream, salmon and tilapia, the percentage may be much higher (FAO 2010). The largest producers are in the Pacific region, but as demand for fish has grown and wild fish stocks have become increasingly stressed, commercial opportunities have attracted producers in many other parts of the world. In some areas existing aquaculture practice has expanded whereas in others, it is being introduced for the first time.

The explosive growth of the aquaculture sector has outstripped the pace at which governance frameworks have adapted. Moreover, the scientific community has only begun to grapple with several important issues including the environmental impacts of fish farms (Primavera, 1997; Naylor et al. 2000, 2009; Black, 2001; Weber, 2003). In addition, farms are often located in the crowded coastal zones and compete with many other users. As a result, stakeholder conflicts are common (Consensus 2006; Halwart et al. 2007). Even in the absence of outright conflict, there is evidence of confusion among the public on issues ranging from the quality and safety of cultured fish to the environmental impacts of fish farming (Robinson 2004; Whitmarsh and Wattage 2006; Mazur & Curtis 2006). Both stakeholder conflicts and public perceptions are important issues for fish farm operators and institutions governing the aquaculture sector.

In Israel, commercial-scale marine cage aquaculture (mariculture) began in the late 1980's. A prolonged and high-profile court case led to the removal of all farms from the Gulf of Eilat in the Red Sea in 2008 and is generally believed to have negatively biased Israeli public opinion about the practice. Farms continue to operate along the Mediterranean coast and the sector is profitable, mainly producing fish for the domestic market. In Germany, commercial-scale mariculture has been practiced intermittently and there is anecdotal evidence of interest on the part of entrepreneurs on one hand and opposition from local stakeholders on the other (Krost, 2010). Potential fish farm sites in Germany are in the North and Baltic Seas. Although neither country is currently a large producer of farmed fish (Halwart et al. 2007), given global trends, there is high potential that the practice will expand. The demand for fish in both countries is rising

(FAO 2011a, 2011b) and well-managed aquaculture can be a local source of high quality, safe fish as well as an attractive investment opportunity. Public receptiveness toward farming activity and its products, especially among the fish-consuming public are factors in the development potential of the sector. Understanding these may also provide important information for effective governance (Kaiser et al., 2007).

This paper reports on research conducted in Israel and Schleswig-Holstein, Germany on the relationship between public attitudes and behaviours with respect to mariculture. Public surveys were conducted in both countries with respondents asked about their attitudes toward aquaculture and their attitudes and behaviours related to employment, governance institutions, health and lifestyle, the tourism sector, environmental quality and the economy as well as civic and political involvement. The project's purpose was to improve information for policy makers, public planners and investors on how the public regards coastal mariculture and its products. Our specific objectives were to:

- (1) Provide insights into attitudes and behaviours relevant to the broad social acceptability of the aquaculture sector in Germany and Israel; and
- (2) To test the feasibility of using survey methods to maximise both information obtained and response reliability in a bi-national comparative context.

1.1 LITERATURE REVIEW

1.1.1 Social Acceptability, public perceptions and preferences in aquaculture

There is little systematic research into public knowledge, perceptions, attitudes, preferences and behaviours related to aquaculture. The relationship between perceptions and behaviours among aquaculture stakeholders was analysed by Chu et al. (2010). One of the largest studies of community perceptions was conducted in Australia over a three year period and involved an extensive review of existing literature, stakeholder interviews and mail surveys conducted in two areas on the country's southern coast (Mazur and Curtis, 2006). One of the survey's foci was the manner in which risk perceptions informed concerns about the sector. Respondents were questioned about their knowledge level, interest and contact with aquaculture; opinions about the sector's social and environmental risks and benefits as well as their attitudes in other domains. While a high percentage of respondents ranked their level of knowledge as low, there was considerable regional variation in these self-rankings and in actual knowledge. Most respondents

expressed strong environmental concerns. Those with the most exposure had the highest of awareness of aquaculture's socio-economic benefits. Those with less direct exposure demonstrated greater concern for environmental sustainability.

Other research also indicates popular support for considering conservation and other environmental benefits in the context of public decisions involving trade-offs between economic and environmental interests (See for example: Nancarrow and Syme 1991; Tarrant et. al. 2003). The environment-economy tradeoff was refined in the context of aquaculture by Whitmarsh and Palmieri (2011) and Whitmarsh and Wattage (2006) who found that economic benefits of the sector were most highly ranked by individuals having direct involvement in aquaculture. Both studies ranked respondents' preferences using the Analytical Hierarchy Process (AHP) and valued their Willingness to Pay (WTP) a premium for sustainably farmed salmon using the Contingent Valuation Method (CVM). They found a positive WTP premium for fish believed to be farmed in a sustainable manner. This finding is similar to the 5-10% WTP premium found in other studies (Ridler et al. 2006; Seafood Choices Alliance, 2003). Trust in the industry and policy makers is also an important determinant of levels of social acceptability of aquaculture and development of the sector (Kaiser and Stead 2002; DFO 2005). In a study by Barrington et al. (2010) many respondents indicated that they were not adequately informed about the seafood available to them.

1.1.2 Attitudes and Behaviours - Social and economic aspects

Research in organizational social psychology and political behaviour point to the major role of attitudes in shaping behaviours in various situations (Lewin, 1936; Rokeach, 1968; Randolph 1985). For example, in Human Resource Management, the notion that employees with positive workplace attitudes will exhibit better performance and higher contribution to the organization's productivity is widely accepted (Mowday, 1985). In Political Science citizens' attitudes toward government are known to influence electoral behaviour and political participation (Philip & Angell, 1987; Philip, 1991; Verba et al., 1995). Social research related to aquaculture has begun to shed light on factors that influence people's attitudes and behaviours and how these interact in the context of aquaculture activities (Mazur et al. 2005). In particular, it has been used to answer the questions:

1. How does the public perceive the business operations and management within the sector?
2. How knowledgeable are people with respect to the ecosystems on which aquaculture depends?
3. How are the trade-offs between mariculture and other stakeholders in the coastal zone perceived?

2 MATERIALS AND METHODS

2.1 Research Model and Hypotheses

Figure 1 provides a schematic of the research model used to analyse the relationship between attitudes toward mariculture and attitudes and behaviours in four domains: employment, environment, tourism and lifestyle. Each domain was chosen either because of evidence of a similar relationship found in prior research or from observations in the field. Box 1 lists the research hypotheses stemming from the model.

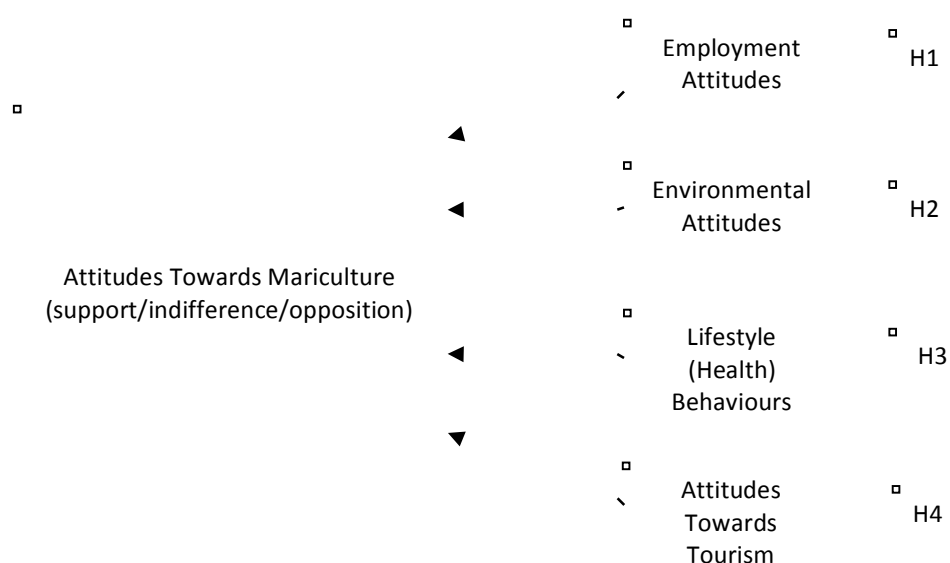


FIGURE 1: Research Model and Hypotheses

In the case of the relationship between employment and mariculture, fish farming and related activities (e.g.: processing, transport and marketing) have been shown to create jobs and

rejuvenate communities that were formerly reliant on capture fisheries (Paquette & Lacroix, 1997; Commission of European Communities, 2002). Research by Whitmarsh and Wattage (2006) showed that people in areas most economically dependent on aquaculture showed the greatest support for the sector. Klandesman and van Vuuren's (1999) observed that people most concerned about employment issues also tend to support undertakings that they believe will contribute to employment. Taken together with evidence showing a positive relationship between concerns for employment and support for aquaculture (Mazur and Curtis, 2006; Mazur et al. 2005; Burbridge et al. 2001) we concluded that testing the hypothesis that higher concerns for employment are positively correlated with attitudes toward mariculture was appropriate for Israel and Germany. We considered two aspects of employment attitudes. The first is the centrality of one's job to one's self-image and life. The second is the perception of job security, in particular, the individual's assessment of the likelihood of losing his/her job and the consequences – for example, the length of time unemployed and economic losses. This assessment need not be based on the objective reality (Hesselink and van Vuuren, 1999; Anderson and Pontusson, 2007; Greenhalgh and Rosenblatt, 1984). For example, an individual who believes that finding a new job will be difficult will suffer a greater sense of insecurity than an individual who believes that he or she will find a job easily, even if the two perceive the chances of job loss as the same (Anderson and Pontusson, 2007; Klandermans and van Vuuren 1999). Hypothesis 1 therefore tests the assumption that individuals who view their job as more central or who are more concerned about job security, or both will be more supportive of mariculture.

It is reasonable to assume that both the German and Israeli public have been exposed to communications concerning the potential environmental effects of mariculture. In the context of European environmental policy, aquaculture has been identified as a major environmental concern (EEA 2006). In Israel, environmental regulation has been used as the basis for a court case that resulted in the removal of fish farms from the Gulf of Eilat. The media coverage given this case was extensive and largely negative. For this reason, we tested the assumptions: the attitudes of people who are exposed to negative messages concerning aquaculture's environmental impacts will be negatively influenced by these messages; and individuals with greater concern about the environment will be more influenced by these negative messages.

The health dimension draws on the research of Maiman et al. (1977), Ajzen and Timko (1986) and Brown et al. (2003) and assumes that individuals are willing to engage in a range of activities aimed at reducing disease and improving the quality and length of life. Nutrition is key to this

concept and our third hypothesis addresses two elements. The first is the belief that fish is an important part of a healthy diet (von Schacky et al., 1999) and the second is that the safety and quality of farmed fish is at least as high as wild caught fish (Halwart et al., 2007).

The relationship between tourism and aquaculture was chosen because of the large number of stakeholder conflicts between these sectors in coastal zones. The relationship was also of interest because of a large literature showing that attitudes toward tourism and other activities perceived to impact the tourism sector are strongly related (either positively or negatively) (Andereck and Vogt, 2000; Lindberg and Johnson, 1997; Liu and Var, 1986). Public opinion research on the topic does not universally support the notion that tourists and residents view the aquaculture and tourism sectors as conflicting. Mazur and Curtis (2006) found that only 11% of respondents view aquaculture as damaging to tourism. Tango-Lowy and Robertson (1999) found that overall, the majority of tourists see no conflicts between their activities and mariculture and 89% support the notion of developing the sector. Because tourism and mariculture potentially share the same physical space in Israel and Germany, our fourth hypothesis addresses the relationship between attitudes toward the two sectors.

Box 1: Hypotheses

- H1. positive relationship between job security and support for mariculture.
- H2. negative relationship between concern for the environment and attitudes towards mariculture.
- H3. positive relationship between care for health and attitudes towards mariculture.
- H4. positive relationship between support of tourism and attitudes towards mariculture.

2.2 Methods

Data were collected by means of public surveys. The survey design was based on Mazur and Curtis (2006) with modifications to suit the Israeli and German contexts and to facilitate comparisons between the two populations. The Israeli and German surveys consisted of 93 and 73 questions, respectively, grouped into seven common categories: environment, tourism, government and policy, employment and job security, health and lifestyle, political and community participation, aquaculture, and socio-demographics. Because of the latency of attitudes, validity and reliability were concerns in designing the questionnaire (AECT, 2001). Therefore, each category contained several questions, which permitted us to obtain information on multiple dimensions of each category. In addition there were a number of questions with the same

information content but different structure to test whether the answers elicited were invariant to the question structure. In order to ensure that comparison between the German and Israeli surveys could be conducted, at least two questions within each category were identical.

All surveys were conducted in face-to face interviews with respondents reading the questions and writing their answers on forms provided. Approximately twenty minutes were required to complete each questionnaire. Teams of graduate students who had received prior training administered the surveys. Respondents had access to the surveyors at all times to provide clarifications on request.

In Israel, 431 respondents were surveyed. Approximately half of these were drawn from weekday travelers on Israel's main rail route (Haifa-Tel Aviv) at various times. Because train travel is heavily used by all segments of the Israeli population, we believed that a broadly representative sample could be obtained by sampling travelers. The other half were drawn from surveys conducted in numerous locations in the city of Eilat. Eilat was chosen since it was the site of Israel's earliest cage aquaculture operations and the authors believed that the anticipated high level of awareness about the sector in this city would provide an opportunity to examine attitudes among respondents with high levels of prior knowledge. In Germany, surveys were conducted in Kiel, on the Baltic coast. This is an area where mariculture development has been proposed and small scale fish, mussel and an alga farms exist. In total, 363 in-person surveys were conducted at different locations around the city.

The two questionnaires differed somewhat in the organization of questions. In the German questionnaire, the environment section was subdivided into general environmental questions and ones specific to the marine environment. In addition, the German questionnaire included a category of questions on respondents' views of the future. The Israeli environmental attitudes section was not subdivided and most questions concerned the coast. No questions about the future were asked. The section on mariculture in the Israeli questionnaire contained three types of questions. The first was designed to elicit general opinions, for example by asking respondents whether they think that mariculture's advantages outweigh its disadvantages. The second set of questions focused on the potential conflicts and complementarities between mariculture and tourism. The third focused on the conflicts and complementarities between mariculture and capture fisheries. The reason for the breakdown was to capture general perceptions and check their consistency with more directed inquiries. In the German questionnaire, there was concern

that low levels of awareness might hinder respondents' ability to answer questions about mariculture. Respondents were therefore provided with a table listing 6 possible advantages and 6 possible disadvantages of marine aquaculture and asked to choose the four most important points out of the 12. The mariculture issues were chosen in consultation with experts including representatives of environmental organisations and of the regional economy. The mariculture category in both countries' surveys included a sub-section on respondents' willingness to pay a premium for farmed fish raised in sustainable manner.

Questions about attitudes were answered using a 5-point Likert scale ranging from "strongly disagree" to "strongly agree". Questions about behaviours were answered using a 3-point scale ranging over "never", "was true in the past but not currently" and "is currently the case". Socio-demographics and level of knowledge data were assessed using multiple choice questions and the willingness to pay was based on a payment card. In the German questionnaire, an additional section on advantages and disadvantages of mariculture used a binary (Yes/No) format allowing respondents to prioritise four choices from among 12 options.

Pilot surveys were conducted to identify problems with the questionnaire format and potential trends needing further attention. In Israel, 50 students from the Department of Political Science were surveyed and in Germany the survey was tested on 45 students from the Department of Geography and 25 employed residents of Kiel. Based on the results of the German pilot study, the questions on income and employment were modified since most respondents were unwilling to reveal their income levels. Therefore, in the German questionnaire the respondents were asked if their salary was high enough to allow them to spend extra money for fish farmed in an environmentally sustainable manner. No major changes were made to the Israeli questionnaire as a result of the pilot study.

Data analysis was conducted using SPSS© (Statistics Package for Social Science) 15.5 and 18.0. Within-group consistency for each group of scales was measured using Cronbach's alpha test and correlation between scale pairs was checked using Pearson's correlation coefficient. All of the analyses were completed for each site individually and in the context of comparative analyses.

2.3 The Sample

The Israeli sample of 431 was almost evenly split between respondents drawn from train travelers (209) and those in Eilat (222). The response rate was 95%. The proportion of males and females was 52.3% and 47.7%, compared to the national average of 49% and 51% respectively.² The mean age was 31.64 years compared to the national average of 32.2 years. The vast majority of respondents had at least a high school baccalaureate; 36.8%; 20.5% had some post-secondary education, but not necessarily an academic degree; and 38% had at least one academic degree. The Jewish population was somewhat over-represented with 88.6% of respondents identifying themselves as Jews, compared to the national average of 76%. Christians, Muslims and others were 3.2%, 3.2% and 2.2% respectively; 2.8% did not answer this question. This minor skew may be explained by the fact that the surveys were conducted in areas frequented by Jews more than other religious groups. Income levels also appear to over-represent lower-earning groups. The average monthly income cited in the survey was 7,500 New Israeli Shekels and 29.2% indicated that their income was “far below average”, 28.9% indicated that their income level was “below average” and 20.2% indicated that their income level was “average”. 16.5% and 5.2% indicated that their income levels were above or well above the average, respectively. Overall, this sample is representative of the Israeli population with a slight bias toward more educated and younger respondents and a larger bias toward Jewish respondents.

The German response rate was 70%-75% and the sample was broadly representative of the population of Kiel as a whole. The mean age of the respondents (38.9 years) was slightly lower than the German population average (41.9 years). The gender distribution 47.7% males to 52.3% females by the in-person surveys compared to the Kiel average of 48.9% and 51.1%. High school baccalaureates were held by 29.8% and 25.9% had an academic degree. About 66.7% were Christians and 32.0% indicated no religion. The average of the Christian population in Germany is 62.8%.

² Israeli Bureau of Statistics, 2008.

3 RESULTS

3.1 Reliability

The reliability of each set of scales was measured using Cronbach's Alpha (α) and is shown in Table 1. In Israel, of the seven groups, the two most reliable scales were *Attitudes Toward Aquaculture* and *Attitudes Toward Tourism* with $\alpha=0.83$ and $\alpha=0.87$, respectively. Of the remainder, three had scores of $\alpha=0.7$ or greater and two, *Attitudes toward Job Centrality and Security* and *Political Participation and Community Involvement* scored $\alpha=0.65$ and $\alpha=0.69$, respectively. Since all the within-group scores were above $\alpha=0.6$, every group was treated as a single scale for the purpose of the correlation analysis. For example, the mean value of the nine scales in the *Attitudes Toward Aquaculture* category, 3.24 (± 0.72) was used to indicate weak support for the sector. Overall, Israeli respondents expressed the highest level of agreement with statements supporting conservation of the coastal environment (mean value 4.5 ($\pm .65$)). Questions related to community involvement elicited the lowest level of agreement (mean 1.3 (± 0.41)).

In the German sample, reliability analysis was conducted for six of the seven scale categories. All but one scale met the $\alpha=0.6$ threshold. *Trust in Governance and the Public System* had the highest score (0.81), followed by *Attitudes Toward the Environment* (0.77). Scores for the rest of the scales were between 0.6 and 0.7, with the lowest reliability attributed to *Ecological and Health Related Behaviour*. Reliability analysis was not conducted for *Attitudes Toward Aquaculture* category because it contained only one Likert scale question.

TABLE 1 Reliability

	SCALE GROUPING	Cronbach's α	mean	Standard Deviation	n
ISRAEL	1. Attitudes toward Aquaculture	0.83	3.24	0.72	422
	2. Attitudes toward environment	0.72	4.50	0.65	426
	3. Ecological and health-related behaviour				
	Ecological behaviour	0.70	1.99	0.49	428
	Health and nutrition	0.77	2.04	0.60	456
	4. Employment				
	Attitudes toward job security	0.67	2.86	0.96	428
	Attitudes toward job centrality	0.62	4.09	0.74	429
	5. Political participation and community involvement				
	Political participation	0.69	1.56	0.38	422
	Community involvement	0.69	1.30	0.41	419
	6. Attitudes toward tourism	0.87	3.98	0.77	430
	7. Trust in governance and public system	0.73	2.36	0.89	427
	GERMANY	1. Attitudes toward Aquaculture	N/A	3.87	0.95
2. Attitudes toward environment		0.77	3.97	0.47	363
3. Ecological and health-related behaviour		0.60	2.32	0.32	363
4. Employment					
Attitudes toward job security		N/A	3.07	1.18	363
Attitudes toward job centrality		N/A	4.1	0.98	363
5. Political participation and community involvement		0.64	1.68	0.43	363
6. Attitudes toward tourism		0.66	3.44	0.7	363
7. Trust in governance and public system		0.81	2.43	0.81	363

The main difference between the German and Israeli reliability analyses relates to the scale groupings for aquaculture and employment attitudes, health and environmental behaviours, community involvement and political participation. In the German sample, correlation analysis was based on the mean of the single Likert scale question on aquaculture attitudes (3.87 \pm 0.95) and the means of each of the three individual employment questions. In the analysis of the Israeli

sample, health and environmental behaviours were treated as two scales while in the German sample, they were treated as one. The same is true of community involvement and political participation. The sub-groupings within these last two groups had α -scores of less than 0.6.

3.2 Correlations

The Pearson's Correlation Coefficient (r) for between group correlations for all scale groups, subgroups and relevant individual scales is shown in Table 2A. The coefficient provides two important types of information. First, it gives a preliminary indication of the level of support for the four research hypotheses. Second, it indicates potential collinearities among independent variables that need to be accounted for when regression analyses are conducted. In most cases, no correlation ($r=[0, |0.09|]$) or a small correlation ($r=(|0.1|, |0.3|]$) among the independent variables (i.e. attitudes and behaviours not related to aquaculture) is indicated. Where moderate ($r=(|0.3|,|0.5|]$) to large ($r=(|0.5|,|1|]$) correlations are indicated, statistical significance of the result is at the 1% level.

Five pairings had moderate to large correlations. The most highly correlated pair in the Israeli sample was political participation and community involvement ($r=.514$). In the German sample (Table 2B), two pairings had moderate to large correlations: *Attitudes toward the coastal environment* and *ecological and health behaviour* ($r=.415$) and *political and community involvement* and *ecological and health behaviour* ($r=.381$).

Hypotheses H1, H2 and H4 are broadly supported in the Israeli analysis. In the case of H1, respondents with greater concern about employment security are more supportive of aquaculture ($r = 0.2$; $p<0.01$). The correlation between job centrality and aquaculture attitudes is positive, but small and not statistically significant. More committed environmental behaviours are negatively correlated with attitudes toward aquaculture ($r= -0.28$; $p<.01$) indicating support for H2 and support for tourism is positively correlated with support for mariculture ($r= 0.36$; $p<.01$) indicating support for H4. The correlation between health behaviours and support for mariculture (H3) is negative, very low and not statistically significant ($r= -0.5$; $p>.05$). In addition, the potential for collinearities among the four independent variables of interest (environmental behaviour, attitudes toward tourism, attitudes toward job security and health) is small as the Pearson coefficient is either statistically insignificant or too low to be of concern.

In the German analysis, hypotheses H3 and H4 are supported whereas hypothesis H2 (negative relationship between concern for the environment and attitudes toward mariculture), is not. Because health and environmental behaviours were combined in a single scale in the German sample, individual scales related to health were examined for the correlation analysis. In the case of H3, the health attitude most strongly associated with positive attitudes toward aquaculture, was maintaining a healthy diet ($r=.109$; $p<.01$). The remaining scales in the health behaviours group were positive but not statistically significant. On the basis of these results we conclude that H3 should not be rejected. Hypothesis H4 – positive relationship between support of tourism and attitudes toward aquaculture, was significant ($r=0.159$; $p<0.01$). The rejection of H2, in the German survey, was based on the positive correlation ($r=0.253$; $p<0.01$) between *attitudes toward aquaculture* and *attitudes toward the coastal environment*. An examination of individual scales in the environmental behaviour category reveals only one statistically significant correlation, between *attitudes toward aquaculture* and *donations to environmental organizations* ($r=0.123$; $p<0.01$). This lends support to the rejection of H2. Moreover, no significant correlation between job security and attitudes toward aquaculture (H1) was observed in the German sample.

TABLE 2 – BETWEEN GROUP CORRELATION

A. Israel

Variable	Mean	SD	N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1
1. Attitudes toward aquaculture	3.24	0.72	422	1														
2. Attitudes toward coastal envir	4.50	0.65	426	-.075	1													
3. Ecological behavior	1.99	0.49	428	-.28**	.25	1												
4. Health behavior & good nutrition	2.04	0.60	456	-.05	-.06	-.20**	1											
5. Attitudes toward employment	2.86	0.96	428	-.20**	-.20	.06	-.05	1										
6. Attitudes toward job centrality	4.09	0.74	429	.08	.09	.03	.04	.10	1									
7. Attitudes toward tourism	3.98	0.77	430	-.36**	.09	-.23**	-.09	.05	.22**	1								
8. Political participation	1.56	0.38	422	-.17**	.14**	.32*	.23*	-.06*	.11*	-.03	1							
9. Community involvement	1.30	0.41	419	-.08	-.11*	-.28*	.25*	-.01*	.13**	.05	-.51	1						
10. Involvement in decision-making	2.25	1.00	427	-.23**	-.12*	-.08	.06	.05	.16**	.15**	-.06	.06	1					
11. Trust in governance and public system	2.36	0.89	427	-.23**	-.15**	-.02	.02	.06	.11	.01	.02	.06	.58	1				
12. Gender (1 = female)	-	-	411	.09	-.10	-.05	.117	.18**	-.07	-.02	-.09	-.04	.05	.01	1			
13. Education	1.92	0.96	410	-.03	.09*	.126*	.113	-.05*	.02	-.107	.18**	.17**	-.06	.01	-.02*	1		
14. Age	31.64	12.58	423	.01	-.02	.04	.19*	.22**	.11*	.12*	.24**	.30*	NS	-.03	-.11*	.21**	1	-

*Correlation is significant at the 0.05 level

**Correlation is significant at the 0.01 level

B. Germany

* Correlation is significant at the 0.05 level

**Correlation is significant at the 0.01 level

1. Attitudes toward aquaculture	3.87	0.95	1															
2. Attitudes toward coastal enviro	3.97	0.47	.253**	1														
3. Ecological & health behavior	2.32	0.32	.105*	.415**	1													
4. Attitudes toward employment	3.07	1.18	.007	-.011	.129*	1												
5. Attitudes toward job centrality	4.10	0.98	.037	.137**	.174**	.08	1											
6. Political & community involvement	1.68	0.43	.047	.296**	.381**	.072	.085	1										
7. Attitudes toward tourism	3.44	0.70	.159**	-.121*	-.04	-.013	.018	-.04	1									
8. Trust in governance & polit. system	2.43	0.81	.073	-.001	.086	.119*	.244**	-.063	.234**	1								
9. Attitudes to future dev. of resources	4.18	0.60	.064	.281**	.085	.034	.158**	.133*	-.039	-.046	1							
10. Gender	0.52	0.50	-.049	.055	.067	-.071	.043	.065	-.043	-.001	.008	1						
11. Education	2.60	1.19	.072	.092	.229**	.033	.087	.132*	.016	.043	.058	-.026	1					
12. Age	38.88	15.25	-.125*	.04	.128*	-.179**	-.034	.02	.08	.117*	-.137**	-.04	.042	1				

4 DISCUSSION

The main purpose of this research was to examine attitudes and behaviours related to mariculture and their relationship with attitudes and behaviours related to employment, governance institutions, civic involvement, health and lifestyle, the tourism sector, environmental quality and the economy. The study was carried out in a bi-national comparative context, in Germany and Israel; countries with small aquaculture sectors and relatively low awareness about the sector among the general population. Both countries import and consume aquaculture products and there is interest in increasing domestic production. Based on experience in other countries, public attitudes and stakeholder interactions play a role in determining the social acceptability of aquaculture (Burbridge et al. 2001; Kaiser & Stead, 2002; Robertson & Carlsen, 1999; Mazur & Curtis, 2006). Surveys of the type conducted in this study provide important baselines for assessing the levels of knowledge, perceptions and attitudes needed to inform policies and planning for future mariculture activities.

The main challenges for this comparative research were the differences in cultural, geographic, political and informational contexts in Germany and Israel. Our questionnaires were designed to maximise the number of directly comparable scales while accommodating differences between the two sample populations. This was particularly important for handling sensitivities regarding questions about employment and income among the German respondents and greater hesitancy among the German respondents regarding their level of knowledge and ability to respond to questions about aquaculture.

The high reliability of responses (Cronbach's $\alpha > 0.6$) in all but two scale groups allowed us to treat multiple questions in the relevant category as a single scale. Comparing the means of the grouped scales in Germany and Israel reveals both similarities and differences in the extent to which respondents agreed or disagreed with statements. Seven scales were directly comparable. Of these, three had identical ordinal ranking (Table 1). Job centrality was ranked in second place in both Germany and Israel. Support for aquaculture ranked fourth and trust in governance sixth. Both populations were similar with respect to low levels of civic, community and political involvement. Israelis indicated higher support for the coastal environment and tourism and lower levels of ecological and healthy lifestyle than the Germans surveyed.

The support for only one hypothesis, H4 in both samples, is a very important result from the standpoint of stakeholder interactions since it appears that the public perceives coastal tourism and mariculture as legitimate uses of the coastal zone that need not be in conflict with each other. This contrasts with actual experience in parts of Europe and North America where tourism and recreation come into direct conflict with aquaculture. In extreme cases, fish farms have been ordered removed or relocated to offshore sites as a result of conflicts (FAO 2011). The result points to potential synergies such as those exploited in areas of Pacific Asia where fish farms are incorporated into tourist itineraries. Closer examination of stakeholder attitudes is therefore warranted, in order to implement policies and planning that accommodates both sectors.

The mixed results in the case of H1 may be due to the lower level of familiarity with mariculture in Germany and low awareness of its economic potential and contribution to employment. The Israeli public has somewhat more exposure than the German public, especially in places like Eilat. It may be worthwhile to examine the Israeli sub-samples (Eilat and General Public) separately to see whether correlations are higher in groups with greater exposure to the sector. This type of result conforms to results of previous studies such as Whitmarsh and Wattage (2006) showing highest support for aquaculture in areas in which farms already operate.

The mixed results for H2 are somewhat surprising in light of the fact that environmental concerns are highly ranked in both samples. An examination of the characteristics of the environmental orientations in each country offers a plausible explanation. Among Israelis, the major environmental concern is fish-farm effluent and pollution of marine environments and this is consistent with the negative correlation between environmental concerns and support for aquaculture. The reason may be that many Israelis were influenced by media coverage of the

court case in Eilat that focused on pollution and damage to coral reefs. In Germany, the positive relationship between concern for the environment and attitudes toward mariculture may be related to concerns about depletion of wild fish stocks. Of the twelve different advantages and disadvantages listed by German respondents, 77.1% indicated that mariculture has the advantage that it does not lead to overfishing and 55.1% indicated that the practice is not associated with damage to natural habitat such as is the case in trawl fishing. All other advantages and disadvantages were chosen in less than 50% of the cases. Furthermore, almost 80% of the respondents believe that traditional fishery will continue to decline in importance because of the pressures of overfishing and a sizable minority (46%) listed food security as an advantage of mariculture. Concern for the environment and food security coupled with the belief that sustainable mariculture can decrease pressures on wild fish stocks is arguably the main driver behind the positive relationship observed in the German sample. These orientations may also explain why, notwithstanding broad support in both samples for expansion of the aquaculture sector, support is highest in Germany.

These environmental perspectives also warrant further examination of the influence of the respondents' level of knowledge and sources of information. Scientific evidence around pollution from the Israeli farms both during the farms' operations and following the removal indicates that damage caused by farm effluent was minimal and reversible (Atkinson et al., 2004; Israel Ministry of Environmental Protection, 2005; Oron et al. 2011). The German view that aquaculture may benefit marine biodiversity also indicates limited awareness of major controversies related to the contribution of the manufacture of fish feed used in aquaculture of carnivorous species to overfishing.

The mixed results for H3 are difficult to explain without further examination of how Israelis and Germans perceive the quality and safety of the products of aquaculture. Again, this may be related to respondents' knowledge levels. Although a large percentage of the fish consumed in both countries comes from farms, we do not know the extent to which consumers are aware of this fact. The support for H3 in the German population appears to support the claims that farms offer quality control that capture fisheries lack (Tacon and Halwart, 2007). Concerns about pollution in the farm environment and the use of chemical and antibiotic treatment within the farms have been cited by a number of researchers (e.g.: Hites et al., 2005) and these may be in part responsible for the weakly negative correlation in the Israeli sample. Without further research, it is too early to say with certainty.

Scales with medium to high levels of correlation have implications for collinearity. These will be analysed more fully in the context of the multiple regression analyses to be conducted in subsequent work. The low levels of pairwise correlation among attitudes toward tourism, job centrality/security, the environment and health/environmental behaviours and tourism indicates that combining the four as multiple regressors will be viable.

Beyond the variables addressed in the four hypotheses, correlations among several other scales bear further examination and will be addressed in the formulation of the regression analyses. The correlation between *ecological behaviour* and *health behaviour and good nutrition* in both countries may be in part explained by evidence that health concerns may be embedded in attitudes toward environmental quality. Von Stackelberg and Hammitt (2009) found that people's willingness to pay to lower health risks associated with PCB contamination was positively correlated with and consistently higher than their willingness to pay to reduce the ecological damages associated with the same contamination. That is, concern for human health is probably often embedded within environmental concerns. *Political participation* and *community involvement* may both be influenced by factors such as a desire to exert influence versus more altruistic motivations (Verba et al. 1995; Peterson, 1990). *Age* and *community involvement* correlations may in part be related to time commitments, if older individuals with fewer responsibilities for young children or retirees with fewer job-related time constraints can commit more time to community.

5 CONCLUSION

The technical issues above reveal important considerations for study design and interpretation of results in comparative research involving public surveys. Context, especially national attributes and level of prior knowledge was very important in designing questions and in understanding certain results, especially divergent ones. Notwithstanding these challenges, or perhaps because of them our research provides a rich information set related to attitudes, behaviours and perceptions, toward aquaculture and the relation among them. These can be used to inform policy and planning in both Germany and Israel. Moreover, the comparative context provides significant added value. Fish markets are international; however consumer receptiveness to the products of aquaculture is largely influenced by local factors. Domestic production has potential advantages in adapting to local market conditions. In the realm of governance, sectoral planning is guided by

local, national and transnational provisions and understanding local factors are a key determinant policies' effectiveness.

Our finding with respect to environmental attitudes and behaviours and levels of knowledge illustrate the usefulness considering local conditions in a comparative multinational context. While the German and Israeli samples were similar in their ranking of environmental concerns, the effect of these concerns on their attitudes toward aquaculture was highly divergent. Moreover, attitudes of both groups revealed a poor understanding of the interactions between aquaculture and the environment. This interplay among prior knowledge, the accuracy of perceptions and attitudes in different domains was revealed because we simultaneously engaged two sample populations, using the same modeling platform. This framework can be extended for use with a larger number of samples. To the best of our knowledge, most existing public survey-based research of this type has been based on single (i.e. national) samples. This type of multi-national comparative research is extremely relevant given the large number of trans-boundary governance and international trade issues relevant to the mariculture sector, in particular, for addressing public acceptability and consumer receptiveness.

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GLOSSARY OF TERMS AND LEGENDS FOR TABLES AND BOXES

EEA European Environment Agency

H1-4 Hypothesis 1-4

n sample size

a Cronbach's Alpha statistic of reliability

r Pearson's sample correlation coefficient

p p-value

The future potential of Marine Aquaculture -

Stakeholders' perception, governance and policy-making in Germany and Israel

**Michael Schultz^{a*}, Horst Sterr^a, Elisabeth Goldschmidt^a, Peter Krost^b, Eran Vigoda-Gadot^c,
Noam Cohen^c, Shirra Freeman^d, Dror Angel^d**

*corresponding author

- a. Institute of Geography, Christian-Albrechts University Kiel, Ludewig-Meyn-Str. 14, 24098 Kiel, Germany; Phone: +49 (0)431 880-2946, Fax: +49 (0)431 880-4658, Electronic Addresses: Michael Schultz : m.schultz@geographie.uni-kiel.de, Elisabeth Goldschmidt: elisabeth.goldschmidt@googlemail.com, Horst Sterr : hsterr@geographie.uni-kiel.de
- b. CRM, Coastal Research and Management, Tiessenkai 12, Kiel, Germany; Phone: +49 431 3645880; e-mail: peter.krost@crm-online.de
- c. School of Political Science, University of Haifa, Mt. Carmel, Haifa, Israel, 31905
Tel: 972-4-8240709 Fax: 972-4-8257785 Electronic Addresses: Eran Vigoda-Gadot: eranv@poli.haifa.ac.il; Noam Cohen: nc.noamcohen@gmail.com
- d. Recanati Institute of Maritime Studies, University of Haifa, Mt. Carmel, Haifa, Israel 31905; Tel: +972 4 828 8130, Electronic Addresses:
Shirra Freeman*: shirra.freeman@gmail.com; Dror Angel: ardor@research.haifa.ac.il

Abstract

Aquaculture has become the most important contributor to the seafood market supplying more than 50 percent of all aquatic products. Mariculture farms, as an important part of the aquaculture sector, are often located in crowded coastal areas. Hence, the mariculture development often comes along with competition between stakeholders of different sectors such as decision-makers, producers, NGOs, scientists and other users. Based on qualitative interviews with these stakeholder groups, not only the awareness and perception of aquaculture's benefits but also their influence on the political will and governance related to mariculture were identified. In this context, the concept of sustainability was used to categorise environmental, economic and socio-political sustainability barriers in Israel and Germany. Generally, in both countries the media seem to be the main source of information about mariculture, but even if the picture of the aquaculture sector drawn by the press is rather negative almost all stakeholders have a neutral or rather positive attitude towards this sector, at least on a global level. In Germany in particular, a kind of NIMBY effect could be observed. However, whereas in Israel mainly technical aspects seem to slow down further development, in Germany doubts regarding the economic efficiency seem to be stopping the entire progress.

The focus regarding mariculture in Israel is on commercial-scale fish farms whereas in Germany only the development of high-quality regional products from small-scale farms are valued positively. A main barrier for the development and expansion of aquaculture in Israel and Germany is the availability of appropriate sites. This often depends on the outcome of the competition between different sectors claiming space along the coastal zones. Hence, as long as stakeholders, especially in Germany, are unaware of the economic potential and benefits of this sector the political will and support will be negative and, hence, the availability of suitable places. In general, the potential for a further development of the mariculture sector is given in both research areas but not only technical improvements but also awareness-raising based on collaborations and information exchanges between the different stakeholder groups are essential for the future of this sector in Israel and especially in Germany.

Keywords: aquaculture, mariculture, stakeholder perceptions and attitudes, socioeconomics

1 Introduction

Aquaculture has grown rapidly during the past few decades and has globally become a very important contributor to the seafood market. It is still the fastest-growing animal-food-producing sector in the world with per-capita supply increasing from 0.7 kg in 1970 to 7.8 kg in 2008, which is an average annual growth rate of 6.6 percent (*FAO 2010*). From a market share of less than 10% in the 1970s, aquaculture products currently account for more than 40% of all fish and seafood in world markets and for species such as seabream, salmon and tilapia, the percentage may be much higher. While aquaculture production (excluding aquatic plants) was less than 1 million tonnes per year in the early 1950s, the production increased to 52.5 million tonnes in 2008. Aquatic plant production in 2008 was 15.8 million tonnes (live weight equivalent), representing an average annual growth rate in terms of weight of almost 8 percent since 1970. Thus, if aquatic plants are included, total global aquaculture production in 2008 amounted to 68.3 million tonnes with a first-sale value of US\$106 billion. Hence, aquaculture is about to overtake capture fisheries as a source of food fish (*FAO 2010*). According to a study of the Irish Marine Institute aquaculture has the biggest growth potential in the marine industries besides the cruise industry, port industry, renewable energy and submarine telecommunications (*Douglas-Westwood Limited 2005*).

However in Europe, the average annual growth in aquaculture production since 2000 has slowed substantially (*FAO 2010*), although the EU is one of the main seafood markets and the EU waters have the capacity to hold (much) more aquaculture productions. Moreover, the demand for seafood is still increasing while the wild fish stocks are depleted and hence, the commercial capture fisheries landings are declining (*Ojeda 2010*). The once-leading countries in aquaculture development such as France and Spain have shown falling production within the last decade. While world aquaculture production will continue to grow in the coming decade, it is expected that the rate of increase in most regions will slow down (*FAO 2010*). Concurrently, European retailers and importers are expanding their international operations in order meet the growing consumer demand for seafood products. Currently Europe imports about 65% of its aquatic food (*FAO 2010, Roth and Rosenthal 2006*).

According to *Ojeda (2010)* and others, one of the main reasons for this negative development of aquaculture and especially mariculture, as the marine part of the aquaculture sector, is the restriction on the availability of appropriate sites. Often, fish farms are located in the crowded coastal zones and compete with many other users. Hence, regional settings may influence the decision-making processes. The capacity for growth and development is limited by population densities, economic diversity, competing uses of marine/coastal environments, the size and structure of the aquaculture industries and the existence of aquaculture-related conflicts (*Mazur et al. 2005*).

Sustainable development of aquaculture:

Aquaculture is the most heavily regulated food production sector in Europe (*Varadi 2010*). However, the explosive growth of this sector has exceeded the pace at which the governance framework has been adapted. Today there is a lot of literature dealing with framework requirements for a sustainable development of aquaculture. In this context, many scientific publications refer directly or indirectly to the concept of sustainability, which is based on three pillars: environmental, economic and socio-political sustainability (*Folke and Kautsky 1992; Vassalloa et al. 2007; Roel et al. 2011*). In the past, especially environmental conflicts created a negative picture of the aquaculture sector, e.g., Pollution problems, the diet of farmed fish causing pressure on wild stocks, antibiotics and drugs, as well as social aspects such as conflicts with other coastal uses, e.g., tourism. Harmful aquaculture practices have generated a number of concerns about this industry (*Nobre et al. 2010; Allsopp et al. 2008; Gibbs 2009; Islam 2005; Kaiser and Stead 2002*). Therefore, the development and expansion of aquaculture is often restricted before its technical and commercial potential is fully exploited. Especially environmental impacts and their negative feedbacks on this sector, often caused by negative media coverage may, on the other hand, influence governance, political will and public awareness (*Nobre et al. 2010; Gibbs 2009*). Policy- & decision-makers as well as coastal stakeholders are often unaware of the social and environmental benefits aquaculture can generate, e.g., through poverty reduction, employment, income and food security (*FAO 2005; Kaliba et al. 2007; Msuya 2006; Robertson-Andersson et al. 2008; Troell et al. 2006*) or through water biofiltration (*Ferreira et al. 2007; Lindahl et al. 2005; Newell 2004; Rice 2008; Žydelis et al. 2010*). In addition to these aspects, the current boom of the aquaculture sector and especially the mariculture sector along coastal areas may lead to conflicts with other coastal uses, e.g., tourism, sailing and fishery, not only within the research areas of this study.

Due to both increasing importance of food security (*Ahmed and Lorica 2002*), negative ecological-economic impacts of non-sustainable aquaculture methods (*Nobre et al. 2010; Islam 2005*) and spatial conflicts with mariculture farms, appropriate governance, including integrated planning and management of aquaculture, is essential for further development (*GESAMP 2001*). This also includes cooperation between the aquaculture sector and the fishery sector as well as other uses, e.g., harbours, wind farms, tourism, coastal protection and nature conservation. It is important to find solutions to the specific problems and ways to guide the development of the aquaculture sectors towards a sustainable and aim-oriented direction. External benefits of socially and environmentally responsible aquaculture may have direct economic value. For example, different studies indicate that consumers are showing increased awareness of and preference for sustainably produced seafood (*Nobre et al. 2010;*

FAO 2006) and are willing to pay higher prices for such products (*Whitmarsh and Palmieri 2008; Whitmarsh & Wattage 2006; Barrington et al. 2008; Seafood Choices Alliance 2003*).

Therefore, instead of the prominent 3-pillar concept (ecological, economic and social) a more appropriate approach towards sustainable mariculture is to consider a fourth pillar: Governance. Good Governance is a distinct key for sustainability of aquaculture. Vice versa, the lack of good governance is considered the main barrier for sustainable aquaculture development in the European Union and other countries. Ojeda argued that good governance is the most modern paradigm for successfully driving aquaculture into the 21st century (*Ojeda 2010*). Furthermore, he stated that the main barrier regarding further development of aquaculture in Europe is the availability of appropriate sites: "Successful aquaculture nations have availability of sites, favourable legislation and political will." (*Ojeda 2010*). According to *IUCN (2009)* good governance implies finding solutions to problems, creating opportunities, guiding the development of sectors towards specific goals and addresses long-term societal trends and needs:

"Governance is a key issue in site selection and site management. Aquaculture development involves the administrative authorities directly, since it occupies and uses areas in the public domain. Licensing, site management, interference with other uses, rights and obligations, policies that apply to it, economic interests, and its close relation to the environment and its preservation all form part of an overall, changeable system that needs to be managed and on which decisions have to be made. Governance has to deal with all these aspects and must therefore apply new concepts and characteristics in order to address sustainability criteria".

Attitudes towards aquaculture and perceptions about aquaculture's benefits may influence the governance process and stakeholders' decisions to support the expansion of aquaculture as well as constraints to aquaculture development and the strictness of regulations. Therefore, stakeholders' attitudes and perception are factors, which should not be underestimated.

Perceptions and expectations are crucial factors, which affect people's decision making (*Levitt and Dubner 2005; Evan and Garling 1991*). Within the last few years stakeholders' perceptions and social attitudes toward the aquaculture industry have been largely neglected (*Nash 2004; Mazur and Curtis 2008*). Furthermore, only few studies have explored the importance of perception-behaviour relationships in the aquaculture policy field (*Tango-Lowy and Roberson 2002; Robertson et al. 2002; Mazur and Curtis 2008*).

Therefore, this paper is dealing with the following main questions:

1. How are the importance and the future development of aquaculture viewed and judged by local stakeholders and decision-makers in Israel and Germany?
2. How can awareness and perception about aquaculture's benefits influence stakeholders' decision to support the further development of aquaculture and future expansion of aquaculture sites?
3. How do stakeholders' attitudes influence the political will and governance related to aquaculture?

2 Research Area and Background

The research was carried out in Israel and Schleswig-Holstein, Germany. Differences not only in the aquaculture history, but also in development strategy and political framework were the trigger for a cross-country analysis regarding stakeholders' awareness and perception as well as their possible influences on the future development and/or expansion of aquaculture in both countries. In Israel, commercial-scale marine cage aquaculture has been practiced since the late 1980s. A prolonged and highly observed court case led to the removal of two farms from the Gulf of Eilat in 2008. This case is generally believed to have negatively biased Israeli public opinion in Israel about aquaculture as a source of marine pollution and hazard for ecosystems such as coral reefs in the Red Sea. Farms continue to operate along the Mediterranean coast and the sector is profitable, producing fish for the local market and for export. In Germany, commercial-scale marine finfish farming was never developed (except a few very small enterprises, e.g., in the Kiel Fjord). However, there is an increasing interest on the part of potential fish farmers, but also opposition from local stakeholders. Although neither country is currently a large-scale producer of farmed fish, it is likely that the business will expand. The demand for fish in both countries has been rising and well-managed aquaculture is a domestic source of high quality, safe fish as well as investment opportunity.

3 Methodology

This study focuses on analysing the attitudes of decision-makers and the wider public about regional mariculture development. In Israel and Germany different stakeholders and levels of government play an important role in aquaculture decision making. Therefore, selected stakeholders and decision-makers were interviewed in order to identify their attitudes towards and perception of marine aquaculture, their criteria for a further development and their estimation of the future development of this sector in Israel and Germany.

The research was carried out by means of qualitative interviews in Israel and Germany during May 2010 to December 2010 and the study involved stakeholders from the following sectors: scientists; economists; environmental NGOs, fish, algae and mussel farmers; politicians and potential competing users within research areas. In Germany, a total of 15 and in Israel a total of 13 representatives of institutions and organisations were interviewed, which have or might have a voice in a potential planning process. The questionnaire for the individual semi-structured interviews included questions about aquaculture in general and about a national level, status quo and potential of growth of aquaculture, its chances & risks in the respective areas and stakeholders' criteria for a further development. Regarding the different forms of qualitative interviews the focus was laid on the problem-centred interview (*Witzel 1982, 1985*). In order to ensure the comparability of the results in Israel and Germany, the questionnaire for the interviews were very similar. There were some minor adjustments depending on the stakeholder group the interviewee belonged to.

The first contact with the interviewees was made by email, explaining the background of the project and the focus of our study. Mostly, a research assistant, who observed the overall conversation, accompanied the lead researcher, who conducted the face-to-face interviews. With the consent of the participants all interviews were recorded and transcribed verbatim.

Data analysis was carried out using Grounded Theory (Glaser and Strauss 1967) combined with qualitative content analysis (Mayring 2000) as it enables the researcher to reduce and structure the large amount of interview material to handy units through the process of coding and summarising. In addition to those approaches the idea of the expert interview (Meuser and Nagel 2002) was taken into account.

It was decided to work with both, deductive and inductive category building. According to the qualitative content analysis codes and core categories were developed based on theoretical assumptions and the research questions. Those deductive codes mirror the main interests of the study. Due to the fact that the code building of the qualitative content analysis does not allow any modification of the once-developed codes, the analysis was combined with the Grounded Theory, which allows adjusting the code system during the whole analytical process. With this inductive approach codes were generated directly from the data without any assumptions from the researcher. This data-driven approach allows novel theoretical ideas or hypotheses to be generated from the data as opposed to testing theories specified beforehand. The coding was not only descriptive but rather categorical, analytic and on a theoretical level of coding, which includes the interpretation of what the interviewees say.

An essential tool of the Grounded Theory is writing memos, by which the development of the analytic thinking is recorded. Furthermore, memos were used to note rules for adopting the codes by describing the nature of each code and of what text should be linked to that

particular code. For developing a hierarchical code system and analysing the data the software MaxQDA was used.

After structuring the interviews by codes the cross-case analysis was conducted (Meuser and Nagel 2002) in order to find out what latent content was hidden in the manifest statements. Following the approach of thematic coding the interviewees are considered in their respective field of interests. This means that the participants are grouped concerning their field of work, e.g., NGOs, producers or scientists. Some of the interviewees belong to more than one group, e.g., two of the German scientists are also active in aquaculture production.

In order to find differences and similarities as well as irregularities within and between the groups, the statements were examined group-wise. By comparing the groups' similarities and differences with each other it is possible to reveal the spectrum of the stakeholders views on the research field and to look for certain patterns. To get a better overview of all statements the interviews were paraphrased and ordered in a table. The findings of the cross-case analysis were written down in the form of hypotheses.

4 Results

The analysis of the interviews generated a number of categories, each of which have an impact on stakeholders' perception of and attitudes towards aquaculture. The core categories identified were a. Awareness of aquaculture in general and b. Ecological and economic aspects and spatial conflicts in Israel and Germany.

4.1 Awareness of aquaculture in general

The awareness of aquaculture in general is quite similar in Israel and Germany although the respective national experiences are somewhat different as mentioned above. Almost all stakeholders pointed out that in the context of overfishing and growing demand for seafood, aquaculture is an important sector with a high potential for solving future world food problems. Differences in the attitude towards aquaculture thus become more obvious when it comes to aquaculture on national level.

4.2 Ecological aspects in Israel and Germany

Environmental sustainability was one of the key factors regarding a further development of aquaculture in both countries (e.g., nutrient input, stocking rate, invasive species, medicine/antibiotics). A German scientist and producer for example, phrased it in a nutshell with the statement:

“Environmental sustainability is a knock-out criterion”

Nevertheless, the initial conditions concerning a future expansion of aquaculture in both countries are seen quite different. Whereas in Israel, e.g., by a representative of the Ministry of Environment, the Mediterranean Sea was described as short of nutrients, where aquaculture could change this ecosystem positively, in the German research area almost all stakeholder described the Baltic Sea as a sensitive ecosystem where eutrophication is a big issue.

While in both countries the main consensus in this context was that nutrient inputs of aquaculture farms have to be reduced to a minimum and mistakes made on national and global level in the past should not be repeated, the difference comes with the details. In Germany most of the stakeholders are rather reluctant towards aquaculture in the Baltic Sea in order to avoid additional nutrient inputs and only a few stakeholders, e.g., producers and scientists, are mainly thinking about integrated multi-trophic polyculture systems in order to reduce the nutrient input to a minimum. In Israel the approach is slightly different. There, an environmental NGO suggested investigating how much nutrient input is de facto emitted by the aquaculture farms and to correlate these results with maximum amount the Mediterranean Sea is able to tolerate in order to find a sustainable balance.

Especially in Germany quite often the importance of Environmental Impact Assessments as a key aspect for the approval of future aquaculture farms was emphasised. Almost all German stakeholders, especially politicians, had a strong confidence in this planning tool as well as in the political framework in general. However, also for the environmental NGOs this was a main issue:

“We want an ecological sustainable Aquaculture, but definitely with a consequent enforcement of ecological criteria.”

Furthermore, it seems that the higher environmental requirements are, the more the growth of aquaculture is limited in each country. In this context a representative of an international NGO in Germany mentioned:

“I think the growth of aquaculture is limited. The boom that occurred in other countries in the past does not work. And what we think is that it is really interesting to compare countries with a good environmental legislation and where it is ensured that it is really implemented, in those countries such a boom does not exist. In those countries the aquaculture does not get out of hands like in Vietnam, for example, where you can see a duplication, triplication or quadruplication of production within 2 or 3 years. And

that are always countries that either do not have any environmental standards at all or where it only exists on paper.”

Generally speaking, all stakeholders in Israel and Germany agree that sustainability aspects of aquaculture farms need to be carefully examined. In addition to that, the problem of an adequate diet was a big issue as well. Besides scientists and producers especially the NGO's pointed out that:

“Provided that a solution to the problem of wild stock overfishing is kept in view, sustainable aquaculture is a expedient supplement to the commercial fishery”

Furthermore, a very import ecological consideration of aquaculture versus wild fishing, mentioned by German and Israeli stakeholders, is the source of feed for fish raised in net cages. The problem pointed out by, e.g., scientists, NGOs and politicians is that the fish are fed with fish or fishmeal from the wild fishery. This enhances to the problem of an increasing depredation of the oceans. One representative from a German NGO expresses this problem as follows:

“I do not see this as a chance because even though oceans are empty due to fishery, for aquaculture a lot of fish is caught for feeding. This should be organised somehow differently.”

Opposing this opinion some stakeholders such as a German politician state that fish could be produced in net cages with very low impact on the environment:

“The image of aquaculture is improvable because fish can be cultured with comparatively low environmental impact.”

Analysing the main criteria of the German stakeholders it becomes obvious that the main interests in the context of aquaculture in Kiel/Germany is sustaining a sufficient water quality of the Kiel Fjord. Mainly politicians mentioned that the current good potential of water quality should not suffer from aquaculture. Other interviewees evaluate the Kiel Fjords water quality as rather critical and hence the Kiel Fjord's potential is regarded as limited concerning aquaculture. Altogether, German and Israeli stakeholders stress the importance of a sustainable way of cultivating fish in net cages to keep the environmental impact as low as possible. Moreover, the diet problem, which includes the enrichment of the water with

nutrients, as well as the problem of feeding cultured fish with caught fish, is mentioned by representatives of diverse groups. Only representatives of the trade group do not argue in terms of ecological criteria at all. In Germany they mainly stress the importance of certifications such as ASC in order to increase the market potential.

4.3 Potential & economic aspects in Israel and Germany

Generally speaking, aquaculture is seen in both countries as an alternative to commercial fisheries in order to avoid further overfishing as well as providing a reliable food source for the growing global population. There is also a broad consensus that aquaculture not only has to be ecologically sustainable but also profitable. Nevertheless, the main foci of the stakeholders in Israel and Germany concerning the future potential are different. While in Israel mainly technical aspects were pointed out to be a barrier for aquaculture, German stakeholders mainly stressed the market potential for German aquaculture products as a key factor.

Even though the commercial-scale marine cage aquaculture in Israel has been practiced since the late 1980s, this sector takes a very small percentage of the total Israeli agriculture. When analysing the interviews the main result for the slow growth seems to be the lack of technological advancement in order to develop aquaculture in the Mediterranean Sea of Israel. Israel is a small country with a desert climate. Many of the interviewed stakeholders (e.g., politicians, scientists and NGOs) pointed out that due to these reasons, the growth of many forms of agriculture and fresh water aquaculture is very problematic. They talked about the shortage of freshwater in Israel, which makes the rearing of fresh-water fish undesirable. This creates a big advantage for marine aquaculture e.g., in the Mediterranean Sea. In other words: Israel has a long Mediterranean coastline, almost without agricultural use. This area is suitable for avoiding both of the problems mentioned above as it does not require land or freshwater.

However, the problems of the Israeli coastline, especially in the Mediterranean Sea are well known by most of the stakeholders, e.g., stormy seas, sometimes with waves up to 7-8 meters high and no deep-water bays to protect the cages. A representative of an Israeli NGO stated:

“The disadvantage is that there are no deep water bays. If we will be able to find the technological solutions for the problems that are caused by the natural conditions, we will have a great advantage over other countries.”

Due to the above-mentioned facts, Israel lades suitable places for aquaculture. Many of the countries in the fishing industry have much better growing conditions and economic feasibilities. An Israeli scientist, for example, mentioned specifically:

"If a person wants to get in the aquaculture industry, Israel shouldn't be his choice."

Nevertheless, recapitulating all Israeli interviews, it may be summarised that expectations for continued growth and development of aquaculture do exist. Aquaculture is seen as an important industry with a great future. A representative from the fishing department of the Ministry of Agriculture mentioned that Israel is a leading country in developing new, revolutionary agricultural methods. This provides economic advantages to growers and the possibility of exporting this knowledge. Furthermore, he stated that:

"There is going to be an increase of the amount of cages in the Mediterranean Sea. In Eilat and a long the Mediterranean coastline, I hope for an Increase of the land's pools. We believe that the aquaculture is going to be developed in two main directions – land systems that are connected to the sea for water renewal and open-sea systems in the Mediterranean Sea"

Hence, in Israel all of the interviewees agree on the great potential that aquaculture has in the country. This can be underlined exemplarily by a statement of an Israeli environmental NGO, who stated:

"...and the lack of food that is going to be over the next 10, 20 years will force us to have more and more experience and more and more sophisticated technology to increase the fish production."

In this respect the situation is different in Germany. There, almost all stakeholders estimated the potential for aquaculture development in Germany as rather low. As the main reason for this opinion, the "minimal" economic potential of aquaculture as well as a lack of appropriate sites, caused by a lot of competing uses, were mentioned. Only aquaculture methods and techniques, which can be exported as know-how, were estimated more positive. The negative appraisal concerning the economic value of aquaculture is based on the fact that Germany is disadvantageous for aquaculture farming due to high wages, production costs and unfavourable climate, which would lead to increasing prices for fish produced in

Germany. Furthermore, almost all stakeholders agree that consumers are not willing to pay higher prices for high-quality regional products.

In Germany all stakeholders pointed out that due to the fierce competition through low-priced foreign aquaculture products, German seafood products from aquaculture only have a chance to stay in the market in the long term if they are of high quality. A German retailer describes this concern as follows:

“The chances for German aquaculture products are not bad but they must be of high quality and there must be a good story behind the products, e.g., regional products”

Many stakeholders, mainly politicians, producers and retailers, voiced their concern that the production volume in countries without strong environmental specifications will continue to rise and their products could glut the German market. As stated by a German environmental NGO, in comparison to other countries (e.g., Vietnam) the growth of aquaculture in Germany is limited due to more rigid environmental legislation and standards. A German producer specified the chances for aquaculture as follows:

“In Germany you have to pin your hope on high-quality niche products which can be brought to the market with a high price.”

In addition, there is a concern by producers that consumers predominantly are less concerned about the quality of seafood products than about prices. Nonetheless, the same stakeholders argued that certification of products (e.g., eco certification or ASC certification) could promote these products. In this context awareness rising through environmental NGOs in order to sensitise the consumers would be indispensable. Additionally, public awareness can be increased by producers through active marketing of their own fish gained from sustainable production.

In total there seem to be several obstacles to develop aquaculture in Germany. All German interviewed producers mentioned their negative experiences with wholesalers and retail markets regarding price policy. Furthermore, the bottom line in Germany is that all stakeholders agree that the growth of aquaculture is very limited by space. There is no chance for large-scale aquaculture in the Baltic Sea. Hence, it can only be a small supplement to the commercial fishery and profitable only through direct marketing instead of retailer.

4.4 Spatial conflicts

A further problem, which was mentioned mainly in Germany as a key factor were spatial conflicts with other uses. Due to the density of population, economic diversity and competing uses along the coastal areas, appropriate sites for aquaculture are rare. There are many uses of sea space: shipping and sailing routes, fishing areas, tourism & public beaches, nature reserves (e.g., NATURA2000) and more. All of that narrows the possibilities to find space for aquaculture. A German representative of an international environmental NGO described the situation as follows:

“...in this regard spatial planning is certainly the biggest challenge. The North Sea and the Baltic Sea are two highly industrialized rooms. Hence, it is difficult to establish an additional use like aquaculture due to high space competition. Additional uses could further limit shipping and fishing and that is certainly a big challenge as well as environmental compatibility, of course. In such highly used areas still additional ecological loads have to be seen critical. It must be held so slightly as possible. But I believe, to tell the truth, spatial planning anyhow, the competing interests, will be the biggest challenge.”

One of the main conflicts mentioned by stakeholders from both countries is the competition of aquaculture with tourism. While in Germany especially conflicts with cruiser ships and sailors limit the space for aquaculture, in Israel the main conflicts were seen with beach tourism at the Mediterranean Sea or diving tourism along the Red Sea coast. In this context a German producer argued:

“Of course space competition is an important factor and, of course, often there is a competition where aquaculture farms were or will be built up. But you have to distinguish between real space competition and alleged competition. In certain cases areas allow a dual use, e.g., mussel farming from autumn to spring and sailing from spring to autumn”

On the other hand, some of the interviewees argued that there is a potential to combine tourism and aquaculture due to the fact that in many places in the world aquaculture or its products attract tourism. Nevertheless, almost all tourism stakeholders denied a possible benefit from a combination of tourism and aquaculture in their own area of responsibility. Hence, recapitulating this aspect all interviews, a general consensus of potential benefits was observed but also a kind of NIMBY effect. This also applies to other sectors, which might

be combined with aquaculture. In this regard, one important exception could be observed in Germany, where two politicians and a producer and scientist agreed that a combination of mussel aquaculture and sailing might be possible due to seasonality.

4.5 Perception, Attitudes and Political Will

In both countries all stakeholders are aware of the growing demand on seafood, which has to be met. All interviewees agreed that in general aquaculture might be an alternative (or at least a supplement) to commercial fishery, as it helps to avoid further overfishing and yields a reliable food source for the growing global population. Nevertheless, many stakeholders especially in Germany also mentioned bad-practice examples that should be avoided on national or regional level, e.g., marine fish farming as in Norway or Asia where mariculture is seen to pollute the environment. Here a broad consensus about negative mariculture practices in Norway could be observed but also a lack of knowledge regarding the positive changes achieved within the last few years. Additionally, in several German interviews, the problem of feeding farmed fish with products from wild fish catches (e.g., from Chile) was pointed out. Here, the proportion of 5 kg of fish cached for cultivating 1 kg farmed fish was cited very often. In both cases, fish farming in Norway and fish diet, the influence of negative press and media campaigns seems to be very sustainable. Knowledge of improvements could hardly be observed.

In Israel, a prolonged court case led to the removal of two farms from the Gulf of Eilat in 2008 accompanied by wide public attention. Thus, many stakeholders mentioned the media and press as their main source of information in this context. Hence, knowledge and opinion about aquaculture in Israel seems to be strongly influenced by media coverage as well.

A wide political support for a national aquaculture development in both countries could hardly be observed. Even though in Israel the future potential of aquaculture had received better evaluation by the interviewed politicians and decision-makers than in Germany, many stakeholders (e.g., producer and scientists) in both countries mentioned missing political support. In Germany a few stakeholder considered a lack of trust regarding the cost-effectiveness of this industry as the main reason for the missing political will besides negative attitudes towards aquaculture. A German producer and scientist stated:

“There have been several approaches to establish aquaculture in Schleswig-Holstein which failed due to a lack of political will to keep supporting new developments which are not immediately profitable. Aquaculture is never such a sector with which you can make a fast buck.”

In Israel, an academic expert of city and environmental planning at the University of Haifa, with expertise in coastal planning, mentioned the lack of proper governmental policy, and the statutory chaos in this field. Without governmental support, there will hardly be an economic chance for the aquaculture market in this country. Under these conditions the market might probably grow only by a small percentage and only for exclusive seafood products. In this regard, a representative from the fishing department of the Israeli Ministry of Agriculture stated:

“The future is big but it is just starting to happen. There is a support in legislation but still no government founding.”

In general, German stakeholders trust in the legal framework is rather high but not in the political will, governance and support. Nevertheless, there was a broad consensus within almost all stakeholder groups (scientists, NGOs, politicians, users and producers) about getting involved in upcoming planning processes and receiving more information about upcoming developments in this sector.

5 Discussion

Often media seem to be the main source of information about aquaculture and the picture of this sector drawn by press/media is rather negative. Surprisingly, almost all stakeholders have a neutral or rather positive attitude towards aquaculture in general. However, in Israel and Germany marine aquaculture does not seem to be a main focus of interest in stakeholder offices. Most of the German stakeholders do not believe in the future of marine aquaculture in Schleswig-Holstein (apart from high-quality regional seafood products) mainly due to economic reasons. Contrary to that in Israel the economic potential of aquaculture is regarded to be much higher than in Germany. However, the governmental support up to now is described as rather low in both countries.

The future development and expansion of aquaculture in Israel and Germany seem to depend on the availability of appropriate sites, which often depends on the outcome of the competition between different sectors claiming space along the coastal zones. Concerning this matters, diverse attitudes regarding the importance of the different sectors in terms of a sustainable coastal and economic development could be observed. In Israel the further development of aquaculture is seen as a very important aspect regarding independency from food imports but not as a sector with a high economic potential. Despite negative experiences with aquaculture farms (e.g., in Eilat) all Israeli stakeholders stated that there is still an interest in developing the aquaculture sector in Israel. The main barriers for an extension seem to be primarily technical aspects. Even though Israel's coastline of the

Mediterranean Sea is short, crowded and full of competing uses, finding appropriate site for aquaculture seems possible in the opinion of most of the stakeholders. In contrary to that, no commercial-scale aquaculture farms have been established in Germany so far. Therefore, no aquaculture-related conflicts have occurred and influenced the stakeholders' perception and attitudes. As a result aquaculture in this country is mostly seen as a sector competing for (additional) space, believed to have negative ecological impacts and a minimal economic potential, only high-quality regional products from small-scale farms are valued positively. Furthermore, the independence from food imports does not seem to be such an important issue. Even though the import of seafood is steadily increasing in order to meet the growing consumer demand, national or regional strategies for future development of aquaculture exist only on paper, according to several stakeholders. One of those papers is the Schleswig-Holstein policy paper for fishery, where the development of aquaculture is explicitly mentioned in order to strengthen the marine industry.

Some negative perceptions concerning aquaculture could be observed in both countries – in Israel based on experiences with local fish farms (e.g., Eilat) and international press & media, in Germany mainly influenced by media coverage in more generic terms. Nevertheless, comparing the results in Israel and Germany, the (political) will regarding future development and support of the aquaculture industry seems to depend not only on perceptions of and attitudes towards this sector in general but rather on the attitudes towards the importance of national aquaculture regarding food security and economic value.

Although additional studies in both research areas have indicated that consumers are showing increased awareness of and preference for sustainably produced seafood and are willing to pay an increased amount for such products, the need for the development of regional aquaculture was observed only by Israeli but not by German stakeholders. Furthermore, almost all German stakeholders disagree with a willingness of the public to pay more for sustainable-farmed aquaculture products.

In Israel, the missing governmental and financial support as well as technical advancements seem to be the main barriers for aquaculture. Contrary to that, in Germany most of the stakeholders have to be aware of the potential biological benefits and economic value of aquaculture at first before an appropriate support and management, including site selection and site management, can be developed. In this context, Israel seems to be one step ahead.

6 Conclusion

During the European Aquaculture Conference in Porto, Portugal 2010, Javier Ojeda stated: "Successful aquaculture nations have availability of sites, favourable legislation and political will." After having carried out this study in Israel and Germany the *perception of the economic potential* should be added to this statement due to the fact that without awareness of the

benefits that aquaculture can generate, neither political will nor favourable legislation can be reached.

Political will and favourable legislation are, of course, key factors for a further development as well as an appropriate governance of aquaculture.

However, in Germany, policy- and decision-makers as well as coastal stakeholders are often unaware of the social and environmental benefits and economic value of aquaculture and this seems to be one of the main reasons for the missing support. In general, all stakeholders support the idea of aquaculture, but especially the German stakeholders do not see an economic potential, except from knowledge export in case of recirculation systems. Hence, they see no need to strengthen the mariculture sector on local or regional level. As the results of this study show, these attitudes towards the aquaculture sector and especially mariculture farms seems to influence the political will negatively and hence, the availability of appropriate sites within the German research area. In both countries, stakeholders are aware of the fact that in general aquaculture can generate food security in compensation of the declining fishery sector but not regarding social and environmental benefits such as water biofiltration, employment and income. In addition to that, many stakeholders are still influenced by former media campaigns about bad practice examples from Norway, Asia or even Israel. Therefore, a clarification of the actual risks and benefits of aquaculture even on local and regional level has to be done before the integrated planning and management processes of aquaculture, based on the 4 pillars of sustainability, can be improved. In this regard, a better collaboration and information exchange between decision-makers, producers and scientists should be intended.

The potential for a further development of the aquaculture sector is given in both research areas but even if the main attitudes regarding this sector are quite similar in Israel and Germany the main barriers are different. Whereas Israel mainly has to find technical solutions in order to increase their aquaculture and mariculture production in Germany the economic potential has to be discovered.

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6 SYNTHESIS

6.1 Evaluation of the research methods

The main challenges for this comparative research were the differences in cultural, geographic, political and informational contexts in Germany and Israel.

The first problem was the state of experience with aquaculture, especially mariculture. While in both countries inland aquaculture in ponds is a small but well-developed sector, commercial-scale mariculture farms only existed in Israel. However, conflicts in Eilat were the origin for the idea to investigate the field of public and stakeholders' awareness, perception and attitudes towards mariculture and their role in the context of policy- and decision-making processes.

The investigation of public awareness of and attitudes towards the aquaculture sector was combined with an overall stakeholder analysis conducted in both countries. Originally it was expected that the results of the quantitative analysis would be in line with the results of the qualitative analysis. However, both differences and similarities within and between these analyses show the complexity of the research and its results. The overall outcomes of this research have shown important issues with regard to a future development of mariculture. They may help to improve the understanding of local factors influencing attitude formation and inter-relationships in the context of decision-making processes. Hence, they are significant for decision-makers, NGOs and other stakeholders. Moreover, they point out the importance of this type of comparative research.

The main challenge for this research was to find adequate research models and methods in order to get comparable results for both countries. Within the quantitative research first of all the cultural differences between Germany and Israel as well as the levels of knowledge and experience had to be considered. In order to ensure the comparability between the German and Israeli surveys, at least two questions within each category were identical (see Chapter 4.1.1.2). The other questions had to be adjusted slightly after the pretests. Contrary to the Israeli questionnaire, the environment section of the German questionnaire was subdivided into general environmental questions and specific questions about marine environment. In addition, the German questionnaire included a category of questions on respondents' views of the future. The Israeli environmental attitudes section was not subdivided and most questions concerned the coast. No questions about the future were asked. Here, the survey indirectly focused more on current problems around the mariculture farms such as in Eilat. Afterwards these results can be used to identify bad practice examples and to transfer the experience to other regions, such as Germany, in order to avoid similar problems. The section on mariculture in the Israeli questionnaire contained three types of questions dealing

with general opinions, potential conflicts and complementarities between mariculture and tourism as well as between mariculture and capture fisheries. Contrary to that, within the German questionnaire respondents were provided with a table listing 6 possible advantages and 6 possible disadvantages of marine aquaculture and asked to choose the four most important points out of the 12. That was done due to concerns that low levels of awareness might hinder respondents' ability to answer questions about mariculture. Furthermore, the mariculture issues were chosen in consultation with experts including representatives of environmental organisations and of the regional economy. Another big issue showing mainly cultural differences between Germany and Israel was the question concerning the income of the respondents. Here, the pretest indicated that German respondents are not willing to reveal their income. Therefore, the question was changed into "My salary allows me to spend extra money on a healthy and environmentally conscious living" while in the Israeli questionnaire it was phrased "I earn ... per Month". Detailed explanations of the differences between the Israeli and German questionnaires can be found in Chapter 4.1.1 and 5, Article 1.

Due to the fact that the quantitative study in the German research area was conducted within the framework of this doctoral thesis a second, postal survey was carried out in order to test the results. Between the face-to-face and the postal surveys only marginal differences were observed which supported the results of the face-to-face surveys.

The qualitative research of this study was of even greater complexity. Here, the main challenge was to identify the appropriate stakeholder groups in both countries and to find suitable stakeholders within these groups willing to be interviewed. All stakeholders hold an important position and hence have a voice for their organisation. The different stakeholder groups interviewed for this thesis are listed in Chapter 4.2.5.

Another challenge in the context of the qualitative analysis was the comparability of the results from the different stakeholder groups. The different foci of the groups not only made the results very comprehensive but also the analysis complex (Table 6-1). It became obvious that none of the stakeholders had a comprehensive overview of the whole set of issues. Furthermore, often lack of knowledge was used to justify personal statements. Therefore, it is indispensable to aim at a better cooperation and information exchange between the different stakeholder groups with regard to a future mariculture development on a national level. This problem will be discussed in detail within the following chapters.

Table 6-1: Main criteria and main interest of German stakeholders regarding mariculture

		Pro- ducer	Scien- tists	Politician				User		Environmental NGO				
	Criteria	Pro1	S1	S2	P1	P2	P3	P4	U1	U2	E1	E2	E3	
no decrease of water quality	no nutrient		x	x			x			x				Save quality of Kiel Fjord
	no antibiotic input						x			x	x			
	Sustainable				x		x			x	x	x	x	
	no decrease of water quality					x			x	x				
Environ- mental Protection	no impact on environmental protected areas				x	x								Animal health
	creating compensation areas						x				x			
	no break out of fish			x	x									
	no impact on plants		x											
	low stocking rate					x	x			x	x		x	
Local Conditions for Mariculture	deep water		x											Quality of pro- ducts
	good water quality		x	x										
	good water perfusion		x	x		x								
Food	solve food problem		x	x		x				x	x			Food

Note: Keep in mind that scientists S1 and S2 also belong to the group of producers!

In addition to the methodological challenges, general problems in the context of both the quantitative and qualitative data collection and analysis have to be mentioned as well. First of all the different languages, Hebrew and German, which had to be translated into English can implicate mistakes, especially using citation. Further, due to this fact most of the qualitative interviews in Israel had to be conducted by the Israeli project partners due to communication problems based on the different languages. Academic researchers conducted the interviews translated them into English in order to keep the mistakes to a minimum. However, the analysis of all interviews was carried out with the same methodology (see Chapter 4.2) to secure the comparability.

The evaluation of the analysis shows that some of the results need further examination of the influence of the respondents' level of knowledge and sources of information, which was not possible in the framework of this thesis.

6.2 Potential of mariculture in Israel and Germany – a summary of key findings

The import and consumption of fish and aquaculture products in Israel and Germany has been steadily increasing over the past few years. Thus, there seems to be an interest in developing the domestic fish production – not only from the stakeholders' point of view but also among the wider public in Israel and Germany. However, even though the main attitudes and interests of stakeholders and the public towards aquaculture in both countries seems to be a consensus about:

- media and press are one of the main sources of information,
- concerns about the environmental sustainability of mariculture,
- support of sustainable mariculture as a reliable food source,
- fish and seafood are important components of healthy diet,
- willingness to pay higher prices for sustainably farmed products

the differences are in the detail. Attitudes and risk perception strongly influence decision-making processes in Israel and Germany and hence the future development of mariculture. Whereas in Germany opportunities are seen in high-quality niche products, in Israel the focus is on commercial-scale mariculture farms. However, in both countries the estimation of the potential was linked to the evaluation of the fishery sector and the increasing demand for seafood. Local conditions and levels of awareness heavily influence the detailed attitudes towards this sector across multiple domains. However, differences between the countries as described in the publications, but also between the public and the stakeholders within the respective country could be observed. Therefore, in this chapter the main findings of the quantitative and qualitative research are summarised country by country. Furthermore, in addition to the summary of the key findings the potential and risk perception regarding aquaculture and especially mariculture will be described. This substantiates the basis for the overall cross-country analysis in the following chapters.

Due to the aforementioned differences within the surveys as well as the fact that the German part of the quantitative study was more comprehensive, some results are only relevant for Germany whereas others are found to be valid for Israel and Germany.

All in all, the results of the whole study will be very important for future planning processes in the context of aquaculture, especially mariculture, in Israel and Germany due to the identification of the following facts:

- the perception and interest of the wider public regarding sustainable mariculture practices in both countries
- consumer behavior regarding mariculture products
- the different attitudes of stakeholder groups towards this matter

- the potential to increase marine aquaculture as a regional economic sector from the stakeholders' point of view
- how the awareness and perception about mariculture's benefits effect stakeholders' decisions to influence the further development of the aquaculture sector and future expansion of mariculture sites

Generally speaking, the results are very important to get a better overview of:

- the potential and risk perception regarding mariculture in Israel and Germany
- the potential for integration of mariculture with other coastal activities
- the potential for a better integration of mariculture on political level

These are essential issues for the integration of mariculture as a partly new economic sector into existing management structures and to ensure not only a better coastal area management, but also a sustainable coastal development in the future. Further, the methodological approach as well as the results may be transferrable to other upcoming uses in coastal areas in the future.

In the following chapters the lessons learned from this study will be analysed by a cross-country comparison of public and expert perceptions with regard to the above-mentioned results.

6.2.1 Summary of the key findings in Israel

A majority of the surveyed Israeli public (>65%) as well as most of the interviewed stakeholders mainly support the idea of sustainable aquaculture, especially mariculture. Despite a previous conflict with a mariculture farm in Eilat there seems to be a broad social acceptability of the aquaculture sector. In addition, this result can be further differentiated by the following findings:

In both countries the results of the quantitative study show that aquaculture is seen as an appropriate alternative to commercial fishery in order to avoid further overfishing as well as to provide a reliable food source for the growing population. Nevertheless, according to the wider public and the stakeholders, mariculture has to be ecologically sustainable in order to have a future in Israel. As mentioned above in this thesis a main concern regarding the future extension of mariculture focuses on environmental risks. In fact, sustainability was one of the key factors regarding a further development of mariculture, mainly facing problems such as nutrient input, stocking rate, invasive species and medicine/antibiotics. Both, public and stakeholders agree that especially nutrient inputs of mariculture farms have to be reduced to a minimum, and mistakes made on national and global level in the past should not be repeated. While the German and Israeli samples of the quantitative study were similar in their ranking of environmental concerns, the effect of these concerns on their attitudes toward mariculture was highly divergent. In this regard especially the mixed results for Hypothesis 2 “negative relationship between concern for the environment and attitudes towards mariculture” are somewhat surprising. Among Israelis, the major environmental concern is fish-farm effluent and pollution of marine environments. This is consistent with the negative correlation between environmental concerns and support for mariculture. In this regard, it seems that most of the respondents and interviewees are influenced by the media coverage of the court case in Eilat that focused on pollution of and damage to coral reefs, even though this threat could never be proved by biological studies. Further, this case may be one reason for the result of the quantitative study that respondents with a more committed environmental behaviour are showing more negative attitude towards mariculture. Additionally, a positive correlation between ecological behaviour and health behaviour and good nutrition could be observed, which can be in part explained by evidence that health concerns may be embedded in attitudes towards environmental quality.

While in Eilat the problem of nutrient input from potential mariculture facilities is still a big issue for the wider public, some of the Israeli stakeholders described the Mediterranean Sea as short of nutrients, where mariculture could change this ecosystem positively. Even a member of an Israeli environmental NGO suggested to investigate how much nutrient input is de facto coming from the mariculture farms and to correlate these results with the maximum amount of nutrients the Mediterranean Sea is able to tolerate in order to find a sustainable

balance. In the context of a sustainable mariculture development another big issue from both the public and the stakeholders' point of view was the adequate diet of farmed fish in the context of overfishing, which means that the source of food for fish raised in net cages should be sustainable too.

In the case of the quantitative study in Israel, considering the environmental risks and benefits of mariculture, risks seem to influence the attitudes more strongly. Nevertheless, respondents of the quantitative study in both countries seem to regard farmed fish as an enriching component of their diet. Further, they are willing to pay a premium for fish farmed using environmentally sustainable methods. They also appear to be aware of the potential advantages in terms of employment and possibly other related economic concerns. One result of the quantitative analysis is that respondents who have greater concerns about employment security are more supportive of aquaculture. Even if job centrality was ranked second, the relationship between employment and mariculture, fish farming and related activities (e.g., processing, transport and marketing) have been shown to create jobs and rejuvenate communities that were formerly reliant on capture fisheries. Although the issues of employment and income were not a main interest of the interviewed stakeholders, almost all agreed on the good potential of further development of aquaculture in Israel. The further development of aquaculture is seen as a very important aspect regarding independency from food imports, but not as a sector with a high economic potential.

Further, they agreed that in general aquaculture might be an alternative or at least a supplement to commercial fishery with regard to food security.

Concerns for spatial conflicts, e.g., with the tourism sector, rank second to environmental concerns in Israel. Furthermore, within the quantitative study the support of tourism is positively correlated with the support of mariculture. Because of the history of conflicts between mariculture and other sectors (e.g., tourism, recreation, fisheries) in many places such as Eilat, this relationship bears further examination, especially in Israel.

One main problem regarding the future development of mariculture in Israel, the technical challenge, was mentioned by most of the stakeholders. Especially at the Mediterranean coast high waves of 7-8 metres and the absence of deep-water bays to protect the cages seem to be barriers for mariculture at the moment. In addition, the main development in the past, the inland fresh water aquaculture, is also seen as very problematic. Considering the shortage of freshwater in Israel, a further development of inland aquaculture rearing fresh-water fish seems to be unreasonable for most of the stakeholders. This circumstances could become a big advantage for marine aquaculture e.g., in the Mediterranean Sea when the technical problems are solved. Furthermore, this knowledge could also be exported and hence strengthen the position within this sector worldwide. Most stakeholders believe that

aquaculture is going to be developed in two main directions: land systems that are connected to the sea for water renewal as well as open-sea systems in the Mediterranean Sea.

Even though the Israeli stakeholders see the future of aquaculture quite positive, there seems to be a lack of political support for a national aquaculture development. Besides the technical challenges many stakeholders saw this issue as another main barrier for the further development of aquaculture in Israel.

When summarising the Israeli interviews, almost all stakeholders expect a continuing growth and development of aquaculture. Many stakeholders regard aquaculture as an important industry with a great future with regard to the national seafood market. However, comparing both the results of the quantitative and qualitative studies, the future development of mariculture in Israel was evaluated much more optimistic by the stakeholders than by the public. This may be caused by the fact that the wider public mainly considers environmental aspects in the context of mariculture and seems to be influenced much more by the result of the court case in Eilat than the stakeholders.

6.2.2 Summary of key findings in Germany

As well as in Israel a majority of the German population (>75%) and most of the interviewed stakeholders mainly support the idea of sustainable aquaculture and mariculture. Nevertheless, the broad social acceptability of aquaculture has to be further differentiated, just like in Israel.

First of all, the results of the quantitative research in Germany show a positive relationship between concern for the environment and attitudes towards the aquaculture sector. This positive relationship may be related to concerns about depletion of wild fish stocks. About 77.1% of the interviewees stated that an advantage of mariculture is that it does not lead to overfishing and 55.1% do not associate mariculture with damage to natural habitat, like trawl fishing. Environmental sustainability was one of the important key factors regarding a further development of mariculture in Germany. Even though both the public and the stakeholders want to preserve the Baltic Sea as a sensitive ecosystem, the focus, especially in the context of mariculture, is different. The German respondents of the quantitative study are strongly concerned about environmental pollution in general. More than 92% believe that the global environmental pollution will increase in the future. These orientations may also explain why, notwithstanding broad support in both samples for expansion of the aquaculture sector, support is very high in Germany. The main results in this context from the German face-to-face survey are shown in Figure 6-1. The whole table listing the major advantages and disadvantages can be found in Chapter 4. The stakeholders' point of view in this regard is different. Especially in Germany, stakeholders' trust in the legal framework with regard to the environment is high and hence, in their opinion, future pollution and degradation problems through mariculture can be avoided.

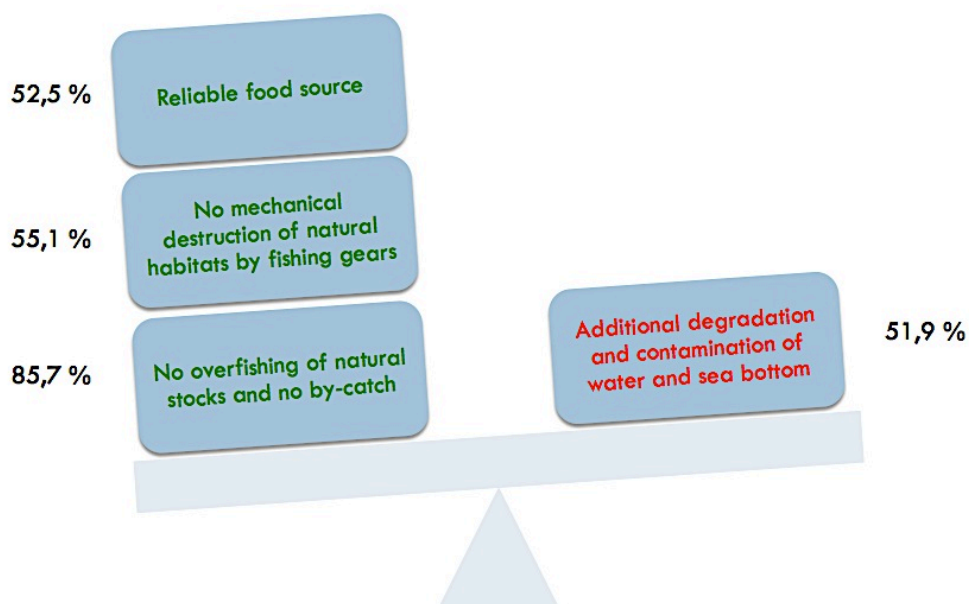


Figure 6-1. The 4 most frequent answers regarding advantages and disadvantages of mariculture.

However, as mentioned before in this thesis the environmental perspectives of the public warrant further examination of the influence of the respondents' level of knowledge and sources of information. Scientific evidence concerning pollution from the Israeli farms both during the farms' operations and following the removal indicate that damage caused by farm effluent was minimal and reversible. The view of the German public that aquaculture may benefit marine biodiversity also indicates limited awareness of major controversies related to the contribution of the manufacture of fish feed used in aquaculture of carnivorous species to overfishing.

Contrary to the results of the quantitative analysis the stakeholders are mainly focussing on the fact that the Baltic Sea and the Kiel Fjord are ecosystems where eutrophication is a big issue. Therefore, the main interest of the stakeholders is to save the water quality of these areas and to avoid additional nutrient inputs. Hence, in the context of ecological sustainability several stakeholders have a rather negative attitude towards mariculture. Only a minority of the stakeholders, e.g., producers and scientists, are thinking about polyculture systems in order to avoid additional inputs. Within the qualitative research the importance of Environmental Impact Assessments (EIA) as a key aspect for the approval of mariculture farms was emphasised quite often. Most of the stakeholders, especially politicians, had a strong confidence in this planning tool as well as in the political framework in general. But also for the environmental NGOs an ecological sustainable mariculture with a consequent enforcement of ecological criteria was a main issue.

In addition to these results, almost 80% of the respondents of the public survey believe that traditional fishery will continue to decline in importance because of the pressures of overfishing and a sizable minority (46%) listed food security as an advantage of mariculture.

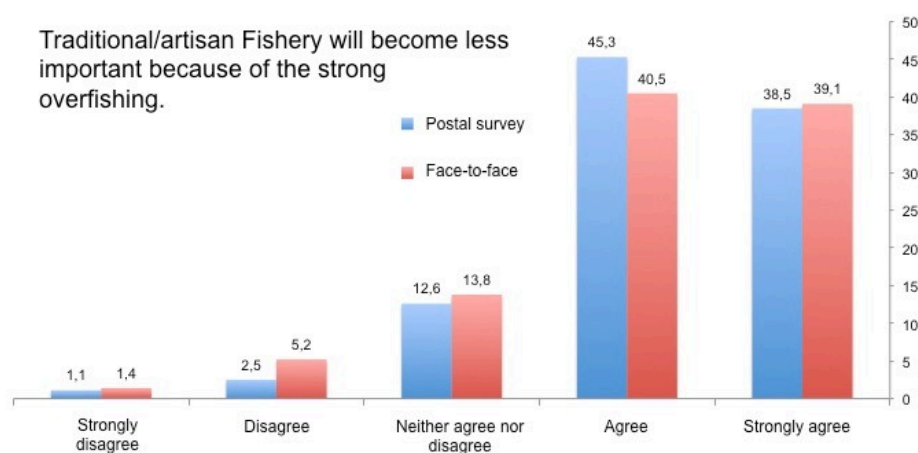


Figure 6-2. Estimation of German respondents regarding future of the traditional/artisanal fishery.

Respondents of the quantitative study as well as stakeholder statements showed a consensus that the fishery sector will become less important because of the strong overfishing and that aquaculture will be a reliable food source for seafood in the future. In this context, the Figure 6-2 and 6-3 provide a short glance into the future from the German respondents' point of view.

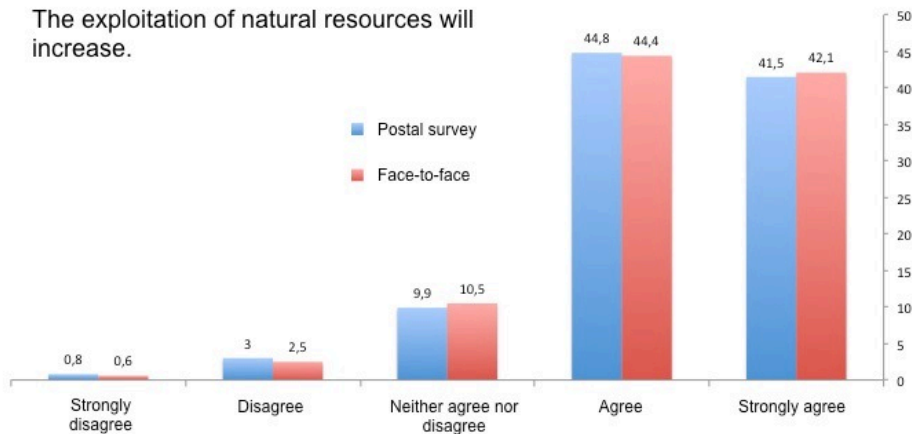


Figure 6-3. Estimation of German respondents regarding the increase of exploitation of natural resources.

Both Figures 6-2 and 6-3, indicate that the wider public within the German research area is very concerned about the future handling of natural resources as well as the environmental pollution and degradation. This is seen as the main reason why the German public perceive sustainable mariculture as an alternative to the fishery sector. Whereas the wider public in Germany agreed with future extensions and advancements of marine aquaculture under ecological supervision in the region, as indicated in Figure 6-4, the stakeholders were very sceptical in this regard mainly due to economic concerns. Only one scientist and producer saw a potential for this sector in the future whereas most of the other stakeholders highlighted the potential of recirculation systems.

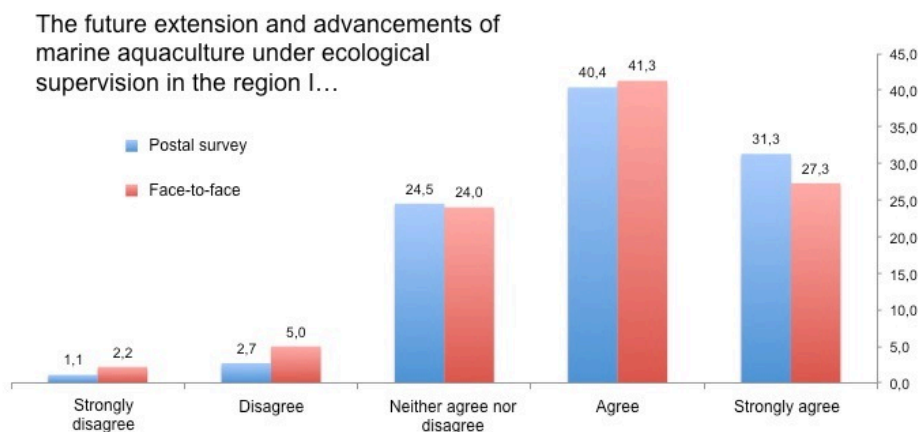


Figure 6-4. The future extension of mariculture.

However, the view about the potential of mariculture within the research areas has slightly changed over the last two years. During the interview phase in 2010, the German public and the Israeli stakeholders mainly supported a further development of mariculture on national level whereas the Israeli public and the German stakeholders were more sceptical and had a rather neutral or negative attitude in this regard. Today, the situation is slightly different. Within 2011 in Germany three new networks aiming at a sustainable national development of aquaculture and mariculture were built up not only on the producer level but also on political and scientific level. This will be discussed in detail in Chapter 6.3.3. Hence, the potential for future mariculture farms in Germany increased significantly due to fact that now both the public and the stakeholders not only support the idea of mariculture but also see the economic chances for the region.

Concern for the environment and food security coupled with the belief that sustainable mariculture may reduce pressures on wild fish stocks is arguably the main driver behind the observed positive relationship. In contrary to the quantitative results, many stakeholders mentioned the diet of farmed fish as a big problem as long as they are fed with caught fish. This could point out that aquaculture does not avoid overfishing. Furthermore, stakeholders stressed the market potential for German aquaculture products as a key factor. The quality, the acceptance and the price of seafood from mariculture facilities are important for the success of this sector. According to the stakeholders the estimated potential for mariculture development in Germany is rather low not only due to a lack of appropriate sites, caused by a lot of competing uses but also due to the fact that people are not willing to pay much higher prices for high-quality regional products. German stakeholders are afraid that consumers are predominantly less concerned about the quality of seafood products than prices. In this context, they were arguing that appropriate certification of products (e.g., eco certification or ASC certification) could promote marketing chances of these products. Awareness rising through environmental NGOs in order to sensitise the consumers would be indispensable. About a third of the German respondents of the quantitative study think that fish and products from aquaculture facilities are not as healthy as from free-living organisms. In this context, awareness rising through environmental NGOs as well as certification of such products (e.g., eco certification or ASC certification) seems to be indispensable. Nevertheless, in the case of hypothesis H3 of the quantitative research, a positive relationship between care for health and attitudes towards mariculture could be observed within the wider public. In this case, the health attitude most strongly associated with positive attitudes towards aquaculture, was maintaining a healthy diet. Furthermore, there has been a positive relationship between *lifestyle (environment/health) behaviour* and *aquaculture* attitudes. Although a large percentage of the fish consumed in both countries comes from farms, it is unknown to what the extent the consumers are aware of this fact. However, according to the quantitative

research the German population appears to support the claims that mariculture farms offer quality control. According to all stakeholders from the trade group the quality as well as the perception of it is an essential issue to bring such products to the market successfully. As long as these criteria are met, the potential for mariculture products seems to be good. In Germany more than 50% of respondents eat and buy fish or seafood at least once a week. Furthermore, about a third stated that their salary allows spending extra money for a healthy and environmentally conscious living. On average German respondents would pay 2.52 euro/kilo more for environmentally friendly produced salmon.

A further significant positive relationship within the quantitative results was observed between coastal tourism and mariculture attitudes. Contrary to that, for most of the stakeholders' spatial conflicts with other uses are key factors regarding the future of mariculture in the German research area. They agreed that due to the density of population, economic diversity and competing uses along the coastal areas of both countries, appropriate sites for mariculture are rare. There are many competing uses of sea space within this area: shipping and sailing routes, fishing areas, tourism & public beaches, nature reserves (e.g., NATURA2000) and more.

According to the German stakeholders mariculture not only has to be ecologically sustainable but also economically profitable. In this context Germany has a disadvantage for mariculture farming due to high wages and production costs as well as unfavourable climate, which would lead to increasing prices for fish produced in Germany. All stakeholders pointed out that due to the fierce competition through low-priced foreign aquaculture products, German seafood products from local mariculture only have a chance to stay in the market in the long term as high-quality niche products. In accordance to that all interviewed producers mentioned their negative experiences with wholesalers and retail markets regarding price policies. They stated that German mariculture can only be a small supplement to the commercial fishery and profitable only through direct marketing instead of retailers.

Another important issue regarding the future development of mariculture in Germany is political support. A few stakeholders mentioned that besides negative attitudes towards aquaculture, especially mariculture, mainly a lack of trust regarding the cost-effectiveness of this industry is the main reason for the missing political will. According to a German producer and scientist there have been several approaches to establish mariculture in Schleswig-Holstein which failed due to a lack of political will to keep supporting new developments, which are not immediately profitable. In his opinion mariculture will never be a sector with which you can make "a fast euro".

Generally, stakeholders' trust in the political framework is rather high but not in the political will, governance and support regarding mariculture. Nevertheless, there was a broad consensus within almost all stakeholder groups about getting involved in upcoming planning

processes and receiving more information about upcoming developments in this sector. However, none of them believes in an aquaculture boom in Germany. Mainly aquaculture methods and techniques, especially recirculation systems, which can be exported as know-how, were estimated more positive.

In Germany, all interviewees as well as the public agreed that in general aquaculture might be an alternative (or at least a supplement) to commercial fishery, as it allows further overfishing to be avoided and yields a reliable food source for the growing global population. While a sustainable aquaculture and mariculture development on local and regional level was strongly supported by the public most of the stakeholders are supporting it only in general on a global level. Here, a kind of NIMBY effect can be observed.

Some of the aforementioned results may be explained due to the lower level of familiarity with mariculture in Germany and low awareness of its economic potential and contribution to employment. Aquaculture, marine fish farming and related activities such as processing, transport and marketing hardly exist in Germany. Hence, a low level of familiarity with mariculture in Germany as well as a low awareness of its economic potential and contribution to employment was observed.

6.3 Integration of mariculture with other coastal activities

The integration of land and marine components of the coastal zone as well as between the different marine uses is essential for a sustainable coastal development with regard to social, economic and environmental benefits. Spatial compatibility is a complex issue and in the context of new sectors such as mariculture a particular challenge, which often lets conventional controls come up against their limits. The possibilities of co-existence of mariculture with other forms of coastal use were partly discussed in Chapter 3.3. Within this chapter the main concerns, suggestions and examples identified through the quantitative and qualitative studies of this research will be highlighted.

Generally, mariculture can co-exist or even be combined with several coastal uses. Harbours, wind farms, tourism, coastal protection and nature conservation are only some examples mentioned in scientific publications. In this regard, as a result of this study the main issues stated by the wider public and the stakeholder were sailing, tourism and fishery. The relationship between tourism and mariculture is very important because of the large number of well-known stakeholder conflicts between these sectors in coastal zones. The relationship is also of interest because a large number of studies showed that attitudes towards mariculture and other activities perceived to impact the tourism sector are strongly related to each other (either positively or negatively).

The quantitative study on this topic in Israel and Germany does not universally support the notion that tourists and residents view the mariculture and tourism sectors as conflicting uses. One main hypothesis of the quantitative study, hypothesis 4, indicated a positive relationship between support of tourism and attitudes towards mariculture. The results of the German and Israel samples are very important from the standpoint of stakeholder interactions since it appears that the public perceives coastal tourism and mariculture as two legitimate uses of the coastal zone that do not necessarily need to be in conflict with each other. In Germany, for example, only 10% of all respondents think that fish farms disturb the natural beauty of the coasts and thus harm the tourism sector. This contrasts with actual experience in parts of Europe and North America where tourism and recreation come into direct conflict with mariculture. The result of the quantitative study rather points to potential synergies such as those exploited in areas of Pacific Asia where fish farms are combined with the tourism sector.

The competition of mariculture with tourism was one of the main issues mentioned by stakeholders from both countries during the interviews. Within all stakeholder groups a general consensus of potential benefits but also a kind of NIMBY effect, mainly in Germany, was observed in this regard. This might be due to an unawareness of the social and economic benefits that mariculture can have when combined with tourism. As mentioned before, in many places in the world mariculture and its products attract tourism.

Nevertheless, considering a combination of tourism and mariculture in their own area of responsibility almost all tourism stakeholders denied a possible benefit. Whereas the main conflicts in Israel were seen with beach tourism at the Mediterranean Sea or diving tourism along the Red Sea, in Germany especially conflicts with cruiser ships and sailors limit the willingness for a mariculture development.

Besides the above-discussed concerns there are also several potentials for co-uses and cooperation's with mariculture in the research areas. According to an interviewed scientist and producer from Germany, it is important to distinguish between real space competition and alleged competition. In certain cases areas allow a dual use, e.g., mussel farming from autumn to spring and sailing from spring to autumn in German marinas. Further, a few stakeholders, e.g., a scientist, a producer and a marketing expert, stated that mariculture could be a benefit for several other sectors besides tourism, such as fishery and the regional food market, and should be better supported in the Baltic Sea region of Schleswig-Holstein.

Furthermore, the German marketing expert stated that even if there were other, more important economic interests besides mariculture in Kiel, such as sailing, for many tourists the maritime flair and especially fresh local fish belongs to the image of Kiel as well. A lot of tourists are asking for regional fish products and seafood restaurants in tourist information centres. In this context he stated that Kiel, unfortunately, has a pent-up demand. In order to meet the consumer demand the mariculture products have to be of high quality and should be from sustainable, in the best case certified, regional marine aquaculture farms. In this regard all stakeholders in Germany agreed that the focus should be rather on quality instead of quantity, whereas in Israel the quantity was seen as an important focus too, in order to become independent from fish imports. In this context it is obvious that both strategies need different marketing. Whereas the products of a potential mass production in Israel will probably be brought to the national market through wholesalers the situation with local or regional niche products is different. A German marketing expert, a producer and a wholesaler agreed that a special marketing for regional mariculture products is important. Without an adequate promotion and a further image improvement of the diverse aquaculture industry the products will not be successful on the regional market. Even though farmed fish and seafood has a less symbolic value due to a missing link to naturality, wildness and open sea, the results of the quantitative study show that the consumer perception of farmed fish is close to general beliefs about fish. This offers diverse opportunities for a future development of mariculture. According to several stakeholders, e.g., producer, scientist, marketing expert and retailer, the special values of mariculture products are in freshness, swift delivery, sustainability and health control. Additionally, the products can provide a story or represent former traditions and cultural values, e.g., mussel farming in the Kiel Fjord. In the opinion of the marketing expert local mariculture has the advantages of a local identity and visibility and

should be brought to the market accordingly not only for the residents but also for the tourist. Furthermore, this could imply a real benefit for the region and increase the maritime flair. In order to strengthen this sector sustainably the future development should also be supported by research, e.g., for improving mariculture technologies, and by stakeholders who are able to promote the sector and its products to the customer and consumer. First and foremost, environmental NGOs, media and retailers could do this.

Co-management structures with stakeholders directly affected or involved are very important for a sustainable regional development of mariculture. Besides tourism, sailing and regional products another key sector in this regard is the fishery sector. The results of both the quantitative and qualitative study in Israel and Germany show that respondents and stakeholders believe that the fishery sector will become less important in the future due to overfishing. In addition, this sector will soon no longer be able to meet the growing demand for seafood. However, according to many stakeholders, especially environmental NGOs, the aquaculture sector must not replace or compete with the fishery but is supposed to support it in order to strengthen this sector again. The cooperation between both sectors can meet the increasing demand for seafood more sustainably. Hence, the future development of the aquaculture and mariculture sector might be able to both strengthen the maritime flair of the region and to support the weak fishery sector.

Likely, in this context it will be a challenge to discuss the issue of mariculture with the fishermen. According to the results of a Bachelor thesis, done within the scope of the SPAMA project, fishermen's perception of the mariculture sector is rather negative. Nevertheless, most think that the market for sustainable produced ecological products will become more important in the future. Therefore, a few of them see the whole aquaculture sector as a possible employment market for fishermen in the future.

Further possible integrations of mariculture with coastal activities shortly mentioned by a few stakeholders were: the combination of mariculture with offshore wind farms; mussel and algae farms for bio-filtration and mariculture farms supporting coastal protection efforts.

However, the overall level of awareness and knowledge about the possible implications or benefits of mariculture for the tourism and the fishery sector were rather low. Even if the support for tourism is positively correlated with support for mariculture, due to the history of stakeholder conflicts between mariculture and other sectors (e.g., tourism, recreation, fisheries) in many places, this relationship needs to be further examined.

6.4 Integration of mariculture on political level

In the context of European environmental policy, aquaculture has been identified as a major environmental concern (EEA 2006). Therefore, the political framework requirements regarding a sustainable development of mariculture are complex.

However, even if appropriate sites for mariculture farming do exist, several issues may constrain the development of this sector, e.g.:

- environmental concerns from politicians, NGOs and residents,
- complicated and sometimes contradictory legislative rules,
- zoning issues, which include marine protected areas of different political and protection status and
- competing uses assessed as more important than mariculture.
- uncertainties about free sites and development plans within the respective area

Especially in Germany many stakeholders see the complexity of the legislation regarding mariculture and the lack of good coordination between the administration and the institutional bodies as the main barriers for a further development of this sector. As described in Chapter 2.6 there are 4 levels of administration in this sector: the European Union, the national level, the state level and the municipalities. The legislative instruments seem to be a real challenge for producers and investors, especially facing the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD). Additionally, even for nature-friendly mariculture techniques it is hard to comply or be compatible with environmental constraints in case of NATURA2000, which narrows the site selection accordingly.

One very important opportunity to improve the regulatory framework regarding mariculture in Germany is the reform of the Common Fisheries Policy (CFP) on European level. In 2012 all member states are asked to submit proposals for this reform. Afterwards, in 2013, the new Common Fisheries Policy will come into effect. With the new CFP a better framework for the production and supply of fish and seafood from mariculture farms on European level shall be established. Furthermore, it aims at reducing the dependencies on fish and seafood imports and bring forward the mariculture development in the coastal areas of the European Union.

In this context the European commission recommends that the member states shall:

- overcome the bureaucratic burden
- ensure environmental, social and economic standards for mariculture

An advisory board giving advice in this regard will be established. According to the aims of the European Commission the member states have to develop a national statement of strategy with the goal to strengthen both the fishery and the aquaculture sector. For the development of such strategies on national level and in order to ensure a realisation close to the reality it is important to include stakeholder and experts from all relevant sectors,

organisations and bodies. This might improve the conditions for new mariculture sites in the future. Furthermore, participation in such procedures as well as in planning and decision-making processes is desired by most of the interviewed stakeholders in Germany and Israel. Several interviewed stakeholders see the reform of the CFP as a great opportunity for not only strengthening the mariculture sector in Germany but also for improving the cooperation and information exchange between different actors, e.g., producer, scientist, decision-maker and environmental NGOs.

Additionally, in the context of this reform there should not only be improvements of the political framework on national level. According to the interviewees the following issues should be focussed on in this regard:

- assessment of the existing legal framework aiming at identifying requirements necessary for the establishment of new mariculture facilities,
- assessment of the “prevention of deterioration of the status of all bodies of surface water” of the Water Framework Directive with regard to mariculture
- assessment of the “Landwirtschaftsklausel” of the German *federal law on nature protection* with regard to mariculture

Based on the new CFP and the suggestions mentioned above a precise catalogue of requirements regarding mariculture should be developed. Target-oriented and transparent legal frameworks as well as supportive administrative procedures combined with standards for applications would strongly improve the chances for the future development of mariculture. However, German stakeholders’ trust in the legal framework with regards to environmental issues in general is rather high but not in the political will, governance and support.

Furthermore, there was a broad consensus within almost all stakeholder groups (especially scientists, NGOs, politicians, users and producers) about getting involved in upcoming planning processes and receiving more information about upcoming developments in this sector. According to many stakeholders, but especially producers and scientists, it is important not only to reduce the administrative burden but also to ensure a better participation of the stakeholder as well as a more transparent and appropriate information system, even for the wider public. In fact, participation and information seem to be the essential points for many stakeholders in order to enhance the political framework and hence the potential for the integration of new mariculture farms. This ensures not only a transfer of knowledge and information but also the consideration of all interests and hence the trust in the government. The integration and information of the wider public is an essential issue as well. As the quantitative results show the confidence of the public in the political (planning) structures of the regional politics is rather low. Furthermore, they mainly believe that the

government and the public administration do not sufficiently attend to the citizen's concern & needs and do not have an interest to integrate the general public in important decision-making processes.

In Israel, the struggle about the mariculture farms in Eilat shows that one-sided politics without the consideration of the different needs and concerns, an adequate information exchange and sustainable monitoring is bound to fail. In this case the lack of the mentioned issues influenced the awareness and perception about mariculture's benefits negatively and resulted in the removal of these farms.

As the studies were carried out between January 2008 and spring 2011 some new findings and development have to be added at this stage. The cooperation and information exchange between the different stakeholders has changed significantly within the last few months in Germany. Several networks aiming at strengthening the aquaculture and mariculture sector were established, such as:

- a competence network consisting of decision-maker, scientists and producer
- a collaboration network between different mariculture producer within Kiel Bay and
- a German association of aquaculture sector

However, there is still enough space for improvements, especially with regard to the political framework. Furthermore, the following questions still need to be answered:

- Which is the food supply model that Germany or Schleswig-Holstein wants?
- What is Schleswig-Holstein aiming at with regard to mariculture?

The answers of these questions are essential when facing the reform of the Common Fisheries Policy. At this stage the development of the mariculture sector in Germany should be initiated sustainable.

Besides the hard laws partly mentioned in this chapter the soft laws have to be improved as well. Based on the findings and facts described in this chapter it seems obvious that an improvement of the marine spatial planning and integrated coastal zone management as well as well as a better integration of mariculture in such planning systems is required. This will be discussed in the following chapter.

6.5 Integration of mariculture management into coastal area management

Even though the import of seafood is steadily increasing in order to meet the growing consumer demand, national or regional strategies for a future development of mariculture seem to only exist on paper, according to several stakeholders. Good practice experiences in this regard are still missing. Furthermore, several stakeholders but mainly producers complained especially about the missing allocation of appropriate mariculture sites.

In this chapter the mariculture sector will be considered as a whole, focussing on the high complexity of the multiple cause-and-effect relations. The findings and recommendations in this chapter are based on the results of the qualitative and quantitative studies conducted in the framework of this thesis. Further this chapter contains a summary of the socio-political findings according to the main questions, stated in Chapter 1.

With regard to the concept of sustainability as well as coastal zone management different aspects of future development of mariculture have to be considered. Here, the driver-pressure-state-impact-response (DPSIR) framework is an appropriate way to classify components relevant in these terms.

In general this approach is used to organise information about the state of the environment and to assess and manage environmental problems. The DPSIR model provides an appropriate structure to identify and illustrate different indicators, which enable recommendations and feedback to policy and decision-makers with regard to political decisions made in the future. Hence, the DPSIR model is an analytical framework suitable for analysing the risks and opportunities of the mariculture sector.

The DPSIR framework considers cause-effect relationships between the following interacting components of social, economic, and environmental systems:

- the **driver** of the current change;
- the **pressure** imposed by mariculture activities on some aspects of the overall system;
- the **state** of these aspects;
- the **impact** of the changing system and
- the actual or desired societal and political **response**.

Figure 6-5 describes the main aspects of the DPSIR approach, which will be explained in detail afterwards.

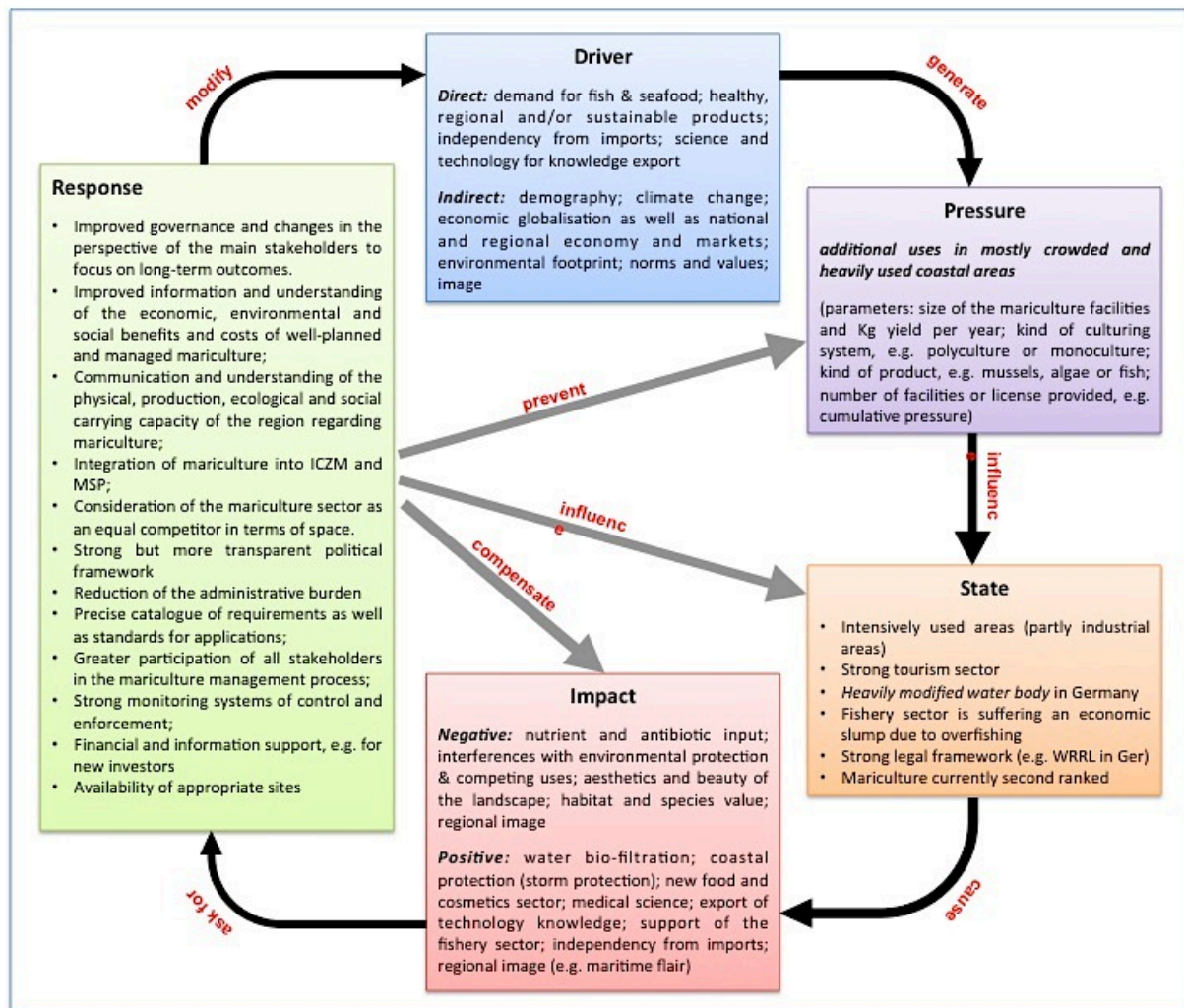


Figure 6-5. Driver-Pressure-State-Response model based on the results of the qualitative & quantitative studies

Drivers

At first the drivers of mariculture development shall be identified. Such drivers mainly consist of social, economic, institutional and ecological factors and can be subdivided into direct and indirect drivers.

Within the two research areas the following *direct drivers* for this sector could be identified: increasing societal demand for fish and seafood products, healthy products and regional and/or sustainable products; job security; science and technology for knowledge export; freedom of choice and action, independency from imports. Even if all of these drivers are found both in Israel and Germany, the ranking is different. Whereas the first drivers concerning food supply as well as the knowledge transfer were important in both countries, a relationship between mariculture and job security was only seen in Israel and was connected to unemployment rates with respect to the fishery sector. Further, the independency from imports was a main issue only in Israel but ranked second in Germany.

Besides the direct drivers there are several *indirect drivers* which may influence the direct ones such as: demography; climate change; globalised economy as well as national and

regional economy and markets (e.g., steady supply, quality of the products, competing prices and environmental standards); environmental footprint of the products; social policy, norms and values; cultural and image matters on national and regional level, as mentioned in the chapters above. Among the economic factors especially the profit, the employment per tonne of product, the capital investment per job created and the future chances and challenges were important issues for the stakeholders.

All of these factors influence the direct drivers and hence the mariculture development in both countries. However, the differences between Israel and Germany in this regard is the level of reference, meaning that in Israel mariculture is mainly discussed on a national level whereas for the German stakeholders the regional or federal state level is of importance.

Pressure

Based on the drivers here pressure means the pressure which mariculture farms may cause on the coastal system. The main pressure stated by almost all stakeholders can be summarised briefly: Mariculture farms require additional space in mostly crowded and heavily used coastal areas and cause additional nutrient input. The suspected aftermath will be discussed under *impacts*. The intensity of the pressure depends on several aspects such as the size of the mariculture facilities and Kg yield per year, kind of culturing system (e.g., polyculture or monoculture), kind of product (e.g., mussels, algae or fish); number of facilities or license provided (cumulative pressure).

State

The state in this model represents the status quo of the system characteristics, which might be influenced by the drivers and the pressure. In the context of coastal uses within the research areas and considering a future mariculture development, the analysis of state includes the ecosystems, the economic state, the social state and the institutional system governing coastal and marine resource use.

Germany

As described in Chapter 1 the German research area is an intensively used industrial area. The whole area is dominated by marine industries such as cruise shipping & shipbuilding as well as sailing and tourism. On the other hand, there are several nature protection areas such as Natura2000 along Kiel Bay. In those areas mussels, herring spawning grounds as well as breeding areas for seabirds are found. Besides protected areas, biotopes and habitats the seascape along this area is predominantly shaped by human impacts. The strong uses of the fjord have influenced the overall appearance of the water body, which is classified as a *heavily modified water body* according to the European Water Framework

Directive. The fishery sector in this area was very important and characteristic for the region in former times. Today this sector is undergoing an economic slump due to overfishing. Mariculture is currently less important than maritime sectors but is seen as sector with a potential for growth in the future. In this regard, especially the breeding or farming of high-quality sea fish as well as the production of organic and renewable marine resources for medical science are interesting sectors.

Israel

The Mediterranean coast of Israel is characterised by a variety of landscapes and historical sites and by a rich biodiversity. Further it holds rich habitats for a wide variety of fish and other species and hence, the protection of the marine environment enables wise use of this resource for fishing. Within the last year several factors such as marine pollution, climate change and invasive species are responsible for a degradational change of the Mediterranean Sea's marine environment.

The Red Sea is the northernmost tropical sea ecosystem of the world with oxygen-rich water and a constant temperature of 21 to 24 degrees. Further, the coral reef ecosystem of the Gulf of Aqaba embodies an important, complex and rich habitat, which is currently being threatened.

The coastal strips of both the Mediterranean Sea as well as the Red Sea are short, crowded and full of competing uses. Hence, both are heavily used coastal strips, especially considering Eilat, where tourism sector has grown rapidly within the last decade. The future of this region relies largely on clean water, air, beaches and healthy coral reefs. Hence, in the future it will be necessary to reduce the pressure, particularly in the densely populated regions, in order to protect open areas and provide space for ecological corridors. Like in Germany the Israeli fishery sector is suffering an economic slump due to overfishing.

The social state as well as the institutional system governing coastal and marine resource use of Germany and Israel were described within Chapters 6.1 to 6.4 and shall not be repeated here.

Impacts

In this section the suspected impacts of mariculture affecting or changing the state of the respective coastal system will be discussed. In this context impacts on the environment as well as on the provision of ecosystem goods and services will be considered. The impacts can be subdivided into negative and positive impacts but some aspects have both a positive and negative side.

Impacts on the ecosystem:

The impacts on the ecosystem were the major concerns mentioned by all stakeholders in Israel and Germany. Effects on the functionality and quality of the environment are significantly influencing the attitudes of the public and the stakeholders towards mariculture. In this regard the following issues have to be considered:

Negative: enhanced eutrophication; bad wastewater management; interferences with environmental protection; escapes of farmed species; feeding farmed fish with caught fish (overfishing); antibiotic input; fish meal and fish oil

Positive: water bio-filtration; coastal protection (storm protection); no overfishing and unwanted by-catches; no mechanical destruction of natural habitats by fishing gears

Impacts on the economic system and coastal use:

Negative: interferences with competing uses such as tourism, sailing, shipping, fishery; spatial conflicts

Positive: new food and cosmetics sector; medical science; jobs; income; export of technology knowledge; support of the fishery sector; independency from imports

Impacts on the cultural system:

Negative: aesthetics and beauty of the landscape; sense of place; cultural heritage; habitat and species value; regional image; recreation sector; ethical concerns about intensive livestock farming

Positive: regional image (e.g., maritime flair); informal education; knowledge systems

Impacts on the social system:

Negative: human well-being, e.g., loss of recreation and sailing areas

Positive: production of high-quality food and cosmetics; medical innovation; strengthening of regional identity; employment and income; education; safety

Differences of the stakeholder foci within the interviews do not allow ranking the described impacts precisely. Nevertheless, the overview of the German stakeholder foci can be seen in Annex 4.

Response

As stated above, besides negative impacts there are as well some positive aspects to be expected. In order to reduce the negative impacts to a minimum and strengthen the benefits of this sector an adequate response system is necessary.

Interactions between the coastal population and the physical environment affect the carrying capacity of the environment as a life-supporting system. Environmental carrying capacity reflects the potential of the environment to provide basic life needs, such as food and physical living space, and its ability to absorb products and wastes generated by human activities. Changes in population size, population growth rate, population dispersion and population density affect the carrying capacity of the environment and, consequently, the quality of life and the environment in Israel and Germany. Hence, the response also includes changes to the existing legal framework and changes in governance architecture or governance processes. In this regard, this research provides rich information related to attitudes, behaviours and perceptions towards aquaculture/mariculture and the relation between them as well as challenges facing a future mariculture sector.

In the context of tomorrow's mariculture, political will and favourable legislation are essential. Especially in Germany, an appropriate governance concept of mariculture seems to be missing. Here, a better integration of mariculture into a sustainable coastal management should be the overall target in order to strengthen the marine technology and national/regional food sector, e.g., through a combination of fishery management and aquaculture development. Closer evaluation of the results revealed that attitudes and perceptions of the stakeholder are strongly influenced by environmental and economic concerns. Another significant result is the relatively low level of knowledge/understanding about the aquaculture sector among the general public and a rather low level of the benefits among the stakeholders. There is therefore a dual challenge for planners: Against the background of broad support for expanding sustainable mariculture, there is also a need for improved communication of (scientific) information on mariculture-environment interactions as well as on the benefits, quality and safety of this sector.

Besides the environmental impacts further primary concerns regarding mariculture expansion were spatial conflicts and interferences with other coastal uses, especially tourism. However, as stated before, the tourism-mariculture relationship found within the research areas indicates potential synergies between the two sectors reliant on the coastal zone that should be taken into account by planning authorities. In this case, the use of planning tools such as Maritime Spatial Planning (MSP) or Integrated Coastal Zone Management (ICZM) combined

with adjustments in legislation as well as political priorities and political support are indispensable.

One of the basic requirements for a successful and sustainable integration of the mariculture sector is the availability of appropriate sites. Without optimal sites only suboptimal production conditions can be realised. In this regard, inefficient or less efficient production conditions are leading to higher production costs and hence to a loss of competitiveness. Especially in Germany, where the current main focus is on regional small-scale mariculture sites, less competitiveness means also a loss of profits, which is important for marketing issues, image building within the region, new farming innovations and social matters, such as employment, income and safety. Therefore, the site selection mainly influences the sustainability of the mariculture sector. Hence, in this regard the following aspects have to be assured:

- Are the site selections done through a participatory process (horizontal and vertical integration), e.g., according to the ICZM approach?
- Are all relevant stakeholders and components of the society involved in the decision-making process?
- Are all medium and long-term strategies on community level communicated to the wider public in a transparent way?
- Are choices and decisions taking into consideration all laws, regulations and directives, relevant on international and national level?

The results show that good governance as well as tools such as Maritime Spatial Planning or Integrated Coastal Zone Management (see Chapter 3) are crucial for a sustainable future mariculture development in order to meet the interests of the stakeholders and the public. Further, according to the results of the quantitative and qualitative studies sustainable development of mariculture require improved governance and changes in the perspective of the main stakeholders to focus increasingly on long-term outcomes. This include:

- improved collection and sharing of information as well as a better understanding on the economic, social and environmental benefits and costs of well-planned and managed mariculture;
- better communication and understanding of the physical, ecological and social carrying capacity of the region regarding mariculture production;
- integration of mariculture management into coastal area management;
- consideration of the mariculture sector as an equal competitor in terms of space. This implies solving potential conflicts with other users & using synergies with other activities;

- strong and more transparent political framework (role of national and regional authorities, better implementation of EU legislation);
- reduction of the administrative burden
- precise catalogue of requirements as well as standards for applications;
- closer participation of all stakeholders in the mariculture management process;
- strong monitoring systems of control and enforcement;
- financial and information support, e.g., for new investors.

Furthermore, the planning, decision-making and implementation process of mariculture might be supported, besides the hard and soft laws, by virtual tools such as Geographical Information Systems (GIS). The introduction of monitoring systems also belongs to the response part of the DPSIR model. Geographical Information Systems are important tools for site selection. They can identify and illustrate environmental effects of mariculture. In this regard GIS should include the environmental, spatial and temporal indicators in order to avoid problems and spatial conflicts in this regard. Furthermore, it can be combined with the Environmental Impact Assessment (EIA) and an Environmental Monitoring Programme (EMP).

With Geographical Information Systems the potential for mariculture farms in specific regions can be evaluated taking into account ecological, economic and social aspects. In this context it is important to find suitable indicators for the mariculture sector in order to ensure an adequate monitoring for the future. GIS data and information can include, for example, the following variables:

- Climate (air temperature, humidity, wind speed, storm frequency, climate change scenarios etc.)
- Morphologic and hydrographic parameters (bathymetry, flow conditions, temperature, salinity, oxygen, nutrients etc.)
- Economic aspects (intense of marine uses, important shipping routes etc.)
- Socio economic and cultural aspects (infrastructure etc.)
- Mariculture related aspects (farm size, production size, nutrient input of mono- or polyculture sites etc.)

Besides the current or short-term challenges there are also long-term challenges to be considered regarding a future mariculture development. Here, mainly the direct and indirect effects of climate change should be taken into account. Rapid or gradual environmental changes will have profound consequences on the farmed species as well as on the coastal communities. In this regard, mariculture might face the following problems:

- Invasive species
- Change of coastal use
- Change in temperature, salinity and oxygen
- Extreme weather conditions

Changes in temperature and oxygen may have strong effects on the physiology of aquatic reared species. Such animals are often linked to strict annual cycles linked to the seasons. Generally, new mariculture sites are established for a long-term period. Therefore, in the context of a future development of mariculture these parameters have to be taken into account, especially facing climate change.

Additionally, the effects of local weather conditions, e.g., storms with high wave water levels, will become an important technical challenge. Especially from the Israeli stakeholders' point of view this seems currently to be a main barrier for tomorrow's mariculture.

Changes of the climate have already been observed over the 20th century and further changes are strongly expected. Therefore, it is important to deal with stress data related to climate change in order to develop long-term sustainable mariculture sites.

7 CONCLUSIONS AND OUTLOOK

The SPAMA project has yielded some unexpected and highly relevant results for future planning processes of marine aquaculture. The study shows that public and stakeholders' attitudes towards marine aquaculture are not generally negative.

Knowledge, source of information and personal experiences are important components in the context of attitude formation and risk perception regarding mariculture. As a result of this thesis' analyses, it can be summarised that a lot of statements by as well as answers from the public were based on media and press campaigns of cases in, e.g., Norway, Asia or Eilat. Even if this information is partly obsolete in the meantime or could not be substantiated by science yet, the risk perception concerning these matters is still present.

The press and media often shape the image of mariculture, as well as the environmental concerns. Especially in Israel the media coverage about the Eilat case was extensive and largely negative. For this reason it was tested within the quantitative study if the media negatively influence attitudes of people who are exposed to negative messages concerning mariculture environmental impacts and if individuals with greater environmental concerns might be more easily influenced by these negative messages. Both assumptions could be proved. As a result it can be said that for the wider public in Israel the Eilat case is still present and hence, the image of mariculture is rather negative compared to the German results.

In Germany, marine aquaculture farming and related activities such as processing, transport and marketing hardly exist. Hence, a low level of familiarity with mariculture in Germany as well as a low awareness of its economic potential was observed. Here, the former negative press coverage about mariculture practices in Norway seems to be the main factor for environmental concern. However, due to the changed focus of the current press and media on issues like mechanical destruction damage to the seafloor and overfishing of the North and Baltic Sea the main focus of the public has changed as well. Today, for the wider public in Germany mariculture seems to be more a solution to avoid problems such as overfishing in the Baltic Sea than an environmental problem as in Norway.

As the results of the studies show, the effects of the environmental concerns on the public attitudes towards mariculture were highly divergent in both countries even if the ranking of environmental concerns were similar in the German and Israeli samples.

This indicates that negative press and media information have a strong influence on the attitudes towards the mariculture sector. Therefore, an exchange of information and

experiences between scientists, decision-makers, producers, NGOs etc. is essential as well as the information of the wider public and the consideration of their needs and requirements. Currently less than 20% of the German public feel that they are well informed about the ecological production of food and mariculture related products.

The findings with respect to environmental attitudes and levels of knowledge illustrate the usefulness considering local conditions in a comparative multinational context. The quantitative surveys of the type conducted in this study provide important baselines for assessing the levels of knowledge, perceptions and attitudes needed to inform policies and planning for future mariculture activities. Additionally, the interviews with stakeholders of different sectors indicate the main barriers for a future development of mariculture on a political and technical level.

Despite the differences in cultural, geographic, political and informational contexts in Germany and Israel as well as the history and future focus regarding mariculture, the influence of perception and attitudes on decision-making processes and hence on the development of mariculture on regional or national level is strong in both countries. Moreover, most of the attitudes revealed a limited understanding of the interactions between mariculture and the environment.

In general, the potential for the growth of mariculture in both countries is higher than expected at the beginning of the research, even though the focus in Israel and Germany is different. Whereas in Germany opportunities were seen in high-quality niche products, in Israel the focus is on commercial-scale mariculture farms. However, in both countries the estimation of the potential was linked to a negative evaluation of the national fishery sector and the increasing demand for seafood. Fish markets are global. However, consumer receptiveness to the products of aquaculture is largely influenced by local factors. Hence, domestic productions have potential advantages in adapting to local market conditions. In the context of good governance the understanding of local factors as well as an appropriate sectorial planning, guided from local, national and transnational provisions, are key determinants of policies' effectiveness.

The legal framework requirements regarding the sustainable development of mariculture, both on national and international level, are very important. Nevertheless, it is essential to integrate the mariculture sector in soft laws and planning tools such as the Integrated Coastal Zone Management and the Marine Spatial Planning as described in Chapter 6.5. It is

important to find solutions to the specific problems identified in Chapter 6 and to guide the development of the aquaculture sectors towards a sustainable direction.

In order to strengthen a sustainable fish and seafood supply both the fishery and the mariculture sector should be better linked to each other and should not be seen as competing sectors. In this context the reform of the Common Fisheries Policy on European level provides a good opportunity to improve the regulatory framework regarding mariculture within the German research area.

However, even if the future of mariculture in Israel and Germany is undetermined the path to success can be cleared now starting not only with the improvement of the Common Fisheries Policy but also with the information exchange, better participation and institutional framework as well as the reduction of the administrative burden and the development of standards for application on national and regional level. In Germany the first step in this direction was done with the establishment of mariculture networks and the positive change in the assessment of the economic benefits of mariculture.

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ANNEX

Annex 1 - European regulations and directives, which apply to aquaculture

European regulations:

- Corrigendum to Council Regulation (EC) No 2792/1999 of 17 December 1999 laying down the detailed rules and arrangements regarding Community structural assistance in the fisheries sector
- Council Regulation (EC) No 104/2000 of 17 December 1999 on the common organisation of the markets in fishery and aquaculture products
- Commission Regulation (EC) No 2722/2000 of 13 December 2000 establishing the conditions under which the Financial Instrument for Fisheries Guidance (FIFG) may make a contribution towards the eradication of pathological risks in aquaculture
- COMMISSION REGULATION (EC) No 2065/2001 of 22 October 2001 laying down detailed rules for the application of Council Regulation (EC) No 104/2000 as regards informing consumers about fishery and aquaculture products
- Commission Regulation (EC) No 2200/2001 of 17 October 2001 concerning provisional authorisations of additives in feedingstuffs
- Commission Regulation (EC) No 77/2002 of 17 January 2002 amending Annexes I and III to Council Regulation (EEC) No 2377/90 laying down a Community procedure for the establishment of maximum residue limits of veterinary medicinal products in foodstuffs of animal origin (Text with EEA relevance)
- Commission Regulation (EC) No 221/2002 of 6 February 2002 amending Regulation (EC) No 466/2001 setting maximum levels for certain contaminants in foodstuffs
- Corrigendum to Regulation (EC) No 852/2004 to No 854/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs
- Council Regulation (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture
- Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation
- Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel
- Regulation (EC) No 762/2008 of the European Parliament and of the Council of 9 July 2008 on the submission by Member States of statistics on aquaculture and repealing Council Regulation (EC) No 788/96
- Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control

- Commission Regulation (EC) No 710/2009 of 5 August 2009 amending Regulation (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007, as regards laying down detailed rules on organic aquaculture animal and seaweed production

European directives:

- Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
- Council Directive 92/65/EEC of 13 July 1992 laying down animal health requirements governing trade in and imports into the Community of animals, semen, ova and embryos not subject to animal health requirements laid down in specific Community rules referred to in Annex A (I) to Directive 90/425/EEC
- Council Directive 95/71/EC of 22 December 1995 amending the Annex to Directive 91/493/EEC laying down the health conditions for the production and the placing on the market of fishery products
- Council Directive 96/22/EC of 29 April 1996 concerning the prohibition on the use in stockfarming of certain substances having a hormonal or thyrostatic action and of β -agonists
- Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products
- Council Directive 96/43/EC of 26 June 1996 amending and consolidating Directive 85/73/EEC in order to ensure financing of veterinary inspections and controls on live animals and certain animal products
- Council Directive 97/78/EC of 18 December 1997 laying down the principles governing the organisation of veterinary checks on products entering the Community from third countries
- Council Directive 98/45/EC of 24 June 1998 amending Directive 91/67/EEC concerning the animal health conditions governing the placing on the market of aquaculture animals and products
- Council Directive 98/58/EC of 20 July 1998 concerning the protection of animals kept for farming purposes
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy
- Council Directive 2000/27/EC of 2 May 2000 amending Directive 93/53/EEC introducing minimum Community measures for the control of certain fish diseases

- Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council
- Council Directive 2001/102/EC of 27 November 2001 amending Directive 1999/29/EC on the undesirable substances and products in animal nutrition
- 2001/288/EC: Commission Decision of 3 April 2001 amending Council Directive 93/53/EEC introducing minimum Community measures for the control of certain fish diseases, in relation to the list of national reference laboratories for fish diseases
- Corrigendum to Council Directive 2006/88/EC of 24 October 2006 on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals
- Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control
- Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds
- OSPAR, MARPOL etc.
- Fishing quotas

Annex 2 – The questionnaire



Dear Citizen

This survey is part of a joint research project at the University of Haifa (Israel) and the University of Kiel (Germany) on citizens' attitudes, perceptions and behaviours related to issues in the environment, society, economy and government. You will be asked a number of questions on these issues and would like to have your opinion.

The information that you will provide is of great value and will be kept confidential. The questionnaire requires about 15 minutes of your time to complete. It is the main source of data for this research project. Please try to answer all the questions. There are no right or wrong answers. We are only interested in your opinion.

Your personal participation is most appreciated. If you have any questions, please do not hesitate to ask any questions of the interviewer. If you are interested in seeing the results of this survey, we will be happy to send these to you at the end of this project

Thank you for your effort and participation,

***The Research Team
University of Haifa and University of Kiel***

October 2008

The following section relates to your attitudes toward the environment, the economy and the role of government in citizens' life. Please circle a number from 1 to 5 indicating your personal agreement with the following statements.

Environment Protection	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I think that investments in environmental protection should be financed from the (local) government budget.	1	2	3	4	5
I think that investments in environment protection should also be financed by the private economic sector.	1	2	3	4	5
I think that investments should also come from private citizens on a voluntarily basis.	1	2	3	4	5
I would be willing to pay increased taxes in order to achieve environmental improvements.	1	2	3	4	5
The economic situation/development (such as employment) should have a higher priority than measures for environmental protection.	1	2	3	4	5
A persistent environmental policy will have positive effects on the future competitiveness of the private economic sector.	1	2	3	4	5
If we continue with business as usual, it will result in an environmental disaster.	1	2	3	4	5
The importance of environmental problems is strongly exaggerated by environmentalists.	1	2	3	4	5
The scenic beauty, character and quality of our regiob should be preserved and protected.	1	2	3	4	5
The many regulations in nature conservation are constraining the citizens too much.	1	2	3	4	5
As citizens we are able to make an essential contribution to environmental protection by our buying behaviour.	1	2	3	4	5
Measures for environmental protection increase the cost for the private economic sector and therefore also for goods and services, but they do pay off on a long-term basis.	1	2	3	4	5

Ocean Environment Protection	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I think the protection of the Baltic Sea and its coasts is very important.	1	2	3	4	5
We have done enough already for the protection/conservation of the Baltic Sea and is coasts.	1	2	3	4	5

Tourism	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
The tourism holds great promises for my region's future.	1	2	3	4	5
I favour building new tourism facilities (such as hotels, adventure baths, marinas) in order to attract more tourists to Eilat/Aquaba/Kiel	1	2	3	4	5
The benefit and the advantages of tourism are outweighing its disadvantages.	1	2	3	4	5
Tourism and environment protection are compatible/reconcilable with each other.	1	2	3	4	5

Regional politics	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
The government and the public administration attend sufficiently to the citizen's concern & needs.	1	2	3	4	5
The (regional) politicians have an interest to integrate the general public in important decision making processes.	1	2	3	4	5
Generally Speaking, I confide in the political (planning) structures of the regional politics and I agree with their decisions.	1	2	3	4	5

Employment	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
A good profession/job is one of the most important things in life.	1	2	3	4	5
My job means more to me than my salary.	1	2	3	4	5
I think I would find easily a new employment/job	1	2	3	4	5

The next section asks you about your behaviour in a variety of areas related to your life style and political behaviour. Please indicate the frequency with which you have taken part in each activity on a scale from 1 to 3. Double entries are possible (in the past as well as today).

Life style	Never	In the past	Today
I go to the beach/ I swim in the sea / I go snorkelling or diving	1	2	3
I do water sports (sailing, surfing, etc.)	1	2	3
I prefer to buy groceries with an eco-certificate.	1	2	3
If possible, I use public transportation, I go by bicycle or by foot.	1	2	3
I am separating my rubbish.	1	2	3
I dispose my problematic rubbish (such as batteries, paints) in an appropriate and professional way.	1	2	3
I donate money for environment organisations.	1	2	3
I try to eat healthy.	1	2	3
I try to keep physically fit.	1	2	3
I receive electricity from regenerative sources.	1	2	3
I purposely shop for products from our region.	1	2	3

Political commitment	Never	In the past	Today
I am a member of a political party.	1	2	3
I actively keep myself informed about political circumstances and events.	1	2	3
I express my political opinion and attitude publically (e.g. letters to the editor, letters of protest, petitions).	1	2	3
I participate in demonstrations.	1	2	3
I do voluntary work in my community.	1	2	3
I participate in regional cultural activities.	1	2	3
I am a member of an organisation that supports the conservation and protection of nature and environment (such as Greenpeace, WWF)	1	2	3

In the next section we want to venture a short glance into the future and we would like to have your opinion about the future prospects. Please circle a number from 1 to 5 indicating your personal agreement with the following statements.

If you would venture a short glance into the future, how likely do you think these statements are?	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
The global environmental pollution will increase.	1	2	3	4	5
The agriculture will adapt more and more to ecologically sustainable cultivation.	1	2	3	4	5
The cultivation of genetically altered plants will increase.	1	2	3	4	5
The exploitation of natural resources will increase.	1	2	3	4	5
Traditional/artisan Fishery will become less important because of the strong overfishing.	1	2	3	4	5

The next sections deal with aquaculture. Do you have any knowledge about aquaculture? (see last page)

If yes, where does your knowledge come from?

(1) Media (2) Personal Information (3) School/ University (4) Apprenticeship/Profession

In the next two tables you will find possible advantages and disadvantages of marine aquaculture that have been mentioned by experts (such as representatives of environment organisations and of the regional economy). Which of the following points is the most important in your opinion? Please read first all of the points and then mark maximal 4 at large with a cross.

Advantages of marine aquaculture (ONLY EXAMPLES)	Please mark with a cross	Disadvantages of marine aquaculture (ONLY EXAMPLES)	Please mark with a cross
No overfishing of natural stocks and no unwanted by-catch		Additional degradation and contamination of water and sea bottom	
No mechanical destruction of natural habitats by fishing gears (as in traditional fishery)		Loss of employment (e.g. in the regional fisheries sector)	
Production of healthy food		Fish farms disturb the natural beauty of the coasts and thus harm the tourism sector	
Creation of new jobs /employment		Deployment of fish meal and fish oil	
Reliable food source for the growing global population		Fish and products from aquaculture facilities are not as healthy as from free-living organisms	
Economic boost in coastal areas which are only weakly developed		There are ethical concerns about intensive livestock farming	

The environmental friendly aquaculture techniques lead to higher prices of products at the end than the traditional aquaculture. Today 1 kilo of non-ecologically produced salmon costs around 14 Euros in the supermarket. How much more would you be willing to pay if you knew it would come from environmentally friendly production (ecological salmon)?

Additional cost for 1 kilo of salmon filet

0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
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If you do not wish to pay additionally for sustainable produced fish, please name a reason:

- (1) I do not have the sufficient financial resources to pay more for fish.
- (2) I do not eat fish.
- (3) I do not believe fish from aquaculture facilities is healthy.
- (4) I do not believe marine aquaculture can be sustainable/ environmental friendly ever.
- (5) Others (please specify) _____.

I eat fish or seafood:

(0) never (1) several times a year (2) once a month (3) once a week (4) several times a week

Aquakultur

Unter Aquakultur wird die Aufzucht von Süßwasser- und Meerwasserorganismen (Fische, Algen, Krabben, Muscheln etc.) in Käfigen, Teichen, Tanks usw. verstanden. Sie bildet eine Alternative zum traditionellen Fischfang. Aquakultur im Küstenbereich kann wie folgt unterteilt werden:

Käfiganlagen im Wasser:



Durchflussanlagen:



Kreislaufanlagen:



Teichwirtschaft:



Annex 3 – Example set of questions – environmental NGO (Israel)

Name: _____

Position: _____

<i>Number/ kind of information</i>	Central questions	Check & Aim of this question: <i>Did the interviewee answer the following questions?</i>
<i>1. Introduction</i>	Short introduction GIF-project	
<i>2. Professional background</i>	How does aquaculture affect your business?	<ul style="list-style-type: none"> • <i>How is she/he related with or involved in aquaculture?</i> • <i>How important is aquaculture for her/his business?</i> • <i>Has this importance of aquaculture risen during the last years?</i>
<i>3. position towards Aquaculture in general</i> ----- <i>Personal perception and knowledge</i>	In your opinion: What are the potential negativ/positiv aspects about marine aquaculture?	<ul style="list-style-type: none"> • <i>Major concern/advantages</i> • <i>General position towards marine aquaculture</i>
	How important is aquaculture for food supply in Israel	<ul style="list-style-type: none"> •
	What were the reasons for removing the net cages in Eilat?	<ul style="list-style-type: none"> • <i>Had you conducted some scientific research concerning the environmental impacts?</i> • <i>Where there some conflicts between Aquaculture and other sectors?</i>

	Is there a plan for a further or future development of marine aquaculture in Israel?	•
4. <i>Aquaculture in Kiel</i>	<p>Please imagine a future extension of marine Aquaculture in Israel:</p> <p>In your opinion: What should be the most important criteria concerning a planning permission?</p>	<p>e.g.:</p> <ul style="list-style-type: none"> • <i>Is there a Regulatory framework for A. in Israel</i> • <i>Positive or negative economical/ ecological impacts</i> • <i>Attitudes, perception, acceptance</i>
5. <i>Information/ Personal perception and knowledge</i>	<p>What is the basis for your criteria? Or</p> <p>What is your source of information?</p>	<ul style="list-style-type: none"> • <i>Do you cooperate with or do you get information from other environmental and/or trade associations</i>
6. <i>Position in decision making process</i>	<p>Do you have a voice in the planning and decision making processes.</p>	<ul style="list-style-type: none"> • <i>Possibilities to influence the planning and decision making process in the Kiel fjord</i>
8. <i>Future of aquaculture in general</i>	<p>What do you think about the future chances (and importance) of aquaculture in Israel and in general?</p> <p>Possible additional questions:</p> <p>If positive: What kind of cooperation between aquaculture and other economic sectors could you imagine? (e.g.: regional products, tourism,...)</p> <p>If negative: Give us the scenario under which you would consider to change your mind (e.g; proof of water quality, etc.)</p>	<ul style="list-style-type: none"> • <i>General position towards future of aquaculture</i> • <i>General position towards further development of marine aquaculture</i> • <i>(Commercial) relevance for this region</i>

Thank you!

Example set of questions – Ministries, local government, authorities (Germany)

Name: _____

Position: _____

	Central questions	Check <i>Did the interviewee answer the following questions?</i>
<i>1. Introduction</i>	Short introduction GIF-project	
<i>2. Professional background</i>	How does aquaculture affect your business?	<ul style="list-style-type: none"> • <i>How is she/he related with or involved in aquaculture?</i> • <i>How important is aquaculture for her/his business?</i> • <i>Has this importance of aquaculture risen during the last years?</i>
<i>3. position towards Aquaculture in general</i> ----- <i>Personal perception and knowledge</i>	<i>In general, what is your (official) position towards aquaculture?</i>	
<i>4. Aquaculture in Kiel</i>	Please imagine a future extension of Aquaculture in the Kiel fjord: What are the most important criteria concerning a planning permission?	<i>e.g.:</i> <ul style="list-style-type: none"> • <i>Regulatory framework</i> • <i>Positive or negative economical/ ecological impacts</i> • <i>Attitudes, perception, acceptance</i> <i>e.g.:</i>

<p><i>Information/ Personal perception and knowledge</i></p>	<p>What is your source of information? Or What is the basis for your decision? (<i>Depends on the interviewee</i>)</p>	<ul style="list-style-type: none"> • <i>Do you cooperate with or do you get information from environmental and/or trade associations</i>
<p><i>5. Future of aquaculture in Kiel</i></p>	<p>What do you think about the future chances of aquaculture in this region?</p> <p><u>Possible additional questions:</u> <i>If positive:</i> What kind of cooperation between aquaculture and other economic sectors could you imagine? (e.g.: regional products, tourism,...) <i>If negative:</i> Give us the scenario under which you would consider to change your mind (e.g: instruction from minister to administrator; proof of water quality (NGO), etc.</p>	<p>e.g.:</p> <ul style="list-style-type: none"> • <i>Potential negative aspects/ major concerns about aquaculture?</i> • <i>Potential positive aspects/ major advantages of aquaculture?</i>
<p><i>6. Future of aquaculture in general</i></p>	<p>What do you think about the future chances (and importance) of aquaculture in general?</p> <p><u>If negative:</u> What would it need to change your mind?</p>	

Thank you!



Figure 6-6. Main focus of the different stakeholder groups during the qualitative interviews.

Eidesstattliche Erklärung

Ich versichere an Eides statt, dass die vorliegende Abhandlung - abgesehen von der Beratung durch meine Betreuer – nach Inhalt und Form die eigene Arbeit ist.

Die Arbeit ist unter Eihaltung der Regeln guter wissenschaftlicher Praxis der Deutschen Forschungsgemeinschaft entstanden. Ferner habe ich weder diese noch eine ähnliche Arbeit an einer anderen Abteilung oder Hochschule im Rahmen eines Prüfungsverfahrens vorgelegt, veröffentlicht oder zur Veröffentlichung eingereicht.

Kiel, 14. Mai 2012 _____