MASTERARBEIT | MASTER'S THESIS

Titel | Title

Marine Pollution in the South China Sea: Environmental, Territorial and Economic Implications

verfasst von | submitted by

Camilla Wallner licence

angestrebter akademischer Grad | in partial fulfilment of the requirements for the degree of

Master of Arts (MA)

Wien | Vienna, 2024

Studienkennzahl lt. Studienblatt | Degree programme code as it appears on the student record sheet:	UA 066 589
Studienrichtung lt. Studienblatt | Degree programme as it appears on the student record sheet:	Masterstudium Internationale Entwicklung
Betreut von | Supervisor:	ao. Univ.-Prof. Mag. Dr. Friedrich Edelmayer MAS

This thesis is dedicated to the world, and to life on earth, to biodiversity and nature on the blue planet. To those who value and treasure flora and fauna, who understand that the environment depends on us and vice versa. The protection and preservation of our environment, especially our oceans are no longer an option but a necessity to ensure that life as we know it endures; this work is dedicated to those that have a sense of responsibility and care to preserve our waters, the source of all life, for future generations.

"There is a widening gap between the declining health of the ocean and the growing demand for its benefits. Securing healthy oceans and coasts to contribute to sustainable development requires widespread changes in how we manage our activities in and around coastal and marine areas. The need for change is clear as the impacts of over- exploitation, pollution, coastal development and climate change on oceans and coasts become increasingly visible."[1]

(Source: United Nations Environment Programme (UNEP))

[1] Jones, RJS., Murray RH., Vestergaard O. (2019). Enabling Effective and Equitable Marine Protected Areas: guidance on combining governance approaches. Regional Seas Reports and Studies No. 203. University College London, Department of Geography; UN Environment, Ecosystems Division, Marine and Coastal Ecosystems Branch.

Abstract

In Hinblick auf die rapide Verschmutzung der Weltmeere ist das Ziel dieser Arbeit auf den Schutz und die Notwendigkeit der Erhaltung von marinen Ökosystemen aufmerksam zu machen. Das Südchinesische Meer (SCM) ist ebenfalls von der Verschmutzung durch Mikroplastik sowie Schwermetallen und anderen Schadstoffen betroffen. Sechs Staaten erheben Anspruch auf Teile der Region (China, Malaysia, Philippinen, Taiwan, Brunei Darussalam und Vietnam). Es hat sich bislang schwierig erwiesen das SCM auf Basis der Statuten des Seerechtsübereinkommens der Vereinten Nationen (United Nations Convention on the Law of the Sea (UNCLOS)) aufzuteilen. China stellt hegemoniale Ansprüche auf einen großen Teil der Region basierend auf einem historischen Recht, anhand der sogenannten „Nine-Dash Line". Alle Küstenstaaten der Region bauen auf die lebenden sowie nicht lebenden Ressourcen der Region; aufgrund dieser allgemeinen Abhängigkeit in Bezug auf Wirtschaftswachstum sowie auch Transport, ist es umso wichtiger Lösungen zur Förderung eines nachhaltigen Wirtschafsmodells zu finden, wobei der Schutz und die Wahrung der Meeresumwelt sowie Umweltsicherheit stets im Vordergrund stehen müssen. Wenn die Küstenstaaten nicht mehr auf die Ressourcen des Meeres bauen können, könnte dies zu Spannungen führen und in weiterer Folge Konflikte veranlassen. Diese Arbeit verfolgt drei Ziele. Es gilt in einer ersten Etappe die Ursachen der Meeresverschmutzung zu identifizieren und ihre Auswirkungen zu analysieren. In weiterer Folge gilt es die rechtlichen Grundlagen in Bezug auf territoriale Ansprüche sowie umweltrechtliche Aspekte, unter Berücksichtigung der UNCLOS-Bestimmungen und der internationalen Rechtsprechung, näher zu erörtern. Ein dritter Teil ist der Suche nach Lösungen gewidmet, um den Schutz und die Erhaltung der Meeresumwelt zu gewährleisten. Die Organisation der Vereinten Nationen für industrielle Entwicklung (United Nations Industrial Development Organization (UNIDO)) und das Umweltprogramm der Vereinten Nationen (United Nations Environment Programme (UNEP)) sind Schlüsseleinrichtungen für die Erreichung dieser Ziele. Ihre Arbeit im SCM wird eingehend analysiert, aber auch private Initiativen setzen sich mit Unterstützung des Programms der UN-Ozeandekade (UN Ocean Decade) für den Erhalt der biologischen Vielfalt im Meer ein.

Abstract

The aim of this paper is to raise awareness of the rapid degradation of the marine environment in the South China Sea (SCS). Six states claim parts of the region (China, Malaysia, Philippines, Taiwan, Brunei Darussalam and Vietnam). It has proven difficult to divide the SCS according to the United Nations Convention on the Law of the Sea (UNCLOS) statutes due to China's hegemonial aspirations throughout the region, the latter referring to a historical right („Nine-Dash Line"). Given that all coastal states of the region depend on the living and non-living resources of the SCS and due to a general dependence on the sea for resources, economic growth, and transportation, it is important to find solutions as to promote sustainable economic growth throughout the region with a strong focus on the protection of the marine environment in order to maintain environmental security. If the coastal states can no longer rely on the sea, it could cause a flare-up of tensions and lead to military conflicts. The aim of this paper is threefold. A first step will consist in identifying the sources of marine pollution throughout the SCS as well as to analyze their repercussions. A second step will consist in discussing the legal groundwork in terms of territorial claims and environmental law in the SCS by taking into account the UNCLOS regulations as well as international case law. The third part will be dedicated to finding solutions which allow environmental security without compromising sustainable economic growth. Those findings will mostly rely on preexisting environmental policies in the SCS region which have proven to be successful. The United Nations Industrial Development Organization, as well as the United Nations Environment Programme are key institutions in achieving those goals. Their work in the SCS will be analyzed thoroughly, but also private ventures have been created to preserve marine biodiversity with the endorsement of the UN Ocean Decade.

Table of contents

Register of Images

List of abbreviations

Ai	Aluminum
ASEAN	Association of Southeast Asian Nations
BAP	Biodiversity Action Plan
BAP BEP	Best available techniques and best environmental practices
BC 92	Basel Convention
BMC	Bilateral Consultant Mechanism
AFS Convention 2001	Convention on the Control of Harmful Anti-Fouling Systems on Ships 2001
CBD	Convention on Biological Diversity
CE	Circular Economy
CEPU	Coastal Enforcement Protection Unit
CLCS	Commission on the Limits of the Continental Shelf
CMR	Coastal and Marine Resources
CSO	Civil Society Organisation
DNPS	Daya Bay Nuclear Power Station
DENR-EMB	Environmental Management Bureau of the department of Environment and Natural Resources
ECC	Environmental Compliance Certificate
EE	Environmental Education
EGF	Environmental Guarantee Fund
EIS	Environmental Impact Statement System
EMF	Environmental Monitoring Fund
EEZ	Exclusive Economic Zone
EPU	Economic Planning Unit
EQA	Environment Quality Act 1974
FISH	Fisheries Improved for Sustainable Harvest
FSPCC	Framework Strategy and Program on Climate Change

GAIA	German Institute of Global and Area Studies
GEF	General Environment Fund
HM	Heavy Metal
HG (II)	Inorganic mercury
ICM	Integrated Coastal Management
ICPME	International Convention for the Protection of the Marine Environment
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission
Fe	Iron
ISID	Inclusive and Sustainable Industrial development
ISO	International Standards Organization
ITC	Institute of technology of Cambodia
JICA	National River Mouths Siltation Improvement Study
LOSC	Law of the Sea Convention
LCD	Local Multi-Stakeholder Developments Council
LIT	Local Implementation Team
London Convention 72	Convention of the Prevention of the marine Pollution by Dumping of Wastes and other Matter
LMEs	Large Marine Ecosystems
MAF	Ministry of Agriculture, Forestry and Fisheries
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee
MP	Microplastic
MSO	Merchant Shipping Ordinance
MTW	Malaysian Territorial Waters
IMTA	Integrated Multi-trophic Aquaculture
NCES	National Coastal Erosion Study
NGOs	Non-Governmental Organization
Ni	Nickel

PAHs	Polycyclic aromatic hydrocarbons
PATTLEPAM	Philippine Association of Tertiary Level Education Institutions in Environmental Protection and Management
PBE	Philippine Business for the Environment
PCA	Permanent Court of Arbitration
PCAP	Pollution Control Association of the Philippines
PCSD	Philippine Council for Sustainable Development
PEACEMEC	Philippine Association of Tertiary Level Education Institutions in Environmental Protection and Management
MMT	Multi Partite Monitoring Teams
PAMB	Protected Areas Management Board
PHCs	Persistent halogenated Compounds
POPs	Persistent Organic Pollutants
RUA	Royal University of Agriculture
SCS	South China Sea
SGP	Small Grants Programme
SMEs	Semi-and medium sized enterprises
UBB	University of Battambang
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
TBT	tributyltin
TSS	Total suspended solids

Introduction

The purpose of the following thesis is to shed light on an omnipresent problem and its repercussions. Marine pollution, more generally the degradation of marine ecosystems, is a rapidly growing problem in the world endangering life as we know it. The scope of this topic is vast and cannot be covered in its integrity, which is why the choice was narrowed down to the study and analysis of the South China Sea (SCS). Marine pollution has many consequences, not only does it raise environmental but also economic, political and security issues.

In the course of this work three major research questions shall be answered, all in connection with the rapid degradation of the marine ecosystems in the SCS.

All three questions are linked to each other in the form of a gradual progression towards finding an ultimate solution.

Marine pollution in the SCS does not correspond to an under-researched topic, however only few scholars draw a line between marine pollution, territorial disputes and the risk of potential conflicts resulting from a degradation of the marine ecosystem. Sustainable growth and environmental security are fundamentals goals that have to be reached. Therefore, it is necessary to identify the problems, both from an environmental perspective as well as from a geopolitical and economic perspective in the SCS.

Each part of this thesis is dedicated to answering one research question based on various collections of data. The first part, which is dedicated to identifying the major threats to the marine ecosystem of the SCS, seeks to establish a cause-and-effect relationship between pollutants and the harmful effects on the marine environment. In order to achieve this goal, it is necessary to evaluate quantitative data. In this specific case it will not be possible to collect primary data, due to practical challenges and a lack of qualification to take and analyze samples according to scientific standards of marine biology. Therefore, the data collection is based on secondary data and will be descriptive. Given that the data was collected in a statistically valid manner, the most suitable structure of analysis consists in carrying out a meta-analysis in order to statistically analyze the results and findings from the gathered sources.

The second and third part of this work are based on legal documents and academic literature concerning territorial disputes, diplomatic issues as well as solution frameworks in order to achieve diplomatic cohesion based on common interests, such as reversing environmental degradation and furthering sustainable economic growth. Identifying paths towards environmental security and regional solutions are the ultimate goals of this paper.

It is important for this research to be carried out for several reasons. Environmental issues are becoming more acute in the imminent future, which is why it is important to carry out research in order to support the evolution towards a more environmentally friendly and conscious coexistence and a sustainable use of primary resources. There is an increasing demand for eco-friendly solutions in many fields, such as technology, transportation, domestic and agricultural activities, food supply, waste management as well as safeguarding primary resources such as clean water and fresh air.

What used to be labeled as an "eco- trend" has now become a necessity in order to avoid a further degradation of the environment, which would also engender political dismay and an overall higher risk of conflicts. The SCS project or thesis tries to identify and analyze the sources of marine environmental degradation in order to work on sustainable solutions and identify a model that may be transposed and reused in other conflict-prone regions of the world that deal with a problem of marine pollution. The outcome of this thesis may benefit other scholar as it brings together different facets of marine pollution and combines scientific data with legal regulations as well as practical solutions for a complex topic.

However, this inquiry also reaches its limits. By its nature, data collection will only be possible by having recourse to secondary data given to the complexity of collecting and analysing marine samples by the standards of scientific research of marine biology.
Still, this research topic highly contributes to the field of international development given to its interdisciplinary and transdisciplinary nature. It proves the importance of combining as well as going beyond the threshold of isolated disciplines in order to find holistic solutions that are not

one- sided and that cover the entire spectrum of the problematic.

In terms of sub-sections three major topics will be covered:

- *Marine pollution*
- *Legal responsibility, territorial claims and environmental protection*
- *Sustainable growth, environmental security and regional solutions*

In the course of this thesis three research questions have to be answered, all three questions are linked to each other in the form of a gradual progression towards finding an ultimate solution. Marine pollution in the SCS does not correspond to an under-researched topic, however only few scholars draw a line between marine pollution, territorial disputes, and the risk of potential conflicts resulting from a degradation of the marine ecosystem. Sustainable growth and environmental security are fundamentals goals that have to be reached. Therefore, it is necessary to identify the problems, both from an environmental perspective as well as from a geopolitical and economic perspective in the SCS.

Each part of this thesis is dedicated to answering one research question based on various collections of data. The first part, which is dedicated to identifying the major threats to the marine ecosystem of the SCS, seeks to establish a cause-and-effect relationship between pollutants and the harmful effects on the marine environment. In order to achieve this goal, it is necessary to evaluate quantitative data. In this specific case it will not be possible to collect primary data, due to practical challenges and a lack of qualification to take and analyze samples according to scientific standards of marine biology. Therefore, the data collection is based on secondary data and will be descriptive. Given that the data was collected in a statistically valid manner, the most suitable structure of analysis consists in carrying out a meta-analysis in order to statistically analyse the results and findings from the gathered sources.

The second and third part of this work are based on legal documents and academic literature concerning territorial disputes, diplomatic issues as well as solution frameworks in order to achieve diplomatic cohesion based on common interests, such as reversing environmental degradation and

furthering sustainable economic growth. Identifying paths towards environmental security and regional solutions are the ultimate goals of this paper.

It is important for this research to be carried out for several reasons. Environmental issues are becoming more acute in the imminent future, which is why it is important to carry out research in order to support the evolution towards a more environmentally friendly and conscious coexistence and a sustainable use of primary resources. There is an increasing demand for eco-friendly solutions in many fields, such as technology, transportation, domestic and agricultural activities, food supply, waste management as well as safeguarding primary resources such as clean water and fresh air.

What used to be labeled as an „eco- trend" has now become a necessity in order to avoid a further degradation of the environment, which would also engender political dismay and an overall higher risk of conflicts. The SCS project or thesis tries to identify and analyze the sources of marine environmental degradation in order to work on sustainable solutions and identify a model that may be transposed and reused in other conflict-prone regions of the world that deal with a problem of marine pollution. The outcome of this thesis may benefit other scholar as it brings together different facets of marine pollution and combines scientific data with legal regulations as well as practical solutions for a complex topic.

However, this inquiry also reaches its limits. By its nature, data collection will only be possible by having recourse to secondary data given to the complexity of collecting and analyzing marine samples by the standards of scientific research of marine biology.
Still, this research topic highly contributes to the field of international development given to its interdisciplinary and transdisciplinary nature. It proves the importance of combining as well as going beyond the threshold of isolated disciplines in order to find holistic solutions that are not one- sided and that cover the entire spectrum of the problematic.

Literature Review

The focus of this literature review consists in structuring research related to the recurrent topic by following a thematic approach. To get a better overview and a clear understanding of the sources and in order to summarize their findings, a division in sections and subsections is necessary.
At this point it appears pertinent to reiterate the research questions this thesis attempts to answer by dividing them into three sub questions. In accordance with the research questions the entire work will be divided into three parts, each part answering to one question with the aim of finding an overarching solution to the problems discussed.

The first research question consists in identifying major threats to the marine ecosystem in the SCS, to trace them back to their point of origin with the aim of identifying the biggest sources of marine pollution in the SCS.

The second research question seeks to discuss the law of the sea in the light of environmental responsibility in connection with territorial claims.

The third research question deals with the problematic of aligning sustainable economic growth with environmental protection and security throughout the SCS. The last research question seeks to fill the void, offer a future outlook and regional solutions in terms of economic and environmental cohesion, regional solutions to preserve the marine ecosystem and how to introduce environmental responsibility by instrumentalizing recurrent territorial claims by bordering nations.

Therefore, the literature review will be divided into three major parts in the course of which the current research status, the provenance of the sources and their accuracy and timeliness will be amply outlined and discussed. The first part corresponds to marine pollution; a second part will be dealing with legal responsibility, territorial claims and environmental protection. The third part is consecrated to sustainable growth, environmental security and regional solutions.

1. Marine Pollution

The first part of this literature review is consecrated to the major sources of marine pollution in the SCS. The literature of this part is mostly technical and based on scientific data collected during field research, such as the examination of fish and water samples. The other sources are mostly regional working groups lead by the United Nations (UN) organizations, such as the United Nations Environment Programme (UNEP) as well as papers focusing on health threats and threats to the ecosystem because of marine pollution.[2]

An important part of marine pollution can be traced back to land-based pollution. Land-based pollution includes every type of pollutant that originates through land-based activities and is transported to the sea through groundwater and rivers. Land-based activities that heavily pollute groundwater and rivers are divided into the following categories: domestic sources, industrial sources, harbor, ship-borne pollution and fishing as well as agricultural sources, mining and construction and aquaculture.

After establishing the various sources of marine pollution, it has to be pointed out that the same polluting agent can be traced back to various sources of pollution, for instance microplastic pollution in the sea stems from domestic sources, industrial sources of pollution as well as from fishing. Hence, the literature is organized in respect to the polluting agent and not according to its provenance - unless the polluting agent can be specifically linked to one single land-based activity such as aquaculture, mining, and construction as well as ship-borne pollution.

Land-based activities are the main source of pollution in the coastal waters of the SCS. Nearly 70% of all pollutants enter the SCS through coastal rivers[3], most of which can be traced back to agricultural activities, to urban as well as industrial discharges and ship-borne pollution in harbors. The countries bordering the SCS are amongst the fastest growing economies in Asia, not to mention

[2]Jones, RJS., Murray RH., Vestergaard O. (2019). Enabling Effective and Equitable Marine Protected Areas: guidance on combining governance approaches. Regional Seas Reports and Studies No. 203. University College London, Department of Geography; UN Environment, Ecosystems Division, Marine and Coastal Ecosystems Branch.

[3] Vercruysse, K., Grabowski, A.C., Rickson, R.J. (2017). Suspended sediment transport dynamics in rivers: Multi-scale drivers of temporal variation. Earth-Science Reviews, Volume 166, March 2017, Pages 38-52. https://doi.org/10.1016/j.earscirev.2016.12.016.

densely populated areas and rapidly expanding coastal cities, which amplifies the increasing risk of pollution in the region.

Following data sourced from the United Nations World Population Prospects as well as data retrieved from the World Bank show that in 2021 the urban population in China amounted to 842,933,962 people, with a growth rate of 2.32% in 2019.[4]

In 2019 the urban population of Vietnam and Brunei grew by 2.96%, Malaysia and the Philippines saw an increase of 2.1%. With a population of 23,855,010 in 2021, Taiwan experienced an overall increase of its population of 0.16% in the same year.

An increased pollution due to an overpopulation in the region presents a major risk factor for marine ecosystems in the SCS. Therefore, the major pollutants and sources of pollution (one pollutant linked to a specific activity) need to be identified in order to find solutions as to contain the threat towards the environment.

The South China Sea is a semi-enclosed body of water that occupies 648,000 square miles of the Pacific Ocean going from the Strait of Malacca (Southwest) to the Strait of Taiwan (Northeast).[5]

According to Burgess, the area can be best described as "hundreds of small, scattered islands, atolls and reefs". The Spratly islands (Nansha) and the Paracel islands (Xisha) are the most sought-after territories of the SCS due to their rich fishing grounds and for geopolitical reasons.[6]

However, these aspects will only be touched upon in the second part of this work.

1.1. Microplastic

Microplastic pollution represents an important part of marine pollution in the SCS. Not only does it affect fish, sea birds, and coral reefs, but it also represents and indirect health risk to humans through the ingestion of polluted fish and seafood.[7]

---

[4] See Appendix.

[5] Burgess, J. P. (2003). The Politics of the South China Sea: Territoriality and International Law. *Security Dialogue*, *34*(1), 7–10. https://doi.org/10.1177/09670106030341002.

[6] Ibidem.

[7] Sharma, S., & Chatterjee, S. (2017). Microplastic pollution, a threat to marine ecosystem and human health: a short review. *Environmental Science and Pollution Research*, *24*(27), 21530–21547. https://doi.org/10.1007/s11356-017-9910-8.

Most literature related to microplastic pollution of the sea is based on field studies, on water and fish samples from different regions in the SCS. It comprises literature specifically dealing with micro debris as well as literature addressing the problem of large debris dumps[8] as well as litter on the shore and the beaches.
The timeliness of the reports related to microplastic pollution must be noted - given that most data was collected no earlier than in 2019, it provides updated and accurate information about the current situation in the SCS. In order to gain a comprehensive understanding of the situation it is important to study research results from different parts of the SCS.

In terms of microplastic pollution it is important to point out the correlation between the ingestion of microplastics by fish and microplastic pollution of the marine ecosystem. In order to be categorized as "microplastic", a plastic debris should have a size of <5mm.[9] Two types of microplastics exist, primary and secondary microplastics. Primary microplastics are manufactured in small sizes and can be found in cosmetic products such as micro-beads in shower gels and scrubs, as well as in the manufacturing of jewelry and ready-to-wear fashion items.

Secondary microplastics are the result of the fragmentation of larger pieces of plastic in the process photooxidation and biodegradation.[10]
The first research paper dedicated to the data collection of microplastic pollution deals with microplastic ingestion in deep-sea fish from the SCS.

The paper is divided into three parts. The first part attempts at characterizing the microplastic debris in terms of their size, color and shape, their occurrence and polymer type.
In a second part the aim is to establish a correlation between the level of microplastic pollution according to fish species and the sampling depth. In other words, the aim is to find out whether the

[8] Peng, X., Dasgupta, S., Zhong, G., Du, M., Xu, H., Chen, M., Chen, S., Ta, K. & Li, J. (2019). Large debris dumps in the northern South China Sea. *Marine Pollution Bulletin*, *142*, 164–168. https://doi.org/10.1016/j.marpolbul.2019.03.041.
[9] Arthur, C., Baker, J., Bamford, H., 2009. Proceedings of the International Research Workshop on the Occurrence, Effects and Fate of Microplastic Marine Debris. NOAA Technical, Memorandum NOS-OR & R30.
[10] Auta, H.S., Emenike, C.U., Fauziah, S.H., 2017. Distribution and importance of microplastics in the marine environment: a review of the sources, fate, effects, and potential solu- tions. Environ. Int. 102, 165–176.

level of pollution depends on the fish species and whether the level of microplastic pollution is higher in coastal waters than in the deep sea. The third part aims at comparing the pollution levels of deep-sea fish to previous studies in the SCS.[11] The study project was conducted on the continental slope in the Northern part of the SCS. The data collected in the course of this research paper dates back to 2017, but it still allows an accurate evaluation of the current pollution levels. The aim remains in evaluating research papers and data that is no older than five years in order to assure accuracy and timeliness of the conclusions drawn from the research results.
The paper also stresses the factor that microplastic pollution can pose a health threat to humans. Microplastic is ingested by fish due to their small size and because the plastic particles are mistaken for plankton. Through the food chain those harmful particles can also be ingested by humans.[12]
In the course of this thesis, the findings and environmental implications of this study will be discussed in the section consecrated to the analysis of the results.

Another article investigates "microplastic pollution in water and fish samples around Nanxun Reef",[13] which is in the area of the Nansha islands.

This study focuses on organic pollutants in offshore waters by taking 15 water samples and 35 fish samples. The data was collected in May 2018 and situates itself within a reasonable timeframe in order to be eligible for analysis. The distinction between primary and secondary microplastics is clearly stated in the article alongside the size of a microplastic debris of <5mm. The study aims at recording the abundance, distribution as well as the morphological specificities of microplastics.
It is the first study related to microplastic pollutant around Nanxun reef and the greater area of the Nansha islands. The aim of this paper consists in demonstrating that fishing activities alongside human domestic sewage are major sources of microplastic pollution in the SCS and specifically around the Nansha islands. Additionally, the paper also outlines a few examples of primary micro plastics, such as for example microbeads contained in cleansers or toothpaste.[14]

---

[11] Zhu, L., Wang, H., Chen, B., Sun, X., Qu, K. & Xia, B. (2019). Microplastic ingestion in deep-sea fish from the South China Sea. *Science of The Total Environment*, *677*, 493–501. https://doi.org/10.1016/j.scitotenv.2019.04.380.
[12] Van Cauwenberghe, L., Janssen, C.R., 2014. Microplastics in bivalves cultured for human consumption. Environ. Pollut. 193, 65–70.
[13] Nie, H., Wang, J., Xu, K., Huang, Y. & Yan, M. (2019). Microplastic pollution in water and fish samples around Nanxun Reef in Nansha Islands, South China Sea. *Science of The Total Environment*, *696*, 134022. https://doi.org/10.1016/j.scitotenv.2019.134022.
[14] Cole, M., Lindeque, P., Halsband, C., Galloway, T.S., 2011. Microplastics as contaminants in the marine environment: a review. Mar. Pollut. Bull. 62, 2588–2597.

It is also mentioned that micro plastics can absorb other pollutants from surrounding their surrounding environment, such as for instance heavy metals.[15]

The next research paper dealing with microplastic pollution in remote areas such as the uninhabited coral reefs of Nansha islands, goes a step further by establishing a link between microplastic pollution and fishing gear. It is the most recent study carried out in May 2019 and stresses on the importance of acknowledging the high susceptibility of coastal and fringing reefs to MP (microplastic) pollution. It also aims at proving an increase of MP pollution in remote coral reefs of the SCS.[16]

The samples were collected in four major reef groupings, such as the Zhongye, Daoming, Jiuzhang, and Zhenghe reefs. The samples were collected in shallow water (<30m) in proximity to the reef atolls. The data analysis was entirely performed with SPSS 20.0. of which the results will be discussed in the corresponding section of this thesis.

The physical characterization of litter and microplastic along the beaches of urban coasts are also a major threat to the marine ecosystem of the SCS. A research paper published in 2020 analyses littering and microplastic pollution along the urban coast of Cagayan de Oro in Macajalar Bay in the Philippines.[17]

There is only limited literature on litter disposal on Filipino beaches which is why this paper fills a void in research and in putting in evidence the threat to the marine environment.

Coastal areas adjacent to highly urbanized regions present a higher level of MP pollution including indiscriminate disposal of solid waste. Former studies were carried out focusing on sand and organism samples. However, those pre-existing studies do not cover urbanized coastal areas. [18]

---

[15] Teuten, E.L., Saquing, J.M., Knappe, D.R., Barlaz, M.A., Jonsson, S., Bjorn, A., et al., 2009. Transport and release of chemicals from plastics to the environment and to wildlife. Philos. Trans. R. Soc. Lond. Ser. B Biol. Sci. 364, 2027–2045.

[16] Ding, J., Jiang, F., Li, J., Wang, Z., Sun, C., Wang, Z., Fu, L., Ding, N.X., He, C., 2019. Microplastics in the Coral Reef Systems from Xisha Islands of South China Sea. Environ. Sci. Technol. 53, 8036–8046.

[17] Esquinas, G. G. M. S., Mantala, A. P., Atilano, M. G., Apugan, R. P. & Galarpe, V. R. K. R. (2020). Physical characterization of litter and microplastic along the urban coast of Cagayan de Oro in Macajalar Bay, Philippines. *Marine Pollution Bulletin*, *154*, 111083. https://doi.org/10.1016/j.marpolbul.2020.111083.

[18] Browne, M. A., Crump, P., Niven, S. J., Teuten, E., Tonkin, A., Galloway, T. & Thompson, R. (2011). Accumulation of Microplastic on Shorelines Woldwide: Sources and Sinks. Environmental Science & Technology, 45(21), 9175–9179. https://doi.org/10.1021/es201811s.

The data analysis of this paper will also be included in the discussion related to the findings concerning MP pollution.

1.2. Heavy metals

This section of the literature review focuses on organizing research and data related to pollution by heavy metals in the SCS. The first study considered deals with heavy metal pollution in the Malaysian aquatic environment. The paper was published in July 2006 and its objective is "*to review the status of the Malaysian aquatic environment with respect to heavy metal [pollution].*"[19] The main sources of metal pollution "*come from manufacturing, agriculture, sewage and motor vehicle emissions.*"[20] The main contributor to heavy metal pollution in the aquatic environments of Malaysia is the manufacturing sector. The industrial waste contains high concentrations of Nickel (Ni), Iron (Fe), Aluminum (Al), Manganese (Mn), Chromium (Cr)[21], and many others. The metal concentrations were measured in water, in biota with a focus on bioavailability and bioaccumulation. The results will be discussed further in the corresponding section in connection with other findings.

Another source deals with heavy metal pollution in *Porites* coral reefs around Daya Bay, which is located in the northern part of the SCS.[22] To evaluate the level of heavy metal (HM) pollution it is necessary to measure metal-to-calcium rates in the growth bands of the corals. It enables the measurement of long-term trends, in this case HM pollution levels over a period of 32 years or from 1976-2007. It must be noted that this paper was published back in 2010, however the scarcity of this kind of study renders it impossible to find timelier sources on that specific form of coral pollution. The results of the study also reflect the construction of the Daya Bay Nuclear Power Station (DNPS) in 1994, as well as an increase in domestic industrial sewage. It will show that the

[19] Shazili, N. A. M., Yunus, K., Ahmad, A. S., Abdullah, N. & Rashid, M. K. A. (2006). Heavy metal pollution status in the Malaysian aquatic environment. *Aquatic Ecosystem Health & Management*, *9*(2), 137–145. https://doi.org/10.1080/14634980600724023.
[20] Ibidem, p.1.
[21] Rahman, R. A., Surif, S., 1993. Metal finishing wastewater: characteristics and minimization. In: B. G. Yeoh, K. S. Chee, S. M. Phang, Z. Isa, A. Idris, M. Mohamed (Eds.), *Waste management in Malaysia: Current status and prospects for bioremediation*, pp. 3–7. Ministry of Science, Technology and the Environment, Malaysia.
[22] Chen, T. R., Yu, K. F., Li, S., Price, G. J., Shi, Q. & Wei, G. J. (2010). Heavy metal pollution recorded in Porites corals from Daya Bay, northern South China Sea. *Marine Environmental Research*, *70*(3–4), 318–326. https://doi.org/10.1016/j.marenvres.2010.06.004.

SCS is heavily impacted by human activities and that the growth of population, industry and agriculture only worsened the outlook.

The analysis of the findings will provide evidence for a clear degradation of the marine environment of Daya Bay, especially the water quality over the last years.[23]
The following paper was published in 2013 and corresponds to a review of 90 different research papers related to heavy metal pollution in coastal areas of South China. According to Wang et al., meta levels are to be associated with local economic development: "*Metals in sediments are one of the topics of discussion in regions such as Hong Kong, Guangdong, Daya Bay, Hailing Bay, Zhanjiang Harbor and Guangxi, but to name a few.*"[24] Pollution levels in organisms as well as related health risks will be thoroughly assessed.[25]

In the following research paper that was published in 2013, heavy metal contaminations in sea water and sediments from a heavily industrialized harbor in southern Taiwan all the main subject of discussion.[26] The study will show that the harbor area was polluted by outflows from River mouths, as well as Wastewater discharging pipes and due to Industrial activities in the area. It has to be said that the high salinity of seawater allows a faster sedimentation of heavy metals.[27]
The major pollutants, according to Lin et al., are chromium, zinc, arsenic, cadmium, mercury, cooper, lead and aluminum. The results of this study will show a lack of comprehensive solutions to minimize HM pollution.

A 2014 research paper on metal pollution in Zhelin Bay shows the importance of reducing HM pollution as it may entail health threats for humans.[28] Zhelin Bay is the largest mariculture region

[23]Wang, Y.S., Lou, Z.P., Sun, C.C., Wu, M.L., Han, S.H., 2006. Multivariate statistical analysis of water quality and phytoplankton characteristics in Daya Bay, China, from 1999 to 2002. Oceanologia 48 (2), 193e211.
[24] Ibidem.
[25] Wang, S. L., Xu, X. R., Sun, Y. X., Liu, J. L. & Li, H. B. (2013). Heavy metal pollution in coastal areas of South China: A review. *Marine Pollution Bulletin*, *76*(1–2), 7–15. https://doi.org/10.1016/j.marpolbul.2013.08.025.
[26]Lin, Y. C., Chang-Chien, G. P., Chiang, P. C., Chen, W. H. & Lin, Y. C. (2013). Multivariate analysis of heavy metal contaminations in seawater and sediments from a heavily industrialized harbor in Southern Taiwan. *Marine Pollution Bulletin*, *76*(1–2), 266–275. https://doi.org/10.1016/j.marpolbul.2013.08.027.
[27]Du Laing, G., Rinklebe, J., Vandecasteele, B., Meers, E., Tack, F.M.G., 2009. Trace metal behaviour in estuarine and riverine floodplain soils and sediments: a review. Sci. Total Environ. 407, 3972–3985.
[28] Gu, Y. G., Lin, Q., Jiang, S. J. & Wang, Z. H. (2014). Metal pollution status in Zhelin Bay surface sediments inferred from a sequential extraction technique, South China Sea. *Marine Pollution Bulletin*, *81*(1), 256–261. https://doi.org/10.1016/j.marpolbul.2014.01.030.

of the Guangdong Province and has a higher concentration of heavy metals and other chemical pollutants than the benchmarks allow. One of the reasons is that sediments incorporate and hold metals in aquatic ecosystems.[29]

The next source investigates heavy metal concentration in fish and how this is linked to potential health risks.[30] When ingested over a long period of time even small amounts of toxic metals can have negative effects on human health.[31] Therefore, the study will offer an overview of HM pollution levels in fish and human health risks based on data collected in 2015.

The last source investigates pollution from persistent halogenated compounds (PHCs) in birds from the SCS. The study was published in 2020 and based its results on the excision of birds and the PHC levels in their muscular tissue. PHCs are a dangerous pollutant due to their persistence, bioaccumulation and of course their toxicity and long-range transport characteristics.[32]

1.3. Aquaculture

Aquaculture or mariculture is a major source of pollution for the marine ecosystem because it interferes with natural cycles.[33] The first article that deals the problematic of mariculture was published in 2011 and investigates the correlation between mariculture and mercury distribution in sediments and figs in the Hong Kong area.[34]

---

[29] Burton, J.G.A., 2002. Sediment quality criteria in use around the world. Limnology 3, 65–76.
Chapman, P.M., Wang, F., Caeiro, S.S., 2013. Assessing and managing sediment contamination in transitional waters. Environ. Int. 55, 71–91.

[30] Gu, Y. G., Lin, Q., Wang, X. H., Du, F. Y., Yu, Z. L. & Huang, H. H. (2015). Heavy metal concentrations in wild fishes captured from the South China Sea and associated health risks. *Marine Pollution Bulletin*, *96*(1–2), 508–512. https://doi.org/10.1016/j.marpolbul.2015.04.022.

[31] Arts, M.T., Ackman, R.G., Holub, B.J., 2001. "Essential fatty acids" in aquatic ecosystems: a crucial link between diet and human health and evolution. Can. J. Fish. Aquat. Sci. 58, 122–137.

[32] Batt, A.L., Wathen, J.B., Lazorchak, J.M., Olsen, A.R., Kincaid, T.M., 2017. Statistical survey of persistent organic pollutants: risk estimations to humans and wildlife through consumption of Ffish from US rivers. Environ. Sci. Technol. 51, 3021–3031.

[33] Sun, R., Luo, X., Li, Q.X., Wang, T., Zheng, X., Peng, P., Mai, B., 2018. Legacy and emerging organohalogenated contaminants in wild edible aquatic organisms: im- plications for bioaccumulation and human exposure. Sci. Total Environ. 616, 38–45.

[34] Liang, P., Shao, D. D., Wu, S. C., Shi, J. B., Sun, X. L., Wu, F. Y., Lo, S., Wang, W. X. & Wong, M. H. (2011). The influence of mariculture on mercury distribution in sediments and fish around Hong Kong and adjacent mainland China waters. *Chemosphere*, *82*(7), 1038–1043. https://doi.org/10.1016/j.chemosphere.2010.10.061.

Major sources of mercury pollution are due to industrial activities and urbanization in coastal areas. On top of that inorganic mercury (Hg (II)) transforms into methylmercury through an organic process. Methyl mercury is a highly toxic substance that poses a threat to the marine environment as well as humans. Mariculture has an influence on the sedimentation and the accumulation of those harmful substances due to an increased deposition of natural waste, such as for example food supplies and fish excretion. An increased oxidation also favors the presence of methyl mercury.[35] The objective of this study is to prove an increase of marine pollution through mercury and its oxidized form of methyl mercury due to sediment that originates from uneaten fish feed and fish excretions.

The next source that was published in 2014 also collects data on mercury pollution in fish from the SCS. Its focus concerns the study of pollution levels, on finding out whether some species carry more mercury than others and finally it attempts at identifying possible sources of mercury pollution.[36]

The following study investigates the distribution as well as the potential danger stemming from the use of antibiotics in marine aquaculture farms. The paper was published in 2020 and took its samples from farms in the Yellow Sea. Although the Yellow Sea is not part of the SCS it is a common practice in areas of the SCS too. Data for regions in the SCS are not available or not existent, which is why the choice was made to replace it with data from a neighboring region in order to get a better understanding of the pollution created by mariculture farms.[37] The objective of this study is to identify the potential risks of antibiotics for the marine ecosystem as well as for human health. It also aims at proving that biofilms act as a sink for antibiotics in mariculture. This

[35] Cossa, D., Gobeil, C., 2000. Mercury speciation in the Lower St. Lawrence Estuary. Can. J. Fish. Aquat. Sci. 57, 138–147.
[36] Liu, J., Xu, X., Yu, S., Cheng, H., Hong, Y. & Feng, X. (2014). Mercury pollution in fish from South China Sea: Levels, species-specific accumulation, and possible sources. *Environmental Research*, *131*, 160–164. https://doi.org/10.1016/j.envres.2014.03.004.
[37] Han, Q., Zhao, S., Zhang, X., Wang, X., Song, C. & Wang, S. (2020). Distribution, combined pollution and risk assessment of antibiotics in typical marine aquaculture farms surrounding the Yellow Sea, North China. *Environment International*, *138*, 105551. https://doi.org/10.1016/j.envint.2020.105551.

accumulation and synthesis of toxic compounds can be dangerous to both human and animal health.[38]

Economic-environmental trade-offs in mariculture are another negative factor for the protection of the marine environment. A paper published in 2020 studied lobster farming in Vietnam and the toll it takes on the marine ecosystem.[39] Given that Vietnam has territorial claims in the SCS, this paper was chosen to avoid any bias of only studying Chinese waters and in order to allow a broader perspective.

Lobster farming is a lucrative business in Vietnam, however recurrent disease outbreaks and an increase of lobster mortality have pushed farmers to invest in more antibiotics and chemicals to fight diseases among the crustacea. This paper tries to demonstrate that improving environmental performance also reduces production costs and the use of antibiotics and chemicals. It tries to show a conflict between sustainable and environmentally friendly solutions and economic performance.[40]

The last source of this section is a paper published in 2011 that investigates the environmental impact of aquaculture and aims at finding countermeasures to aquaculture pollution in China.

Although it is one of the oldest sources in this section it is most pertinent to only mention this point, because it offers solutions to the problems identified in the course of this section.[41] It also states that one of the advantages of shifting towards a sustainable and environmentally friendly system does not only result in higher efficiency and improves the water quality, but also offers the possibility of job diversification.[42]

---

[38] Klosterhaus, S.L., Grace, R., Hamilton, M.C., Yee, D., 2013. Method validation and re-connaissance of pharmaceuticals, personal care products, and alkylphenols in surface waters, sediments, and mussels in an urban estuary. Environ. Int. 54, 92–99.

[39] Ton Nu Hai, A. & Speelman, S. (2020). Economic-environmental trade-offs in marine aquaculture: The case of lobster farming in Vietnam. *Aquaculture*, *516*, 734593. https://doi.org/10.1016/j.aquaculture.2019.734593.

[40] Nishitani, K., Jannah, N., Kaneko, S., Hardinsyah, 2017. Does corporate environmental performance enhance financial performance? An empirical study of Indonesian firms. Environ. Dev. 23, 10–21. https://doi.org/10.1016/j.envdev.2017.06.003.

[41] Schwitzguébel, J. P. & Wang, H. (2007). Environmental impact of aquaculture and countermeasures to aquaculture pollution in China. *Environmental Science and Pollution Research - International*, *14*(7), 452–462. https://doi.org/10.1065/espr2007.05.426.

[42] Chopin T, Yarish C, Wilkes R, Belyea E, Lu S, Mathieson A (1999): Devel- oping Porphyra/salmon integrated aquaculture for bioremediation and diversification of the aquaculture industry. Journal of Applied Phycol- ogy 11, 463–472.

1.4. Oil and ship-borne pollution

Due to transportation, trade, and high traffic in the SCS, oil and ship-borne pollution is a matter of concern. The following research paper published in 2000 aims at identifying polycyclic aromatic hydrocarbons (PAHs) in sediment samples collected in the SCS. The aim is to prove PAH contamination in the surface sediments of the SCS.[43] In the course of this thesis, this paper will be sued to prove the presence of hydrocarbons in sediments and to define hydrocarbons as one of the sources of marine pollution.

1.5. Mining, agriculture, and construction

This section of the literature review analyses sources of marine pollution that are caused through mining activities, agriculture, and construction. The first article reviewed was published in 2009 and deals with organochlorine pesticides in the ecosystem of Deep Bay in South China.[44]

Organochlorine pesticides (OCPs) are a class of synthetic, persistent and lipophilic compounds. They are most used in agriculture against insects. Those pesticides were banned in most countries in the 1970s-1980s.[45]

In the course of this research, different samples were taken in a mangrove wetland region between Hong Kong and mainland China, such as seawater samples, suspended particulate matter (SPM), surface sediment and sediment core and fish.[46] The aim of this research paper is to prove that there is an ecological and human health risk due to OCP pollution. Food consumption is the primary

[43] Yang, G. P. (2000). Polycyclic aromatic hydrocarbons in the sediments of the South China Sea. *Environmental Pollution*, *108*(2), 163–171. https://doi.org/10.1016/s0269-7491(99)00245-6.
[44] Qiu, Y. W., Zhang, G., Guo, L. L., Cheng, H. R., Wang, W. X., Li, X. D. & Wai, O. W. (2009). Current status and historical trends of organochlorine pesticides in the ecosystem of Deep Bay, South China. *Estuarine, Coastal and Shelf Science*, *85*(2), 265–272. https://doi.org/10.1016/j.ecss.2009.08.010.
[45] J.D. Meer, M. Boas, in Encyclopedia of Environmental Health, 2011.
[46] Qiu, Y. W., Zhang, G., Guo, L. L., Cheng, H. R., Wang, W. X., Li, X. D. & Wai, O. W. (2009). Current status and historical trends of organochlorine pesticides in the ecosystem of Deep Bay, South China. *Estuarine, Coastal and Shelf Science*, *85*(2), 265–272. https://doi.org/10.1016/j.ecss.2009.08.010.

route of human exposure to pesticides and industrial pollutants after other sources such as drinking water, oral inhalation, and dermal exposure.[47]

Another important source is a groundbreaking paper published in 2018 seeks to establish a correlation between environmental changes and Chinese island-building.[48] The aim is to provide a deeper understanding of the far-reaching impacts from dredging and island creation on marine ecosystems. Also an important source of pesticides are rivers adjacent to the SCS. A research paper published in 2006 identifies the occurrence of alkylphenols in the Pearl River Delta[49]. From there the pesticides are transferred into the northern SCS. Alkylphenols are mostly used in industrial products and pesticide formulations in agriculture and enter the ocean mostly through industrial and domestic wastewater. This paper consolidates the theory that pesticides used in agriculture play a key role in marine pollution and that marine pollution can be traced back to land-based pollution.

Offshore coral reef damage is another important threat to the marine ecosystem of the SCS. The International Journal of Marine and Coastal Law published a working paper in 2017 dealing with offshore damage of coral reefs, as well as overfishing.[50] However, this section will only address harbor dredging due to the overarching topic of this section and build a transition to the next part of this literature review consecrated to the ongoing conflict in the SCS, territorial claims and political tensions.

2. Responsibility and territorial claims

In the first part of the literature review, the aim was to cover various sources of marine pollution in order to proceed to a second part dedicated to the analysis of legal and environmental regimes of

[47] Dougherty, C.P., Holtz, S.H., Reinert, J.C., Panyacosit, L., Axelrad, D.A., Woodruff, T.J., 2000. Dietary exposures to food contaminants across the United States. Envi- ronmental Research 84, 170–185.
[48] Smith, L., Cornillon, P., Rudnickas, D. & Mouw, C. B. (2019). Evidence of Environmental Changes Caused by Chinese Island-Building. *Scientific Reports*, *9*(1), 1–11. https://doi.org/10.1038/s41598-019-41659-3.
[49] Chen, B., Duan, J. C., Mai, B. X., Luo, X. J., Yang, Q. S., Sheng, G. Y. & Fu, J. M. (2006). Distribution of alkylphenols in the Pearl River Delta and adjacent northern South China Sea, China. *Chemosphere*, *63*(4), 652–661. https://doi.org/10.1016/j.chemosphere.2005.08.004.
[50] McManus, J. W. (2017). Offshore Coral Reef Damage, Overfishing, and Paths to Peace in the South China Sea. *The International Journal of Marine and Coastal Law*, *32*(2), 199–237. https://doi.org/10.1163/15718085-12341433.

the islands and waters of the South China Sea in order to find out who is responsible from an environmental perspective.

The first source to be examined in this part deals with legal and environmental regimes in the light of international law.[51] The paper was published in 2005 and discusses territorial claims based on historical documentation from the Chinese. It also deals with international regulations related based on geographical implications, such as a continental shelf, maritime zones. The problematic of boundary zones comes especially into play when discussing the protection of the environment, such as for instance the marine ecosystem and environment of the Spratly or Nansha Islands. The article 121 of the United Nations Convention of the Law of the Sea (UNCLOS) is a major regulation when it comes to setting maritime boundaries. The International Tribunal of the Law of the Sea as well as the role of arbitrators is very importance in the matter. The paper aims at consolidating the theory that advocates internationally initiated programmes, such as the UNEP initiative in cooperation with the Association of Southeast Asian Nations (ASEAN).

Another paper published in 2017 suggests an update of Part XII of the Law of the Sea Convention (LOSC). It is based on the presumption that the LOSC does no longer reflect the current circumstances and does not have the tools to protect the environment due to changes in the recent years. The paper aims at finding out whether steps at improving international regulations are taken and if the normative scope of international law has evolved towards expanding environmental protection.[52]

A Vietnamese paper published in 2018 investigates environmental degradation such as depletion of fishing grounds and the destruction of coral reefs. It points out that these changes have severe from an economic, socio-economic, and political point of view. The large-scale reclamations and construction of artificial islands are at heart of the discussion, as well as China failing to protect the marine environment as well as protected species under the Law of the Sea.[53]

---

[51] Liakopoulos, D. (2005). Legal and Environmental Regime of Islands in the South China Sea: Status under International Law. *Global Jurist Topics*, *4*(3). https://doi.org/10.2202/1535-167x.1142.

[52] Gavouneli, M. (2017). Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? *SSRN Electronic Journal*. Published. https://doi.org/10.2139/ssrn.3073263.

[53] Chu Hoi, N. & Dang, V. H. (2018). Environmental Issues in the South China Sea: Legal Obligation and Cooperation Drivers. *International Journal of Law and Public Administration*, *1*(1), 8. https://doi.org/10.11114/ijlpa.v1i1.3260.

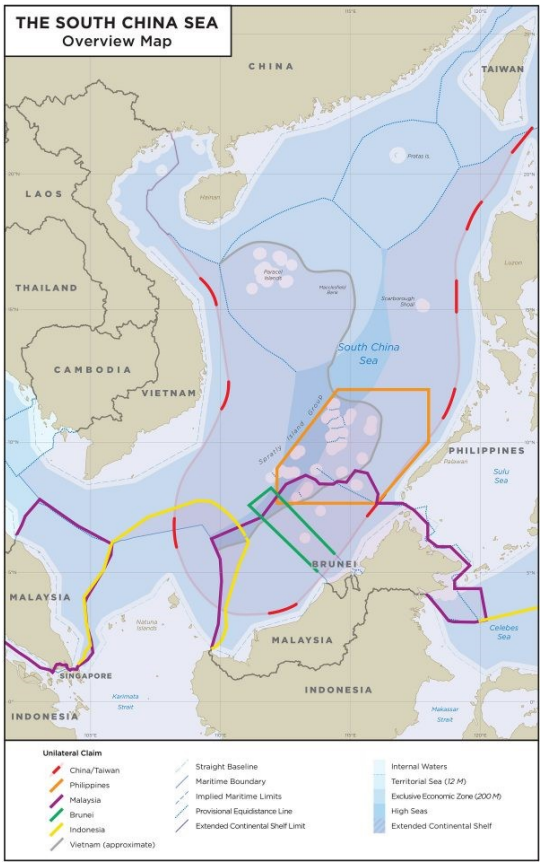

Figure 1: Territorial claims in the South China Sea
This map illustrates the territorial claims in the South China Sea, the claims of the respective claimant countries are color-coded. *(Source: "The South China Sea Overview Map". Sovereign Limits, 7 May 2024, url: South China Sea | Sovereign Limits)*

The thematic of maritime order and the scope and tech of the UNCLOS is thoroughly discussed in a 2020 report that aims at defending the maritime order and identifies two major politico-legal options in the SCS. It examines a territorial order based on sovereignty and the demonstration of „effective occupation", while also acknowledging the possibility that the SCS dispute serves the purpose of challenging and redesigning the maritime order, just like a litmus test.[54]

An article published in 2020 by the German Institute of Global and Area Studies (GIGA) focuses on the policy implications of an increasing trend of countries such as China expanding their sphere of influence in the SCS. This leads to a militarization of the SCS as well as it is challenging the

[54] Strating, R. (2020). Norm contestation, statecraft and the South China Sea: defending maritime order. *The Pacific Review*, 1–31. https://doi.org/10.1080/09512748.2020.1804990.

freedom of navigation in the SCS. This article will help to shed a light on the complex implications when it comes to territorial claims and to identify the big players in the SCS.[55]

Another source published in 2020 proceeds to a critical assessment of China´s role in the SCS dispute. Although conflict is unavoidable there is a possibility of regional cooperation. However, this would entail heavy diplomatic implications, the results of those findings will be discussed in the appropriate section.[56]

The last paper of this section relative to legal responsibility and regional cohesion assesses the operational impacts on China in terms of its marine policy in the light of developments in marine environmental protection as provided by art.192 UNCLOS. This paper was published in 2020 and aims at outlining major changes and implications for China.[57]

3. Outlook and solutions

A third part is dedicated to discussing how the situation in the SCS can be improved from a socio-economic aspect as well as a political and environmental aspect. These aspects are tightly linked to each other and reciprocally influence each other. Environmental security is an important term in relation to this subject because the degradation of the marine ecosystem go hand in hand with economic consequences, such as the depletion of fishing grounds. On top of the preexisting conflicts in the SCS, a shortage of natural resources in the area will only aggravate an already complex situation and potentially fuel conflicts.

The first source of this part was published in 2012 and deals with large-scale and international water management projects, which are based on intergovernmental cooperation. This paper can be of benefit and offer and outlook for the disputes in the SCS.[58] The protection of a shared marine

[55]GIGA Focus | Asia | Number 5 | August 2020 | ISSN 1862-359X

[56] Peng, J. & Shi, J. (2020). A Critical Assessment of China's Role in the South China Sea Dispute. *Journal of Politics and Law*, *13*(4), 169. https://doi.org/10.5539/jpl.v13n4p169.

[57] Guo, J. (2020). The developments of marine environmental protection obligation in article 192 of UNCLOS and the operational impact on China's marine policy – A south China sea fisheries perspective. *Marine Policy*, *120*, 104140. https://doi.org/10.1016/j.marpol.2020.104140.

[58] Chen, S., Pernetta, J. C. & Duda, A. M. (2013). Towards a new paradigm for transboundary water governance: implementing regional frameworks through local actions. *Ocean & Coastal Management*, *85*, 244–256. https://doi.org/10.1016/j.ocecoaman.2012.10.019.

environment could function as a common ground that enable the countries of the SCS to foster new bonds.

The following paper specifically examines multi-lateral and intergovernmental projects such as the UNEP/GEF SCS project. It was published in 2013 and gives and outlines the obstacles faced in the implementation of the project. The aim is to evaluate the advantages and disadvantages of such cooperation models and to which extent they prove to be efficient.[59]

A research paper focusing on ocean & coastal management published in 2013 evaluates the outcomes of the SCS project and to what extent this model can be transposed to other cooperative initiatives.[60] Not only does it outline the benefits, but it also draws attention to their sustainability on the long-term.

Not only is it important to focus on the structure and effectiveness of intergovernmental projects, but it is also essential to focus on specific environmental challenges, such as land-based pollution. The following paper outlines how the management of land-based pollution in China can be improved in order to minimize the impacts on the marine ecosystem. It was published in 2013 and seeks to document actions taken towards reversing environmental degradation.[61]

Another study published in 2013 focuses on the factors, actors and mechanisms of environmental cooperation in the SCS.[62] The majority of literature available focuses on the disputes in the SCS, however only few mentions regional cooperation projects.[63] This study seeks to provide a different

[59] Pernetta, J. C. & Jiang, Y. (2013). Managing multi-lateral, intergovernmental projects and programmes: the case of the UNEP/GEF South China Sea project. *Ocean & Coastal Management*, *85*, 141–152. https://doi.org/10.1016/j.ocecoaman.2012.10.012.

[60] Bewers, J. M. & Pernetta, J. C. (2013). Outcomes of the SCS project and their applicability to multilateral cooperative initiatives for the management of coastal seas and marine basins. *Ocean & Coastal Management*, *85*, 268–275. https://doi.org/10.1016/j.ocecoaman.2012.12.008.

[61] Vo, S. T., Pernetta, J. C. & Paterson, C. J. (2013). Lessons learned in coastal habitat and land-based pollution management in the South China Sea. *Ocean & Coastal Management*, *85*, 230–243. https://doi.org/10.1016/j.ocecoaman.2013.02.005.

[62] Chen, S. (2013). Environmental cooperation in the South China Sea: Factors, actors and mechanisms. *Ocean & Coastal Management*, *85*, 131–140. https://doi.org/10.1016/j.ocecoaman.2013.02.004.

[63] Valencia, Mark J., 1995. China and the South China Sea Disputes. Oxford University Press, Oxford.

outlook and put forward the rapprochement that has effectively taken place between the states surrounding the SCS.

The next paper published in 2015 advocates for a shift from disputes and security issues to scientific cooperation within the region of the SCS. Research programs that address complex maritime questions as well as resource management and the maintenance of an ecological balance are at the center of discussion. Instead of conflicts, the authors of the paper advocate for mutually beneficial interdependencies.[64]

In line with this logic, the next paper published in 2016 explores the possibilities of a joint development in the SCS. It was first triggered with an increase in oil and gas exploitation back in the 1960s where interests overlapped. The idea of a joint development has been present since the 1958 Geneva Convention on Continental Shelf. The idea of sharing resources is also present in international soft law, such as in the 1982 United Convention on the Law of the Sea (UNCLOS). It is also mentioned in the 1974 UN Charter of Economic Rights and Duties of States.[65]

It therefore appears pertinent to further discuss the SCS Tribunal Award. An article published in 2017 weighs in on the advantages and disadvantages of the above-mentioned award. This award resolved once and for all the uncertainty concerning jurisdiction in the SCS and which rules of law to apply. The Tribunal Award specified the legal authority of the UNCLOS and its provisions regarding the delimitation of maritime zones. Therefore China´s historical claims and the „nine-dash line" has no legal basis. This conclusion will be important in establishing a difference between legal authority in the SCS and de facto authority.[66]

A source that has already been explored in a different part will be used again in this part in order to investigate potential paths to peace. The paper published in 2017 deals with the harm inflicted

[64] Boisseau du Rocher, S. (2015). Scientific cooperation in the South China Sea: Another level for China? Australian Strategic Policy Institute (ASPI), 96, 1-9. http://www.jstor.com/stable/resrep04091.
[65] Li, J., Chen, P. (2016). Joint Development in the South China Sea: Is the Time Ripe? Asian Yearbook of International Law, Volume 22. https://www.jstor.org/stable/10.1163/j.ctvrxk3zz.11.
[66] Kusuma, W., Cery Kurnia A., Agustian, R.A. (2021). South China Sea: Conflict, Challenge, and Solution. Lampung Journal of International Law 3 (1): 51-62- 10.25041/lajil.v3i1.2266.

to the marine ecosystem to then provide solutions. For this part only the third section related to peace finding is of relevance.[67]

It is insufficient to solely propose solutions and remedies to restore the ecosystem and stop the degradation of the marine environment. Therefore, the next source published in 2017 aims at demonstrating that the smallest action towards safeguarding the marine ecosystem has an important positive effect on the environment. The paper studies the impacts of suspended mariculture on coastal zones in China and shows the advantages of Integrated Multi-trophic Aquaculture (IMTA).[68]

To sum up all the information gathered during this part of the literature review dedicated to finding solutions and predicting the outlook in terms of environmental protection and the protection of the marine ecosystem in the SCS, it is important to mention a report divided into two parts. The first part was published in 2017 and the second part in 2018. The report deals with the marine environmental protection in the SCS - its challenges and prospects. The S.Rajaratnam School of International Studies at Nanyang Technological University published the report and it provides a comprehensive overview of what was being discussed in previous papers.[69]
This report will serve as quick overview of what can still be improved and what possibilities there are to find peaceful solutions and cohesion between the states surrounding the SCS in order to reverse the degradation of the marine ecosystem.

This literature review provided a general overview of all the research, studies, articles, and reports integrated in this thesis in order to answer all three-research questions. As for the structure of this review - the division into three parts can be justified by the presence of three research questions. Therefore, each section of the literature review presented the data relevant for each topic and each question. The sources are organized by theme in a first time. In a second time each theme has its

[67] McManus, J. W. (2017b). Offshore Coral Reef Damage, Overfishing, and Paths to Peace in the South China Sea. *The International Journal of Marine and Coastal Law*, *32*(2), 199–237. https://doi.org/10.1163/15718085-12341433.
[68] Wartenberg, R., Feng, L., Wu, J. J., Mak, Y. L., Chan, L. L., Telfer, T. C. & Lam, P. K. S. (2017). The impacts of suspended mariculture on coastal zones in China and the scope for Integrated Multi-Trophic Aquaculture. *Ecosystem Health and Sustainability*, *3*(6), 1340268. https://doi.org/10.1080/20964129.2017.1340268.
[69] Trajano, J. Gong, L., Sembiring, M., Astuti, R. (2017 & 2018). Marine Environmental Protection in the South China Sea: Challenges and Prospects Part I/II. S. Rajaratnam School of International Studies; Nanyang Technological University, Singapore.

sources listed in a chronological order to show potential changes and evolutions in the status of research.

Methodology

The aim of this thesis is to find answers to three major research questions by collecting sufficient data to ensure valid results. This section is dedicated to a thorough outline of the methodological approaches used in order to offer a clear overview of the structure of this work and therefore provide a better understanding of the overall approach to research in this specific case.

1. Methodological approach

In the course of the thesis three research questions have to be answered, all three questions are linked to each other in the form of a gradual progression towards finding an ultimate solution. Marine pollution in the SCS does not correspond to an under-researched topic, however only few scholars draw a line between marine pollution, territorial disputes and the risk of potential conflicts resulting from a degradation of the marine ecosystem. Sustainable growth and environmental security are fundamentals goals that must be reached. Therefore, it is necessary to identify the problems, both from an environmental perspective as well as from a geopolitical and economic perspective in the SCS.

Each part of this thesis is dedicated to answering one research question based on various collections of data. The first part, which is dedicated to identifying the major threats to the marine ecosystem of the SCS, seeks to establish a cause-and-effect relationship between pollutants and the harmful effects on the marine environment. To achieve this goal, it is necessary to evaluate quantitative data.[70]

[70] Vethaak, A. D., Davies, I. M., Thain, J. E., Gubbins, M. J., Martínez-Gómez, C., Robinson, C. D., Moffat, C. F., Burgeot, T., Maes, T., Wosniok, W., Giltrap, M., Lang, T. & Hylland, K. (2017). Integrated indicator framework and methodology for monitoring and assessment of hazardous substances and their effects in the marine environment. *Marine Environmental Research*, *124*, 11–20. https://doi.org/10.1016/j.marenvres.2015.09.010.

In this specific case it will not be possible to collect primary data, due to practical challenges and a lack of qualification to take and analyze samples according to scientific standards of marine biology. Therefore, the data collection is based on secondary data and will be descriptive. Given that the data was collected in a statistically valid manner, the most suitable structure of analysis consists in carrying out a meta-analysis to statistically analyze the results and findings from the gathered sources. The second and third part of this work are based on legal documents and academic literature concerning territorial disputes, diplomatic issues as well as solution frameworks in order to achieve diplomatic cohesion based on common interests, such as reversing environmental degradation and furthering sustainable economic growth. Identifying paths towards environmental security and regional solutions are the ultimate goals of this paper.

1.2. Validity

According to a scientifically correct approach, the criteria of validity and reliability have to be verified.[71] In terms of validity, it is important to evaluate the accuracy of the measurement methods. Different types of validity need to be verified.

a) Construct validity

Construct validity is important to ensure that the results of the studies do not deviate from the subject matter of the thesis and allow to answer the research question. The first part of the thesis is examining marine pollution in the SCS; therefore, the indicators measured are levels of pollution taken from water and fish samples from the SCS.[72] The second part investigates the law of the sea and territorial claims, which justifies the use of legal documents and academic papers commenting on pieces of international legislation. The third part is based on academic literature that seeks to identify regional solutions from economic, diplomatic, and environmental perspectives as well as to predict a potential outlook. The literature put at use comments upon pre-existing projects and evaluates their outcome to propose improvements.

[71] Heale, R. & Twycross, A. (2015). Validity and reliability in quantitative studies. *Evidence Based Nursing*, *18*(3), 66–67. https://doi.org/10.1136/eb-2015-102129.
[72] Bagozzi, R. P., Yi, Y. & Phillips, L. W. (1991). Assessing Construct Validity in Organizational Research. *Administrative Science Quarterly*, *36*(3), 421. https://doi.org/10.2307/2393203.

b) Content validity

Content validity seeks to verify that the data is a comprehensive representation of what is examined. In terms of marine pollution, a broad sample collection as well as different types of samples ensure a valid content.[73] When it comes to study international legislation the examination of the UNCLOS, and other provisions linked to the law of the sea are within the scope of the topic. Finally, the literature examined in the third part is related to the challenges and prospects in the SCS and stays within the scope of the subject matter.

c) Face validity

Like content validity, face validity seeks a compatibility of the data and the phenomenon that is assessed.[74] Given that face validity is very similar yet more superficial than content validity, it is safe to assume that in the light of the paragraph above, the necessary criteria are met.

d) Criterion validity

Criterion validity can be verified by the sum of research papers utilized in this specific case. The number of different studies used in evaluating levels of marine pollution and the homogeneity of results serve as proof of validity.[75]

When it comes to the interpretation of legal documents and literature commenting upon such legal provisions, a comparison of the conclusions of various scholars on the same legal documents allow to state that criterion validity is given. This also applies to future prognosis of potential outcomes in the SCS.

1.3. Reliability

[73] Adcock, R. & Collier, D. (2001). Measurement Validity: A Shared Standard for Qualitative and Quantitative Research. *American Political Science Review*, *95*(3), 529–546. https://doi.org/10.1017/s0003055401003100.
[74] NEVO, B. (1985). FACE VALIDITY REVISITED. *Journal of Educational Measurement*, *22*(4), 287–293. https://doi.org/10.1111/j.1745-3984.1985.tb01065.x.
[75] Foldspang, A. & Montgomery, E. (2000). Criterion-validity-based assessment of four scale constructs. *Scandinavian Journal of Public Health*, *28*(2), 146–153. https://doi.org/10.1080/713797397.

Interrater reliability

The criterion of reliability only applies to the data used in the first part of the thesis, due to the quantitative interpretation of the data. The studies concerned with identifying levels of marine pollution in water, fish and coral samples are almost identical in their implementation. Interrater reliability refers to the same test conducted by different people. In this case, similar studies have been carried out by different research teams, which qualifies for interrater reliability.[76]

2. Methods of data collection

2.1. Quantitative data collection

a) Microplastic pollution

To collect data both quantitative and qualitative methods were utilized. Quantitative methods are necessary to identify levels of marine pollution.
In the course of the first part of the thesis various forms of marine pollution are being examined, therefore various methods of data collection are necessary to assess the levels of pollution.
In the case of large debris and littering of beaches, two distinct methods of data collection are being used. In the case of large debris dumps on the seafloor it was necessary to collect underwater footage. This footage was collected in 2018 in the course of seven dives. Each dive lasted 6-8 hours and covered an area of 3-6 km of seafloor. Submersibles equipped with high-definition pan tilt zoom cameras Konsberg OE 14-504 were used to make videos. The footage was stamped with a time code, had a geo tag and a depth reference. The videos and dive tracker maps were used to calculate debris per square meter (items/m2).

The amount of litter and microplastic along urban coasts in the Philippines was measured through different methods of data collection. The location for the collection of samples was determined according to following criteria: an urbanized coastal environment, accessibility and picking two distinct districts of the city to ensure an equal representation.

[76] Grayson, K. & Rust, R. (2001). Interrater Reliability. *Journal of Consumer Psychology*, *10*(1–2), 71–73. https://www.jstor.org/stable/1480482.

According to these guidelines samples were taken in April 2018 in Cagayan de Oro, more specifically in Bulua, Bonbon, Macabalan and Baloy. Three additional sites were picked to collect samples of surface sand in a quadrant of 1m x 1m and with 5m distances between stations per site. The litter was sorted in four categories, notably plastic, paper, glass, and organic waste. All samples were visually inspected to examine the plastic type and its chemical composition. The clean coast index (CCI) was determined to identify the level of pollution on the examined beaches. A CCI of 0-2 indicates a very clean beach, 2-5 a clean beach, 5-10 a moderately clean beach, 10-20 a dirty beach and >20 an extremely dirty beach.[77]

In order to study microplastic ingestion by deep-sea fish samples were taken on the continental slope in the northern part of the SCS on an area of 210,000km2 and a depth of 200-1500m. The samples were taken on region that is high in riverine inputs[78] and a primary fishing ground in the SCS.[79] The samples were taken in March 2017 in two different sites named BT01 (20.0983°N, 114.1633°E to 20.0933°N, 114.1200°E) and BT02 (9.6733°N, 114.0013°E to 19.5985°N, 113.8807°E). The samples of BT01 were taken in a depth ranging from 200-209m and BT02 453-478m. The fish samples were collected with the help of a bottom trawl and each trawl was took place for one hour at a speed of three knots.

Another source investigates microplastic pollution in fish as well as water around Nanxun Reef. Therefore, water samples were taken in fifteen different areas in May 2018. A quantity of 20L was collected and filtered with a 48-micrometer steel sieve. To ensure reliability, two replicates were made on each site. For the measurements of fish pollution, 35 fish samples were taken and the characteristics (weight, width, length) of each fish documented.

The measurement of microplastic pollution in remote areas of the Nansha islands were taken by choosing four reef groupings as sampling sites, such as Zhongye, Daoming, Jiuzhang and Zhenge.

[77] Vlachogianni, T., Fortibuoni, T., Ronchi, F., Zeri, C., Mazziotti, C., Tutman, P., Varezić, D.B., Palatinus, A., Trdan, Š. Peterlin, M., Mandić, M., 2018. Marine litter on the beaches of the Adriatic and Ionian Seas: an assessment of their abundance, compo- sition and sources. Mar. Pollut. Bull. 131, 745–756.
[78] Cai, M., He, H., Liu, M., Li, S., Tang, G., Wang, W., Huang, P., Wei, G., Lin, Y., Chen, B., Hu, J., Cen, J., 2018. Lost but can't be neglected: huge quantities of small microplastics hide in the South China Sea. Sci. Total Environ. 633, 1206–1216.
[79] Wang, X., Yu, J., Li, Y., Chen, B., Huang, M., 2015. The relationship between major upwelling and the upwelling fishing grounds in the South China Sea. J. Mar. Sci. 39, 131–137 (In Chinese).

To ensure reliability and validity, two supplementary sampling sites were chosen in the Eastern part of the reef separated from the other four sites. Twenty-four surface water samples were taken with the help of a neuston trawl with 333 micrometers mesh size and 1.0 x 0.5m2 opening from 17 remote reef atolls. It is also important to mention that the samples were taken in a monsoon free season to ensure stable weather conditions.[80] The samples were collected in shallow water with a maximum depth of < 30m for 30 minutes and with a speed of 2 knots.

b) Heavy metal pollution

The heavy metal pollution of corals was measured with the help of two coral specimens of living Porites. Two samples were collected: sample 1 (DLJ-1) in June 2006 in a depth of 1m in proximity of Dalajia island[81]; sample 2 (XLJ-1) was collected in August 2007 in a depth of 3m in proximity of Xiaolajia Islands[82]. It must be noted, that both islands are uninhabited. To ensure reliability, sub-samples were taken.

The samples were washed with freshwater, sectioned by a water-lubricated diamond-bit masonry saw in order to obtain samples of 8mm thickness and the axis of maximum growth of the coral as part of the sample[83]. The coral samples were X-radiographed in a dry state and then soaked in 10% H202 for 48 hours, cleaned for 20 minutes in an ultrasonic bath and then oven dried at 60°C for 48 hours.[84] With the help of the X-radiographs skeletal sub-samples were also taken of both samples DLJ-1 and XLJ-1 with a total of 410 and 495 of each coral respectively. 191 sub-samples of XLJ-1 underwent additional metal analysis.[85]

[80] Wang, B., Huang, F., Wu, Z., Yang, J., Fu, X., Kikuchi, K., 2009. Multi-scale climate variability of the South China Sea monsoon: a review. Dyn. Atmos. Oceans. 47, 15–37. https://doi.org/10.1016/j.dynatmoce.2008.09.004.
[81] Chen, T. R., Yu, K. F., Li, S., Price, G. J., Shi, Q. & Wei, G. J. (2010). Heavy metal pollution recorded in Porites corals from Daya Bay, northern South China Sea. Marine Environmental Research, 70(3–4), 318–326. https://doi.org/10.1016/j.marenvres.2010.06.004.
[82] Ibidem.
[83] Ibidem.
[84] Ibidem.
[85] Ibidem.

To measure the levels of PHCs in birds, six bird species were collected from Xisha islands between 2017 and 2019.[86] The birds were found dead or stranded on the beaches (16°49′53″ N,112°20′22″ E), shipped to Guangzhou Institute of Geochemistry in a frozen state in order to be dissected[87]. The pectoral muscles of the birds were excised, lyophilized, ground, and stored in glass bottles at 20°C until their chemical analysis[88].

In order to measure heavy metal pollution in fish, 29 marine wild fish species were caught from September to October 2012[89] at four stations in the SCS - Wanshan Fishing Ground, Zhongsha Fishing Ground (Macclesfield), Zhubi Reef (Subi) and Meiji Reef (Mischief).[90] The samples were refrigerated at -60°C and transported to the laboratory to be examined.

Heavy metal contamination in seawater and sediments were measured by gathering samples from 16 monitoring sites, such as in the vicinity of river mouths, near industrial parks or near the harbor. Seawater and sediment samples were collected and angled in the period of May and October 2010.[91] All the containers used to store the samples were pre-washed using 10% nitric acid and reverse osmosis (RO) water and then oven dried at 40°C.[92] The seawater samples were analyzed using a water quality sensor (Compact-AAQ1183-IF, ALEC Electronics Ltd., Japan).[93] Those samples were collected at two different depths, 1-2m above the bed and 1-2m below, respectively. As for the sediment samples, they were collected with an Ekman dredge grab sampler (6“x 6“x 6“). [94]The sediments were stored in acid-washed plastic bags at 4°C in quantities of maximum 10kg. The samples were stored at -20°C and triplicated (x3) to ensure the reliability of the findings.[95]

---

[86] Zhu, C., Sun, Y., Li, D., Zheng, X., Peng, X., Zhu, T., Mo, L., Luo, X., Xu, X. & Mai, B. (2020). Evidence for complex sources of persistent halogenated compounds in birds from the South China Sea. Environmental Research, 185, 109462. https://doi.org/10.1016/j.envres.2020.109462.
[87] Ibidem.
[88] Ibidem.
[89] Wang, S. L., Xu, X. R., Sun, Y. X., Liu, J. L. & Li, H. B. (2013). Heavy metal pollution in coastal areas of South China: A review. Marine Pollution Bulletin, 76(1–2), 7–15. https://doi.org/10.1016/j.marpolbul.2013.08.025.
[90]Ibidem.
[91] Lin, Y. C., Chang-Chien, G. P., Chiang, P. C., Chen, W. H. & Lin, Y. C. (2013). Multivariate analysis of heavy metal contaminations in seawater and sediments from a heavily industrialized harbor in Southern Taiwan. *Marine Pollution Bulletin*, *76*(1–2), 266–275. https://doi.org/10.1016/j.marpolbul.2013.08.027.
[92] Ibidem.
[93] Ibidem.
[94] Ibidem.
[95] Ibidem.

A similar study was carried out in Zhelin Bay with surface sediments with a sequential extraction technique.[96] In the course of the sample collection, all samples were taken in an active aquaculture zone and were collected with a 9890ml volume stainless steel Peterson grab.[97] The surface sediments collected were of 0-3cm and two sets of each were collected in order to ensure reliable results.[98]

Mercury pollution in fish was measured by taking 166 fish samples at Hainan Island[99], including 7 species of wild-caught fish that were collected at local fish markets in 8 cities between August 2012 and August 2013.[100] The fish were divided into carnivorous, omnivorous, and herbivorous in order to find study a correlation between their feeding habits and bioaccumulation of mercury.

A similar study collected fish samples as well as surface sediments at mariculture sites 200-300m away from the cages. The sediment as well as the fish samples (vicinity unknown) were stored at -20°C immediately in order to be shipped to the laboratory.

c) Aquaculture pollution

In order to study antibiotic pollution, water and sediment samples from agriculture sites were collected in Haiyang (Shandong Province) in August (wet season) and November (dry season) of 2018. Organism (fish and crab) samples were collected in November of the same year.

[96] Gu, Y. G., Lin, Q., Jiang, S. J. & Wang, Z. H. (2014). Metal pollution status in Zhelin Bay surface sediments inferred from a sequential extraction technique, South China Sea. *Marine Pollution Bulletin*, *81*(1), 256–261. https://doi.org/10.1016/j.marpolbul.2014.01.030.
[97] Ibidem.
[98] Ibidem.
[99] Liu, J., Xu, X., Yu, S., Cheng, H., Hong, Y. & Feng, X. (2014). Mercury pollution in fish from South China Sea: Levels, species-specific accumulation, and possible sources. Environmental Research, 131, 160–164. https://doi.org/10.1016/j.envres.2014.03.004.
[100] Ibidem.

d) Oil and ship-borne pollution

In order to measure levels of oil and ship-borne pollution, the study under review collected 16 sediment samples that were tested for 11 parent polycyclic aromatic hydrocarbons (PAHs) with the help of gas chromatography and gas chromatography-mass spectronomy.

e) Pollution from mining, agriculture, and construction activities

To measure the levels of organochlorine pesticides in the ecosystem of Deep Bay, it is necessary to gather samples of seawater, suspended particulate matter (SPM), surface sediment, sediment core and fish samples.[101] Those samples were collected in February 2004 at seven different sites from Deep Bay. a stainless-steel gravity corer (8 cm i.d.) was used to extract sediment, the sediment was sliced at 1cm interval and stored in polyethene bags.[102] Concerning the water samples, 50l of surface water (0.3-0.5m depth) were collected by a pump and filtered using Whatman GF/F filters to separate the water from SPM.[103] The fish samples (5-15cm) were collected using fish trawls at seven stations in Deep Bay. They were also stored in polyethene bags, and all samples were transported at a temperature ranging from 0°C to -20°C.[104]

Artificial island-building is accompanied by dredging activities that can negatively affect the marine flora and fauna and damage entire ecosystems. To prove the damage that is done it is necessary to collect data that supports those claims.

A study carried out by Georgetown University uses satellite imagery to describe and draw conclusions from the changes that are perceived. The aim is to prove with all the information accessible, that were is a correlation between island-building and long-term damages to the ecosystem. The construction of an island at Mischief reef was taken as sample and imagery was gathered by using Landsat 7 Enhanced Thematic Mapper Plus (EMT+), Landsat 8 Operational land

[101] Qiu, Y.W., Zhang, G., Guo, L.L, Chneg, H.R., Wang, W.X., Li, X.D., Wai, O.W.H. (2009). Current status and historical trends of organochlorine pesticides in the ecosystem of Deep Bay, South China: Estuarian, Coastal and Shelf Science, Volume 85, Issue 2, 10 November 2009, Pages 265-272. Doi: https://doi.org/10.1016/j.ecss.2009.08.010.
[102] Ibidem.
[103] Ibidem.
[104] Ibidem.

Imager (OLI) and Sentinel 2A imagery (level 1 C).[105] The images were accessed through the United States Geological Survey (USGS) Earth Explorer.[106] The dredging rate was determined over a period from January 2014 to December 2017. Imagery with <50% cloud coverage was used only.[107]

To study the occurrence of alkylphenols (APs), water samples were taken in the Pearl River Delta, notably its major tributaries including the Zhujiang River and Shiziyang River, the Xijiang River and the Dongjiang River.[108] The Pearl River Delta being one of the largest estuaries in the world[109], it also corresponds to a major source of marine pollution. The pollutants that originate from land-based pollution are flushed in the sea.

Therefore, water and sediment were collected prior to reaching the SCS. The samples were collected during the wet season in 2002 from 38 sampling sites.[110] The surface water samples (0.5 m depth) were collected with a stainless-steel submersible pump and stored in amber glass bottles upon analysis. The surface sediment samples (20cm) were collected with a stainless-steel grab sampler and stored in aluminum jars at -20°C.[111]

2.2. Qualitative data collection

In the course of data collection, both qualitative and quantitative data was collected. The qualitative sources consist of academic papers, international legislation as well as international jurisprudence and official reports that analyze the results of regional working groups and projects, such as the UNEP/GEF project. The collection of these secondary sources is important in order to assess legal, political and diplomatic evolutions in the SCS.

[105] Smith, L., Cornillon, P., Rudnickas, D. & Mouw, C. B. (2019). Evidence of Environmental Changes Caused by Chinese Island-Building. Scientific Reports, 9(1). https://doi.org/10.1038/s41598-019-41659-3.
[106] Ibidem.
[107] Ibidem.
[108] Chen, B., Duan, J. C., Mai, B. X., Luo, X. J., Yang, Q. S., Sheng, G. Y. & Fu, J. M. (2006). Distribution of alkylphenols in the Pearl River Delta and adjacent northern South China Sea, China. Chemosphere, 63(4), 652–661. https://doi.org/10.1016/j.chemosphere.2005.08.004.
[109] Ibidem.
[110] Ibidem.
[111] Ibidem.

The legal texts of choice comprise the UNCLOS[112] (United Nations Convention of the Law of the Sea), such as international declarations and the PCA case number 2013–19 Philippines vs. China from the 12 July 2016.[113] International treaties, soft law and the interpretation of scholars will be interpreted in order to identify environmental responsibility in the SCS, the legitimacy of territorial claims as well as environmental issues.

The distinct nature of the documents chosen asks for distinct approaches. Therefore, the legal provisions will be interpreted in their meaning and their scope.

However, academic research papers are grouped and discussed according to their findings and their solutions to find a common ground on evaluating the diplomatic, political, and environmental situation in the SCS. Power imbalances are also a major subject of analysis.

Another set of qualitative data comes into play when resolving the ultimate question of finding a sustainable political, economic, and environmental framework for the SCS. The findings of a collection of academic reports will be pooled together to compare different paths and solutions as well as to identify potential challenges and obstacles in terms of environmental protection, political & military cohesion - and sustainable development.

International law that is to create a framework for solving territorial claims and ascribing environmental responsibility to countries whose claims are legitimate according to the aforementioned international rule of law has been discussed by scholars in various forms.
Therefore, a semi-systematic literature review will be utilized as methodology as it enables to regroup the sources according to their input and the relevant information with the aim of finding answers to the second and the third research question.[114]

---

[112] United Nations, *United Nations Convention on the Law of the Sea* (UNCLOS). (1982), Digitized by UN Library Geneva: United Nations Convention on the Law of the Sea.
[113] PCA Case N°2013-19 (2016). In the matter of the South China Sea Arbitration before an Arbitral Tribunal constituted under Annex VII to the 1982 United Nations Convention on the Law of the Sea between the Republic of the Philippines and the People´s Republic of China: AWARD.PH-CN-20160712.
[114] Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039.

a) Legal responsibility, territorial claims, and environment protection

In the section dedicated to answer the second research question linked to territorial claims and an environmental responsibility arising from that territorial claim, the sources are divided into two subcategories. The first category corresponds to research papers that deal with international law. The second category of papers discuss territorial legitimacy in relation with political reality and diplomatic issues.
The sources have been listed during the literature review and will be thoroughly analyzed in the section dedicated to results and findings.

b) Sustainable growth, environmental security, and regional solutions

The third research question will be answered by utilizing another set of sources that provide information on regional solutions for the SCS - in terms of existing projects, prospects as well as challenges that must be faced. In that instance, the research will be divided into one part dedicated to possible solutions, while the other part will outline the prospects and the challenges.

3. Methods of analysis

In the course of this exercise, both quantitative and qualitative sources were utilized in order to find answers to the research questions. It is important to discuss quantitative and qualitative methods of analysis separately as they require different methods of analysis. It has also to be noted that many of the methods used have already been mentioned in previous sections, however it is important to reiterate the methods used to ensure a complete outline of the methodology.

3.1. Quantitative methods of analysis

It has to be noted that the quantitative data used for this thesis is entirely based on secondary sources. Statistical analyses were conducted with SPSS, ranging from the SPSS version 16 up to the SPSS version 25. A balance and accuracy where the results was achieved by conducting

additional tests if necessary, such as for example in the following cases. In connection with the numerical analysis of microplastic pollution independent-sample t-tests were carried out to test for differences in the abundance of microplastics in fish between the stomach and the intestine.[115]

Numerical data was analyzed as the mean ± standard deviation (SD). The Levene´s test was used to evaluate normality and homogeneity of variances. The one-way analysis of variance was applied to examine differences in abundance of microplastics.[116]

The methodology was carried out according to a semi-systematic approach due to the abundance and the heterogeneity of sources required to answer the research questions. To identify various sources of marine pollution it was necessary to gather studies analyzing different sources of marine pollution. It requires different methods of analysis to identify levels of pollution in a coral from the methods used to analyze surface sediment, water samples or fish. This differentiation is also valid for detecting pollutants, such as microplastic, hydrocarbons, pesticides, or mercury levels.

The necessity of using a broad range of studies is justified by the heterogeneity of pollutants as well as the heterogeneity of surfaces, of flora and fauna carrying those pollutants.

3.2. Qualitative methods of analysis

The qualitative methods considered include content analysis and thematic analysis.[117] However, most of the sources are more suitable for content analysis.[118]

Content analysis will be applied to discuss the legal sources; it will not be used to quantify the occurrence of certain words or phrases. However, the choice of vocabulary and the legal

[115] Zhu, L., Wang, H., Chen, B., Sun, X., Qu, K. & Xia, B. (2019). Microplastic ingestion in deep-sea fish from the South China Sea. *Science of The Total Environment*, *677*, 493–501. https://doi.org/10.1016/j.scitotenv.2019.04.380.
[116] Tan, F., Yang, H., Xu, X., Fang, Z., Xu, H., Shi, Q., Zhang, X., Wang, G., Lin, L., Zhou, S., Huang, L. & Li, H. (2020). Microplastic pollution around remote uninhabited coral reefs of Nansha Islands, South China Sea. *Science of The Total Environment*, *725*, 138383. https://doi.org/10.1016/j.scitotenv.2020.138383.
[117] Tuckett, A. G. (2005). Applying thematic analysis theory to practice: A researcher's experience. *Contemporary Nurse*, *19*(1–2), 75–87. https://doi.org/10.5172/conu.19.1-2.75.
[118] Vaismoradi, M., Turunen, H. & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*, *15*(3), 398–405. https://doi.org/10.1111/nhs.12048.

consequences it entails are of a major importance. In this context, content analysis fulfils the goal to discussing the purposes and the effects of international law regarding territorial claims and environmental protection.[119] The non-legal sources will be examined to identify patterns and correlations, power structures and whether there is a potential for cohesion throughout the SCS in the given context. The analysis can be characterized as a semi-systematic approach given the abundance and the heterogeneity of sources utilized.

4. Methodological choices

The choice of a heterogenous set of sources is relevant to illustrate the issues from different angles. The protection and preservation of the marine environment require studies to be carried out and the collection of data from various fields, such as marine biology, international law as well as practical sources that are directly linked to the implementation of projects. For this topic, it is essential to not disconnect the findings of empirical scientific data and practical solutions that are trying to tackle the very problems that were previously identified.

Part I: Causes and effects of pollution in the marine environment

The first part of this work is mostly consecrated to draw a geopolitical map of the region in order to assure a deeper understanding of regional power mechanisms, hence explain the current situation when it comes to regional cooperation in all matters ecology and environmental protection.
"The ASEAN-way" serves as one of the many attempts of regional cooperation designed to encourage all six major claimant States in the SCS to get actively involved in the protection of their marine environment as a symbolic gesture to strengthen their position and the legitimacy of their territorial claim.

[119] Cavanagh, S. (1997). Content analysis: concepts, methods and applications. *Nurse Researcher*, *4*(3), 5–16. https://doi.org/10.7748/nr.4.3.5.s2.

The second part of this work is divided into three sub-sections, and therefore focuses on three different aspects of pollution in the marine environment. A first section is dedicated to the identification of various causes of marine pollution, whereas the second section deals with the sources of marine pollution and the third section draws attention to the effects as well as the risks and long-term consequences of marine pollution.

In order to avoid any terminological misunderstandings, it appears pertinent to clarify the difference between section one and section two. The "causes" of marine pollution refers to the nature of the pollutant and its characteristics. Therefore, the big difference between section one and section two, which addresses the „sources" of marine pollution, resides in differentiating agent from agency. The agent is the pollutant itself, whereas the agency refers to tracing the pollutant back to where it originates. This step is of a major importance, specifically when it comes to prevent or reduce marine pollution, the provenance of the polluting agent is crucial.

1. The main causes of marine pollution

This section is dedicated to the identification of the major causes of marine pollution in the SCS, such as pollution through microplastic, heavy metals, halogenated compounds and marine oil pollution (oil spills mostly).

1.1. Microplastic Pollution

a) Microplastic pollution

Plastic pollution in the marine environment can be scaled and defined according to the size of the plastic debris, such as megaplastic, macroplastic, mesoplastic and microplastic.[120] Microplastic can occur in its primary or secondary form. Primary microplastics are manufactured in a microscopic size, whereas secondary microplastics stem from bigger plastic debris through various processes,

[120] G.G.N.Thusari, J.D.N. Senevirathna.(2020). Plastic pollution in the marine environment: Badulla, Sri Lanka. Department of Animal Science, Faculty of Animal Science and Export Agriculture, Uva Wellassa University.

such as photooxidation, mechanical and biodegradation.[121] Microplastics are plastic debris smaller than 5 mm in size.[122]

Due to their small size, microplastics are often ingested by fish and other marine organisms which does not only pose a potential lethal threat to marine organisms but also to humans.[123] Yet, the effects and consequences of marine pollution will be discussed more thoroughly in the third section. The first section is consecrated to establishing marine pollution by analyzing secondary data and findings from water samples and fish samples in the SCS.

The SCS is surrounded by several Asian developing countries, which corresponds to a major stressor for the marine environment due to a rapidly increasing urbanization and industrialization.[124] According to Sun et.al (2017b) microplastics are even ingested by zooplankton, which is ingested by bigger fish and marine organisms that feed on zooplankton, leading to a pollution chain.

b) Research survey on microplastic pollution in the SCS

It is therefore important to assess the levels of plastic pollution in the SCS, as well as to identify the pollutants according to their size, color, and other characteristics. The sampling should also occur in different depths in order to assess whether there is a correlation between the depth and the level of pollution. Yet, the most important factor remains the abundance of microplastic debris, their nature, and their provenance in order to trace them back to their sources.

[121] In the marine environment: a review of the sources, fate, effects, and potential solu- tions. Environ. Int. 102, 165–176.
[122] Arthur, C., Baker, J., Bamford, H., 2009. Proceedings of the International Research Work- shop on the Occurrence, Effects and Fate of Microplastic Marine Debris. NOAA Technical, Memorandum NOS-OR & R30.
[123] Van Cauwenberghe, L., Janssen, C.R., 2014. Microplastics in bivalves cultured for human consumption. Environ. Pollut. 193, 65–70.
[124] Sun, Y., Hu, Y., Zhang, Z., Xu, X., Li, H., Zuo, L., Zhong, Y., Sun, H., Mai, B., 2017b. Halogenated organic pollutants in marine biota from the Xuande atoll, South China Sea : levels, biomagnification and dietary exposure. Mar. Pollut. Bull. 118, 413–419.

Given the current means at hand the only reasonable solution is to fall back on secondary data, notably a study conducted in 2017 on the continental slope, in the northern part of the SCS. The area covered is estimated at 210.000km2 with a water depth between 200-1500 meters. It also has to be noted that the area in question is subject to influences from riverine inputs, tropical marine monsoons and it also is a primary fishing ground. The data was analyzed using SPSS 17.0.[125]
Fish samples were taken from two different areas called BT01 and BT02, both along the continental slope of the SCS. The fish were all carnivorous and inhabiting the deep waters (35 fish from 13 species).[126]

c) Results and findings

According to the results there was no significant difference between the two sampling grounds BT01 and BT02, which were at different depths. It leads to the conclusion that microplastic is equally present on the seafloor and that the bigger and heavier debris sink to the bottom of the ocean while the smaller microplastic debris float in the water.
In this survey micro plastics were found in all fish samples, most of the debris were smaller than 1 mm in size with a total of 125 visually identified microplastics.
The most common polymer found in the fish samples was cellophane, but also polyamide and other synthetic fibers.
Those samples were found in the stomach and intestines of the fish samples. Yet, other studies suggest that microplastics may also be present in fish muscles[127] and even wander from the digestive tract to other tissues.[128] It is possible to assume that contaminated fish may induce health risks not only for the fish but also seafood consumers, knowing that the extraction points BT01 and BT02 of the fish samples are fishing grounds.

[125] L.Zhu et al. (2019). Microplastic ingestion in deep-sea fish from the South China Sea: Qingdao/Shanghai, China. Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences (Qingdao); Laboratory for Marine Ecology and Environmental Science, Qingdao National Laboratory for Marine Science and Technology (Qingdao); Shanghai Ocean University (Shanghai).
[126] Ibidem.
[127] Akhbarizadeh, R., Moore, F., Keshavarzi, B., 2018. Investigating a probable relationship be- tween microplastics and potentially toxic elements in fish muscles from northeast of Persian Gulf. Environ. Pollut. 232, 154–163.
[128] Avio, C.G., Gorbi, S., Regoli, F., 2015. Experimental development of a new protocol for ex- traction and characterization of microplastics in fish tissues: first observations in commercial species from Adriatic Sea. Mar. Environ. Res. 111, 18–28.

2. An explanation as to why marine environmental problems in the SCS are not dealt with efficiently

First, it is vital to point out that a comprehensive illustration of the problems in the region of the SCS will require an analysis of both the environmental protection policies on a national level as well as economic growth in order to further assess the potential threats that environmental degradation might have on economic development and poverty rates. Thus, an economic crisis might lead to political upheaval and therefore lead to military action, especially since the PRC acts as hegemonies power throughout the SCS.
Therefore, maintaining the ecosystems as well as the biodiversity of the SCS are vital not only for the environment but also to reduce poverty and guarantee sustainable economic development in the long run. Six countries have issued claims upon parts of the SCS, notably the Philippines, Malaysia, Vietnam, Taiwan, Brunei Darussalam, and the PRC.

2.1. Environmental Protection Policies on a national level

The following part consists in an analysis of each claimant to parts of the SCS in terms of environmental protection. An assessment of the internal framework and means in terms of environmental protection are of major importance before tackling the problems of the SCS. Pollution always starts on the land and expands towards the sea, hence why it makes sense to trail back to the origin of pollution and how it is dealt with on a local level.

a) The Philippines

As far as the Philippines are concerned, environmental protection movements have been existing ever since the Declaration of Martial Law in 1972. The following section will provide an insight into the Filipino institutions and mechanisms of environmental protection, such as its achievements in terms of environmental mainstreaming.

1. Environmental Policies

Two major events are responsible for strongly influencing the political landscape in the Philippines in terms of environmental protection. The 1972 Declaration of Martial Law led to the prohibition of several rights of the Filipino citizens and led nationalists to find a new way of expressing themselves, which led very fast to a strong focus on environmental protection as well as an increased awareness of the consequences that the depletion of natural resources would entail, given that those causes were not prohibited by law.

During the Marcos regime there was also a very strong focus on civil society leading to the creation of many Civil Society Organizations (CSO´s), many of which encouraged the protection of the environment. The 1992 Rio Earth Summit also led to a stronger awareness in terms of environmental protection, notably through establishing a national multi-stakeholder body such as the Philippine Council for Sustainable Development (PCSD). This was only made possible thanks to the rise of the Aquino Administration in 1986 and by the 1987 Constitution which recognizes the right of Filipino citizens to:

"a *balanced and healthful ecology in accord with the rhythm and harmony of nature*".[129]

Sustainable development as well as the reduction of poverty and a more equal distribution of wealth are fundamental concerns in the Philippines. For instance, the Palawan Council for Sustainable Development was created in June 1992, whereas the PCSD was only created on 15 September. The creation of these institutions as well as the early success of the PCSD turned the Philippines into a recognized role model for the international community in terms of environmental protection.

The main role of the PCSD was to act as a consultant on all matters environment, to raise public awareness and to gather and regroup information material, such as encouraging the Philippine Agenda 21 (PA21).

[129] Ibidem, p.28.

The PA 21[130] was established on a local level throughout the creation of local multi-stakeholder developments councils (LCD´s). The latter are present on all levels and are following the 1991 Local Governance Code. It mostly comprises a set of guidelines and strategies that promote sustainable development on a national level, such as action plans and its frameworks.

Although environmental protections seem to be deeply rooted in the political landscape of the Philippines it is not entirely clear up to which degree these environmental initiatives were successful and what challenges remain.

The PCSD has an international reputation for being successful in promoting the protection of the environment, through processes such as for example self-determination, trust-building, the integration of climate change impacts and many others.[131]

Yet, the PCSD has also many challenges to face and appears to be a victim of its own success. The foremost important weakness is its lack of financial liquidity. In other words, the PCSD has no dedicated budget and depends on the support of a minor unit within the National Economic Development Authority´s (NEDA) agriculture department. It lacks resources, of technical support and is constantly facing institutional issues.[132]

Another drawback resides in its institutional instability which is twofold: on one hand each change of presidency holds the risk of the PCSD becoming de facto a dormant institution.
On the other hand, the PCSD has only so much political power, given that it is chaired by the Secretary of Socio-Economic Planning. The Climate Change Commission for instance is chaired by the President itself, ergo it surpasses the reach of the PCSD.

Furthermore, the PA 21 and the PCSD are just a few among many other institutions with an agenda focused on environmental protection. For instance, there are many other action plans that have surfaced since the creation of the PCSD in September 1992, such as for example the “Medium

[130] Ibidem, p.29.
[131] Ibidem, p.29.
[132] Ibidem, p.30.

Term Philippines Development Plan (MTPDP)"[133], the "*Framework Strategy and Program on Climate Change (FSPCC)*"[134] or the "*Biodiversity Action Plan (BAP)*".[135]

To conclude, the PCSD has lost its supremacy as over-arching institution/action plan in all things environmental protection. Yet, the creation of new bodies in order to promote and advance environmental protection in the Philippines is a strong indicator that shows a strong determination and dedication from the Filipinos.

In the section we were able to identify a few agencies responsible for environmental protection in the Philippines, such as the PCSD that encouraged the formulation of the PA 21, as well as a number of CSOs on the local level and the creation of several new entities.

But the first and most significant of all mechanisms in the Philippines is the Philippine Environmental Impact Statement System (EIS) that was created as early on as 1982. It is known for being one of the tightest knit systems for environmental protection. The EIS is derived from and administered by the Environmental Management Bureau of the Department of Environment and Natural Resources (DENR-EMB).

It is mainly responsible for the coordination of action plans by providing scientific data, the validation or refusal of projects by even including the public. Its main concern is a proper implementation of all projects, a regular follow-up on contentious matters.

The battle against environmental degradation in the Philippines could not be ensured if it wasn´t for the EIS. Yet, the EIS is prone to having weaknesses as well as strengths.
The advantages include efficiency, inclusive decision-making, neutrality, and a contribution to sustainable development.[136] The drawbacks of the EIS include a centralized approach, a long processing time, conflicting procedures as well as a lack of efficient feedback and follow-up.[137]

[133] Ibidem, p.30.
[134] Ibidem, p.30.
[135] Ibidem, p.30.
[136] Ibidem, p.31.
[137] Ibidem, p.32.

2. Green accounting and EcoBudget

Another approach taken in the Philippines is the concept of green accounting. It consists in the attribution of an economic value to its coastal and marine resources (CMRs). A Study carried out in 2008 estimates the coastal and marine resources of the Philippines to be worth $480 million per year. [138]

The biggest part goes to fisheries, closely followed by the ecosystem as well as the protection of the shoreline, waste assimilation and carbon storage. Another interesting aspect is the cultural value that is ascribed to the marine world in terms of the cultural heritage being monetized. Apart from cultural values. marine resources are also being assessed in terms an alternative source of energy and food.

The study also evaluates the cost of environmental degradation, which amounts to $5.7 billion per year and by far surpasses the benefits gained from the exploitation from coastal and marine resources, from the destruction of the ecosystem and the threat to the flora and fauna.

The municipality of Tubigon in Bohol adopted an EcoBudget, which was put into action through the issue of an Administrative Order that saw the creation of the Local Implementation Team (LIT) responsible for the coordination.[139]

The concept of the EcoBudget is especially important for regions that depend on natural resources for their social and economic sustainability as well as development. Tubigon has several ecosystems that are of the utmost importance for the subsistence of the local population, especially the poor part of the population.[140]

There is a strong dependency in terms of agriculture, fisheries as well as tourism. In order to keep track of how the ecosystem develops the municipality of Tubigon adopted the EcoBudget. It is a

[138] Ibidem, p.35.
[139] Ibidem, p.37.
[140] Ibidem, p.36.

mechanism specially developed for local entities. It enables them to closely monitor the consumption of natural resources within the boundaries of the municipality in question.

The EcoBudget is an analogy to financial budgeting with the only difference that assets are do not have a financial value such as shares but are evaluated in function to their environmental contribution.[141] Therefore, the analogy starts from budget planning, over budget spending and balancing as well as reinvesting, for instance by planting trees or by cleaning the ocean.

This tool is just one of the successful expanse pf local protection and preservation of the environment. This model can probably not be transposed one to one on a bigger scale, given that its success factors are based on the local component. For instance, the commitment of local stakeholders, local education campaigns and lessons learnt through the process of implementation are easier to oversee on a local scale.

A regional or national scale of implementation would not fulfil its goal given to the differences between the various ecosystems and the specific needs and interest of both the local population as well as the environment.

3. Integrated Coastal Management (ICM)[142]

Poverty reduction and protected areas are closely linked to each other, especially in countries such as the Philippines where it is crucial to reconcile both the protection of the ecosystem and biodiversity but also the needs of rural populations that rely on agriculture or fishing in order to make their livelihoods. In the Philippines the Protected Areas Management Board (PAMB) is responsible for coordination and surveillance.[143]

The island province of Ubay, Bohol for instance is condoned with the outfitting, a major concern for most coastal or island states in the SCS. The decrease in fisheries is mostly due to

[141] Ibidem, p.36.
[142] Ibidem, p.42.
[143] Ibidem, p.40.

environmentally harmful fishing methods, such as the use of dynamite. But cyanide fishing, illegal mesh sizes and the use of Danish seine nets also contributes to this trend.

Ever since 1998 the Philippines had the "Bantay Dagat" the so-called sea watchers, but it proved highly inefficient due to conflict of interest and abuse of power from the sides of the Batay Dagat. The old concept of the Banty dagga was replaced by the Fisheries Improved for Sustainable Harvest (FISH), which also saw the creation own 2003 of the Coastal Enforcement Protection Unit (CEPU).

In 2005 commercial fishing was banned from municipal waters and as early as 2006 there was already an increase in fish of 6-8% and an increase in sea turtles, dolphins and whale sharks.[144]

Today the ICM serves as successful model that is replicated in other coastal regions and municipalities throughout the Philippines. The two key principles upon which this control system is based is responsible for its efficiency and consists in local governance and accountability.

4. Environmental Education (EE)

Sustainable development draws a link between economic prosperity and environmental protection in the long run. In other terms the protection of the environment is a necessary aspect of maintaining a healthy economy as well as for poverty reduction; especially in rural areas where most of the population depends on natural resources for their livelihoods.

The Philippines has a long tradition of preserving the environment with the goal to fight poverty. Environmental Education (EE) plays an important role in the public as well as the private sector. EE dates to the 1970s and has continuously evolved.[145] The PCSD has created a sub-Committee on EE for information gathering and educational purposes. Other examples from the public sector are special school and university programmes, such as for example the Public Education and Awareness Campaign for the Environment of Miriam College (PEACEMC) which turned into the Institute of Environmental Studies.

[144] Ibidem, p.40.
[145] Ibidem, p.60.

The Philippine Association of Tertiary Level Education Institutions in Environmental Protection and Management (PATLEPAM) was created in 1995 to further promote EE and spread information on the issue.

Environmental protection in the Philippines also has a strong media presence, such as on TV, the radio and with several television programmes; for instance, the weekly programme EARTH Institute Asia or "Kalikasan Kaunlaran", which translates itself "Environment, Development".

The private sector is also very active in raising awareness in terms of environmental protection through several initiatives. A few private companies offer EE for their employees with training programmes on Environment Management Systems and ISO 14001 as well as Environment Audit and Environment Health and Safety.

The Philippine Business for the Environment (PBE) is a non-profit organization (NGO) that was created upon a private initiative and aims at increasing profitability with an environmentally responsible approach. The PBE is specialized in communications, such as informative courses.

It also mentors companies by helping them to reduce their ecological footprint by following the Greenhouse Gas Accounting Protocol and it also organizes "Trash Talks" in order to raise awareness on recycling. The PBE also offers interactive group programs for schools, which are an alternation of classroom lessons and field activities in nature.[146]

The Pollution Control Association of the Philippines (PCAP) was created upon another initiative of private associations and carries out tests and exercises in order to regularly control the work and skills of Pollution Control Officers and therefore shows a strong dedication to improve the preexisting mechanism and make them more efficient in terms of environmental protection.

[146] Ibidem. p.61.

There are several more institutions of private or public initiative, such as the Partnership for Clean Air, the Philippine Mine Safety and Environmental Association or earth Day Network which is an awareness campaign under the umbrella of a CSO.[147]

b) Malaysia

Malaysia is another claimant in the SCS dispute between China and five other coastal nations surrounding the SCS. The country of Malaysia covers a total land area of 332,556 km2 divided into two regions, notably the Malaysian Peninsula and the States of Sarawak and Sabah.[148]

The coastline is composed of two formations, notably mangrove fringed mud flats and sandy beaches and is 4,800 km long.[149] As it is also the case for the Philippines, marine resources play an important role in the Malaysian economy as well as its overall socio-economic development. Subsequently environmental protection is vital in order to maintain the Malaysian ecosystem, a primary source of income for a vast part of the Malaysian population. Furthermore, environmental protection is also necessary in order to assure a sustainable development that does not infringe on the livelihoods of the coastal population, given that 70% of the Malaysians live in coastal zones.[150]

The rich ecosystem plays an important role in many fields of the economy, notably in fisheries and aquaculture more generally, but also in terms of gas and oil exploitation, transportation, and communication as well as tourism.[151]

1. Major economic sectors that rely on a healthy marine ecosystem

Fisheries and aquaculture

As mentioned above fisheries play a central role in the Malaysian economy and are an important pillar in order to ensure a steady economic growth. Yet, the deposition of marine resources poses

[147] Ibidem, p.61.
[148] Dato´ IR. Tan Sri.; Bin Abdullah S. (1993). Coastal Development in Malaysia - scope, issues and challenges: Department of Irrigation and Drainage Malaysia (p.1).
[149] Ibidem, p.1.
[150] Ibidem, p.3.
[151] Ibidem, p.1.

a threat to economic development, hence induces an increase in poverty in the long run. It is the unique ecosystem, a mix of mangrove wetlands and coral reefs that ensure the existence of many different species and a large quantity of fish.

A rough estimation of fisheries present within the twelve nautical miles amounts to 588,00 tons of fish with another 400,000 tons if one counts the Exclusive Economic Zone (EEZ).[152] Given that fisheries and aquaculture represent an important source of income it is not surprising that the total amount in aquaculture increased from 63.500 tons in 1988 to 200,000 tons in 2000.

The rapid expansion of the sector raises legitimate concerns in terms of depletion of marine resources, notably fish and the destruction of the mangrove wetlands in order to develop aquaculture. Mangrove wetlands are among the most productive and richest ecosystems on the planet because they provide unique conditions in order for any species to thrive. They provide shelter to endangered species, such as the proboscis monkey, stork, or crocodiles.[153]

On top of that the mudflats of Matang, Kelang and Rejang are a popular feeding ground for migratory birds but also sedentary ones, such as herons, egrets and storks and even provide rhinoceros.[154]

Mineral resources

A less important source of revenue stems from mineral resources, such as gold, tin, platinum, chromite, copper, aluminum, silica sand, coal and clay.[155] Not to mention an increase in nearshore and offshore sand mining[156] that poses a serious threat to the environment given to an increased danger of coastal erosion.[157]

Industry

[152] Ibidem, p.2.
[153] Ibidem, p.4.
[154] Ibidem, p.4.
[155] Ibidem, p.4.
[156] Ibidem, p.4.
[157] Ibidem, p.5.

The manufacturing sector especially is found in the coastal zones around the the areas of Klang Valley, Pensang, South Johor, Paka-Kemanan and Bintulu.[158] This concentration is mostly due to the proximity of ports, roads, and other means of transportation. An easier access to raw material as well as labour force are another key aspect that make the coastline attractive for the industry. Yet, it poses concerns in terms of waste management, sewage, and chemical spills into the ocean.[159]

Transportation and Communication

The Malaysian coastline is an important hub for transportation given that it has 103 ports. The central ports are the ports of Klang, Penang, Kuantan, Passer Gudang (Johor), Bintulu, Kuching and Kota Kinabalu.[160] 54 ports are located along the coast of the Malaysian Peninsula, 36 in Sarawak and another 13 in Sabah.[161]

Figure 2: A depiction of the major seaports and hubs along the Malaysian coastline
This illustration showcases the importance of the seaports for Malaysia, more specifically for its economy and for transportation. *(Source: "Map of Peninsular Malaysia Map of Sabah & Sarawak". Fidelius, 7 May 2024, url: IIS 8.0 Detailed Error - 500.0 - Internal Server Error (fidelius.com.my)*

[158] Dato´ IR. Tan Sri.; Bin Abdullah S. (1993). Coastal Development in Malaysia - scope, issues and challenges: Department of Irrigation and Drainage Malaysia (p.3).
[159] Ibidem, p.3.
[160] Ibidem, p.3.
[161] Ibidem, p.3.

Oil and Gas

Although oil and gas are only a limited resource in the coastal zone of Malaysia, there are offshore extraction points of crude oil along the Malaysian Peninsula.[162]

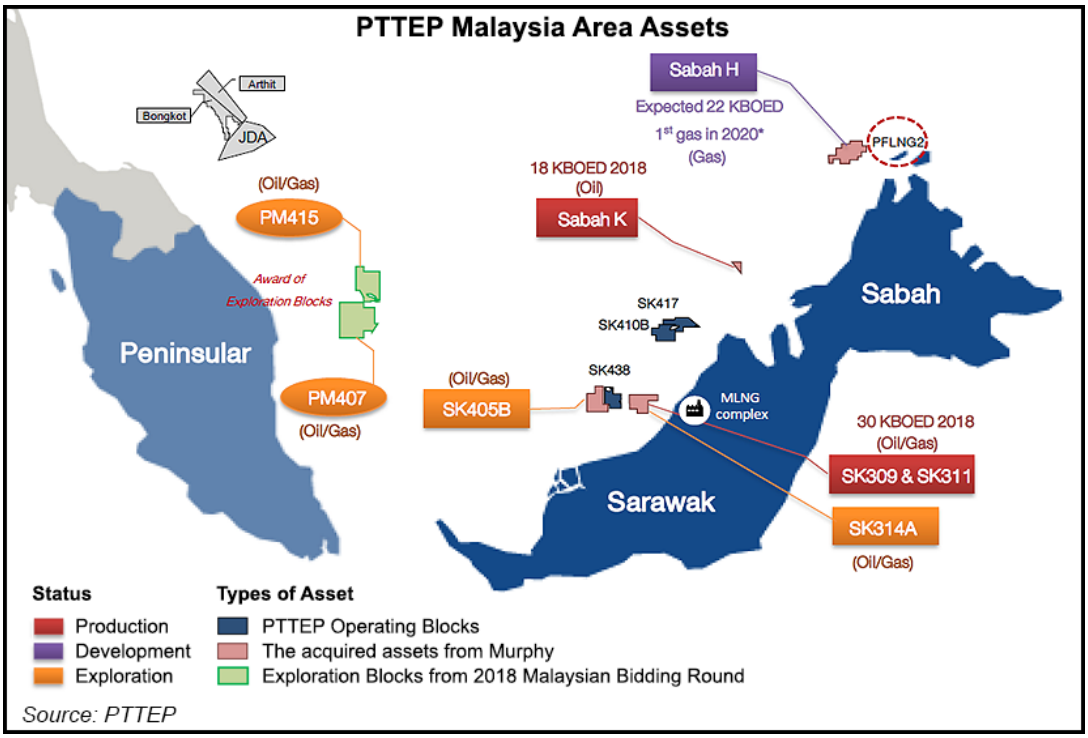

Figure 3: Recent discoveries of oil and gas offshore of Malaysia
This map shows offshore oil and gas discoveries in order to illustrate the pivotal role of natural resources in the South China Sea. The discoveries were made in 2019 by the PTTEP, which is part of Thailand´s PTT Exploration and Production Public Co. *(Source: "PTTEP Malaysia Area Assets". Natural Gas Intelligence, 7 May 2024, url: Latest Malaysia Offshore Natural Gas Discovery May Hold 2 Tcf - Natural Gas Intelligence)*

2.2. Major sources of pollution

a) Shipborne pollution

Illegal or accidental discharge of solid waste is a major issue in the SCS, also along the coastline of Malaysia, i.e. the Malaysian Territorial Waters (MTW) and the EEZ.[163]

[162] Ibidem, p.3.
[163] Gomez, J.I.G., Velazquez, O.H., Daniela, S.I. (2004). The Sea and its contaminants: Journal of Maritime Research, I.

It has to be noted that the ocean has a natural capacity to absorb and neutralize a reasonable amount of waste[164], yet there are specific substances that have the capacity to destroy the marine environment or at least have severe repercussions on an ecosystem.

The most common substances that affect coastal areas are oil, heavy metals, synthetic organic chemicals, sediment, sewage, waste heat as well as introduced species (species from another ecosystem that are susceptible of destroying local species) and solid waste.[165]

Another problem is the absence of correct waste disposal, notably by simply throwing pollutants overboard instead of being discharged at the ports according to procedure.[166]

According to maritime research throughout the SCS[167] there is a high concentration of hydrocarbons to be found in the regions of Terengganu, Sarawak and Sabah within the EEZ[168], which confirms the above-mentioned statement that the vessels that cross the MTW must discharge pollutants and other hazardous substances such as oil during deviant tank cleaning operations, illegal discharges or but rather unlikely unintentional oil spills.[169]

Marine pollution from vessel sewage is another factor that contributes to the degradation of the ecosystem of the SCS, specifically the MTW. According to West (2004), pollution from vessel sewage is even more harmful, because there is less water available upon discharge.[170] A direct consequence from this practice is an increased danger of contaminated water; notably through pathogenic streptococci, decal coliform and more generally other bacteria.[171] According to UNEP a person that comes in direct contact with a body of water that is contaminated with the aforementioned bacteria and pollutants may have to face severe illness, such as hepatitis, diarrhea,

[164] Trujillo, A.P., Thurman, H.V. (2005). Essential of Oceanography 8th Ed. Upper Saddle River, New Jersey: Pearson Prentice Hall.
[165] Garrison, T. (2005). Oceanography - An Invitation to Marine Science 5th Ed. Belmont, California: Thomson-Brooks/Cole.
[166] Law, A.T., Hii, Y.S. (2006). Status, impacts and mitigation of hydrocarbon pollution in the Malaysian seas. Aquatic Ecosystem Health & Management Society.
[167] Walker, T.R., Grant, J., Archambault, M. (2006). Accumulation of marine debris on an intertidal beach in an urban park. Water Quality Research Canada.
[168] Law, A.T., Hii, Y.S. (2006). Status, impacts and mitigation of hydrocarbon pollution in the Malaysian seas. Aquatic Ecosystem Health & Management Society.
[169] Khalid, N., Tang, J. (2010). Greening the maritime sector: Issues, challenges, and options. Kuala Lumpur: Maritime Institute of Malaysia.
[170] West, A. (2004). Marine Pollution from vessel sewage in Queensland.MLAANZ Journal, 1995.
[171] Ibidem.

bacillary dysentery, skin rashes, typhoid and even cholera.[172]All in all, it can be concluded that shipborne pollution through incorrect discharges such as vessel sewage or oil spills are responsible for destroying the ecosystem, for posing a threat to human health as well as for engendering the depletion of natural resources such as fisheries and aesthetically destroying the environment.[173]

b) Plastic-based pollution

Aside from shipborne pollution, more precisely oil spills, illegal discharges and vessel sewage, plastic-based pollution is another threat to the environment.

It is important to note that Malaysia figures among the twelve "mega biodiversity countries" in the world due to its rich flora and fauna and the number of different species domestic to the region.[174] All discharges of shipborne waste have been prohibited as of 1973, yet a lack of commitment from the international community has led to the situation that the oceans today are flooded with plastic debris.[175]

According to Khalid and Tang (2010) a ship necessitates big mounts of water, ballast water to be precise in order to maintain stability on the sea. Therefore, water intake takes place in port A in order to be discharged again at destination in port B. [176] The problem with this practice is twofold. On one hand it flushes contaminated water and waste debris back into the ocean and on the other hand the water from port A contains different components as it originates from a different body of water than port B. In other words, the ballast water from port A contains so-called non-native materials that present a nuisance or might even be toxic to the ecosystem in the surrounding waters of port B. Subsequently, it can create a severe ecologic imbalance and pose a real threat to both the

[172] United Nation Environment Programs (UNEP). Marine Litter: A Global Challenge. Nairobi: UNEP.
[173] Barnes, D.K.A. (2002). Invasions by marine life on plastic debris. Nature (nr. 416).
[174] Hamid, M. N. (2012). National Strategies and Action Plans on Agricultural Biodiversity Conservation and Sustainable Utilisation. Kuala Lumpur, Malaysia: Malaysia Agriculture Research and Development Institute.
[175] Carpenter, A. Macgill, S. M. (2005). The EU Directive on port reception facilities for ship-generated waste and cargo residues: The results of a second survey on the provision and uptake of facilities in North Sea ports. Marine Pollution Bulletin.
[176] Khalid, N., Tang, J. (2010). Greening the maritime sector: Issues, challenges, and options. Kuala Lumpur: Maritime Institute of Malaysia.

ecosystem and by extension to economic growth, given that most of the local population depends on marine resources for their livelihoods (fisheries, diving expeditions for tourists etc.).[177]

To be more resilient to outside factors, vessels are typically coated with anti-fouling paint in order to avoid outside agents such as certain species of algae to inhibit the performance of the vessel in terms of speed and efficiency. Yet, a study [178] shows that the anti-fouling paints contain tributyltin (TBT) and that the latter are stored or accumulate in the tissues of marine organisms. Hence, TBT poses a serious threat to the environment as well as it raises concerns in terms of health, given that fish is part of marine organisms and counts as one of the primary sources of food for the Alcoa population. The contamination of TBT is already widespread to the point where it is no longer restricted to the coastal area but already spread 200 km farther than the inland waters. Therefore, even fish or clams from the open waters can be carriers of TBT.[179]

As shown in the two sections dedicated to shipborne and plastic-based pollution, both have detrimental impacts on the ecosystem and will have a strong impact on economic development. The steady destruction of the ecosystem will see a drastic fall in revenue for fisheries, thus threatening the livelihoods of the local population. The locals also being the ones consuming fish as primary source of food will also engender an increase in chronic diseases.

c) Coastal erosion

Apart from pollution coastal erosion is a serious threat to the environment. As early as the 1980s the Government already showed concerns as to this issue. The National Coastal Erosion Study (NCES) dating back to 1984-1985 that was carried out under the Economic Planning Unit (EPU) of 1985 showed that the damage was already severe 40 years ago.

[177] Joachimstal, E. L., Ivanov, V., Tay, S.T.-L., Tay, J.-H. (2004). Bacteriological examination of ballast water in Singapore Harbour by flow cytometry with FISH. Marine Pollution Bulletin.
[178] Borja, A., Belzunce, M.J., Garmendia, J.M. Rodriguez, J.G., Solaun, O., Zorita, I. (2011). Impact of Pollutants on Coastal and Benthic Marine Communities. Ecological Impacts of Toxic Chemicals, Bentham Science Publishers Ltd.
[179] Stewart, C., Thompson, J.A.J. (1994). Extensive butyltin contamination in south-eastern coastal British Columbia, Canada. Marine Pollution Bulletin.

The study showed that 1390 km or 29% of the entire coastline were prone to erosion. According to the study erosive areas were divided into different categories, notably critical, significant, and acceptable [180]. As early as 1985 there were 62 sites subject to erosion or 197km of the Malaysian coastline., which was mostly due to incorrect planning of coastal development projects.

d) River mouth siltation

The National River Mouths Improvement Study (JICA) published in 1994 examined the problem of river mouth siltation. An increase in siltation alongside bigger vessels has made it difficult for vessels to move forward. In Malaysia 35 river mouths are considered not deep enough to ensure safe navigation,[181] such as for example in the ports of Klang, Bintulu, Kuantan, Kuala Perlis and Kuala Kedah. Subsequently, local fishermen experienced important economic losses due to an inadequate water depth, which resulted in dredging activities. Port Klang requires 226,000 m3 of dredging per year, in Kuala Perlis and Kuala Kedah up to 500,000 m3. [182] This activity has led to a serious degradation of the marine environment and poses a special threat to endangered species that seek shelter in river mouths. It has also contributed to overfishing.

e) Depletion of marine resources

Aside from dredging activities due to river mouth siltation and coastal erosion, the depletion of marine resources is another important issue that must be addressed. The destruction of mangrove wetlands in order to convert them into agricultural land has severe consequences in terms of environmental protection and protection of the biodiversity of such a rich ecosystem. The destruction of the above-mentioned mangrove wetlands and swamp forests have led to a significant decline in fisheries, the latter serving as breeding ground for fish and prawns. Both the shrinking size of mangrove wetlands and swamps as well as overfishing have led to a drastic decrease in

[180] Dato′ IR. Tan Sri.; Bin Abdullah S. (1993). Coastal Development in Malaysia - scope, issues, and challenges: Department of Irrigation and Drainage Malaysia. (p.5).
[181] Ibidem, p.5.
[182] Ibidem, p.5.

fishing resources.[183] There a several factors that put wildlife at risk, notably overfishing, the destruction of the natural habitats of many species, poaching, pollution and other human disturbances (i.e. dredging, clearing swamp forests and mangrove wetlands). Coral reefs are also heavily impacted by the tourism sector on one hand and by agricultural activities on the other hand.

f) Deterioration of water quality

The increasing water pollution is another important threat to the marine environment along the Malaysian coastline. Data collected within the period of five years between 1985-1991 would show an abnormally high presence of TSS (total suspended solids). The entire coastline of the Malaysian Peninsula was heavily affected, especially the east coast, with 81% of the samples collected being superior to the standard of marine quality that is 50 mg/l. On the west coast 57% of the samples collected surpassed the standard of marine quality.[184] On top of that the Malaysian coastal waters are also contaminated with eschericia coli, the contamination being more important on the west coast.

Tests show that between 1985-1991 60% of the samples from the west coast exceeds the interim standards for marine quality that amounts to 100 MPN/100ml.[185] The major factors responsible for water pollution or the deterioration of the overall water quality, both in rivers as well as the coastal areas are either heavy metals, pollution that stems from transportation or the human factor. The coastal waters of Perak, Pulau, Pinang, Selangor and Negri Sembilan show a high concentration in heavy metals such as mercury levels that exceed the Interim Standard for marine qualit. High concentrations of lead have been found in the coastal area of Johor, Perak, Pulau, Pinang and Kelatan.[186]

Another major cause of pollution that was mentioned earlier is due to vessels and transportation more generally. Therefore, vessel sewage, cleaning as well as waste disposal and oil spills are

[183] Ibidem, p.5.
[184] Ibidem, p.6.
[185] Ibidem, p.6.
[186] Ibidem, p.6.

responsible for a higher presence of oil and grease as well as plastic and micro plastic fibers in the ocean. Between 1985-1991 alone there were 52 oil spills in the SCS.[187]

The major source of river pollution is the human factor, notably every human activity that would lead to any kind of disturbance of the natural ecosystem. The pollution of rivers is mostly linked to agricultural activities, settlement, and housing projects as well as the manufacturing industry and agro-based industries (palm oil and rubber).[188]

2.3. Legal framework and local initiatives

a) International Conventions

There are several international conventions dedicated to the protection of the marine environment against pollution. Thus, the IMO (International Maritime Organization) has created the Marine Environment protection Committee (MEPC); the MEPC has introduced an important Convention for the protection of the marine environment.

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) is another and the central piece of international legislation dealing with pollution by ships and vessels. It came into force on 2 October 1983 with its Annex VI coming into force on 19 May 2005. Annex I and II of the Convention are mandatory, while annexes III, IV, V and VI are optional. Malaysia has ratified Annex I and II as well as III, IV, V and VI.[189]

The Convention of the Prevention of Marine Pollution by Dumping of Wastes and other Matter or the London Convention 72 was created in order enhance the control of dumping waste in the ocean, especially hazardous waste. According to Kershaw et al. the London Convention 72 has three annexes, of which Malaysia has not yet ratified one.[190]

[187] Ibidem, p.6.
[188] Ibidem, p.6.
[189] Marine Department Malaysia (JLM). List of International Conventions.
[190] Kershaw, P., Katsuhiko, S., Lee, S., Samseth, J., Woodring, D., Smith, J. (2011). Plastic debris in the ocean. UNEP Yearbook 2011: Emerging issues in our global environment. Nairobi: United Nations Environment Programme.

Malaysia has ratified several treaties, such as the MARPOL, the Merchant Shipping Ordinance (1952), the Merchant Shipping or Oil Pollution Act (1994), the Solid Waste and Public Cleansing Management Act (2007) and the Environment Quality Act (1974).[191]

b) Domestic Legislation

Although shipborne pollution is a serious threat to the marine ecosystem in Malaysia, the State has not taken as much initiative as the Philippines. From 2000 to 2004 the daily number of vessels passing through MTW has increased from 153 vessels a day in 2000 to 217 vessels a day in 2014.[192] Among these vessels 33.18% are container ships, 23.05% tankers, 12.86% bull carriers and 10.81% general cargo vessels.[193]

The Merchant Shipping Ordinance (MSO) of 1952 is the legislation of reference when it comes to marine pollution, which shows how little initiative there is on the national level.[194] The MSO clearly prohibits the "pollution from ships" such as through the discharge of oil or other harmful substances int the MTW, EEZ and more generally the entire coastline. In case of non-compliance with the act the offender must face a fine of RM 50,000.00, a two-year prison sentence or both.[195]

The Oil Pollution Act (1994) that was formulated at the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage in 1971 focuses on civil liability, thus monetary compensation. Any vessel that causes damage due to the discharge of oil (even bunker oil) within the EEZ engages its civil liability and constitutes claims for compensation on the grounds of property damage, cleanup costs, economic loss, and the cost

[191] Mobilik, J. M. & Hassan, R. (2016). Pollution Threat from Shipping Activity Towards Ocean Sustainability. In M. Samsur, M.L. Shabdin, L. Nyanti, A.R. Khairul Adha, R. Hadil, R. & J.M. Mobilik (Eds.), Aquatic Science Colloquium 2016: Experiences Sharing in Aquatic Science Research IV: Malaysia Exclusive Economic Zone (EEZ) Cruise and other Aquatic Science Research (pp. 143-163). Monograph, Department of Aquatic Science, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia.
[192] Mobilik, J. M. & Hassan, R. (2016). Pollution Threat from Shipping Activity Towards Ocean Sustainability. In M. Samsur, M.L. Shabdin, L. Nyanti, A.R. Khairul Adha, R. Hadil, R. & J.M.
[193] Ibidem.
[194] Mustafa, M., Ariffin, M. (2011). Protection of marine biodiversity from pollution: Legal strategies in Malaysia. International Journal of Bioscience, Biochemistry and Bioinformatics, I.
[195] Merchant Shipping Ordinance, Section 360 CA (2).

of the reinstatement of the environment.[196] Finally, the Environmental Quality Act (1974) aims at prohibiting any kind of pollution within twelve nautical miles and subjects any offending to a RM 500,000.00 fine or a prison sentence for up to five years.[197]

The discharge of environmentally hazardous substances, pollutants or wastes into Malaysian waters is subject to a severe penalty.[198] It is also prohibited to discharge oil tanker sludge and oil water mixture i.e. ballast water without an written approval of the authorities[199], although this is a highly questionable legal loophole. If not specifically approved by the authorities it constitutes a violation of the Environment Quality Act (EQA), hence is subject to fine or a penalty.[200] Marine pollution that goes beyond the boundaries of the MTW up to 200 nautical miles is regulated under the EEZ Act (1984). The EEZ Act attributes full authority to the Director General of the Department of Environment to detain any vessel[201] and prosecute any person[202] that discharges hazardous substances deliberately or intentionally within the EEZ. The offending shall be liable for a fine not exceeding RM 1,000,000.00.[203]

[196] Saharuddin, A. H. (2001). National ocean policy. New opportunities for Malaysian ocean development. Marine Policy, (25).
[197] The Environmental Quality Act (1974), Section 27.
[198] Ibidem, Section 29.
[199] Ibidem, Section 34B.
[200] Ibidem, Section 34B (4).
[201] EEZ Act (1984), Section 15(1).
[202] Ibidem, Section 36 (1).
[203] Ibidem, Section 10.

Part II: The position of international legislation in the light of territorial claims in the SCS

The first part of this thesis consisted in identifying major threats to the marine ecosystem in the SCS, to trace them back to their point of origin with the aim of identifying the biggest sources of marine pollution in the SCS. The second part however seeks to discuss the law of the sea in the light of environmental responsibility in connection with territorial claims throughout the SCS. It is therefore important to look at different legal provisions and articles of international law that regulate the law of the sea in order to gain a better understanding of the complexity of territorial claims within the South China Sea, specifically in relation to smaller islands such as the Spratly Islands, also called Nansha Islands.

The main convention that will be analyzed throughout this part is the United Nations Convention on the Law of the Sea (UNCLOS) to interpret the relevant articles and to discuss their legal scope and implications with regards to territorial claims and environmental protection in the SCS.

1. Contextualization

1.1. Political and geostrategic context

According to Liakopoulos (2004)[204] the territorial claims of parts of the South China Sea, specifically claims to the islands within the SCS have started to rise in the late 1960s and were mostly motivated by economic and geo-strategic concerns from countries such as China, Taiwan, Malaysia, Vietnam, the Philippines and Brunei Darussalam. Those distinctive territorial claims have led to overlapping claims of sovereignty which have then led to problems, notable geographical problems of delimitations. As stated by Liakopoulos (2004) and in order to illustrate the difficulties with adjacent territorial claims, it seems pertinent to cite but a few, China as well as Taiwan have claimed the Macclesfield bank also called Zhungsha.

[204] Liakopoulos, D. (2004). Legal and Environmental Regime of Islands in the South China Sea: Status under International Law. Global Jurist, 4(3) Article 2.

The very same countries also claimed the Paracels or Xisha islands.[205] The claim over the parcels was contested not only vice versa between China and Taiwan, but also Vietnam has contested the claim of sovereignty expressed by China and Taiwan as Vietnam sought to claim them for themselves.

The Spratly Islands or Nansha Islands are the most famous, most cited illustration of territorial claims in the SCS due to a multitude of countries in the region that claimed sovereignty over them. China, Taiwan, but also Vietnam and Malaysia as well as the Philippines have expressed their claim of sovereignty over this specific territory in the SCS.

It also must be added that some of those islands are situated in the Exclusive Economic Zone (EEZ) of Brunei. This is just an example to illustrate how complicated territorial claims in the South China Sea are.[206] Different theories and different strategies are used in order to justify territorial claims and their legitimacy. A paramount factor consists in whether an island is capable to generate maritime zones, because this would have important consequences on maritime delimitations within the SCS.

For instance, the Spratly Islands were claimed by all 6 claimant states within the SCS, however all claims are geographically overlapping, and many States have not clearly defined their maritime claims.

1.2. Legal framework of the UNCLOS

International law more specifically the United Nations Convention of the Law of the Sea (UNCLOS) seeks to answer those open questions. The regime of islands is regulated by Article 121 of the UNCLOS and divided into 3 paragraphs.[207]
Article 121, paragraph 1 of the UNCLOS sets forth the following rule:

[205] Ibidem, pp.1-2.
[206] Ibidem, p.4.
[207] Ibidem, p.5.

"*An island is a naturally formed area of land surrounded by water which is above water at high tide*." [208]

Article 121, paragraph 2 provides as follows:

"[…]The *territorial sea, the contiguous zone, the exclusive economic zone and the continental shelf of an island are determined in accordance with the provisions of the convention applicable to other land territory.*"[209]

Article 121, paragraph 3 provides as follows:

"Rocks which cannot sustain human habitation or economic life of their own shall have no exclusive economic zone or continental shelf."[210]

The problem with the UNCLOS is that it does not determine how coastal states can claim sovereignty over specific islands or rocks of land. The only hint that the United Nations Convention on the Law of the Sea provides is that any patch of land can only be defined as island if it is always above waters and if of course it can sustain human habitation and an economic life on its own.[211]

Therefore, a bigger rock or naturally formed island within the ocean does not automatically correspond to an island according to international law. Subsequently it cannot be claimed by any state. Only islands can be claimed, only islands can generate territorial seas, contiguous zones, exclusive economic zones, and continental shelves. The only thing a rock can generate are territorial waters.

According to the United Nations Convention of the Law of the Sea the Spratly Islands do have the right to an exclusive economic zone as well as the continental shelf however the Spratly Islands also only get 12 nautical miles territorial waters in the contiguous zone. The UNCLOS has helped in shaping the maritime landscape and in setting boundaries however some countries have used a different line of argumentation to justify the legitimacy of their claim. For instance, China has claimed and does still claim sovereignty over the Spratly Islands using a historical justification

[208] United Nations, United Nations Convention on the Law of the Sea (UNCLOS). (1982), Digitized by UN Library Geneva: United Nations Convention on the Law of the Sea. (p.48).
[209] Ibidem, p.48.
[210] Ibidem, p.48.
[211] Liakopoulos, D. (2004). Legal and Environmental Regime of Islands in the South China Sea: Status under International Law. Global Jurist, 4(3) Article 2. (p.8) + (p.9-10).

natively that the Spratly Islands were already mentioned in records Chinese records from the 12th century. The claim made by China is being reinforced by Japan renouncing all its rights over the Spratly Islands through the 1951 peace treaty: *"international law and the history of the claims to the Spratly Islands in American Enterprise institutes"*.[212] This historical claim over the Spratly Islands is reinforced by the famous "nine-dash line" by which the Chinese claim most of the South China Sea to fall under their sovereignty.

Vietnam has claimed sovereignty over the Spratly Islands based on Vietnamese activity from the 17th to the 19th century in those areas in 1979 and 1982 the governments of Vietnam published papers showcasing historic evidence of their claims.[213] Not only Vietnam but also France has claimed them in 1993, although the French did not succeed with their claims this incident was used by Vietnam in all the to strengthen their position.

A major issue when it comes to the Spratly Islands are weather conditions notably the monsoon according to article 121 paragraph 1 of the United Nations Convention on the Law of the Sea a rock in order to be defined as an island must permanently be above water, which is not the case for the Spratly Islands during the monsoon season.[214] Paragraph 3 of article 121 of the convention also poses a problem given that the Spratly Islands are too small in order to be defined as habitable islands with an economic life of their own.

The Philippines have also made claims to islands in the SCS however following a different strategy. The legitimacy of their claim of specific islands was based on the discovery of said islands. The islands of Kapayaan were supposedly discovered by the Philippines abandoned by the Japanese towards the end of World War 2 in 1951 and therefore became res nullius. The Philippines started occupying and gradually start claiming sovereignty over those territories in the 1970s they also claimed sovereignty over the sea, the seabed as well as the airspace. [215]

[212] Ibidem, p.12.
[213] Ibidem, p.10.
[214] Ibidem, p.12.
[215] Ibidem, p.10.

This brief outline of various territorial claims shows the volatility as well as the vulnerability and the instability of the entire region as well as the need for international regulations to set clear rules and boundaries. The United Nations Convention on the Law of the Sea is the very document that has attempted to build a legal framework in order to organize territorial claims over islands and bodies of water.

The convention has also led to international rulings such as the landmark ruling of the Permanent Arbitration Court in The Hague on 12th of July 2016. In the arbitration case Philippines versus China the activities of China in the waters of the Philippines were deemed unlawful. China claimed a right to those activities based on a historic hegemonic right as well as the aforementioned "nine-dash line". Even though the court ruled against China the People's Republic of China considered the rolling to be null and void, which leads to question the authority as well as the usefulness of the UNCLOS as a tool of international law in order to regulate the international maritime landscape. This arbitration case will be analyzed more thoroughly at a later point during the discussion as well as an in-depth analysis of the role of China.

2. Law of the Sea convention and protection of the marine environment

The United Nations Convention on the Law of the Sea is supposed to be an international legal instrument with the mission to regulate the marine landscape in order to preserve peace and avoid conflict. Evidence has shown that international law is weak in comparison to state sovereignty. Decisions and rulings that have a legal standing de jure are being de facto completely disregarded such as the 2016 landmark ruling Philippines versus China.

If the United Nations Convention on the Law of the Sea is not competent to protect the territorial waters of one country in the South China Sea against the hegemonic claims of another more powerful country, then how is it possible for the convention to be instrumentalized for the protection of the marine environment.

The following section is dedicated to the analysis of the law of the sea through the lens of protection of the environment specifically the marine environment.

2.1. The UNCLOS: protection and preservation of the marine environment

According to Gouvaneli (2017)[216], the UNCLOS does include a general obligation to both protect and preserve the marine environment. Part XI of the United Nations Convention of the Law of the Sea entitled "*protection and preservation of the marine environment*" states in its section one "*general provisions*" under article 192 the general obligation: "*states have the obligation to protect and preserve the marine environment.*"[217]

Article 194 entitled "*measures to prevent reduce and control pollution of the marine environment*" states in paragraph 1:
"*States shall take individually or jointly as appropriate all measures consistent with this convention that are necessary to prevent reduce and control pollution of the marine environment from any source using for this purpose the best practicable means at their disposal and in accordance with their capabilities and they shall endeavor to harmonize their policies in this connection.*"[218]

According to articles 192 as well as 194 of the UNCLOS a legal framework exists in International Maritime law that regulates the protection of the marine environment.

Article 192 corresponds to a general legal provision; due to its open formulation its legal reach could be questioned. However according to Gouvaneli (2017) this general formulation is an advantage because it does not only obligate states to protect and preserve the marine environment within the scope of their national jurisdiction, but it also obligates the protection of the marine environments in the high seas.[219] The landmark ruling of 12 of July 2016 PCA Case Philippines versus the People's Republic of China confirmed that:

---

[216] Gouvaneli, M. (2017). Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? SSRN Electronic Journal (January 2017): (PDF) Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? (researchgate.net) (p.2).
[217] United Nations, *United Nations Convention on the Law of the Sea* (UNCLOS). (1982), Digitized by UN Library Geneva: United Nations Convention on the Law of the Sea. (p.85).
[218] Ibidem, p.86.
[219] Gouvaneli, M. (2017). Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? SSRN Electronic Journal (January 2017): (PDF) Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? (researchgate.net) (p.4).

"*Because the environmental obligations in part XII apply to states irrespective of where the alleged harmful activities took place its jurisdiction is not dependent on the question of sovereignty over any particular feature on the prior or determination of the status of any maritime feature on the existence of an entitlement by China or the Philippines to an exclusive economic zone in the area or on the prior delimitation of any overlapping entitlements.*"[220]

According to another ruling stated by Gouvaneli (2017) the South China Sea tribunal has also confirmed the applicability of article 192 of the UNCL OS and went even further by stating as follows: "*the content of which is informed by the other provisions of part 12 and other applicable rules of international law.*"[221]

This also includes the Convention on Biological Diversity (CBD) of 1992 which states in its article 2: "an *obligation to prevent the harvesting of species that are recognized internationally as being at risk of extinction and requiring international protection*".

To go even further in section 11 of the UNCLOS entitled "*obligations under other conventions on the protection and preservation of the marine environment*", article 237 entitled "*obligations on the other conventions on the protection and preservation on the marine environment"* states as follows in paragraph 1:*" the provisions of this part are without prejudice to the specific obligations summed by states under special conventions and agreements concluded previously which relate to the protection and preservation of the marine environment into agreements which may be concluded in furtherance of the general principles set forth in this convention paragraph two specific obligations assumed by States and special conventions with respect to the protection and*

[220] *In the matter of the South China Sea Arbitration* before an arbitral tribunal constituted under Annex VII to the 1982 UN Convention on the Law of the Sea between the Republic of the Philippines and The People´s Republic of China, PCA case no.2013-19, Award, 12 July 2016,para.927 (emphasis added);see also with the same wording Maria Gouvaneli, "State jurisdiction in relation to the protection and preservation of the marine environment", in David Attard, Malgosia Fitzmaurice, Norman Martínez Gutiérrez & Riyaz Hamza (eds), *IMLI Manual on International Maritime Law, vol. III: Marine environmental law and international maritime security law (OUP 2016), 5-26.*

[221] Gouvaneli, M. (2017). Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? SSRN Electronic Journal (January 2017): (PDF) Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? (researchgate.net) (p.4).

preservation of the marine environment should be carried out in the manner consistent with the general principles and objectives of this convention."[222]

Subsequently, the UNCLOS allows and supports a strengthened marine protection under more specific conventions. Not only does the UNCLOS guarantee and support a more specified protection through other conventions but article 195 of the UNCLOS also states that: "*In taking measures to prevent reduce and control pollution of the marine environment state shall act so as not to transfer directly or indirectly damage or hazards from 1 area to another or transform one type of pollution into another*".[223]

The convention includes and targets various sources of pollution such as the major sources of pollution analyzed and identified in part one such as shipborne pollution plastic-based pollution, and its consequences.

Article 198 of the UNCLOS calls upon the responsibility of the states whenever an imminent danger to the environment or damage to the environment has been noticed: "*When a state becomes aware of cases in which the marine environment is in imminent danger or being damaged or has been damaged by pollution it shall immediately notify other states it deems likely to be affected by such damage as well as the competent international organizations.*"[224]

Article 199 entitled "*contingency plans against pollution"* as well as article 200 entitled "*studies research programs and exchange information and data*" also mention international organizations as entities that play a pivotal role in the protection of the marine environment.[225]

More precisely, article 200 emphasizes the importance of: "*Promoting studies undertaking programs of scientific research and encouraging the exchange of information and data acquired about pollution in the marine environment they shall endeavor to participate actively in regional*

[222] United Nations, *United Nations Convention on the Law of the Sea* (UNCLOS). (1982), Digitized by UN Library Geneva: United Nations Convention on the Law of the Sea. (p.104).
[223] Ibidem, p.87.
[224] Ibidem, p.87-88.
[225] Ibidem, p.88.

and global programs to acquire knowledge for the assessment of the nature and extent of pollution exposure to it and its pathways risks and remedies."[226]

The UNCLOS can be defined as more than a general convention or a superficial document of international law with no coercive power, because it regulates in a detailed manner the steps to be taken by states in order to prevent marine pollution and if damage has already occurred to limit the environmental degradation to share an exchange knowledge with other states for that very same purpose and also reiterates the duty of each state to protect their waters from marine pollution but that this responsibility extends to all states when it comes to the high seas.

However, the UNCLOS also makes repeated reference to international organizations and their key role in coordinating the joint efforts of states in the protection of their marine environment. According to Gouvaneli (2017)[227] the UNCLOS could be interpreted in a way that would include a specific "*obligation to conduct an environmental impact assessment*".

Article 207 of the UNCLOS states in its article 4 that: "*states acting especially through competent international organizations or diplomatic reference shall endeavor to establish global and regional rule standards and recommended practices and procedures to prevent reduce and control pollution of the marine environment from land based sources taking into account characteristic regional features the economic capacity of developing States and their need for economic development such rules standards and recommended practices and procedures shall be reexamined from time to time as necessary*."

This article does not explicitly state the obligation to conduct an environmental impact assessment however it does state the corporation between States and international organizations. The United Nations Industrial Development Organization (UNIDO) for instance, always carries out an environmental impact assessment in the inception phase of each of their projects. The same also goes for United Nations Environmental Programme (UNEP) and General Environment Fund

[226] Ibidem, p.88.
[227] Gouvaneli, M. (2017). Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? SSRN Electronic Journal (January 2017): (PDF) Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? (researchgate.net) (p.6-9).

(GEF) projects. This goes further in line with article 207 that advocates the establishment of recommended practices and procedures.[228]

The UNCLOS is therefore a versatile legal document and instrument that can be used in international arbitration courts, for the protection of the marine environment and to set the ground rules for projects implemented by international organizations.

However, the People's Republic of China has declared the landmark ruling of 2016 to be null and void and has continued with large scale land reclamations, the building of artificial islands, the depletion of fish stocks throughout the South China Sea and has not respected their obligation to preserve and protect fragile ecosystems as stated by article 192 of the UNCLOS.

According to Ngyuen et al. (2018)[229] the SCS is amongst the most important large marine ecosystems and according to the United Nations Environmental Program the "*SCS countries produce one tenth of the total marine fish catch of the world and in the year 2030 China would consume by itself 40% of the total global fish production"*.[230]

Thus, further Ngyuen et al. also claims that the environmental degradation and the depletion of the fish stocks are at such a critical level that the environmental security might become an issue. According to the aforementioned scholars the large-scale land reclamations followed by the building and construction of artificial islands has led to the destruction of coral reefs which are the habitats of many marine species, subsequently this has led to the destabilization of the marine ecosystem and poses a direct threat to endangered species.[231]

Following an in-depth outline of the provisions of the UNCLOS as well as their scope and applicability in international law and through the action of international organizations in the SCS, it is essential to identify the correlation between a severe degradation of the marine environment such as the depletion of fish stocks the destruction of coral reefs and fragile marine ecosystems and

[228] United Nations, *United Nations Convention on the Law of the Sea* (UNCLOS). (1982), Digitized by UN Library Geneva: United Nations Convention on the Law of the Sea. (p.90).
[229] Nguyen C.H; Vu H.D. (2018). Environmental Issues in the South China Sea. Legal Obligations and Cooperation Drivers. International Journal of Law and Public Administration 1(1) (Jun 2018). Redfame Publishing ISSN 2576-2192.
[230] Ibidem, p.8.
[231] Ibidem, p.9.

the actions taken by China in the South China Sea. This section will require a more detailed analysis of the landmark ruling Philippines versus China of the 12th of July 2016, as well as to take a closer look at the role of China. In other words, this section will look at territorial claims in the South China Sea from an angle of environmental responsibility and environmental security.

2.2. Landmark ruling PCA-Case No. 2013-19 Philippines vs. China: international maritime law as coercive tool to preserve the marine environment

As previously established the UNCLOS is an important convention in terms of regulating territorial claims in the SCS, but it also constitutes a framework that allows to set boundaries to the exploitation of marine resources of the SCS. The convention promotes the protection of the marine environment and seeks to establish methods to prevent and limit marine pollution. However international law cannot overrule state sovereignty and is therefore limited in its power of enforcement.

Figure 4: Satellite images of artificial island "Money Island", Paracel Islands
This island is is part of the grouping of the Paracel islands. The image in the left was taken on 25 February 2014, the image on the right on 12 June 2022; an illustration of China´s progress of artificial island building. *(Source: "Money Island". Asia Maritime Transparency Initiative", 7 May 2024, url: Money Island | Asia Maritime Transparency Initiative (csis.org))*

The Permanent Court of Arbitration (PCA) Case No. 2013-19 Philippines vs. China can be exemplified to illustrate the role of China in the SCS and why China plays a pivotal role when it comes to environmental responsibility in the SCS. This section corresponds to an in-depth analysis of PCA Case No. 2013-19, and illustrates on one hand the hegemonic claims of China and their actions in the SCS, and on the other hand showcases the limits of international maritime law when it comes to defend legitimate claims of other states (claims that are in accordance with international

maritime law) and the signification that the aforementioned has for the protection of the environment.

It is therefore of the utmost importance to dissect and analyze parts of the Award issued by the permanent court of arbitration. The findings of this section are based on the award published on 12 July 2026.

The award or ruling itself is divided into ten parts. Parts 1-4 consist of an introduction, the procedural history as well as the relief requested & submissions and preliminary matters. The parts 5-8 form the main body of this landmark ruling; those 4 parts individually address the 4 categories of dispute, or the main submissions brought to the Court by the Philippines. Part 9 contains the ruling as well as an outlook and the future behavior of the countries involved in the dispute, notably the Philippines and China.

The first and foremost tactical decision that has to be addressed is Chinas decision to not participate to the arbitration court´s hearings. According to Annex VII, Article 9 of the UNCLOS entitled default of appearance: "*If one of the parties to the dispute does not appear before the arbitral tribunal or fails to defend its case, the other party may request the tribunal to continue the proceedings and to make its award. Absence of a party or failure of a party to defend its case shall not constitute a bar to the proceedings. Before making its award, the arbitral tribunal must satisfy itself not only that it has jurisdiction over the dispute but also that the claim is well founded in fact and law*."[232]

The wording of the Convention explicitly allows non-participation of one of the parties and this does not result in a dismissal of the case. However, in such a case the arbitral tribunal must fulfil two conditions, such as to verify that is has jurisdiction over the case but also that the claim is "*well founded in law and fact*".[233]

China is bound by the ruling of the tribunal and underlies international maritime law even if it does not participate to the court hearings. However, the non-participation of China to the hearings already shows the involvement of China as well as it gives an indication of a certain lack of

[232] United Nations, *United Nations Convention on the Law of the Sea* (UNCLOS). (1982), Digitized by UN Library Geneva: United Nations Convention on the Law of the Sea. (p.186).
[233] Ibidem, p.186.

coercion of legal bodies of international law. This lack of coercive power will reappear at different stages, most notably at the stage of the award publication and China´s non-compliance.

The claims submitted by the Philippines can be divided into four categories by the subject matter as well as a gradual increase of seriousness.

The first set of claims addressed by the Philippines against China are related to the identification of the legal source that governs the SCS as well as to decide whether the justification of China is in accordance with that very same legal source applicable in the SCS, notably the UNCLOS. The Philippines have submitted two claims against China claiming that the latter does not respect the provisions of the 1982 UNCLOS: "*China's maritime entitlements in the South China Sea, like those of the Philippines, may not extend beyond those expressly permitted by the United Nations Convention on the Law of the Sea ("UNCLOS" or the "Convention");*"[234]

The second claim corresponds to China having based its territorial claims in the SCS solely on the historic rights and the "nine-dash line", which does not constitute a legitimate claim under international maritime law: "*China's claims to sovereign rights jurisdiction, and to "historic rights" with respect to the maritime areas of the South China Sea encompassed by the so called "nine dash line" are contrary to the Convention and without lawful effect to the extent that they exceed the geographic and substantive limits of China's maritime entitlements expressly permitted by UNCLOS;*"[235]

The second set of claims are related to Article 121 of the UNCLOS[236], with regards to Scarborough Shoal and parts of the Spratly Islands. Those territories were claimed by both countries, however according to the definition of an island in virtue of article 121 of the UNCLOS none of the claimed territories would generate the right of an EEZ (200 nautical miles) or of a continental shelf, thus not allowing any of the two claimant states to create a zone of influence around these rock formations according to the UNCLOS. Article 121 paragraph 3 states that in order to generate an EEZ an island or any formation of land in the ocean must be able to "*sustain human habitation or*

[234] PCA Case N°2013-19 (2016). In the matter of the South China Sea Arbitration before an Arbitral Tribunal constituted under Annex VII to the 1982 United Nations Convention on the Law of the Sea between the Republic of the Philippines and the People´s Republic of China: AWARD.PH-CN-20160712. (p.41).
[235] United Nations, *United Nations Convention on the Law of the Sea* (UNCLOS). (1982), Digitized by UN Library Geneva: United Nations Convention on the Law of the Sea. (p.41).
[236] Ibidem, p.48.

economic life of its own". The rocks in question do not qualify for the categorization of an island and therefore no rights and even less the exercise of national sovereignty can be attached to those rock formations.

The third set of claims submitted by the Philippines are related to China´s activities throughout the SCS. These activities must again be categorized in three sub-categories. The first sub-category corresponds to China interfering with some of the Philippines´ rights and prerogatives in the SCS as follows: "*China has unlawfully interfered with the enjoyment and exercise of the sovereign rights of the Philippines with respect to the living and non-living resources of its exclusive economic zone and continental shelf;*"

As per the tribunal´s award, those interferences are classified into living and non-living resources, that include the construction of artificial islands, the exploration for oil and other natural resources, hindering other vessels from navigation and matters related to fishing and the harvesting of living resources in the SCS in a way that is detrimental to the environment.

"*The new results indicate that the People's Republic of China (PRC) is responsible for at least 39 km2 of damage from shallow dredging and 69 km2 of damage from giant clam harvest using propellers to dig up the bottom within the Greater Spratly Islands [...] Vietnam is responsible for shallow dredging covering approximately 0.26 km^2. The overall damage to coral reefs within the Greater Spratly Islands covers at least 124 km^2, of which PRC is responsible for 99%.*"[237]

The second sub-category corresponds to a failure in protecting the marine environment in the SCS.

"*China has violated its obligations under the Convention to protect and preserve the marine environment at Scarborough Shoal, Second Thomas Shoal, Cuarteron Reef, Fiery Cross Reef, Gaven Reef, Johnson Reef, Hughes Reef and Subi Reef;*"[238]

The third sub-category is characterized by the allegation that China is severely harming the marine environment by their activities in the SCS, notably the destruction of coral reefs for trade by building artificial islands in the SCS; this tactic is used to enlarge rocks and sand banks in order

[237] PCA Case N°2013-19 (2016). In the matter of the South China Sea Arbitration before an Arbitral Tribunal constituted under Annex VII to the 1982 United Nations Convention on the Law of the Sea between the Republic of the Philippines and the People´s Republic of China: AWARD.PH-CN-20160712. (p.329).
[238] Ibidem, p.41.

for them to become islands in accordance with the UNCLOS and therefore generate an EEZ, a continental shelf and allowing Chinese supremacy over the waters around those artificially built islands.

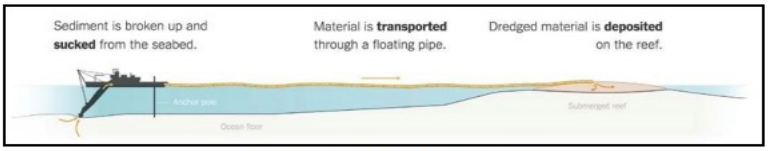

Figure 12: Dredging Operations
Second Carpenter Report, p. 10, reproduced from "What China Has Been Building in the South China Sea," New York Times (27 October 2015)

Figure 5: Chinese offshore dredging for the construction of artificial islands in the South China Sea *Depiction of Chinese dredging activities drawn from the award reports. (Source: PCA Case 2013-19 Philippines vs. China, Award published on 12 July 2016)*

"*This illegal activity disturbed the tranquility of the ecosystem and habitat of important species of marine life and, at the same time, caused irreparable damage to the marine environment of the area. It might be noted that the gathering and trade of corals violate the provisions of three (3) international conventions to which China is a signatory, namely, the Convention on Biological Diversity which entered into force on 29 December 1993; the RAMSAR Convention adopted in Iran in 1971, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which entered into force on 01 July 1975.*"[239]

The fourth set of claims submitted by the Philippines is linked to Chinese activities leading to an aggravation of the tension between the two countries. The fourth claim all allegedly, and later confirmed, unlawful activities pursued by China in the SCS, as follows: "*China has unlawfully aggravated and extended the dispute by, among other things: (a) interfering with the Philippines' rights of navigation in the waters at, and adjacent to, Second Thomas Shoal; (b) preventing the rotation and resupply of Philippine personnel stationed at Second Thomas Shoal; (c) endangering the health and well-being of Philippine personnel stationed at Second Thomas Shoal; and (d) conducting dredging, artificial island-building and construction activities at Mischief Reef, Cuarteron Reef, Fiery Cross Reef, Gaven Reef, Johnson Reef, Hughes Reef and Subi Reef;*"[240]

[239] Ibidem, p.323.
[240] Ibidem, p.42.

Figure 6: Chinese dredging activities at Mischief Reef on 16 March 2015
This satellite image illustrates the scope of the dredging activities of China at Mischief Reef, Spratly Islands. This image was taken before the landmark ruling China vs. Philippines in July 2016. *(Source: "Mischief Reef". Asia Maritime Transparency Initiative, 7 May 2024, url: Mischief Reef | Asia Maritime Transparency Initiative (csis.org))*

In section IX of the present award entitled "*the Future Conduct of the Parties*", the Philippines ask China to discontinue their unlawful activities as well as to take responsibility for the protection and the preservation of the marine environment in the SCS: "*China shall respect the rights and freedoms of the Philippines under the Convention, shall comply with its duties under the Convention, including those relevant to the protection and preservation of the marine environment in the South China Sea, and shall exercise its rights and freedoms in the South China Sea with due regard to those of the Philippines under the Convention*".[241]

In their submission 15, the Philippines establish a direct connection between territorial sovereignty and the "duty to protect and preserve the marine environment" in the SCS. Environmental responsibility goes hand in hand with the exercise of sovereignty over a specified part of the sea. It could be argued that even if China unlawfully occupies and carries out activities in areas of the South China Sea, it would be responsible for the protection of the environment. In other words, claiming rights over a specific territory includes the responsibility and duty to protect and preserve

[241] Ibidem, p.465.

the environment. The U.S.-China economic and Security Review Commission published a review of the landmark ruling Philippines vs. China. The conclusions drawn from that paper are both insightful and alarming as they claim to predict a trend that has ever since 2016 only been confirmed. China considered the ruling "null and void and (having) no binding force"[242]; on top of rejecting the ruling of the arbitration court China also issued a set of responses covering the four main submissions of the Philippines. Therefore, China threatened to increase their presence in disputed territories.

Instead of complying with the award, China issued a set of responses suggesting increasing their military presence in the SCS, specifically in the waters that it de facto claims.[243] The People´s Republic of China also reiterated their activities related to the search of natural resources, hydrocarbons and mineral resources in the waters that are the source for disputes.[244] Furthermore, China also threatened to impose economic sanctions onto the Philippines in retaliation to their submission to the Permanent Court of Arbitration.[245]

However, the major issue corresponds to the message that China sends to the world. By rejecting the ruling of the arbitration court, China proves to the world that international law is not compulsory; subsequently this also heavily impacts the duty to preserve and protect the marine environment – a necessity that has become but an option.

According to Nguyen et al. (2018): "*the richness of the marine living resources of the SCS depends very much upon the biodiversity and health of its coastal and marine ecosystems […] This environmental security issue will become a human security issue due to its negative impacts to the politics economics and social landscape of the region.* "[246]

This argument sums up the key problems that the South China Sea is currently facing, and it also allows to establish a direct causality between the environment as well as economic and political

[242] Campbell, C.; Salidjanova, N. (2016). South China Sea Arbitration Ruling: What Happened and What´s Next? U.S.-China Economic and Security Review Commission: Issue Brief.
[243] Ibidem, p.3.
[244] Ibidem, p.4.
[245] Ibidem, p.4.
[246] Nguyen C.H; Vu H.D. (2018). Environmental Issues in the South China Sea. Legal Obligations and Cooperation Drivers. International Journal of Law and Public Administration 1(1) (Jun 2018). Redfame Publishing ISSN 2576-2192. (p.1).

stability within the region. In order to interpret the above mentioned quote it is important to understand that environmental responsibility and environmental security are closely interconnected. The degradation of the environment specifically of the marine environment will have a consequence on the political stability in the region and therefore also strongly impact economic development which also has repercussions on social structures.

The environmental degradation of the marine ecosystem the South China Sea is directly linked to large scale rent reclamations as well as the construction of artificial islands by the People's Republic of China. The International Court of Justice has ruled against China in the landmark ruling of the 12th of July 2016 in application of the UNCLOS. However, China has ever since disregarded this ruling in accordance with International Maritime law. According to Nguyen et al. (2018): "China *has reclaimed nearly 14 square kilometers of reef in the SCS and satellite images have shown the progress of China's activities which have drastically outstripped the pace of extent of other countries efforts; for example the Subi reef alone was expanded by 74% of its original size in only two months with filling occurring at an average rate of at least 32 square meters per day.*"[247]

According to Nguyen et al. (2018):[248] "*escalating tensions have led to widespread structural reinforcement of military outposts on many reefs via dredging and filling satellite images indicated at least 160 square kilometers of coral reef damage including seventeen square kilometers in essentially permanent damage from filling and channel/harbor dredging in 143 square kilometers of decadal scale damage from dredging for building materials and giant clam harvesting".*

The Chinese practices are described as a "*widening environmental crime scene*" as well as "*attempts to turn rocks into islands and bolster its expansive claims*".[249]

This alarming trend aligns with the statements of other scholars such as McManus (2016):
"*This combination of fisheries effort enhancement and subsidy are driving the regional fisheries into a much worse state than the poor states that market forces alone would have induced".*[250]

[247] Ibidem, p.10.
[248] Ibidem, p.10.
[249] Ibidem, p.11.
[250] Ibidem, p.12.

According to McManus (2016) and Nguyen et al. (2018), China plays a central role in the degradation of the marine environment in the SCS. This trend also heavily affects environmental security and moreover political economic and military security within the South China Sea. China has a key role in ensuring the stability within the region, hence it appears pertinent to take a closer look at the role of China with regards to environmental responsibility territorial claims the degradation of the marine environment in the South China Sea in direct relation with security issues.

A paper published by Kuik C.C. (2017)[251] questions the contradiction in Chinese policies throughout the SCS; on one hand China engages with the Association of Southeast Asian Nations (ASEAN) countries, but on the other hand China displays a growing assertiveness in the SCS.

Prior to the landmark ruling Philippines versus China in 2016 there have been other incidents confirming a trend towards Chinese assertiveness in the South China Sea; according to Kuik C.C. (2017), China had issued warnings as early as 2008 towards international energy firms to no longer seal deals with Vietnam; jointly China had increased their naval presence in the South China Sea and in 2009 China started to expose and confiscate as well as detain foreign fishing vessels.[252]

According to the same source in that very same year China had expelled 147 foreign ships detained 33 Vietnamese boats and 433 fishermen. On 6 May 2009 Malaysia and Vietnam have jointly file the submission to the UN Commission against China not respecting the provisions of the UNCLOS when it comes to the limits of the continental shelf however China has contented themselves to issue a note verbal by which they claimed jurisdiction over the majority of the South China Sea in virtue of the nine-dash line.[253]

"China has indisputable sovereignty over the islands in the South China Sea and the adjacent waters and enjoys sovereign rights and jurisdiction over the relevant waters as well as the seabed

[251] Kuik C.C. (2017). Explaining the Contradiction in China´s South China Sea Policy: Structural Drivers and Domestic Imperatives. China An International Journal 15(1):163-186. (PDF) Explaining the Contradiction in China's South China Sea Policy: Structural Drivers and Domestic Imperatives (researchgate.net)
[252] Ibidem, p.169.
[253] Ibidem, p.169.

and subsoil thereof China´s sovereignty and related rights and jurisdiction this South China Sea are supported by abundant historical and legal evidence [...] the Republic of Philippines occupation of some islands and reefs of China´s Nansha islands as well as other related acts constitutes infringement upon China´s territorial sovereignty".[254]

However, it is insufficient to only state China´s de facto growing presence in the South China Sea ever since the early 2000s. It is even more important to identify the reasons as to why China developed such strong hegemonic claims in the SCS. According to Kuik C.C. there are several major driving forces that are at the origin of Chinese motivations. One important factor constitutes the fast-changing regional environment according to Michael Wesley (2012). Another central factor corresponds to economic interests of China, more specifically a high demand for energy resources and the related fear of a scarcity of oil supply as well as maritime transportation security. According to scholars the South China Sea is a "*vital strategic and economic lifeline"* for China. The strategic importance of the South China Sea has exponentially grown for China over the last yes with a special focus on international maritime trade routes as well as an interest in natural resources and marine livestock.

Political motivations are another important driving force responsible for an increase in assertiveness of China throughout the SCS, notably through an increase of U.S. military presence and a general internationalization of the region.
It is important to mention at this point that political motivations are not part of this thesis as the overarching goal is to identify sources of marine pollution, to analyze environmental responsibility concerning the law of the sea and the goal to finding sustainable long-term solutions against marine pollution and environmental degradation in the South China Sea.

[254] Ibidem, p.169.

Part III: The alignment of sustainable economic growth with environmental protection and security throughout the SCS

As outlined in the early stages of this paper, the pollution of marine ecosystems throughout the SCS has become a major issue not only on a national, but also on a regional and international level. A first part consisted in identifying major threats to the marine ecosystems in the SCS and trace them back to their origins to identify and gain a better understanding of the current challenges. A classification of pollutants in terms of the severity and exposure allow a mapping of the most severe threats to the ecosystems within the SCS and therefore to prioritize further steps to be taken.

The second part was consecrated to the analysis of the law of the sea in the light of environmental responsibility and in connection to territorial claims within the region of the SCS. An attempt to link territorial claims and therefore state sovereignty to environmental responsibility allow to uncover further challenges when it comes to implementing measures that would ensure sustainable economic growth.

The aim of a third and conclusive part will be to use the previously gained knowledge to propose as well as to assess projects and initiatives that have tried to tackle the problematic of aligning sustainable economic growth with environmental protection and environmental security throughout the SCS.

Marine pollution does not consider political borders and therefore solutions must be found through cohesion and based on an eco-friendly regional governance. However, the SCS is a geostrategic complex and politically fragmented region with a multitude of national actors that follow a diverse set of agendas.

Is it possible to maintain regional cohesion while at the same time ensuring environmental security and sustainable economic development?

1. United Nations

This problematic cannot be solved on a national level, and it is therefore crucial to take into consideration third parties and international stakeholders, such as international organizations, non-governmental organizations (NGOs) and private initiatives, such as startups that have taken up the challenge and are aiming to reverse marine environmental degradation through sustainable economic growth.

1.1. The UN Sustainable Development Goals

Therefore, the third part of this thesis is dedicated to the identification of global players endorsing and advocating sustainable economic growth to combat environmental issues such as marine pollution as well as climate change and many others. This part is divided into two main sections: the first section focuses on the operational work of the United Nations in the context of the implementation of the 2030 UN Agenda and the 17 sustainable development goals[255]. The second section will be dedicated to the United Nations Ocean Decade from 2021 to 2030[256]; this is a program coordinated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), more precisely by the Intergovernmental Oceanographic Commission (IOC) of UNESCO that was specifically nominated by the UN General Assembly to fulfill this task[257]. This initiative builds on the slogan: "the science we need for the ocean we want".[258]

The Ocean Decade focuses on 10 specific challenges such as challenge number one "*to understand and beat marine pollution*"[259] or challenge number two to *"protect and restore ecosystems and biodiversity"*[260], challenge number three aims to reach the goal to *"sustainably feed the global*

[255] UN, 2015. Transforming our world: the 2030 Agenda for Sustainable Development. United Nations, A/RES/70/1, Agenda items 15 and 16 and 116, 1-35.
[256] "United Nations Decade of Ocean Science for Sustainable Development (2021-2030)". Unesco, url: United Nations Decade of Ocean Science for Sustainable Development (2021-2030) | UNESCO. Accessed 6 May 2024.
[257] "Vision 2030 The Ocean Decade´s strategic ambition setting process on the road to 2030." Oceandecade, url: Vision 2030 (oceandecade.org). Accessed 6 May 2024.
[258] Thompson, Peter. "United Nations Decade of Ocean Science for Sustainable Development (2021-2030)". Unesco, url: United Nations Decade of Ocean Science for Sustainable Development (2021-2030) | UNESCO. Accessed 6 May 2024.
[259] "10 Challenges Ocean Decade Challenges for collective impact". Oceandecade, url: 10 Challenges - Ocean Decade. Accessed 6 May 2024.
[260] Ibidem.

population"[261], and challenge number four aims at "*developing a sustainable and equitable ocean economy"*[262]. These are but a few examples to illustrate the purpose and goals of the Ocean Decade initiative.

It is important to note that the first section will be based on projects coordinated and implemented by the United Nations Industrial Development Organization (UNIDO) in cooperation with the United Nations Environment Programme (UNEP) as well as the Global Environment Facility (GEF). These projects aim at fulfilling the sustainable development goals within the 2030 UN Agenda.

However, the second section will focus on a different set of goals and challenges, the Ocean Decade initiative aims at overcoming 10 main challenges. What is interesting to observe is that the 10 challenges of the Ocean Decade do have similarities with the 17 sustainable development goals of the UN Agenda.

Both commitments aim at fulfilling their mission by 2030 and given the current international landscape, an intersection of these two programmes cannot be avoided. Even more so the Ocean Decade program can build on former United Nations projects to apply knowledge from past experiences as well as to integrate the lessons learned. It is therefore pertinent to analyze both initiatives to propose viable long-term solutions that would allow to reverse environmental degradation and decrease marine pollution in the South China Sea.

Given that one of the aims of this third part are to find solutions that are replicable in other scenarios and other geographic and political settings, drawing knowledge from both sustainable development projects as well as an initiative for ocean preservation on the long term can only be beneficial for the findings of this analysis. The Sustainable Development Goals (SDGs) implemented by the United Nations are part of a global initiative with the aim to make a difference and empower stakeholders to take joint action to achieve a better future.

[261] Ibidem.
[262] Ibidem.

Figure 7: The United Nations Sustainable Development Goals
This illustration serves as an overview and a graphic representation of the SDGs. *(Source: "The UN Sustainable Development Goals". UN Environment Management Group, 7 May 2024, url: The UN Sustainable Development Goals – UN Environment Management Group (unemg.org))*

The SDGs are a novelty compared to previous development plans as they build on the interdependence and interconnection between each individual goal. A deeper understanding of how the SDGs are interconnected, allows to take into account the grand scheme and work on holistic solutions. For instance, in the context of marine pollution in the SCS the following SDGs are closely linked.

1.2. Circular Economy and Industry 4.0

The 2030 UN Agenda seeks to reduce inequality by promoting "*cross sectorial intergovernmental cooperation towards a systemic change"*, according to Dantas et al. (2020).[263]

In the same paper published in 2018, Dantas et al. are preforming a close examination based on a thorough literature review of the CE-I4.0 nexus, which consists of a synergy between circular economy and I4.0, also known as Industry 4.0.

[263] Dantas, T.E.T., de-Souza, E.D., Destro, I.R., Hammes, G., Rodriguez, C.M.T., Soares.S.R. (2020) : How the combination of Circular Economy and Industry 4.0 can contribute towards achieving the Sustainable Development Goals. Sustainable Production and Consumption 26 (2021) 213-227.

Ghisellini et al. (2016)[264] identify the concept of Circular Economy (CE) as "*systematic shift to an economic feasible, but regenerative model, grounded in the reinsertion of used resources through material cycles*." In other words, CE is viewed as a model that allows to extend the life cycle of a product or a natural resource. Ghisellini et al. (2018)[265] further state that *"CE would promote the minimization of resource consumption, waste generation and emissions, while still ensuring socioeconomic development."* Lieder and Rashid (2016)[266] claims that CE is based on the interconnection between resource scarcity, environmental impacts, and economic benefits.

Based on a definition drawn from research carried out by and synthesized in the paper of Dantas et al. (2020)[267], CE is being defined as *"system/wide change directly linked to resource extraction, waste generation, product design, environmental consciousness, innovative business models, and integrative policies."*

According to Khajuria (2021), the concept of Industry 4.0 includes an increase in digitalization, prompt information, *"[an optimization] of the supply chain of resources by reducing resource utilization and environmental impacts*."[268] The nexus of Circular Economy and Industry 4.0 is widely accepted as strategy that would allow to "*achieve the UN Sustainable Development Goals.*"[269]

The combination of artificial intelligence (AI) and CE to achieve the SDGs raises an important issue related to the social aspects of sustainability, according to Bai et al. (2020)[270] and Lee

[264] Ghisellini, P., Cialani, C., Ulgiati.S. (2016). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. Journal of Cleaner Production, Towards Post Fossil Carbon Societies: Regenerative and Preventive Eco-Industrial Development 114, 11-32.
[265] Ghisellini, P., Cialani, C., Ulgiati.S. (2018). Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. A literature review. Journal of Cleaner Production 178, 618-643).
[266]Lieder, M., Rashid. A. (2016). Towards circular economy implementation: a comprehensive review in context of manufacturing industry. J. Clean. Prod. 115, 36-51.
[267] Bocken, N.M.P., Olivetti, E.A., Cullen, J.M., Potting, J., Lifset.R. (2017). Taking the Circularity to the Next Level: a Special Issue on the Circular Economy. J. Ind.Ecol. 21, 476-482.
[268] A. Khajuria. (2021). Nexus of Circular Economy and Industry 4.0 to achieve the UN Sustainable Development Goals.
[269] Ibidem.
[270] Bai, C., Dallasega, P., Orzes, G., Sarkis.J. (2020). Industry 4.0 technologies assessment: a sustainability perspective. Int. J. Prod. Econ. 229.

(2020)[271]. Korhonen et al. (2018)[272] and Romero et al. (2020)[273] emphasize the repercussions of CE and a general shift towards a sustainable economic growth model would have on the employment market calling for the disappearance of certain professions. According to Khajuria (2021)[274] AI as part of I4.0 plays an important role in waste management as well as a decrease in pollution, which is another important factor in the context of marine pollution in the SCS. This theory goes in line with the need to evolve to meet specific standards that would allow the achievement of the 17 SDGs.

Some of the SDGs are directly linked to marine pollution and building an economic framework around the prerequisites of the 2030 UN Agenda could be one solution to tackle the issue of marine pollution as well as to respond to other societal needs.

Therefore SDG 9 "*sustainable cities and communities*"[275] would allow to drastically reduce marine pollution. As outlined in part I, most of the marine pollution is land-based. A shift towards sustainable cities and communities means a decrease of waste and subsequently a decrease in pollution, notably microplastic.

SDG 12 "*responsible consumption and production*"[276] builds on CE and therefore on environment preserving practices such as recycling or even up cycling.

According to Priyadarshini et al. (2020) "*waste prevention, reuse, recycling, safe waste disposal*"[277] are major characteristics of CE. According to a definition of CE by Khajuria (2021),

[271] Lee. S. (2020). Role of social and solidarity economy in localizing the sustainable development goals. International Journal of Sustainable Development and World Ecology 27, 65-71.
[272] Korhonen, J., Honkasalo, A., Seppälä.J. (2018). Circular Economy: the Concept and its Limitations. Ecol. Econ. 143, 37-46.
[273] Romero, D., Stahre, J., Taisch. M. (2020). The Operator 4.0: towards socially sustainable factories of the future. Comput. Ind. Eng. 139, 106128.
[274] Khajuria. A. (2021). Nexus of Circular Economy and Industry 4.0 to achieve the UN Sustainable Development Goals. (p.33).
[275] UN, 2015. Transforming our world: the 2030 Agenda for Sustainable Development. United Nations, A/RES/70/1, Agenda items 15 and 16 and 116, 1-35. (p.14).
[276] Ibidem, p.14.
[277] P.Priyadarshini; P.C. Abilash. (2020). Circular Economy practices within energy and waste management sectors of India: A meta-analysis. Institute of Environment & Sustainable Development, Banaras Hindu University, Varanasi 221005, Uttar Pradesh, India.

"CE helps to utilize natural resource efficiency while reducing waste generation and preventing pollution."[278]

The concept of CE is an instrument if not an implementation strategy towards the achievement of the SDGs, goals that are interconnected and impact one another interchangeably. The synergy between those goals can be perceived as both an opportunity and adversity, depending on the local implementation process of any given UN project.

A preliminary emphasis on the definition of CE in the context of sustainable economic growth is crucial because it is a central building piece of ongoing UN projects that aim to achieve sustainable economic growth throughout several countries in the SCS. Sustainable growth leads to economic stability which allows to invest in social infrastructures such as schools and education. Knowledge is another key factor that allows for sustainable economic growth and a decrease of pollution, especially marine pollution. For instance, in the fishing industry a sustainable fishing practice as well as the creation of added value to the original product can have a beneficial impact on society as well as the environment.

The modus operandi of the Ocean Decade shares similarities with the sustainable development goals, that are mostly used by the United Nations Industrial Development Organization. There are 17 sustainable development goals and 10 challenges within the ocean decade initiative. The challenges set forth by UNESCO intersect with the SDGs while having a stronger focus on fighting marine pollution. The 10th challenge is particularly interesting as it goes hand in hand with findings and lessons learnt of specific projects implemented in the SCS, more specifically in China that build on changing societies mindset when it comes to Environmental Protection and sustainable economic growth.

[278] Khajuria. A. (2021). Nexus of Circular Economy and Industry 4.0 to achieve the UN Sustainable Development Goals. (p.33).

Figure 8: The UN Ocean Decade challenge 10, change humanity´s relationship with the ocean
A depiction of challenge 10 according to the UN Ocean Decade depiction to serve as comparison to the SDGs, both visually as well as content wise *(Source: "10 Challenges Ocean Decade challenges for collective impact". Oceandecade, 7 May 2024, url:* 10 Challenges - Ocean Decade*)*

The United Nations have implemented many projects in the field of environmental protection and sustainable development or sustainable economic growth. Most projects are endorsed and implemented by the United Nations Industrial Development Organization (UNIDO) in cooperation with the Global Environment Facility (GEF). The focus of this section is to analyze projects in the SCS to identify possible challenges, lessons learnt as well as to build on strategies that were successful and that have a replicability potential.

The selected projects are categorized by implementing country with a special focus on countries with territorial claims in the SCS, such as China, the Philippines and Vietnam. However, this analysis does also include projects in Cambodia, specifically the project CAPFISH that has proven to be specifically successful.

The selection of projects is spread over a period of approximately 15 years to illustrate the evolution of projects over time as well as to show that environmental protection through sustainable development is not necessarily a new and innovative concept as such, although its implementation might be.

Figure 9: The UN Ocean Decade Challenge 1 "understand and beat marine pollution" and Challenge 2 "protect and restore ecosystems and biodiversity"
A depiction of challenge 1 and 2 according to the UN Ocean Decade depiction to serve as comparison to the SDGs, both visually as well as content wise *a depiction of challenges 1 and 2 according to the UN Ocean Decade depiction (Source: oceandecade.org)*

1.3 UNIDO projects in the South China Sea region

a) China

UNIDO has implemented four (4) major projects over the course of the last two decades including the reduction of mercury pollution, POPs and Chemical Pollution Solutions, pollution through room air-conditioning pollution and pollution through refrigerators as well as a country plan for inclusive and sustainable industrial development in China.

This project was launched in the context of Inclusive Sustainable Industrial Development (ISID) and the UNIDO Green Industry Initiative and adheres to the implementation of the Stockholm Convention of POPs. The main objective of this project is to identify a replicable methodology in the field of chemical management in order to eliminate POPs and SAICM chemical wastes in the production process and the life cycle of products in Tianjin and Yiyang. The project was launched in X with a total budget of six (6) million dollars over a period of sixty (60) months.

The project is compatible with the National Implementation Plan (NIP) of the Stockholm Convention, notably by *"[implementing] with the objectives of promoting the optimization and*

upgrading of industrial structure and constructing a resource saving and environment friendly society."[279]

China, within the framework of a socialist system, still follows the economic concept of Five-Year Plans. The project fits into the goals set in the "*12th Five-Year Plan for National Economic and Social Development*"[280] as it specifies goals such as "*to focus on energy conservation, improve the incentive and restraint mechanisms and accelerate the construction of a resource saving and environment friendly society*"[281] as well as to "*adjust product and industrial structures, promote cleaner production, develop a cyclic economy, boost effective utilization of resources, create new economic growth openings and increase employment opportunities, improve the environment awareness of the whole society and the level of public participation, and ultimately promote sustainable development.*"[282]

The implementation of the project also goes in line with the 2009 Circular Economy Promotion Law as well as the Eco Civilization Programme, a program that aims to reconcile human industrial activity with the ecosystem.

This specific project was chosen in the context of the third part of this research not so much because of the industrial land/based pollution it seeks to reduce, but mostly due to its outlook that is elaborated in the project document. The goal of the present thesis is to identify strategies that allow to reverse the degradation of the marine ecosystem in the SCS or at least to decrease marine pollution. One of the main aspects are the sustainability of given strategies in question as well as their replicability on a local, regional as well as international level.

Specific sections of the project document are consecrated to the above-mentioned points, more specifically global environmental benefits, sustainability, and replicability - for the latter a differentiation is made between national, regional, local, and international replicability. By gaining

[279] United Nations Industrial Development Organization; *POPs and Chemical Pollution Solutions through Area-Based-Ecoeffective-Management.* Project Document; Project ID 15073. (p.5)
[280] Ibidem, p.5.
[281] Ibidem, p.5.
[282] Ibidem, p.5.

a deeper understanding of those aspects it is possible to gain knowledge that can be used and replicated as part of the solution in the SCS.

As per the project document, this project aims to eliminate "*POPs and other toxic chemicals from products and production life cycles in Tianjin and Yiyang. The project therefore addresses the socio-economic impact of exposure to POPs and hazardous chemical pollution*".[283] It is further stated in the project document that the fast pace economic development in China comes at a heavy cost "*and is accompanied by chronic environmental degradation and worsening pollution which translates directly to a social and economic cost. The burden of pollution is not distributed evenly across the country and Chinas poor are disproportionally affected by the environmental health burden*".[284]

The long-term consequence of chemical pollution are therefore long/term health issues, specifically respiratory diseases, and heart disease. The project document further states that cancer and diseases of the nervous system as well as fertility issues can be directly linked to the exposure of industrial chemicals (as per the project document "*listed chemicals are lead, cadmium and arsenic*"[285]). Those chemicals are ingested or inhaled and bio/accumulate in the human body.

Therefore, the project does aim to not only decrease or eliminate the above-mentioned chemicals in industrial production, but it also aims at raising awareness and to change people's mindset. The lead concept is to shift the perception of society and societies and advocate an eco-effective approach through eco-effective solutions. This concept also aims at pointing out the advantages of an eco-effective approach such as health, longevity and it also draws a connection with an increase of opportunities for women in the socio-economic realm. In the project document this concept is defined as follows "the big picture is a vision of a closed loop system where no harmful waste is generated. In this respect, the eco/effective approach is like a continuous improvement, ever striving, management system that ultimately seeks to create a closed loop economy."[286]

[283] United Nations Industrial Development Organization; *POPs and Chemical Pollution Solutions through Area-Based-Ecoeffective-Management.* Project Document; Project ID 15073. (p.24).
[284] Ibidem, p.24.
[285] Ibidem, p.24.
[286] Ibidem, p.24-25.

The goal of this project is to come up with an eco-effectiveness model that is both sustainable and replicable by focusing on three main pillars: resource sustainability, social responsibility, and employment opportunities. The implementation of those targets requires a shift in the mindset of people, a no waste philosophy and a drive for innovation allowing to elaborate new concepts and eco/effective approaches. In other words, eco-effectiveness stimulates innovation, but at the same time there would be no chance for an eco-effective approach without innovation.

"It requires at the operational level a critical analysis of unsustainable technologies and practices with emphasis on continuous material flows and ecologically neutral outputs."[287]

To operationally translate the no waste philosophy into action a focus on sustainable practices is key. This leads to the next pillar of social responsibility.

The project document states that "eco-effective management is underpinned by social responsibility taking account of the social and environmental concerns of consumers and stakeholders. Social responsibility and inclusiveness are further underpinned by the eco effective stimulus to create new and innovative employment opportunities."[288]

The human factor is another key component when it comes to applying an eco-effective strategy. Accountability as well as creating awareness with regards to the fragility of our ecosystems as well as to human health and well-being are important. The positive impact of an eco-effective approach as well as stimuli for innovation can be categorized as key comments of social responsibility.

Another incentive towards the implementation of an eco-effective approach is the creation of new employment opportunities on a large spectrum, as per the project document "the holistic framework that eco effectiveness generates, stimulates additional peripheral and supporting economic activity in a given industrial value chain which potentially spans the spectrum from community-based employment to high level technological skill sets."[289]

[287] Ibidem, p.25.
[288] Ibidem, p.25.
[289] Ibidem, p.25.

The most important characteristic besides its effectiveness is whether the findings and solutions gathered during this project are replicable on various levels, notably on a local, national and an international level. On a local level in China two main actors are the driving forces that will be decisive to which degree replicability can take place. On one hand local authorities can reapply national policies and integrate them in a 5-year local development plan. UNIDO project management[290] can also set in motion a project dissemination strategy that allows to share the achievements and incorporate them in the local development plans of other local authorities within China. On the other hand, companies that incorporate innovations in their production can act as a driving force for change.

On a national level the replicability potential depends on the presence of competent institutions such as the National Eco Effectiveness Knowledge Centre that was established in the context of this project. Such knowledge hubs can also be linked to research institutes and universities to share and circulate the acquired knowledge. Another national replicability factor is yet again eh project dissemination strategy that allows to circulate the projects finding on a larger scale, specifically on a national scale. The knowledge drawn from those findings can then be shared through the trickle/down effect from national authorities down to the smallest municipality.[291]

On an international level the backing of international organizations, international certification entities as well as political bodies are important to establish new eco-effective production processes. For instance, during this project the International Standards Organization (ISO) "has identified that eco effective principles have the potential to make industrial processes and consumption pattern more sustainable and greener".[292] Another important actor int he context of this project and in order to illustrate the general importance of the international political landscape. The EU Commission has initiated back in 2014 a CE program that advocates a design out phase of waste in the production process and that builds on innovations along the value chain, such as eco design, durability of the product and many more.[293]

[290] Ibidem, p.26.
[291] Ibidem, p.26.
[292] Ibidem, p.26.
[293] Ibidem, p.26.

A second project that was implemented starting in cooperation with UNIDO and funded by GEF is the project entitled "*Demonstration of Mercury Reduction and Minimization in the Production of Vynil Chloride Monomer in China*".[294] The overarching aim of this project is to reduce the negative impact of mercury pollution on human health as well as to mitigate the negative impact on the environment.

The main goal of this project in numbers is to reduce the use of mercury from by 50% by unit of production by the year 2020 (reference is 2010), as well as to recover 90% of the mercury used during production. Subsequently this would result in an estimated reduction of mercury consumption by 360.5 tons.[295] These results are to be achieved using low mercury "*best available techniques and best environmental practices"*[296] *(*BAT BEPs) technology as well as the application of alternatives that are 100% mercury free. The main challenge consists in the conversion process of the industrial production including the replacement of equipment and the adaptation of the preexisting facilities to new production processes.[297]

The advantages of are not only environmental but also economic. According to UNIDO project management the replacement from a high/mercury to a low/mercury catalyst can save up to US-Dollars 6.5 million per year. Therefore, companies in the context of this project have agreed to follow this strategy as well as to upgrade their production processes to an environmentally friendly and pollution reducing mechanism, notably using mercury-removal devices: *"Hydrochloric acid deep desorption technology, catalyst pumping system, rain and sewage diversion system, sulfide precipitation process".*[298]

These arrangements would lead to a substantial decrease of waste as well as a significant reduction in mercury pollution using a low-mercury technology. It would aim at saving $52.58 million, as well as to decrease the number of harmful & polluting agents by 335 tons, according to the forecast

[294] United Nations Industrial Development Organization; *Demonstration of Mercury Reduction and Minimization in the Production of Vinyl Chloride Monomer in China (VCM project);* Annex K: Environmental and Social Management Plan for the VCM Project.
[295] Ibidem, p.5.
[296] Ibidem.
[297] Ibidem, p.1.
[298] Ibidem, p.6.

of project management. On a yearly basis it would allow companies to save about $30 million, pollution-related waste can be reduced to less than 10%.

The project document follows the theory that the decrease of mercury pollution will also decrease economic loss. The danger emanating from hazardous and poisonous agents, such as mercury, affects the environment and human health - both of which have direct effects on society and indirectly affect economy and engender economic loss.

In 2021 UNIDO has launched a country programme in China in cooperation with the Department of International Trade and Economic Affairs within the ministry of Commerce of the PRC. The goal of this 2021-2025 country programme is to implement the United Nations Sustainable Development Cooperation Framework for China as well as to move towards an inclusive and sustainable industrial development (ISID) in China, through the implementation of the 14th Five-Year Plan of the Chinese Government.

The project the project document identified four different areas and goals that need to be fulfilled within this 14th 5-year plan which are as follows as per the project document: *"boosting innovation driven industrial growth, accelerating development of green industry and green industrial transformation*, *rural revitalization and smart agro-food systems*, *the promoting international cooperation for ISID."*[299]

The goal of this country program is for China to reach the sustainable development goals in different areas notably in its economy, how the Chinese economy is structured as well as ecology in green development. The focus will be to combat poverty and create a balance within the Chinese population in terms of quality of life and to prioritize not just economic growth as such but also to support innovation, specifically industrial production that is environmentally sustainable. To quote the project document and to illustrate the goal in one short sentence the idea corresponds to blue skies clear waters and clean soil. Major pillars of this country programme are going to be circular economy as well as ecological production processes moving towards a more ecological civilization.[300]

[299] United Nations Industrial Development Organization. (2021-2025). *Country Programme for Inclusive and sustainable industrial development*. (p.2).
[300] Ibidem, p.6.

Two sectors will be looked at more thoroughly notably the industrial sector as well as the rural and agricultural sector with the idea that a digitalization of agricultural production could help to boost the agricultural sector in China. This this strategy goes in line with the concept of circular economy and industry 4.0 Nexus that seeks to build on artificial intelligence an increased digitalization as well as a prolongation of a product life cycle and reusable resources. As stated earlier, UNIDO has already carried out a large number of projects based on Environmental Protection and sustainable economic growth such as the Stockholm convention on POPs, many partnerships and projects in cooperation with the global environment facility as well as a number of phase out projects regards to poisonous and hazardous agents used in industrial production.[301] UNIDO has also implemented a number of projects in cooperation with the International Centre on small hydropower. Such projects aim at increasing social responsibility within the corporate industrial sector in China.[302]

In other words, the country programme for China from 2021 to 2025 focuses on free main key players and key components Listed on the priorities in the project document priority number one would be "*people in prosperity*", priority number two *"the planet*" and priority number three "*partnerships*". Those three priorities art proof of the complexity and the interconnection of various factors to reconcile Environmental Protection including marine Environmental Protection as well as to establish and shift from a traditional economic landscape to a sustainable economic pattern.[303]

b) Vietnam

As one of the countries in the SCS that also voiced territorial claims, Vietnam has launched projects in cooperation with the General Environment Fund (GEF). For purposes of illustration one project is being picked during this analysis, notably the project entitled *"implementation of eco industrial park initiative for sustainable industrial zones in Vietnam"*. The project duration are 36 months with a total budget of over $3 million. The project is based on the creation of eco-industrial parks.

[301] Ibidem, p.10.
[302] Ibidem, p.13.
[303] Ibidem, p.24.

However, an analysis of this project document is only relevant with regards to the climate change focal area strategy and the international waters focal strategy.[304]
To the international waters focal area strategy are relevant because they are based on "*a multi-state corporation to balance conflicting water uses in transboundary surface groundwater basins while considering climate variability and change"*.[305]

Innovation and new technologies in the industrial sector are also mentioned such as the use of "*closed water loops and water cascading industrial zone industries which helps to increase the efficiency of what to use and groundwater sources can therefore be preserved"* and to *"rebuild marine fisheries and reduce pollution of coasts and large marine ecosystems (LMEs) while considering climate variability and change"*.[306]

These findings are of relevance because they are allowed to draw a connection between industrial land-based pollution that is one major source of coastal and marine pollution in the South China Sea.[307]

c) Philippines

In September 2022 a project of the duration of five years was launched in the Philippines incorporation with the United nations industrial development organization and the general environment fund among other partners the project is entitled: "*reduction of unintentionally produced persistent organic pollutants (POPs) and mercury for an environmentally sound approach on health care wastes management in the Philippines with a special focus on the pandemic*".[308] At this stage it is important to state that the pandemic has led to an increase to marine pollution through micro plastics specifically masks syringes and other medical equipment. According to the project document the main goal of the project is "*the protection of human health*

[304] United Nations Industrial Development Organization. *Implementation of eco-industrial park initiative for sustainable industrial zones in Vietnam.* Project Document. (p.23).
[305] Ibidem, p.23.
[306] Ibidem, p.28.
[307] Ibidem, p.24.
[308] United Nations Industrial Development Organization. (2022) *Reduction of Unintentionally produced Persistent Organic Pollutants (POPs) and Mercury (Hg) through an Environmentally-Sound Approach on Health Care Wastes management in the Philippines with a Special Focus on the Pandemic*. Annex J: Environmental and social Management plan.

and the environment through the reduction of unintentionally produced pops and mercury in the healthcare waste sector promoting environmentally sound approaches"[309]. The reduction of POPs in the healthcare waste the project also focuses on following points stated in the project document capacity building and awareness raising monitoring evaluation and lesson learned. The implementation of the project seeks to achieve three major goals notably to introduce "*an environmentally sound management of healthcare wastes, establish systems which can be replicated and scaled up to help ensure sustainability and promotion of a sustainable approach, highlight the pivotal role of women in this strategy both in their role in civil society and this medical staff and nurses in healthcare facilities being at the same time the population group most exposed to the risk and the ones which are on the front lines of fighting the virus at home and while in duty*".[310]

The above sighted goals of this project are important for the analysis and the findings needed to reduce marine pollution because they consider human health as an important factor that can both cause an increase in pollution but at the same time pollution can also cause the degradation of human health.

The concept of replicability on a different scale is also very important because the findings of this quite recent project will allow to replicate solutions strategies and lessons learned in different contexts and on different scales. Solutions can be applied in other geographical areas on local, regional as well as on a national or international level. Another important aspect corresponds to the role of women not only in this specific context, but also more generally when it comes to the societal component of pollution and the motivation and shift of mindset within the population. However, this is another complex subject that is going to be set aside as it does not align with the current topic.[311]

---

[309] Ibidem.
[310] United Nations Industrial Development Organization. (2022) *Reduction of Unintentionally produced Persistent Organic Pollutants (POPs) and Mercury (Hg) through an Environmentally-Sound Approach on Health Care Wastes management in the Philippines with a Special Focus on the Pandemic*. Annex J: Environmental and social Management plan. (p.21).
[311] United Nations Industrial Development Organization. (2022) *Reduction of Unintentionally produced Persistent Organic Pollutants (POPs) and Mercury (Hg) through an Environmentally-Sound Approach on Health Care Wastes management in the Philippines with a Special Focus on the Pandemic*. Annex J: Environmental and social Management plan. (p.21).

A second project is implemented by the United Nations Industrial Development Organization and funded by the general environment fund as proposed donor in the Philippines entitled "*Circular solutions to plastic pollution in the Philippines*" and was initiated in 2023.[312] Since this is a recent project, no data has yet been published and therefore no conclusions can be drawn as to the findings challenges goals and lessons learned in the context of reducing plastic pollution in the Philippines through circular economy.

d) Cambodia

Cambodia is not part of the six major states of the SCS that have made territorial claims however Cambodia faces similar challenges when it comes to microplastic pollution as well as to the pollution through POPs and other hazardous substances. Marine pollution does not only encompass the pollution of the water but also the pollution of marine flora and fauna. Therefore, it is relevant to analyze the following project entitled "CAPFISH Capture" and focuses on post-harvest fisheries development in Cambodia. The project was first launched in 2019 over a duration of 58 months until the 13th of June 2024, it is implemented by United Nations Industrial Development Organization in cooperation with a Cambodian government counterpart, notably the fisheries administration of the Ministry of Agriculture, Forestry and Fisheries (MAF). The project is funded by the European Union with a total budget of €16.9 million. CAPFISH is part of a bigger program called the "*Cambodia program for sustainable and inclusive growth in the fishery sector"*[313] and targets the sustainable development goals 1,2 and 9. The aim of this program is to achieve sustainable economic growth on the long term as well as to ensure food security and reduce poverty in Cambodia. Within the implementation of this project, it is important to note that project management has a special focus on synergies and the cooperation between the public and the private sector. The project management builds on the knowledge of pre-existing institutions, but it also builds on the knowledge of previously implemented projects that have already ended such as for example an EU funded project entitled "*promoting inclusive and sustainable growth in the*

[312] United Nations Industrial Development Organization. (2023). *Circular solution to plastic pollution in the Philippines*. Environmental & Social Screening Template.
[313] United Nations Industrial Development Organization. (2019-2024). *CAPFISH Capture – Post Harvest Fisheries Development*. Project Document.

agriculture sector: livestock and fisheries"[314] as well as a project funded by the United States Agency for International Development (USAID).[315]

The project CAPFISH is based on three main outputs:

- Output one focuses on technical competence and sustainability of local authorities that support the post-harvest fisheries.
- Output two seeks to enhance the "*private sector capacity to comply with international standards and market requirements relevant to the post-harvest fisheries*."[316]
- Output three focuses on enhanced business competitiveness of post-harvest fisheries through innovation and research and development.[317]

The three pillars or free outputs on which this project is based can be analyzed as the key stakeholders that allowed to implement changes towards sustainable economic growth and therefore indirectly the protection of the environment specifically the marine environment and a decrease of marine pollution. Those key stakeholders all public authorities the private sector as well as competitiveness based on research in development as well as innovation.

UNIDO has launched other projects in Cambodia such as the project entitled global clean tech innovation program to points accelerating clean tech innovation and entrepreneurship in startups and semi- and medium sized enterprises (SMEs) in Cambodia. The project management works in cooperation with the conversion government over a period of 60 months from 2022 to 2026 with a total budget of $1,417,890.00 dollars. The main donor of the project is GEF, with UNIDO as the main implementing partner. This project was selected for analysis because of its outline of so-called barrier categories as per the project documents. Those categories are relevant because they allow an insight as to the obstacles challenges and blockages faced when it comes to implementing innovation specifically clean tech innovation which allows for environmentally friendly sustainable economic growth and therefore helps reduce land-based pollution and marine pollution.

[314] Ibidem, p.19.
[315] Ibidem, p.19.
[316] Ibidem, p.27.
[317] Ibidem, p.31.

Project management has identified several barrier categories, which correspond to a lack of access for entrepreneurs to clean tech solutions. The project management also defines capacity building as a key factor in all economic sectors in order to promote sustainable green development on one hand and economic growth on the other hand. In conclusion the global clean tech innovation program identifies major weaknesses that slow down the innovation process in the fields of clean tech entrepreneurship and startups which therefore slows down the development of sustainable and environmentally friendly economic growth. Identifying the weaknesses of given frameworks such as a lack of a policy framework a lack of access to the market access to finance as well as lack of capacity help to work on solutions an order to accelerate clean tech in Cambodia as well as other countries with similar issues notably neighboring countries in the South China Sea.

1.4. The Ocean Decade

a) The ever-increasing importance of international organizations in the global dialogue

In the field of development cooperation, the importance of international organizations has steadily increased over the last decades. As a neutral entity they fill the gap between donors, governments as well as the beneficiaries of the projects implemented under their supervision. Chen et al. (2012) refers to GEF Small Grants Programmes (SGP) to be the most successful, as they promote a regional implementation of global strategies. "Think regional, act local"[318] is the trending slogan that furthers the "*building [of] community awareness and capacity*"[319] according to Chen et al. (2012).

[318] Chen, S., Pernetta, J.C., Duda, A.M. (2012). Towards a new paradigm for transboundary water governance: implementing regional frameworks through local actions. Ocean & Coastal management 85 (2013) 244-256. (p.246).
[319] Ibidem, p.247.

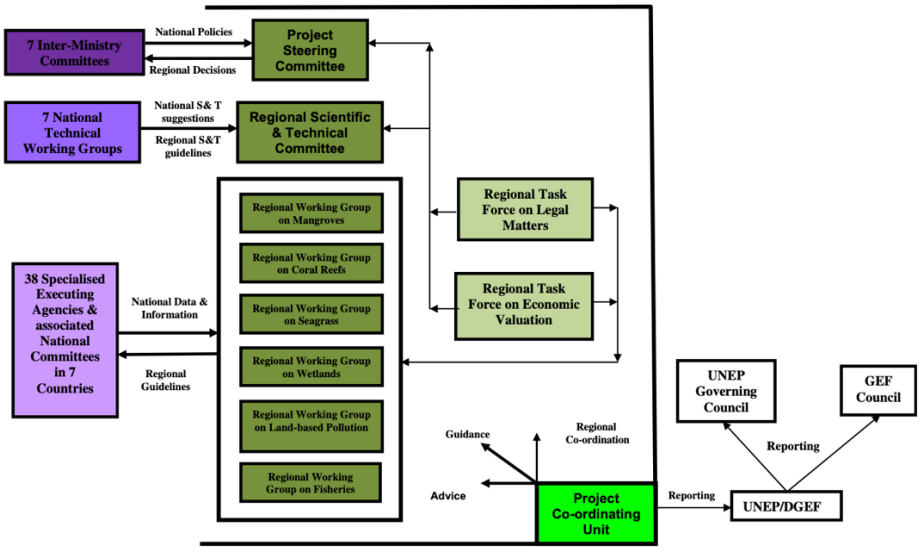

Fig. 2. Management framework at the conclusion of the project, showing information flow between national and regional level and relationships between the task forces and other regional entities.

Figure 10: Adaptation of a visual representation of programme management for an SGP
The table indicates the detailed structure and the various workflows between different entities during the inception phase as well as implementation of an SGP. *(Source: Chen, S., Pernetta, J.C., Duda, A.M. (2012). Towards a new paradigm for transboundary water governance: implementing regional frameworks through local actions. Ocean & Coastal management 85 (2013) 244-256. (p.146)).*

This applies concretely in the case of international water management projects where the strategy consists of replicating international strategies and structures on a regional or local level. Such flexibility is the key to success on a local level of implementation. Thus, Chen et al. (2012) elaborates the concept of a "polycentric approach"[320] applied to international water management strategies that have been scaled down to suit a local context, notably local networks, and capacities.

Pernetta et al. (2012) elaborates on the pivotal role that UNEP plays as a framework in consolidating projects and the cooperation between several stakeholders due to their unique strategy. According to Pernetta et al. (2012) the UNEP promotes horizontal (cooperation between countries) as well as vertical cooperation (cooperation within a country on different hierarchy levels). Through its unique structure of working groups, expert groups, as well as national project

[320] Chen, S., Pernetta, J.C., Duda, A.M. (2012). Towards a new paradigm for transboundary water governance: implementing regional frameworks through local actions. Ocean & Coastal management 85 (2013) 244-256. (p.255).

coordinators, Project Steering Committees[321] and regional task force the fostering of important networks is possible.

Chen et al. (2013) also insists on the harmonizing factor that UNEP appears to have. Through its neutral position, convincing power as well as its role of connecting various entities such as governments, experts, beneficiaries, and donors – the UNEP has a tendency to "de-politicize"[322] environmental cooperation.

Moreover, international organizations can neutralize political tensions from development cooperation, notably in the field of marine environmental protection and the fight against marine pollution in the SCS.

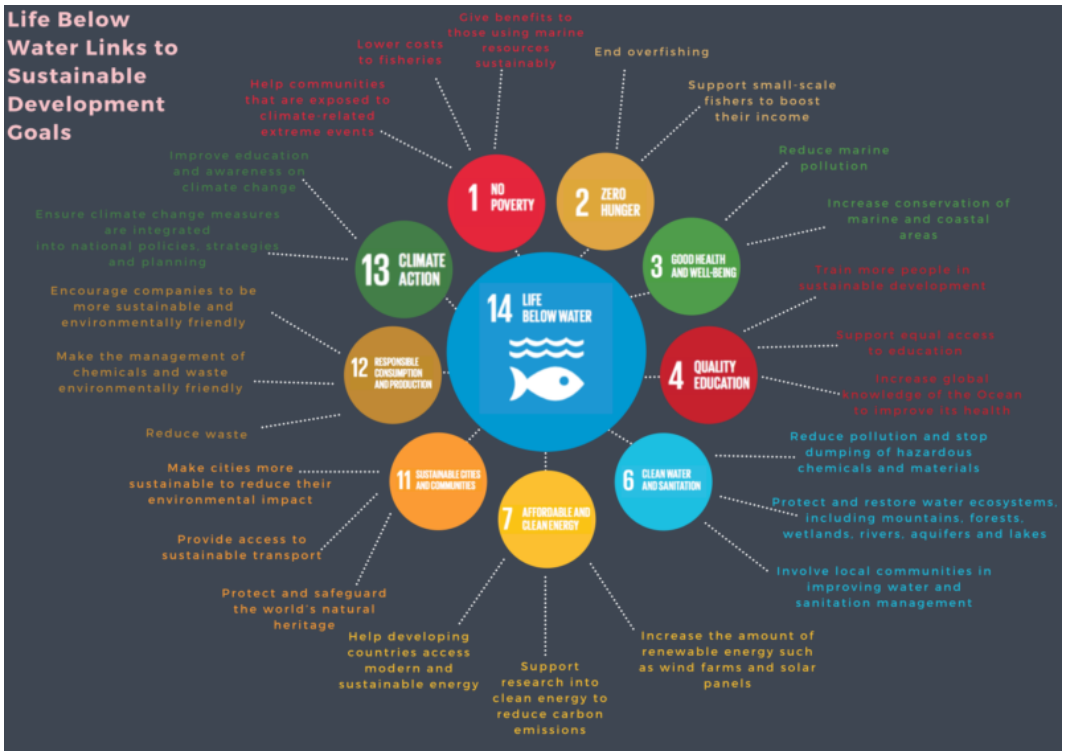

Figure 11: The Sustainable Development Goals through the lens of the UN Ocean Decade
Graphical representation of the sustainable development goal 14 on which the UN Ocean Decade is based and its interconnectivity with the other SDGs. *(Source: "What is the UN Ocean Decade?". Ocean Conservation Trust, 7 May 2024, url: What is the UN Ocean Decade? - Ocean Conservation Trust)*

[321] Pernetta, J.C., Jiang, Y. (2012). Managing multi-lateral, intergovernmental projects and programmes: the case of the UNEP-GEF South China Sea project. Ocean & Coastal Management 85 (2013) 141-152. (p.143).
[322] Chen, S. (2013). Environmental cooperation in the South China Sea: Factors, actors, and mechanisms. Ocean & Coastal Management 85 (2013) 131-140. (p.139).

b) The Strategic Action Programme for the South China Sea and Gulf of Thailand

The Strategic Action Programme for the South China Sea and Gulf of Thailand (SCSSAP)[323] is a perfect illustration of programmes that allow sufficient flexibility to implement on a local, national as well as international level. The SCSSAP is a joint programme uniting the following six countries: China, Cambodia, Indonesia, Philippines, Thailand, and Vietnam.

According to the Project Steering Committee (PSC) meeting in June 2021, the project duration was extended to June 2024. It is a joint project endorsed and implemented jointly by UNEP, GEF and The United Nations Office for Project Services (UNOPS).[324]

c) Innovative ventures to restore the marine ecosystem: urchinomics

This very last paragraph is dedicated to a for-profit organization founded by Bryan Tsuyoshi Takeda that seeks to restore destroyed kelp forests in the oceans and goes by the name of "urchinomics".

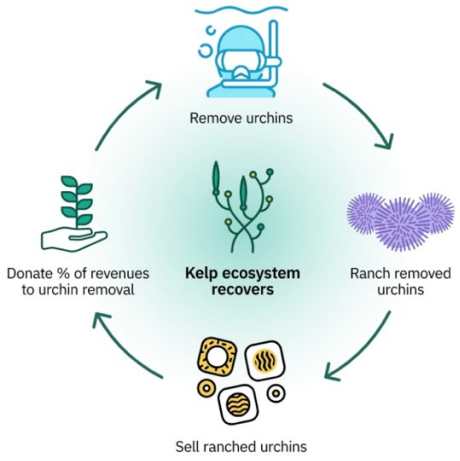

Figure 12: The life cycle of the urchinomics initiative
Urchinomics is one of very few initiatives endorsed by the UN Ocean Decade. The graphic above was drawn from the project description and depicts the sustainable business model of this venture *(Source: "Urchinomics Global Kelp Forest Restoration Sea Urchin Ranching Alliance". Ocean Deacde Collaborative Center Norhteast Pacific, 7 May 2024, url: Urchinomics Global Kelp Forest Restoration Sea Urchin*

[323] "Implementing the Strategic Action Programme for the South China Sea and Gulf of Thailand". Scssap, url: SCSSAP - Strategic Action Programme Implementation - Home. Accessed 6 May 2024.
[324] PSC Meeting Minutes: Implementing the Strategic Action Programme for the South China Sea and Gulf of Thailand, Teleconference 29/30 June 2021: https://scssap.org/scs-sap-first-steering-committee-meeting/155-psc1-8-draft-budget/file.

Due to climate change, the warming of the ocean as well as the acidification of the sea water and an increase in marine pollution (specifically an increase in carbon) the marine environment deteriorates, and kelp forests are on the verge of disappearance. However, kelp forests are essential to maintain the diversity of marine flora and fauna. Sea urchins like to invade the deserted areas where kelp used to grow – urchinomics collect the sea urchins, sell them on the food market, and reinvest parts of their profits in the restoration of kelp forests.

This is one example out of three businesses ventures endorsed by the UN Ocean Decade, that have as their mission to protect and preserve the marine biodiversity, marine ecosystems, and the marine environment more generally.

Conclusion

As mentioned in the course of the analysis, the aim of this thesis consists in identifying the major causes and effects of marine pollution in the SCS, in regard to territorial claims and solutions for an eco-friendly regional governance based on cohesion. Three major research questions have to be answered.

The first research question consists in identifying major threats to the marine ecosystem in the SCS, to trace them back to their point of origin with the aim of identifying the biggest sources of marine pollution in the SCS.

The second research question seeks to discuss the law of the sea in the light of environmental responsibility in connection with territorial claims.

The third research question deals with the problematic of aligning sustainable economic growth with environmental protection and security throughout the SCS.

To put it differently, the questions are as follows:

- *What are the causes and effects of marine pollution in the SCS?*
- *What is the position of international legislation and how does it affect territorial claims in the SCS?*
- *What are possible solutions for ensuring regional cohesion while ensuring environmental security and sustainable economic development?*

All three research questions were answered in the course of this thesis. Research question number three can be considered as the culmination point of all three questions, research questions one and two having fulfilled their purpose to lead the path towards answering the very last question. However, there is no clear answer to the last question. Even if successful projects implemented and endorsed by the United Nations and the Ocean Decade can be cited

as positive examples, those are but small gestures in the right direction. To reverse the degradation of the marine environment and ensure environmental security not only in the SCS but also in other regions of the world other stakeholders must be included in the dialogue. It is not enough to only look at public organizations, private stakeholders such as multinational and globally active firms should also be held accountable to a wider extent.

Bibliography

- Akhbarizadeh, R., Moore, F., Keshavarzi, B., 2018. Investigating a probable relationship between microplastics and potentially toxic elements in fish muscles from northeast of Persian Gulf. Environ. Pollut. 232, 154–163.

- Adcock, R. & Collier, D. (2001). Measurement Validity: A Shared Standard for Qualitative and Quantitative Research. American Political Science Review, 95(3), 529–546. https://doi.org/10.1017/s0003055401003100.

- Antonio, E. /Bass, S. /Gasgonia D. (2012). Philippines experience, lessons and challenges in environmental mainstreaming: International Institute for Environment and Development (IIED), UK. (p.28).

- Arthur, C., Baker, J., Bamford, H., 2009. Proceedings of the International Research Workshop on the Occurrence, Effects and Fate of Microplastic Marine Debris. NOAA Technical, Memorandum NOS-OR & R30.

- Arts, M.T., Ackman, R.G., Holub, B.J., 2001. ‘‘Essential fatty acids’’ in aquatic ecosystems: a crucial link between diet and human health and evolution. Can. J. Fish. Aquat. Sci. 58, 122–137.

- Auta, H.S., Emenike, C.U., Fauziah, S.H., 2017. Distribution and importance of microplastics in the marine environment: a review of the sources, fate, effects, and potential solutions. Environ. Int. 102, 165–176.

- Avio, C.G., Gorbi, S., Regoli, F., 2015. Experimental development of a new protocol for extraction and characterization of microplastics in fish tissues: first observations in commercial species from Adriatic Sea. Mar. Environ. Res. 111, 18–28.

- Bagozzi, R. P., Yi, Y. & Phillips, L. W. (1991a). Assessing Construct Validity in Organizational Research. Administrative Science Quarterly, 36(3), 421. https://doi.org/10.2307/2393203.

- Bai, C., Dallasega, P., Orzes, G., Sarkis, J. (2020). Industry 4.0 technologies assessment: a sustainability perspective. Int. J. Prod. Econ. 229.

- Barnes, D.K.A. (2002). Invasions by marine life on plastic debris. Nature (nr. 416).

- Batt, A.L., Wathen, J.B., Lazorchak, J.M., Olsen, A.R., Kincaid, T.M., 2017. Statistical survey of persistent organic pollutants: risk estimations to humans and wildlife through consumption of Fish from US rivers. Environ. Sci. Technol. 51, 3021–3031.

- Bocken, N.M.P., Olivetti, E.A., Cullen, J.M., Potting, J., Lifset, R. (2017). Taking the Circularity to the Next Level: a Special Issue on the Circular Economy. J. Ind.Ecol. 21, 476-482.

- Borja, A., Belzunce, M.J., Garmendia, J.M. Rodriguez, J.G., Solaun, O., Zorita, I. (2011). Impact of Pollutants on Coastal and Benthic Marine Communities. Ecological Impacts of Toxic Chemicals, Bentham Science Publishers Ltd.

- Bewers, J. M. & Pernetta, J. C. (2013). Outcomes of the SCS project and their applicability to multilateral cooperative initiatives for the management of coastal seas and marine basins. Ocean & Coastal Management, 85, 268–275. https://doi.org/10.1016/j.ocecoaman.2012.12.008.

- Boisseau du Rocher, S. (2015). Scientific cooperation in the South China Sea: Another level for China? Strategic Insights. Australian Strategic Policy Institute (ASPI), 96, 1-9. http://www.jstor.com/stable/resrep04091.

- Browne, M. A., Crump, P., Niven, S. J., Teuten, E., Tonkin, A., Galloway, T. & Thompson, R. (2011). Accumulation of Microplastic on Shorelines Woldwide: Sources and Sinks. Environmental Science & Technology, 45(21), 9175–9179. https://doi.org/10.1021/es201811s.

- Burgess, J. P. (2003). The Politics of the South China Sea: Territoriality and International Law. Security Dialogue, 34(1), 7–10. https://doi.org/10.1177/09670106030341002.

- Burton, J.G.A., 2002. Sediment quality criteria in use around the world. Limnology 3, 65–76.

- Chapman, P.M., Wang, F., Caeiro, S.S., 2013. Assessing and managing sediment contamination in transitional waters. Environ. Int. 55, 71–91.

- Cai, M., He, H., Liu, M., Li, S., Tang, G., Wang, W., Huang, P., Wei, G., Lin, Y., Chen, B., Hu, J. & Cen, Z. (2018). Lost but can't be neglected: Huge quantities of small microplastics hide in the South China Sea. Science of The Total Environment, 633, 1206–1216. https://doi.org/10.1016/j.scitotenv.2018.03.197.

- Campbell, C.; Salidjanova, N. (2016). South China Sea Arbitration Ruling: What Happened and What´s Next? U.S.-China Economic and Security Review Commission: Issue Brief.

- Carpenter, A. Macgill, S. M. (2005). The EU Directive on port reception facilities for ship-generated waste and cargo residues: The results of a second survey on the provision and uptake of facilites in North Sea ports. Marien Pollution Bulletin.

- Cavanagh, S. (1997). Content analysis: concepts, methods and applications. Nurse Researcher, 4(3), 5–13. https://doi.org/10.7748/nr1997.04.4.3.5.c5869.

- Chen, S., Pernetta, J.C., Duda, A.M. (2012). Towards a new paradigm for transboundary water governance: implementing regional frameworks through local actions. Ocean & Coastal management 85 (2013) 244-256.

- Chen, B., Duan, J. C., Mai, B. X., Luo, X. J., Yang, Q. S., Sheng, G. Y. & Fu, J. M. (2006). Distribution of alkylphenols in the Pearl River Delta and adjacent northern South China Sea, China. Chemosphere, 63(4), 652–661. https://doi.org/10.1016/j.chemosphere.2005.08.004.

- Chen, S. (2013). Environmental cooperation in the South China Sea: Factors, actors and mechanisms. Ocean & Coastal Management, 85, 131–140. https://doi.org/10.1016/j.ocecoaman.2013.02.004.

- Chen, S., Pernetta, J. C. & Duda, A. M. (2013). Towards a new paradigm for transboundary water governance: implementing regional frameworks through local actions. Ocean & Coastal Management, 85, 244–256. https://doi.org/10.1016/j.ocecoaman.2012.10.019.

- Chen, S. (2013). Environmental cooperation in the South China Sea: Factors, actors, and mechanisms. Ocean & Coastal Management 85 (2013) 131-140.

- Chen, T. R., Yu, K. F., Li, S., Price, G. J., Shi, Q. & Wei, G. J. (2010). Heavy metal pollution recorded in Porites corals from Daya Bay, northern South China Sea. Marine Environmental Research, 70(3–4), 318–326. https://doi.org/10.1016/j.marenvres.2010.06.004.

- Chopin T, Yarish C, Wilkes R, Belyea E, Lu S, Mathieson A (1999): Developing Porphyra/salmon integrated aquaculture for bioremediation and diversification of the aquaculture industry. Journal of Applied Phycology 11, 463–472.

- Chu Hoi, N. & Dang, V. H. (2018). Environmental Issues in the South China Sea: Legal Obligation and Cooperation Drivers. International Journal of Law and Public Administration, 1(1), 8. https://doi.org/10.11114/ijlpa.v1i1.3260.

- Cole, M., Lindeque, P., Halsband, C., Galloway, T.S., 2011. Microplastics as contaminants in the marine environment: a review. Mar. Pollut. Bull. 62, 2588–2597.

- Cossa, D., Gobeil, C., 2000. Mercury speciation in the Lower St. Lawrence Estuary. Can. J. Fish. Aquat. Sci. 57, 138–147.

- Dantas, T.E.T., de-Souza, E.D., Destro, I.R., Hammes, G., Rodriguez, C.M.T., Soares, S.R. (2020): How the combination of Circular Economy and Industry 4.0 can contribute towards achieving the Sustainable Development Goals. Sustainable Production and Consumption 26 (2021) 213-227.

- Dato´ IR. Tan Sri.; Bin Abdullah S. (1993). Coastal Development in Malaysia - scope, issues and challenges: Department of Irrigation and Drainage Malaysia (p.3).

- Ding, J., Jiang, F., Li, J., Wang, Z., Sun, C., Wang, Z., Fu, L., Ding, N.X., He, C., 2019. Microplastics in the Coral Reef Systems from Xisha Islands of South China Sea. Environ. Sci. Technol. 53, 8036–8046.

- Dougherty, C.P., Holtz, S.H., Reinert, J.C., Panyacosit, L., Axelrad, D.A., Woodruff, T.J., 2000. Dietary exposures to food contaminants across the United States. Envi- ronmental Research 84, 170–185.

- Du Laing, G., Rinklebe, J., Vandecasteele, B., Meers, E., Tack, F.M.G., 2009. Trace metal behaviour in estuarine and riverine floodplain soils and sediments: a review. Sci. Total Environ. 407, 3972–3985.

- Exclusive Economic Zone Act (1984).

- Esquinas, G. G. M. S., Mantala, A. P., Atilano, M. G., Apugan, R. P. & Galarpe, V. R. K. R. (2020). Physical characterization of litter and microplastic along the urban coast of Cagayan de

Oro in Macajalar Bay, Philippines. Marine Pollution Bulletin, 154, 111083. https://doi.org/10.1016/j.marpolbul.2020.111083.

- French, D. (2017). In the Matter of the South China Sea Arbitration. *Environmental Law Review*,*19*(1), 48–56. https://doi.org/10.1177/1461452916680866.

- Foldspang, A. & Montgomery, E. (2000). Criterion-validity-based assessment of four scale constructs. Scandinavian Journal of Public Health, 28(2), 146–153. https://doi.org/10.1080/713797397.

- Garrison, T. (2005). Oceanography - An Invitation to Marine Science 5th Ed. Belmont, California: Thomson-Brooks/Cole.

- Gavouneli, M. (2017). Protection Standards for the Marine Environment: Updating Part XII of the Law of the Sea Convention? SSRN Electronic Journal. Published. https://doi.org/10.2139/ssrn.3073263.

- Ghisellini, P., Cialani, C., Ulgiati, S. (2016). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. Journal of Cleaner Production, Towards Post Fossil Carbon Societies: Regenerative and Preventive Eco-Industrial Development 114, 11-32.

- GIGA Focus | Asia | Number 5 | August 2020 | ISSN 1862-359X.

- Thusari, G.G.N., Senevirathna, J.D.N., (2020). Plastic pollution in the marine environment: Badulla, Sri Lanka. Department of Animal Science, Faculty of Animal Science and Export Agriculture, Uva Wellassa University.

- Grayson, K. & Rust, R. (2001). Interrater Reliability. Journal of Consumer Psychology, 10(1–2), 71–73. https://www.jstor.org/stable/1480482.

- Gu, Y. G., Lin, Q., Jiang, S. J. & Wang, Z. H. (2014). Metal pollution status in Zhelin Bay surface sediments inferred from a sequential extraction technique, South China Sea. Marine Pollution Bulletin, 81(1), 256–261. https://doi.org/10.1016/j.marpolbul.2014.01.030.

- Gu, Y. G., Lin, Q., Wang, X. H., Du, F. Y., Yu, Z. L. & Huang, H. H. (2015). Heavy metal concentrations in wild fishes captured from the South China Sea and associated health risks. Marine Pollution Bulletin, 96(1–2), 508–512. https://doi.org/10.1016/j.marpolbul.2015.04.022.

- Guo, J. (2020). The developments of marine environmental protection obligation in article 192 of UNCLOS and the operational impact on China's marine policy – A south China sea fisheries perspective. Marine Policy, 120, 104140. https://doi.org/10.1016/j.marpol.2020.104140.

- Han, Q., Zhao, S., Zhang, X., Wang, X., Song, C. & Wang, S. (2020). Distribution, combined pollution and risk assessment of antibiotics in typical marine aquaculture farms surrounding the Yellow Sea, North China. Environment International, 138, 105551. https://doi.org/10.1016/j.envint.2020.105551.

- Hamid, M. N. (2012). National Strategies and Action Plans on Agricultural Biodiversity Conservation and Sustainable Utilisation. Kuala Lumpur, Malaysia: Malaysia Agriculture Research and Development Institute.

- Heale, R. & Twycross, A. (2015a). Validity and reliability in quantitative studies. Evidence Based Nursing, 18(3), 66–67. https://doi.org/10.1136/eb-2015-102129.

- Heale, R. & Twycross, A. (2015b). Validity and reliability in quantitative studies. Evidence Based Nursing, 18(3), 66–67. https://doi.org/10.1136/eb-2015-102129.

- In the marine environment: a review of the sources, fate, effects, and potential solu- tions. Environ. Int. 102, 165–176.

- "Implementing the Strategic Action Programme for the South China Sea and the Gulf of Thailand". Scssap, url: SCSSAP - Strategic Action Programme Implementation - Home. Accessed 6 May 2024.

- Jones, RJS., Murray RH., Vestergaard O. (2019). Enabling Effective and Equitable Marine Protected Areas: guidance on combining governance approaches. Regional Seas Reports and Studies No. 203. University College London, Department of Geography; UN Environment, Ecosystems Division, Marine and Coastal Ecosystems Branch.

- Joachimstal, E. L., Ivanov, V., Tay, S.T.-L., Tay, J.-H. (2004). Bacteriological examination of ballast water in Singapore Harbour by flow cytometry with FISH. Marine Pollution Bulletin.

- Khajuria, A. (2021). Nexus of Circular Economy and Industry 4.0 to achieve the UN Sustainable Development Goals.

- Khalid, N., Tang, J. (2010). Greening the maritime sector: Issues, challenges, and options. Kuala Lumpur: Maritime Institute of Malaysia.

- Klosterhaus, S.L., Grace, R., Hamilton, M.C., Yee, D., 2013. Method validation and re-connaissance of pharmaceuticals, personal care products, and alkylphenols in surface waters, sediments, and mussels in an urban estuary. Environ. Int. 54, 92–99.

- Kershaw, P., Katsuhiko, S., Lee, S., Samseth, J., Woodring, D., Smith, J. (2011). Plastic debris in the ocean. UNEP Yearbook 2011: Emerging issues in our global environment. Nairobi: United Nations Environment Programme.

- Korhonen, J., Honkasalo, A., Seppälä, J. (2018). Circular Economy: the Concept and its Limitations. Ecol. Econ. 143, 37-46.

- Kuik C.C. (2017). Explaining the Contradiction in China´s South China Sea Policy: Structural Drivers and Domestic Imperatives. China An International Journal 15(1):163-186. (PDF) Explaining the Contradiction in China's South China Sea Policy: Structural Drivers and Domestic Imperatives (researchgate.net).

- Kusuma, W., Cery Kurnia A., Agustian, R.A. (2021). South China Sea: Conflict, Challenge, and Solution. Lampung Journal of International Law 3 (1): 51-62- 10.25041/lajil.v3i1.2266.

- Law, A.T., Hii, Y.S. (2006). Status, impacts and mitigation of hydrocarbon pollution in the Malaysian seas. Aqutic Ecosystem Health & Management Society.

- Lee, S. (2020). Role of social and solidarity economy in localizing the sustainable development goals. International Journal of Sustainable Development and World Ecology 27, 65-71.

- Liakopoulos, D. (2004). Legal and Environmental Regime of Islands in the South China Sea: Status under International Law. Global Jurist, 4(3) Article 2.

- Liakopoulos, D. (2005). Legal and Environmental Regime of Islands in the South China Sea: Status under International Law. Global Jurist Topics, 4(3). https://doi.org/10.2202/1535-167x.1142.

- Liang, P., Shao, D. D., Wu, S. C., Shi, J. B., Sun, X. L., Wu, F. Y., Lo, S., Wang, W. X. & Wong, M. H. (2011). The influence of mariculture on mercury distribution in sediments and fish around Hong Kong and adjacent mainland China waters. Chemosphere, 82(7), 1038–1043. https://doi.org/10.1016/j.chemosphere.2010.10.061.

- Lieder, M., Rashid, A. (2016). Towards circular economy implementation: a comprehensive review in context of manufacturing industry. J. Clean. Prod. 115, 36-51.

- Li, J.; Chen, P. Joint Development in the South China Sea: Is the Time Ripe? Vol. 22 (2016), Asian Yearbook of International Law: Volume 22 (2016), p. 131-158. https://www.jstor.org/stable/10.1163/j.ctvrxk3zz.11.

- Lin, Y. C., Chang-Chien, G. P., Chiang, P. C., Chen, W. H. & Lin, Y. C. (2013). Multivariate analysis of heavy metal contaminations in seawater and sediments from a heavily industrialized harbor in Southern Taiwan. Marine Pollution Bulletin, 76(1–2), 266–275. https://doi.org/10.1016/j.marpolbul.2013.08.027.

- Liu, J., Xu, X., Yu, S., Cheng, H., Hong, Y. & Feng, X. (2014). Mercury pollution in fish from South China Sea: Levels, species-specific accumulation, and possible sources. Environmental Research, 131, 160–164. https://doi.org/10.1016/j.envres.2014.03.004.

- Marine Department Malaysia (JLM). List of International Conventions.

- McManus, J. W. (2017). Offshore Coral Reef Damage, Overfishing, and Paths to Peace in the South China Sea. The International Journal of Marine and Coastal Law, 32(2), 199–237. https://doi.org/10.1163/15718085-12341433.

- McManus, J. W. (2017b). Offshore Coral Reef Damage, Overfishing, and Paths to Peace in the South China Sea. *The International Journal of Marine and Coastal Law*, *32*(2), 199–237. https://doi.org/10.1163/15718085-12341433.

- Meer, J.D., Boas, M., in Encyclopedia of Environmental Health, 2011.

- Merchant Shipping Ordinance, Section 360 CA (2).

- Mobilik, J. M. & Hassan, R. (2016). Pollution Threat from Shipping Activity Towards Ocean Sustainability. In M. Samsur, M.L. Shabdin, L. Nyanti, A.R. Khairul Adha, R. Hadil, R. & J.M.

- Mobilik (Eds.), Aquatic Science Colloquium 2016: Experiences Sharing in Aquatic Science Research IV: Malaysia Exclusive Economic Zone (EEZ) Cruise and other Aquatic Science Research (pp. 143-163). Monograph, Department of Aquatic Science, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia.

- Mustafa, M., Ariffin, M. (2011). Protection of marine biodiversity from pollution: Legal strategies in Malaysia. International Journal of Bioscience, Biochemistry and Bioinformatics, I.

- NEVO, B. (1985). FACE VALIDITY REVISITED. Journal of Educational Measurement, 22(4), 287–293. https://doi.org/10.1111/j.1745-3984.1985.tb01065.x.

- Nguyen C.H; Vu H.D. (2018). Environmental Issues in the South China Sea. Legal Obligations and Cooperation Drivers. International Journal of Law and Public Administration 1(1) (Jun 2018). Redfame Publishing ISSN 2576-2192.

- Nie, H., Wang, J., Xu, K., Huang, Y. & Yan, M. (2019). Microplastic pollution in water and fish samples around Nanxun Reef in Nansha Islands, South China Sea. Science of The Total Environment, 696, 134022. https://doi.org/10.1016/j.scitotenv.2019.134022.

- Nishitani, K., Jannah, N., Kaneko, S., Hardinsyah, 2017. Does corporate environmental performance enhance financial performance? An empirical study of Indonesian firms. Environ. Dev. 23, 10–21. https://doi.org/10.1016/j.envdev.2017.06.003.

- Oxman, B. (2016). The South China Sea Arbitration Award. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2835534.

- PCA Case N°2013-19 (2016). In the matter of the South China Sea Arbitration before an Arbitral Tribunal constituted under Annex VII to the 1982 United Nations Convention on the Law of the Sea between the Republic of the Philippines and the People´s Republic of China: AWARD.PH-CN-20160712.

- Peng, J. & Shi, J. (2020). A Critical Assessment of China's Role in the South China Sea Dispute. Journal of Politics and Law, 13(4), 169. https://doi.org/10.5539/jpl.v13n4p169.

- Peng, X., Dasgupta, S., Zhong, G., Du, M., Xu, H., Chen, M., Chen, S., Ta, K. & Li, J. (2019). Large debris dumps in the northern South China Sea. Marine Pollution Bulletin, 142, 164–168. https://doi.org/10.1016/j.marpolbul.2019.03.041.

- Pernetta, J. C. & Jiang, Y. (2013). Managing multi-lateral, intergovernmental projects and programmes: the case of the UNEP/GEF South China Sea project. Ocean & Coastal Management, 85, 141–152. https://doi.org/10.1016/j.ocecoaman.2012.10.012.

- Priyadarshini, P, Abilash, P.C. (2020). Circular Economy practices within energy and waste management sectors of India: A meta-analysis. Institute of Environment & Sustainable Development, Banaras Hindu University, Varanasi 221005, Uttar Pradesh, India.

- Qiu, Y. W., Zhang, G., Guo, L. L., Cheng, H. R., Wang, W. X., Li, X. D. & Wai, O. W. (2009). Current status and historical trends of organochlorine pesticides in the ecosystem of Deep Bay, South China. Estuarine, Coastal and Shelf Science, 85(2), 265–272. https://doi.org/10.1016/j.ecss.2009.08.010.

- Rahman, R. A., Surif, S., 1993. Metal finishing wastewater: charac- teristics and minimization. In: B. G. Yeoh, K. S. Chee, S. M. Phang, Z. Isa, A. Idris, M. Mohamed (Eds.), *Waste management in Malaysia: Current status and prospects for bioremediation*, pp. 3–7. Ministry of Science, Technology and the Environment, Malaysia.

- Romero, D., Stahre, J., Taisch, M. (2020). The Operator 4.0: towards socially sustainable factories of the future. Comput. Ind. Eng. 139, 106128.

- Saharuddin, A. H. (2001). National ocean policy. New opportunities for Malaysian ocean development. Marine Policy, (25).

- Sharma, S., S. Chatterjee. (2017). Microplastic pollution, a threat to marine ecosystem and human health: a short review. Environ Sci Pollut Res 24:21530-21547. Doi 10.1007/s11356-017-9910-8.

- Shazili, N. A. M., Yunus, K., Ahmad, A. S., Abdullah, N. & Rashid, M. K. A. (2006). Heavy metal pollution status in the Malaysian aquatic environment. *Aquatic Ecosystem Health & Management*, *9*(2), 137–145. https://doi.org/10.1080/14634980600724023.

- Schwitzguébel, J. P. & Wang, H. (2007). Environmental impact of aquaculture and countermeasures to aquaculture pollution in China. Environmental Science and Pollution Research - International, 14(7), 452–462. https://doi.org/10.1065/espr2007.05.426.

- Shazili, N. A. M., Yunus, K., Ahmad, A. S., Abdullah, N. & Rashid, M. K. A. (2006). Heavy metal pollution status in the Malaysian aquatic environment. Aquatic Ecosystem Health & Management, 9(2), 137–145. https://doi.org/10.1080/14634980600724023.

- Smith, L., Cornillon, P., Rudnickas, D. & Mouw, C. B. (2019). Evidence of Environmental Changes Caused by Chinese Island-Building. Scientific Reports, 9(1). https://doi.org/10.1038/s41598-019-41659-3.

- Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. Journal of Business Research, 104, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039.

- Strating, R. (2020). Norm contestation, statecraft and the South China Sea: defending maritime order. The Pacific Review, 1–31. https://doi.org/10.1080/09512748.2020.1804990.

- Stewart, C., Thompson, J.A.J. (1994). Extensive butyltin contamination in Southeastern coastal British Columbia, Canada. Marine Pollution Bulletin.

- Sun, R., Luo, X., Li, Q.X., Wang, T., Zheng, X., Peng, P., Mai, B., 2018. Legacy and emerging organohalogenated contaminants in wild edible aquatic organisms: im- plications for bioaccumulation and human exposure. Sci. Total Environ. 616, 38–45.

- Tan, F., Yang,H., Xu, X., Fang, Z., Xu, H., Shi, Q., Zhang, X., Wange, G., Lin, L., Zhou, S., Huang, L., Li, H.(2020). Microplastic pollution around remote uninhabitated coral reefs of Nansha Islands, South China Sea. Science oft Total Environment 725 (2020) 138383, doi.org/10.1016/j.scitotenv.2020.138383.

- Teuten, E.L., Saquing, J.M., Knappe, D.R., Barlaz, M.A., Jonsson, S., Bjorn, A., et al., 2009.

- The Environmental Quality Act (1974).

- Ton Nu Hai, A. & Speelman, S. (2020). Economic-environmental trade-offs in marine aquaculture: The case of lobster farming in Vietnam. Aquaculture, 516, 734593. https://doi.org/10.1016/j.aquaculture.2019.734593.

- Trajano, J. Gong, L., Sembiring, M., Astuti, R. (2017 & 2018). Marine Environmental Protection in the South China Sea: Challenges and Prospects Part I/II. S. Rajaratnam School of International Studies; Nanyang Technological University, Singapore.

- Trujillo, A.P., Thurman, H.V. (2005). Essential of Oceanography 8th Ed. Upper Saddle River, New Jersey: Pearson Prentice Hall.

- Tuckett, A. G. (2005). Applying thematic analysis theory to practice: A researcher's experience. Contemporary Nurse, 19(1–2), 75–87. https://doi.org/10.5172/conu.19.1-2.75.

- "The Ocean Decade´s strategic ambition setting process on the road to 2030". Oceandecade, url: Vision 2030 (oceandecade.org). Accessed 6 May 2024.

- Thompson, Peter. "United Nations Decade of Ocean Science for Sustainable Development (2021-2030)". Unesco, url: United Nations Decade of Ocean Science for Sustainable Development (2021-2030) | UNESCO. Accessed 6 May 2024.

- United Nation Environment Programs (UNEP). Marine Litter: A Global Challenge. Nairobi:UNEP.

- United Nations Industrial Development Organization; *POPs and Chemical Pollution Solutions through Area-Based-Ecoeffective-Management.* Project Document; Project ID 15073.

- United Nations Industrial Development Organization; *Demonstration of Mercury Reduction and Minimization in the Production of Vinyl Chloride Monomer in China (VCM project);* Annex K: Environmental and Social Management Plan for the VCM Project.

- United Nations Industrial Development Organization. (2021-2025). *Country Programme for Inclusive and sustainable industrial development*.

- United Nations Industrial Development Organization. *Implementation of eco-industrial park initiative for sustainable industrial zones in Vietnam.* Project Document.

- United Nations Industrial Development Organization. (2022) *Reduction of Unintentionally produced Persistent Organic Pollutants (POPs) and Mercury (Hg) through an Environmentally-*

Sound Approach on Health Care Wastes management in the Philippines with a Special Focus on the Pandemic. Annex J: Environmental and social Management plan.

- United Nations Industrial Development Organization. (2023). *Circular solution to plastic pollution in the Philippines*. Environmental & Social Screening Template.

- United Nations Industrial Development Organization. (2019-2024). *CAPFISH Capture – Post Harvest Fisheries Development*. Project Document.

- United Nations, United Nations Convention on the Law of the Sea (UNCLOS). (1982), Digitized by UN Library Geneva: United Nations Convention on the Law of the Sea.

- UN, 2015. Transforming our world: the 2030 Agenda for Sustainable Development. United Nations, A/RES/70/1, Agenda items 15 and 16 and 116, 1-35.

- "United Nations Decade of Ocean Science for Sustainable Development (2021-2030)". UNesco, url: United Nations Decade of Ocean Science for Sustainable Development (2021-2030) | UNESCO. Accessed 6 May 2024.

- Valencia, Mark J., 1995. China and the South China Sea Disputes. Oxford University Press, Oxford.

- Vaismoradi, M., Turunen, H. & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. Nursing & Health Sciences, 15(3), 398–405. https://doi.org/10.1111/nhs.12048.

- Van Cauwenberghe, L., Janssen, C.R., 2014. Microplastics in bivalves cultured for human consumption. Environ. Pollut. 193, 65–70.

- Vercruysse, K., Grabowski, A.C., Rickson, R.J. (2017). Suspended sediment transport dynamics in rivers: Multi-scale drivers of temporal variation. Earth-Science Reviews, Volume 166, March 2017, Pages 38-52. https://doi.org/10.1016/j.earscirev.2016.12.016.

- Vethaak, A. D., Davies, I. M., Thain, J. E., Gubbins, M. J., Martínez-Gómez, C., Robinson, C. D., Moffat, C. F., Burgeot, T., Maes, T., Wosniok, W., Giltrap, M., Lang, T. & Hylland, K. (2017). Integrated indicator framework and methodology for monitoring and assessment of hazardous substances and their effects in the marine environment. Marine Environmental Research, 124, 11–20. https://doi.org/10.1016/j.marenvres.2015.09.010.

- Vlachogianni, T., Fortibuoni, T., Ronchi, F., Zeri, C., Mazziotti, C., Tutman, P., Varezić, D. B., Palatinus, A., Trdan, T., Peterlin, M., Mandić, M., Markovic, O., Prvan, M., Kaberi, H., Prevenios, M., Kolitari, J., Kroqi, G., Fusco, M., Kalampokis, E. & Scoullos, M. (2018). Marine litter on the beaches of the Adriatic and Ionian Seas: An assessment of their abundance, composition and sources. Marine Pollution Bulletin, 131, 745–756. https://doi.org/10.1016/j.marpolbul.2018.05.006.

- Vo, S. T., Pernetta, J. C. & Paterson, C. J. (2013). Lessons learned in coastal habitat and land-based pollution management in the South China Sea. Ocean & Coastal Management, 85, 230–243. https://doi.org/10.1016/j.ocecoaman.2013.02.005.

- Walker, T.R., Grant, J., Archambault, M. (2006). Accumulation of marine debris on an intertidal beach in an urban park.Water Quality Research Canada.

- Wang, B., Huang, F., Wu, Z., Yang, J., Fu, X. & Kikuchi, K. (2009). Multi-scale climate variability of the South China Sea monsoon: A review. Dynamics of Atmospheres and Oceans, 47(1–3), 15–37. https://doi.org/10.1016/j.dynatmoce.2008.09.004.

- Wang, S. L., Xu, X. R., Sun, Y. X., Liu, J. L. & Li, H. B. (2013). Heavy metal pollution in coastal areas of South China: A review. Marine Pollution Bulletin, 76(1–2), 7–15. https://doi.org/10.1016/j.marpolbul.2013.08.025.

- Wang, Y.S., Lou, Z.P., Sun, C.C., Wu, M.L., Han, S.H., 2006. Multivariate statistical analysis of water quality and phytoplankton characteristics in Daya Bay, China, from 1999 to 2002. Oceanologia 48 (2), 193e211.

- Wang, X., Yu, J., Li, Y., Chen, B., Huang, M., 2015. The relationship between major upwelling and the upwelling fishing grounds in the South China Sea. J. Mar. Sci. 39, 131–137 (In Chinese).

- Wartenberg, R., Feng, L., Wu, J. J., Mak, Y. L., Chan, L. L., Telfer, T. C. & Lam, P. K. S. (2017). The impacts of suspended mariculture on coastal zones in China and the scope for Integrated Multi-Trophic Aquaculture. Ecosystem Health and Sustainability, 3(6), 1340268. https://doi.org/10.1080/20964129.2017.1340268.

- West, A. (2004). Marine Pollution from vessel sewage in Queensland. MLAANZ Journal, 1995.

- Yang, G. P. (2000). Polycyclic aromatic hydrocarbons in the sediments of the South China Sea. Environmental Pollution, 108(2), 163–171. https://doi.org/10.1016/s0269-7491(99)00245-6.

- Zhu, L., Wang, H., Chen, B., Sun, X., Qu, K. & Xia, B. (2019a). Microplastic ingestion in deep-sea fish from the South China Sea. Science of The Total Environment, 677, 493–501. https://doi.org/10.1016/j.scitotenv.2019.04.380.

- Zhu, L., Wang, H., Chen, B., Sun, X., Qu, K., Xia, B. (2019). Microplastic ingestion in deep-sea fish from the South China Sea. Science of the Total Environment 677(2019) 493-501, doi.org/10.1016/j.scitotenv.2019.04.380.

- “10 Challenges Ocean Decade Challenges for collective impact”. Oceandecade, url: 10 Challenges - Ocean Decade. Accessed 6 May 2024.

APPENDIX

United Nations World Population Prospects and Data retrieved from the World Bank

2021	Population	Growth rate (%)	Density per km2	Urban population (2019)	Urban population growth rate 2019 (%)
China	1,444,216,107	0,34%	151,02	842,933,962	2,32%
Taiwan	23,855,010	0,16%	X	X	X
Vietnam	98,168,833	0,85%	296,38	35,332,140	2,96%
Brunei	441,532	0,93%	X	331,711	2,96%
Malaysia	32,776,194	1,27%	99,2	24,475,766	2,10%
Philippines	111,046,913	1,34%	370,16	50,975,903	2,10%

2019	Economy GDP ($)	GDP growth rate (%)	Trade Balance ($)	Trade balance trend
China	14,342.90B	3,22%	164.99B	54,62%
Taiwan	X	X	X	X
Vietnam	261.92B	0,06%	8.36B	1,53%
Brunei Darussalam	13.47B	0,72%	0.99B	26,48%
Malaysia	364.68B	0,47%	X	X
Philippines	376.80B	8,64%	X	X

Development and environment

2016	Poverty rate (%)	Poverty trend (%)	Co2 emissions (kilotons)	Co2 emissions trend (%)
China	24,00%	3,20%	9,893,037.95	2,48%
Taiwan	X	X	X	X
Vietnam	23,10%	5,10%	192,667.85	2,30%
Brunei Darussalam	X	X	7,664.03	8,35%
Malaysia	2,70%	1,30%	248,288.90	5,73%
Philippines	54,90%	5%	122,287.12	4,41%

Data sources:

United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospetcs - Population Division, url: https://population.un.org/wpp/.

The World Bank, World Development Indicators. WDI, url: https://datatopics.worldbank.org/world-development-indicators/.